

2016 DIGITAL REPORT

IIoT



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INDUSTRIAL INTERNET OF THINGS (IIoT)

Click the video link below for an overview on the IIoT Digital Report from Plant Engineering, Content Manager, Bob Vavra.

Welcome to our digital report on the Industrial Internet of things, or IIoT.

Franz Gruber, the president and founder of FORCAM and one of the top industry minds behind IIoT strategy, says this about the potential benefit of IIoT in manufacturing:

“Monitoring the shop floor with technology means that all operators become an integral part of the production process to detect errors and initiate correction of any kind of deviation from the target to ensure a more efficient and leaner production process. Empowerment of these important employees is a key strategy for manufacturing businesses as these translate directly into bottom line business results. The key component to this strategy is engagement through the power of information. And the key to information is technology.”

It's clear by now that the Industrial Internet of Things is a transformative manufacturing strategy that will improve operations, reduce costs and increase quality and safety. This digital report is one of many ways CFE Media will educate audience on the importance of IIoT. We see our publications and the nexus between all interested parties who want to communicate with one another about the processes, products and training needed to successfully deploy IIoT on the plant floor and throughout the enterprise.

We hope this digital report answers some of your questions about IIoT, and we hope it sparks more questions. As IIoT continues to evolve, we will continue to deliver information to help you identify the ways this strategy can transform your manufacturing operation.

Please enjoy this digital report.

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INDUSTRIAL INTERNET OF THINGS (IIoT) BENEFITS, EXAMPLES

The Industrial IoT (IIoT) is much more advanced than the commercial IoT, primarily due to the prevalence of connected sensors in the industrial world, which are the “things” in the IoT. Hundreds of millions of connected wired and wireless pressure, level, flow, temperature, vibration, acoustic, position, analytical, and other sensors are installed and operating in the industrial sector, and millions more are added annually, increasing value with additional monitoring, analysis, and optimization. This is part of the June *Control Engineering* cover story on Industry 4.0 and Industrial Internet of Things to help make smarter factories.

These sensors connect to a variety of higher level software platforms, both on- and offsite. On-site connections are often via a local intranet, creating an Industrial Intranet of Things. Offsite connections are usually made through the Internet, often via a cloud-based storage system.

These higher level software platforms include control and monitoring, asset management, and specialized data-analysis systems. At remote data-analysis centers, sophisticated big data analytics are performed by dedicated experts to reveal patterns, problems, and solutions.

FOUR IIoT BENEFITS

The IIoT connects sensors to analytic and other systems to automatically improve performance, safety, reliability, and energy efficiency by:

1. Collecting data from sensors (things) much more cost effectively than ever before because sensors are often battery-powered and wireless



2. Interpreting this data strategically using big data analytics and other techniques to turn the data into actionable information
3. Presenting this actionable information to the right person, either plant personnel or remote experts, and at the right time
4. Delivering performance improvements when personnel take corrective action.

Here are some of the ways the IIoT is moving from concept to reality.

IIoT IN ACTION

IIoT technology was implemented at Ergon Refining's Vicksburg, Miss., facility. This IIoT implementation connects vibration, acoustic, level, position, and other sensors to an asset management system via both a wired fieldbus network (Foundation Fieldbus) and a wireless network (WirelessHART). [Foundation Fieldbus and Highway Addressable Remote Transducer Protocol (HART) protocols are governed by FieldComm Group.] The wireless network connects instruments to the plant's control and monitoring systems via a wireless mesh network consisting of wireless instruments and access points (Figure 1).

Sensor data is sent to asset management software with specialized data-analysis applications for valves and smart meters. The software analyzes sensor data and transforms it into actionable information. Control room operators view this information on human machine interfaces (HMIs), and mobile workers view it on handheld industrial PCs connected to a plantwide Wi-Fi network (Figure 2).

Capital expenditures were reduced because wireless cut sensor installation costs, and ongoing operational benefits included increased capacity and avoided capital investments through wireless tank monitoring. The asset management software allowed consistent setup and reduced commissioning costs, along with reduced call-outs through the use of alarm management software. Safety was improved by automating vibration monitoring in hard-to-reach locations which were previously checked via manual rounds, and energy was saved with wireless steam trap monitoring.



Ergon now has wireless infrastructure in place for data collection, analysis, and distribution. This existing infrastructure makes it quick and inexpensive to add more wireless sensors to deliver further operational improvements.

STEAM TRAP SAVINGS

Steam trap monitoring via wireless acoustic transmitters is a leading IIoT application.

When traps fail to open, high-pressure steam leaks out, so more steam has to be produced by boilers.

Depending on the price of steam at a facility, a single failed-open steam trap can waste \$30,000 worth of steam each year.

“ Hundreds of millions of connected wired and wireless pressure, level, flow, temperature, vibration, acoustic, position, analytical, and other sensors are installed and operating in the industrial sector, and millions more are added annually, increasing value with additional monitoring, analysis, and optimization. ”

When traps fail to close, they don't remove water droplets from the steam. These water droplets, moving through piping and equipment at a high rate of speed, can rupture steam lines and cause turbines to throw blades. Repairs are very expensive, and downtime is often significant.

Most plants monitor their steam traps manually via annual checks. This is very costly in terms of labor, misses many problems, and in the worst case can allow failed traps to operate for years.

Acoustic sensors and specialized software systems detect steam trap problems automatically and alert plant personnel so they can take action. In the past, these sensors were wired back to software systems, but the preferred modern method is to use wireless acoustic sensors connected back to software systems via a wireless mesh network, creating an IIoT.

These wireless sensors are battery-powered and can operate for up to 10 years between battery changes. Compared to wired sensors, installation takes place much more quickly at significantly lower costs, and required plant downtime for installation is greatly reduced or eliminated.

One corn milling plant was experiencing a 15% annual steam trap failure rate, with 12.5% of the plant's steam traps responsible for 38% of the steam loss. The plant addressed this issue using wireless steam trap acoustic sensors and accompanying analytics. The payback period was just a few months, and the annual savings were \$301,108.

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FLARE GAS MONITORING

Another IIoT example is monitoring valves controlling gas flows to flare stacks in refineries. Using wireless acoustic transmitters, one refinery improved regulatory compliance and reduced hydrocarbon losses by \$3 million annually due to timely detection and repair of faulty valves. The project paid for itself in five months, with an estimated annualized return on investment (ROI) of 271% annualized over 20 years.

The IIoT is here today, and plants are using it to realize value from the hundreds of millions of connected sensors currently installed and the millions more coming online each year. Many of these sensors are wireless because they can be installed more quickly and at less cost than their wired equivalents, often with no required downtime. These low-cost wireless sensors and accompanying analytics can dramatically improve plant performance, increase safety, and pay for themselves within months.

*Bob Karschnia is vice president of wireless,
Emerson Process Management.*

CASE STUDY: EPICOR SUCCESS STORY HUMTOWN PRODUCTS

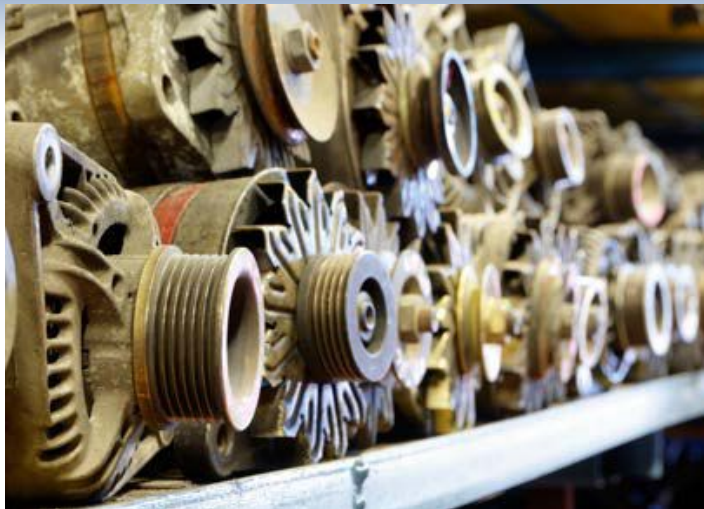
Humtown Products is a family-owned business dedicated to serving the foundry industry since opening its doors in 1959. First established as a pattern shop, Humtown later began serving the core making needs of foundries throughout the Midwest. Humtown Products contributes to the manufacturing of parts and equipment used in a diverse array of industries, including: Agriculture, Construction, Manufacturing, Mining, National Defense, Public Utilities, and Transportation.

While its pattern shop can still handle the tooling process of the past—handcrafted, wood tooling—Humtown recognized the technological advancements being made in the industry by adopting additive manufacturing processes to serve the needs of its customers.

An existing Epicor ERP customer for many years, in early 2014, Humtown decided to upgrade to the new Epicor ERP version 10 platform. Key to Humtown's decision to upgrade was the platform's improved responsiveness.

“Speed spiked our attention the most,” said Brenda Mohr, solution provider, Humtown Products. “Everything we do here we do in real time. Epicor ERP version 10 promised to be faster and we found that very appealing. We are also extremely customized—everything from our product orders to our reports—and one of the key reasons we selected Epicor was its ability to integrate well with our own software we develop onsite.”

Mohr notes the speed and robustness of Epicor ERP version 10 helped turn a complicated report into an automated, near real-time project report that is fully automated. “With the added depth of the Business Activity Queries (BAQ) in Epicor ERP version 10, we're able to format this report with dozens of queries so



that the right information is sourced quickly and in a fully automated fashion. With just a small amount of backend programming added to it, the report enables employees to see the status of any specific project, updated every five minutes.”

The faster response time and automation capabilities of Epicor ERP version 10 have also played a key role in the product ordering process. “We can often quote a customer, have the quote approved, and begin making parts within 15 to 30 minutes,” said Mohr. “Before Epicor, we had to look everything up, write it out, and then create a job order.”

Now, Mohr says, use of Epicor Service Connect—the central business integration platform for secure workflow connections within Epicor service software applications and between Epicor and non-Epicor applications—has enabled Humtown to quickly pull a wide range of information in and out of the ERP platform.

Once the order is completed, the packaging slips are automatically created in the ERP system, which helps streamline the shipping process. Any changes to the order are instantly recorded in the notes section of Epicor ERP version 10, so users can see the updated information.

In addition to quick response times, the new touch-enabled, intuitive user interface of Epicor ERP version 10 was designed from the ground up to work with touch screen devices—empowering Humtown users to work the way they want.

SUCCESS HIGHLIGHTS

CHALLENGES AND OPPORTUNITES

- Needed a next-generation ERP solution to support greater responsiveness
- Needed an easy-to-use user interface to generate custom reports
- Needed a platform that could integrate with third-party software

SOLUTION

- Epicor ERP version 10

BENEFITS

- Improved operational efficiency across all aspects of quoting, order entry, shop floor operations and invoicing
- Real-time automated reporting to support improved collaboration, visibility and decision making
- Powerful and flexible product configurator to handle complex calculations resulting in more competitive pricing

Humtown utilizes the product configurator of Epicor ERP version 10, which integrates a complex set of calculations Humtown has devised to support accurate and competitive pricing. This gives the company the ability to offer the best pricing for its customers—in line with its goal of providing the most cost-effective tooling with the shortest lead time.

Epicor ERP version 10 offers powerful dashboards, and data query capabilities, which combine to give Humtown flexible and more dynamic reports to support better, faster decision making, said Mohr.

“The query builder in Epicor ERP version 10 makes it easy to gather information and combine it into a single report. Before Epicor ERP version 10, we had a few dashboards that we used, but you had to constantly look back and forth between the files. Now, we have what I would characterize as a three-dimensional-like look into the data with everything right in front of you,” she said.

Overall, Epicor ERP version 10 is integrated into all aspects of Humtown Products—from invoicing, product ordering, quoting, and the shop floor. With Epicor ERP version 10, the company now has faster access and improved visibility of all its data, and drill down capabilities to gain better insight.

“Epicor ERP version 10 has been a very integral part of our company,” said Mohr. “Epicor has been very good in supporting us, which has resulted in a great experience and exceptional collaboration.”

THE BUILDING BLOCKS OF IIoT

Manufacturing the Industrial Internet of Things (IIoT) is being envisioned in many ways. One way to look at it, both for today and into the future, is exactly as a manufacturing project, complete with the simplest building block ever created.

A Lego.

At the Oct. 8 Smart Factory Industry Forum in Chicago, Detlaf Zuhlke, chairman of the executive board of the German-based SmartFactoryKL Technology Initiative, said IIoT concept is still a long way from full implementation. When it does come to pass, Zuhlke said it will take a series of standards and principles that will allow IIoT to be effective in any plant, anywhere.

“Our components will look like standardized building blocks, and you can arrange them as you need to like Lego blocks,” Zuhlke told more than 100 industry leaders at the event sponsored by the German-American Chamber of Commerce and held at the Digital Manufacturing and Design Innovation Institute (DMDII). “So you will need fundamental principles.”

Getting to those fundamentals will take more time, Zuhlke said. “Today we have to first demonstrate the potential use,” Zuhlke said. “We need worldwide standards, and there are different approaches to that. We need solutions for safety and security. Industry wants to have a high level of security. We surely will need training, and we surely will need new business models.

“Digitalization of all of these things will bring us completely new solutions,” he added. “It will change our automation world.”



Before that change comes, Zuhlke said the manufacturing world needs to continue to evolve from a centralized view of information to a distributed view. In Manufacturing 2.5, there was one computer behind a glass wall. They were big machines with people wearing white coveralls changing the tapes. In Manufacturing 3.0 there were hundreds of computers, most of them visible. In Manufacturing 4.0, there will be hundreds of thousands of computers. But the most important part is not technological improvement itself; it's the networking of these computers."

THE REALITY OF THE 'SMART FACTORY'

The Smart Factory Industry Forum focused on the still-evolving Industrial Internet of Things concept, and brought together industry leaders to talk about how that evolution may turn out. Holding the event at DMDII, a manufacturing lab focused on developing new concepts for manufacturing in the digital age, highlighted the efforts of government, academic and technology leaders to forge a vision for IIoT.

That vision may mean different things for different companies today, but most leaders see much more common ground. "It's changing industry from CAD centric to a data-based industry. It's providing the right tool for companies to design their machines," said Sean Mulherrin, global product

manager, EPlan, at an IIoT panel discussion at the symposium. “You now can easily predict the outcome of the design, visualize the design and validate the design. The machine’s already been proven in a digital environment.”

“We’re data rich but information poor,” added Mark Beckman, senior business development manager at Microsoft. “We can talk about all things can do with data, but if can’t use it, doesn’t do any good. We’ve got to get data down to the workers. The first step is, how do I collect data? The second step is, how do I start to make it actionable? The third step is, how do I predict things that will happen?”

Many of the challenges around IIoT focus not on the technology, but on the culture change in organizations looking to implement the technology. For global companies such as Bosch Rexroth, it’s a culture change from region to region as well. “As a German-based company, in Germany it’s very systematic and process driven. Bosch doesn’t like anything out the door unless it’s 100%. In the U.S., it’s 80% and we’ll figure out the rest later,” said Robert Magnetti, sales director manufacturing solutions, Bosch Software Innovation. “What we see happening in own industry is that in the IIoT world, things change fast. Without suffering on quality, we’ve got to get to market faster.”

Bob Vavra is Plant Engineering content manager, bvavra@cfemedia.com.

AN OVERVIEW OF THE FOCAL POINTS NECESSARY FOR INTEGRATING IIoT SOLUTIONS

The IIoT trend has hit the industrial market and promises to bring more insight, analytics, and efficiencies to the factory floor.

Information is power, and the Internet has changed the quantity and quality of the information available to companies forever. When the Internet first took shape it used standard network protocols to provide widespread information, reaching into all aspects of today's homes and businesses, and, most recently, into industrial applications with the advent of the Internet of Things (IoT). Now, we're seeing growth and expansion taking shape through IoT in a similar fashion to the Internet's original beginnings. The Industrial Internet of Things (IIoT) is growing quickly and seeing widespread use that will only grow ever broader and more important.

It is only logical that IIoT solutions begin with connectivity, which is designed to provide valuable information to business. From there, pulling that information together and interconnecting it with systems designed for analysis is key. After all, analysis leads to insight and action. The more you know about the machines your using, the climate they are in, and the pressures they are under, the better informed your company becomes and the more agile it can be. The third level relates to how the entire ecosystem of a facility operates together, from purchasing to production to shipping.

INCREASING PRODUCTIVITY

Working alongside present industrial protocols such as Profinet, Modbus, CIP, and others allows the IIoT to harness information already present in each machine, which monitors its own status. By removing that information from their silos, IIoT devices offer data that can be used to boost productivity due to continuous insight into the changing conditions in the machines. Across manufacturing and process industries, companies are scrambling to add products that connect processes with machines and equipment so managers can gather all the data they need to get a better real-time view of what's happening on the factory floor. The bottom line is productivity for this level of inclusion.

As mentioned above, there are three primary phases to the growth in IIoT applications. The first is to connect devices over an industrial IP network, then add analytics and application integration, which will help in the improvement of processes, and finally to interconnect entire ecosystems for further automation and integrated operations.

IIoT Manufacturing Opportunity: Connected Factory



CONNECTING THINGS

In the beginning stages of implementation it is best to focus attention on connections that are expandable, growth oriented, easy to use, and secure, because wherever you go from that point will have a sound foundation on which to grow. Some of the key product offerings in the connection stage include switching networks. Many facilities are already focused on IIoT devices at this lower end—where switches are present but unmanaged, which means when things go wrong there is no easy access to why.

For example, if a cable is accidentally pulled from a machine, it stops working and you don't have any indication why. In this case, it's necessary to move to troubleshooting techniques to narrow down the problem to its source. With a lightly managed switch, such as the IE 1000 from Cisco, tools are available to help monitor and diagnose the problem remotely. In the situation mentioned, troubleshooting tools would indicate that a cable was damaged, making maintenance and repair operations simpler and more efficient. Note that the Cisco IE 1000 managed Ethernet Switch is for entry-level users and it typically installed below the individual cell loop. These switches are the easiest to implement as a beginning solution for small or large facilities, which makes them an important first step.

As a company's IIoT solution ramps up, it's important to connect to each level of information. When connecting close to the edge but at the cell level, Cisco provides the next level of connection, their IE 4000 and 2000 Series switches. These fixed modules deliver Layer 2 switching with proven software support. Cisco provides products at every level of connection as your solution grows. It is important that every component integrate smoothly and easily with the protocols already present on site, so they are careful to support common industrial protocols, including IEEE 1588, Common Industrial Protocol (CIP), and PROFINET, among others.

Another major concern, of course, is that any addition needs to be designed for industrial environments.

Cisco products have all been designed and tested for use in some of the harshest applications around, including those in the mining and steel industries. Factors that are essential include compact form factors, DIN rail mounting capabilities, available alarm channels, DC power operation, and ruggedization, including extreme temperatures, shock, and vibration.

CONNECTING APPLICATIONS AND ANALYTICS

By working directly with the machine builder, Cisco is able to make sense of the data collected from each level of interconnection to understand the needs of specific industry segments. For example, through a partnership with Mazak where IoT data from their machines helps manufacturers increase overall equipment effective-



ness (OEE). For this solution, Cisco employs their highly scalable and resilient switches, the IE 4000 Series, which provide high-bandwidth switching (Layer 2) and software-based routing (Layer 3) capabilities for industrial environments. The 4000 Series switches are built to withstand the extreme environments that many Mazak machines are placed into, while adhering to overall IT network design, compliance, and performance requirements. The IoT data is transformed into information in the network with a fog application running directly on the IOx-enabled IE 4000. IOx provides a common application framework to run fog applications across the IoT network infrastructure. Real-time analytics execute in the fog as well, with Cisco's Connected Streaming Analytics delivering insight in the form of operator actions and predictive maintenance.

Security remains an essential part of every level of implementation because anytime you connect equipment to a network, access must be controlled and risks mitigated. To increase OT security and simplify compliance, Cisco offers their ISA 3000 firewall, which is a ruggedized appliance that offers visibility and threat protection for Common Industrial Protocol; and control and visibility of common IIoT protocols including DNP3, Modbus, and IEC 61850.

Application security and access control always define the devices connected to the network and the permissions those devices have. In addition, protocol security and application security will need to be consistent. Supply chain security will be an issue as well, starting with the coding of products, their manufacturing, delivery, installation, maintenance and disposal. Having services in place to help customers keep systems secure is critical in the IIoT era. Once your facility reaches that point, Cisco's IE 4000 becomes very important because it delivers highly secure access and industry-leading convergence using Cisco Resilient Ethernet Protocol.

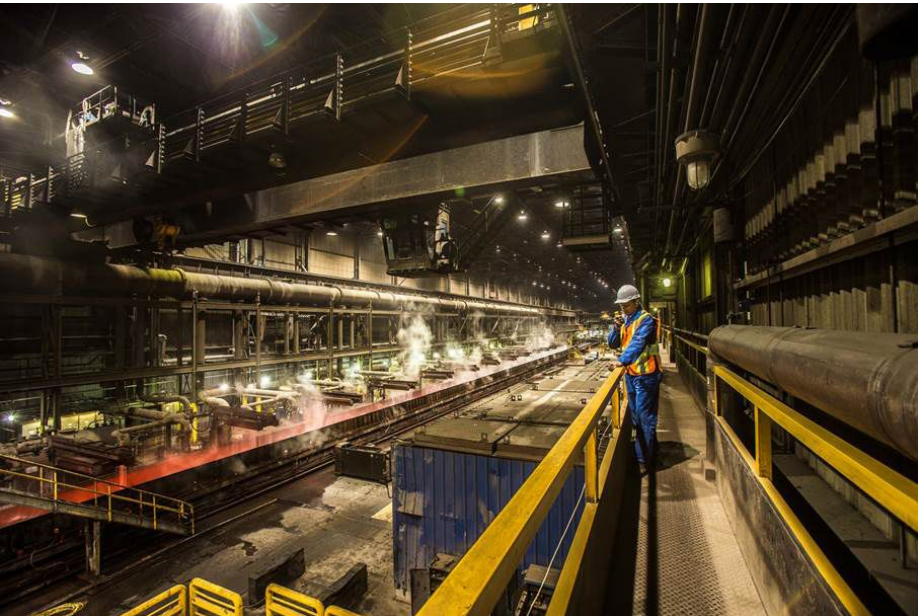
CONNECTING TO THE ECOSYSTEM

The future will definitely find multiple facilities and equipment connected in a variety of ways, where resident and cloud services will become the norm, along with fog computing (a decentralized computing infrastructure where resources and application services are distributed in the most logical and efficient place at any given point, from data collection to the cloud). This is also where IT Network level products come in, and Cisco is ready for that next step with a line of network controllers to help companies man-

age their facilities in the most efficient way. But many companies are just at the start of their implementation of an IIoT solution, so a cohesive, well thought out, solution is key when designing from the ground floor up.

As we have seen, IIoT comprises three basic technology attributes: connecting things, connecting data from those things to application and analysis solutions, and connecting to the overall ecosystem of the facility. All in all, IIoT allows for better business operations through a series of tools. The importance of picking a vendor with IT experience in the industrial space bears out when considering eventual integration and security with the ecosystem—which will be key to secure and drive business value forward. Starting with the right products from the ground up will assure that your company will be able to upgrade regularly to better

implement innovative processes into the workplace. Productivity enhancements delivered through an IIoT network will allow users to increase availability, speed new product introductions, improve supply chain efficiency, and optimize asset utilization.



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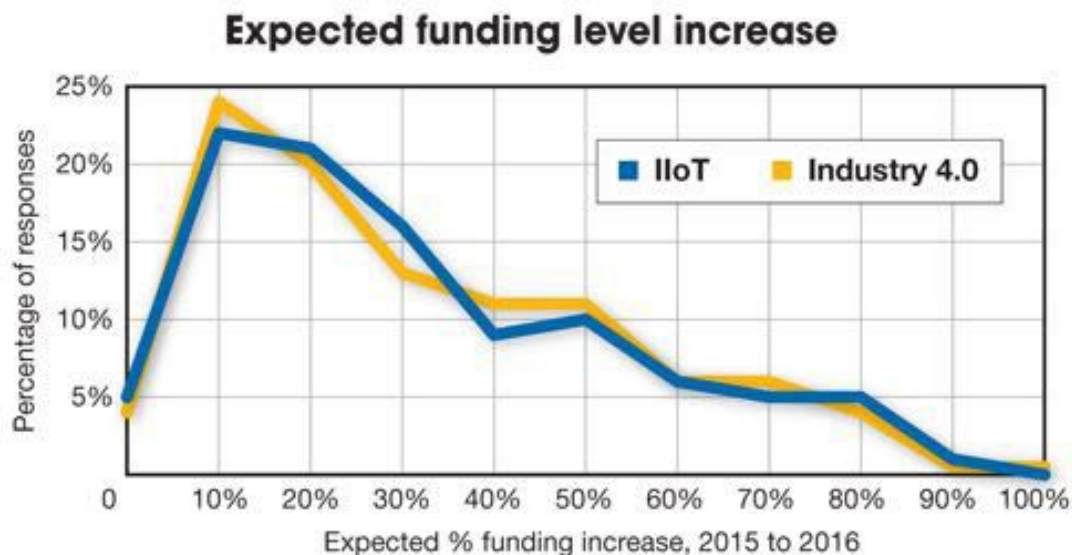
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SIX IIoT, INDUSTRY 4.0 KEY FINDINGS

Respondents to the *Control Engineering* 2015 Industrial Internet of Things (IIoT), Industry 4.0, Information Integration Study identified six high-level findings regarding IIoT and Industry 4.0 and their impact on the industry today:

- 1. Familiarity:** Fifty-nine percent of respondents identified as being “very” or “somewhat” familiar with the IIoT framework, compared to 29% being not very familiar and 12% not at all familiar. Only one-third of respondents identified as being “very” or “somewhat” familiar with the Industry 4.0 platform, compared to 36% being not very familiar and 31% not at all familiar.
- 2. IIoT attributes:** According to respondents, the most useful IIoT framework attributes to their organizations are interoperability and open standards connecting people, processes, and data (79%); as well as security (75%).



- 3. Industry 4.0 attributes:** Realtime capabilities (83%), interoperability (80%), and modularity (78%) are the most useful Industry 4.0 platform attributes, according to respondents.
- 4. Implementing IIoT attributes:** Interoperability and open standards has been implemented by 14% of respondents' facilities, with 38% progressing and 26% just beginning; compared to security having been implemented by 18%, with 35% progressing and 29% beginning to employ.

5. *Implementing Industry 4.0 attributes:* Only 10% of respondents' facilities have fully implemented the real-time capabilities, interoperability, and modularity attributes of Industry 4.0.
6. *Funding levels:* On average, respondents expect funding levels to increase 32% as a result of IIoT and Industry 4.0 discussions.

ONLINE EXTRA

Additional research findings, from other Control Engineering reports, include:

55% of system integrators work on an average of 10 projects or less each year.

Source: Control Engineering 2014 System Integration Study

44% of facilities expect their information integration activity will very slowly increase over the next few years.

Source: Control Engineering 2015 IIoT, Industry 4.0, Information Integration Study

3 out of 4 end users are concerned about the vulnerability of their organization's historians and connections.

Source: Control Engineering 2015 Cyber Security Study

MORE RESEARCH

Control Engineering surveys its audience on five topics each year: cyber security; career survey; system integration; IIoT, Industry 4.0, information integration; and mobility, Ethernet, and wireless. All reports are available at www.controleng.com/ce-research

Amanda Pelliccione is research director at CFE Media, apelliccione@cfemedia.com.

FESTO

Click the video below to view a video provided by Festo



NEW IIoT TECHNOLOGIES, STRATEGIES FOR A NEW YEAR

Industry analysts are offering their year-end predictions for 2016 with a focus on the Industrial Internet of Things (IIoT) and its continuing impact on manufacturing structure and strategy.

ARC Advisory Group analyst Greg Gorbach offered 10 trends for 2016. He said that the trends, “Are an interesting mix of positioning and technologies, but taken together, they point to continued momentum and acceleration in the direction the industry has embarked upon—embracing disruptive technologies to transform manufacturing.” Gorbach’s 10 predictions (which can be found at the IIoT/Industrie 4.0 link on the ARC homepage at www.arcweb.com) include:

- 1. Expect to hear a lot more about “digital transformation.”** In the confusion over what exactly to call the next wave of manufacturing intelligence, Gorbach noted that none of the names do an especially good job of explaining the underlying benefits. “Digital transformation” is a good moniker, Gorbach wrote, “because it reflects what ARC hears from end users who tell us that they can no longer continue to run their business with old technologies, processes, and business models, that things must change, even though they don’t know where to start.”
- 2. Focus on customer relationships.** As more sensors wind up in more devices, there also will be more data available to manufacturers on how end users interact with the device. This, in turn, will help create more responsive new products.
- 3. Platforms, platforms, platforms.** Gorbach said the use of the word “platform” is well ahead of anyone explaining just what a platform will accomplish, but he promises more research to help define the term.

4. External expertise improves asset performance management (APM). This external service offering holds two advantages for manufacturers, Gorbach wrote. “The knowledge, skills, and capability for supporting plant assets such as control valves, exchangers, and other plant equipment will begin to shift from in-sourced or contract direct-hire to remote services,” he said. “This change also lessens the industry concern over retiring skilled workers.”

5. Reference architectures rule. “Reference architectures will continue to be a hot topic in the coming year, and will reinforce the ongoing convergence of IT (information technology) and OT (operational technology) technologies,” said Gorbach.

6. Analytics everywhere. What to do with all the data is one of the big issues for 2016, Gorbach said. “If we had to make just one analytics prediction for 2016, though, it would be this: There will be an outbreak of companies saying ‘OK, we’ve collected the data, now what?’ ”

7. Supply chain control towers. Supply chain management is a crucial issue for IIoT adopters, and Gorbach said that part of the plant will benefit from enhanced tracking, real-time alerts, and improved decision-making enhanced by predictive analytics.

8. Cybersecurity. IT security is one of the key concerns raised in the modern plant that’s getting a lot of attention and analysis. Gorbach cited strategies, such as unidirectional security gateway solutions, that manufacturers can use to take the lead on cybersecurity.



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9. Greater protection for edge devices. Calling them “a weak point for both IoT and IIoT,” Gorbach noted that legacy network edge devices refresh slowly and are expensive to replace. He said it would be the network’s responsibility to provide security for these devices.

10. Wait, this is different! Gorbach noted the fundamental changes in manufacturing driven by IIoT adoption and implementation don’t begin at the device level. “A growing number of control engineers will finally begin to understand why the potential for digital transformation with IIoT... is not the same as what they have been doing with SCADA and automation systems for 30 years,” Gorbach said. “Software, scalability, analytics, and the possibility to reinvent business processes are what will really drive the uptake of technology and the coming digital transformation.”

Bob Vavra is content manager, Plant Engineering, CFE Media, bvavra@cfemedia.com.



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CASE STUDY: FAURECIA

KEPWARE'S IOT GATEWAY PROVIDES FAURECIA WITH DATA TO IMPROVE TRACEABILITY FOR TOP AUTOMOTIVE CUSTOMERS

THE CUSTOMER

Founded in 1997, Faurecia is one of the largest international automotive parts manufacturers in the world and has grown to become a major player in the global Automotive Industry. Recognized for its operational excellence and technological expertise, Faurecia is a preferred partner of the world's largest automakers.



With 330 sites including 30 Research & Development centers in 34 countries around the world, Faurecia is a global manufacturing leader in automotive seating, interior systems, automotive exteriors, and emissions control technologies. Faurecia is recognized as a pioneer in technological innovations—reducing the weight of vehicles, offering customized comfort and style solutions, and mitigating any impact on the environment. At the same time, Faurecia is also developing new manufacturing processes that are set to revolutionize its production methods.

“At Faurecia, we work with some of the biggest original equipment manufacturers (OEMs) in the world,” said Rafael Unruh, Competence Center Manager, Faurecia. “We are a pioneer in automotive technology and manufacturing processes. We pride ourselves on providing our customers with a superior product that keeps them coming back with each iteration of a vehicle.”

ORGANIZATION:

Faurecia is one of the world's largest automotive equipment suppliers in Automotive Seating, Emissions Control Technologies, Interior Systems, and Automotive Exteriors, posting total sales of more than \$21 billion in 2014. At December 31, 2014, Faurecia employed 100,000 people in 34 countries at 330 sites and 30 R&D centers. Faurecia is listed on the NYSE Euronext Paris stock exchange and trades in the U.S. over-the-counter (OTC) market.

SOLUTION:

- IoT Gateway for KEPServerEX
- Device Connectivity
 - Allen-Bradley
 - Modbus
 - Siemens
- Client Connectivity
 - IJ Core (Faurecia's proprietary MES)

THE CHALLENGE

While Faurecia has a long track record of providing its customers with exemplary products, the increasing need to provide customers traceability for the parts it was producing motivated the company to further support these efforts. The large automotive OEMs expected Faurecia to be able to both track the process of operations and production and to make that information available on demand. For example, customers wanted to know which airbags were added to which cars, as well as detailed data characteristics about how each airbag was installed, including torque and angle of installation.

Although the data for providing this traceability had always been available, the organization's solutions for collecting and distributing it were not on par with the efficiency and scalability that can be achieved with today's more modern IoT solutions and supporting architectures.

"In the modern age of manufacturing, data is king," said Unruh. "Consumers today have come to expect that they can get an update on a process at any time without the need for human interaction or intervention, and the same is true for our customers. We realized that we needed to provide greater transparency into our processes and products, so that our customers can plan and react accordingly and improve their own efficiencies."

THE APPROACH

Realizing that connectivity, data access, and scalability would be essential, Faurecia set out to find a communication solution that could connect to the various PLCs on the factory floor. After

experimenting with the product of a well-known OPC server provider, the company found that it was unreliable and resulted in lost data and server overloads. Faurecia turned to Kepware's flagship connectivity platform, KEPServerEX®, and began a pilot project in their Porto Real, Brazil factory. The company was familiar with the solution, having used KEPServerEX for a number of years to connect PLCs on the plant floor to IJ Core, Faurecia's proprietary parts fabrication and Manufacturing Execution System (MES) via the OPC DA protocol.

Using OPC DA to broker communications was complicated and becoming increasingly antiquated. The company considered replacing its OPC DA communications with OPC UA, which—though more modern—proved to be even more complex and required time and resources for implementation.

After learning more about Faurecia's goals, Kepware representatives were able to recommend that Faurecia implement the REST Server Agent in the IoT Gateway for KEPServerEX, which was released to market in October 2015. The developers working on Faurecia's MES were already comfortable with REST/HTTP (protocols ubiquitous in IT and on the web, and used in Internet of Things platforms) and were excited about the new middleware language that used KEPServerEX connections they already had in place.

Faurecia has a local server in each plant running its proprietary MES, IJ Core. Using the IoT Gateway, the company began collecting data from the shop floor and communicating it to IJ Core over REST/ HTTP. IJ Core was then able to store that information, satisfying customer requests for traceability spanning several years.

“The IoT Gateway’s ease of implementation and use—and ability to communicate with the leading devices on the shop floor—gives us peace of mind,” said Unruh. “We’re able to concentrate on other facets of the business because it just works. With greater visibility into the processes we have in place, we’re able to make more educated decisions about our future, which is invaluable.”

THE RESULTS

By implementing the IoT Gateway as the communications medium between PLCs on the plant floor and IJ Core, Faurecia is able to provide customers with the product traceability they require. With new visibility into the manufacturing data of parts provided by Faurecia, the world’s largest automotive OEMs are able to satisfy regulatory requirements and improve overall product quality for consumers.

Internal Faurecia stakeholders are benefiting as well. Operators on the machine floor note that communications are much faster, and the Quality Assurance department has the industrial data they need in order to analyze production quality. The solution has also improved the daily professional quality of life for developers working on IJ Core. Utilizing the familiar REST protocol instead of OPC enables them to spend more time developing new solutions to increase shop floor productivity and less time troubleshooting.

Furthermore, technology from Kepware is helping to bridge the gap between Operations Technology (OT) and Information Technology (IT) by enabling executives in Faurecia’s boardroom to access and leverage data to boost efficiencies across the organization.

“We’re seeing benefits from this implementation from the boardroom down to the shop floor, and only expect them to increase as more locations utilize it. We’re able to be smarter and more nimble in our decision making, which leads to better products and services for our customers.”

Since implementing the IoT Gateway for KEPServerEX, Faurecia was able to decrease its transparency project from a complicated six-month scope to a functioning solution in just a couple of days. This has resulted in significant time and revenue savings—and satisfied customers. Given the ease of implementation and overall success of the Porto Real, Brazil pilot, Faurecia plans to standardize on KEPServerEX in its North American, Asian, and European factories in 2016.

The company is also interested in using the data to do more proactive analytics on the machines. Faurecia plans to serve production data to plant supervisors on a tablet display, allowing them to monitor and make real-time changes to production in order to reduce unplanned downtime and improve operations.

“We see huge potential with the IoT Gateway and are excited to deploy it across the 34 countries we operate in,” said Unruh. “We’re seeing benefits from this implementation from the boardroom down to the shop floor, and only expect them to increase as more locations utilize it. We’re able to be smarter and more nimble in our decision making, which leads to better products and services for our customers.”



OPTIMIZING ELECTRICAL SYSTEMS THROUGH IIoT

Logistics companies such as FedEx and UPS have tracked and optimized assets at an enterprise level for years and have invested billions of dollars doing so. These enterprise-level analytics had been beyond the reach of many other industries because the benefits did not justify the investment. This is changing.

Today, a wide variety of applications and industries are able to make the case for advanced analytics to optimize their assets and improve their bottom line. With infrastructure aging and equipment running on older technology, things aren't operating as they should be. It takes additional manpower to keep operations status quo and to react to problems when they occur. Companies have been digitally monitoring and controlling high-value assets for decades. There still is an enormous fleet of electrical equipment that is offline and disconnected from an operation.

There is hope. Today's electrical distribution equipment incorporates modern solid-state electronics that provide improved power reliability, optimized uptime and selectivity while also providing a safer work environment. In addition, these processor-driven trip units, relays, and meters often are used in power-management schemes. The demand for electrical distribution equipment to contribute data to monitoring and control systems will only grow. Let's start by looking at some common market trends that will play a role in the demand for and implementation of advanced analytics:

- **The digital shift:** With the aging workforce retiring in the coming years, the most significant impact to manufacturing companies will be in the skilled production and production-support sectors. One of the biggest losses will come in the form of experience. Today's "machine whisperers," the people that can detect a problem by just listening to the machine, will be gone. The new workforce was "born digital" and expects collaborative tools to dramatically improve quality and velocity of output. We will see the rise of

“digital” engineers—both mechanical and electrical—and data scientists as the new generation of engineers enters the workforce.

- **If it can be measured, it will be connected:** Some estimates forecast machine connectivity to reach 50 billion connected devices by 2020. This creates an opportunity for businesses to use data and analytics to achieve unprecedented levels of performance, up-time, and productivity.
- **Driving business insight:** Affordable computing power creates opportunities for simpler, more practical resolutions of complex problems. This enables new levels of process performance and business insight that extends from sensor and controls to machines to manufacturing plant and line workers. In essence, data needs to be put into the hands of the people that can benefit from the information.

These industry trends lead us to the conclusion that, in the near future, we are going to experience an influx of new-generation workers into the workforce, many of whom require a different level of digital efficiency than ever before. These workers are used to having the tools they need at their fingertips.

The Industrial Internet of Things (IIoT) will play a large role in the seamless transition of next-generation employees and will enable facility operators and plant engineers to maximize the full potential of their infrastructure, equipment, and operations by making them smarter and more efficient.

IMPACT ON ELECTRICAL DISTRIBUTION

IIoT refers to the integration of complex physical machinery with networked sensors and software. It enables customers to consume equipment data, analyze it, and use it to optimize their operations by connecting intel-

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elligent machines to the people who can do the most with the information and analytics they produce.

IIoT has the ability to significantly improve the way electricity is distributed—from improved efficiency and network awareness to better protection of equipment and personnel. New, modern power-distribution equipment feature current and voltage sensors that can be leveraged to provide operators with valuable insight about the characteristics and volume of the load that is being distributed. This data can be harvested and leveraged at very little additional expense through advanced asset-optimization technologies.

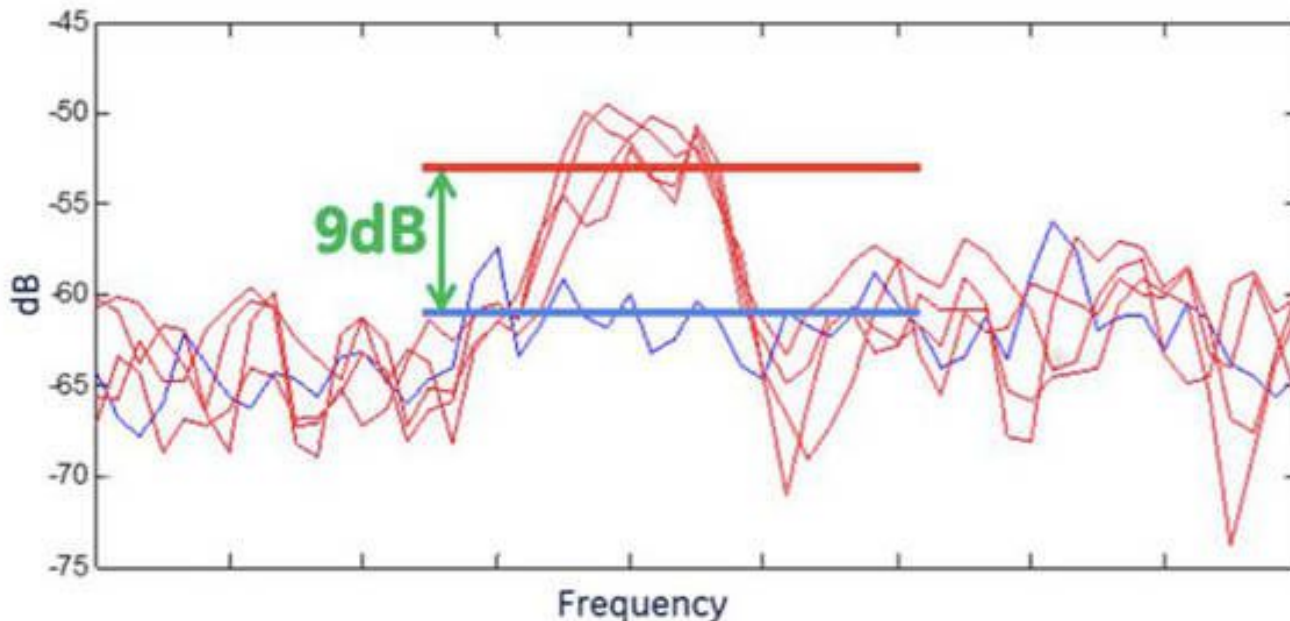
While most new equipment will be able to harness the power of IIoT “out of the box,” there have been questions about what can be done to integrate existing legacy equipment in the new era. Not every distribution system requires large-scale infrastructure

replacement. Instead, recent technology innovations enable these older, but still functional, electrical-distribution systems to be upgraded with retrofit switchgear, circuit breakers, trip units, relays, meters, etc.—all of which feature newer digital devices that can sense, collect, and store data. This data can be stored to the cloud with controlled access and usability, connecting all of the dots for a clearer, better picture of network-wide operations and assets.

SIMPLE STEPS TO START

Asset optimization starts at the data-collection level with sensors. The most commonly used sensors in electrical-distribution systems are current and potential transformers. Data from these sensors correlated with environmental data such as temperature and status creates a basis to begin monitoring assets. It is important to select the appropriate sensor to improve accuracy and reduce its burden.

American National Standards Institute (ANSI) C57.13 is the standard method for classifying the accuracy and burden for these sensors. Most often, class 200 or better is needed for relay-protection applications and



class 100 or lower is sufficient for basic metering applications. If in question, consult the manufacturer to determine what is appropriate for your application needs.

The second step is to upgrade your meter, relay, or trip unit to extract this data. As devices age, plan on upgrading to more modern, smarter electronic units. In addition to providing improvements in safety and selectivity, the electrical signatures of each of the circuit breakers will give further resolution on individual loads. These electrical signatures can provide the first insights into the health and optimization of an asset.

Next, make a plan for connectivity. Electronic trip units and meters selected should all have a means to communicate over any number of industry-standard open protocols. Existing or upgraded power-management systems can be programmed to trend and monitor voltage, current, and the status of assets without additional sensors.

Finally, once you're ready to view or share the data, it should be moved easily to a central data warehouse or cloud-based server, building a system-level perspective. Networking your system together will enable a view of multiple devices at the same time and build a system perspective. Networks can be built from the cloud all the way down to the intelligent electronic-device level. Currently, industrial electrical-infrastructure upgrade projects like these are very common. Owners of a wide variety of aging facilities are actively improving instrumentation, control, and communication for their power-distribution systems.

GETTING SMARTER

Now that the data has been collected, what do you do with it? Enabling a complete IIoT-based solution for your enterprise enables the use of analytics. These analytics can provide insights into operations and present

opportunities ranging from efficient energy management to peak shaving opportunities and failure detection—while also digitally connecting data to people for quicker response and improved collaboration.

Most analytic systems require you to start with an understanding of the data, the system, and the potential failure modes before you even begin. This may sound like a daunting task, but there is a simple solution. Today, software is available that can “learn” your process, automatically determine relationships, and detect anomalies.

TRADITIONAL PREDICTIVE ANALYTICS

Traditionally, equipment targeted for advanced analytics was very expensive and complicated. They included assets such as large turbines, generators, compressors, and pumps. These assets are found in numerous applications for industrial processes, power generation, renewable energy, and transportation. Goals for a traditional predictive analytics project include:

- Reduce corrective maintenance
- Prevent unscheduled shutdowns or delay scheduled shutdowns
- Avoid delays due to availability of technical labor
- Maximize system performance.

Typically, a project included instrumentation for a motor or generator, gearbox, and mechanical load or prime mover. Many sensors (e.g., temperature, pressure, flow, vibration, acoustic, electrical, and visual) monitored system health and detected potential problems. However, collecting and analyzing this data required dedicated high-speed monitoring equipment, data storage, and specialized personnel specific to that particular asset.

MORE ADVANCED METHODS

GE's Global Research Center developed analytical methods using primarily the electrical signature of equipment in lieu of other sensing. These methods not only detect the presence and severity of electrical issues, but also reveal mechanical issues in connected equipment.

When gearbox bearings fail, analytical methods are applied to a variety of signals including vibration, audio, and electrical. The damaged bearing creates minute changes in the electrical profile. After applying advanced filtering and analytical techniques, the failure is clearly visible from the current transformer signals on the motor's primary conductors, as shown in Figure 1. These electrical signals can be coupled with other signals to further improve the resolution. Electrical signature analysis has also been shown to detect the problem earlier and more reliably than with vibration sensing.

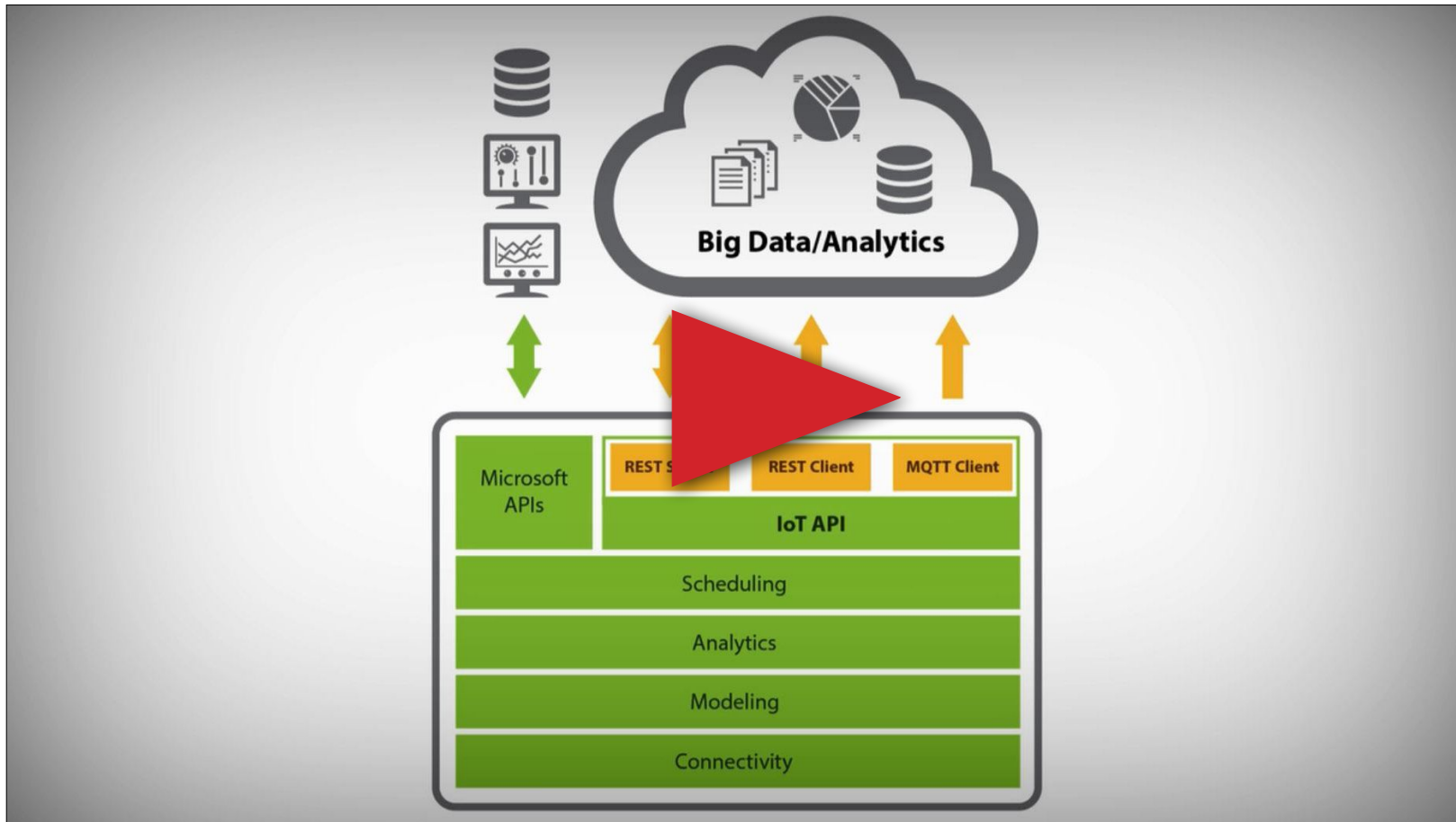
In the future, advanced analytics currently reserved for expensive assets will be available to monitor many, much smaller assets—and will ascertain the health of the overall process, rather than individual pieces of equipment.

Regardless of a facility's age, owners can employ instrumentation, networking, and analytics to reap real benefits. For older facilities, improvements can be made in stages to limit disruption and to work within budget constraints. From improved asset uptime and customer experience to reduce cost-to-serve, the industrial Internet can connect your facility to enhanced revenue streams. Take these steps now and start connecting for a better, smarter, more productive future.

Andrew Sohn is the product line manager for power-delivery services at GE Energy Management's Industrial Solutions business. He also is a member of the IEEE Industrial Application Society. Ted Hill is the senior application engineer for electrical equipment at GE Energy Management's Industrial Solutions business.



Click the video below to view a video provided by Kepware Technologies



MAINTENANCE A PRIME BENEFIT FOR IIoT

The emergence of Industrial Internet of Things (IIoT) as a plant strategy has focused on productivity and operational issues. One area of great potential, and one area that often gets overlooked, is maintenance. A recent study by global consultancy Frost & Sullivan talked about the relationship between IIoT and maintenance. The study found that service strategies will shift from corrective to preventive and predictive maintenance services over the next five years.

“Effective utilization of predictive analytics can optimize costs and eliminate unplanned downtime, which are highly attractive benefits for manufacturers,” Frost & Sullivan officials reported. “Big data analytics is poised to change the maintenance services models across the manufacturing sector. The investments for establishment of robust maintenance and support service model by leveraging the big data analytic concepts is the critical factor for the high growth rate.”

Report author Srikanth Shivaswamy, senior research analyst for industrial automation and process control for Frost & Sullivan, discussed the ways IIoT will impact the maintenance area.

CFE MEDIA: One of the hottest topics around IIoT is the potential for better maintenance within plants. Has maintenance been overlooked by most plant managers? How will IIoT potentially change that?

SHIVASWAMY: Conventional maintenance systems followed pre-set approaches for maintenance and repairs; service activities were performed according to pre-design standard operating procedure. Maintenance and





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repair operations were initiated based on equipment or process flow breakdown.

Internet of Industrial things would see the emergence of scheduled and automatic maintenance and repairs activities generated by pre-programmed algorithms.

- Dynamic maintenance schedules can be generated based on real-time data by sensors.
- Ability to migrate to a completely different service model to adjust to a new process/ product /solution and improve the overall performance of the end-user.
- Flexibility to scale up and down the services capabilities.

CFE: Will this increase in data also change the training and skill set needed for maintenance workers? What are the challenges and opportunities here?

SHIVASWAMY: The skill set of the maintenance

workers need to be tuned to understand the dynamic service models. In most cases the maintenance workers needs to be trained to understand and operate the IIoT based platform.

Challenges and opportunities:

- Development of smart and user-friendly platforms for data management
- Asset and resource management modules
- Standard service and maintenance models
- Use of off the shelf mobile devices
- Development of integrated cloud platforms to execute design, maintenance, and business services.

CFE: It appears that there will be more companies providing third-party services in both maintenance management and cyber-security. What do you see as the pros and cons to such an approach?

SHIVASWAMY: The increase in number niche companies can be attributed to the emergence of industries data services and cyber security services. The lack robust software platform in the industrial space has been seen as a lucrative opportunity by most of the niche companies. This would witness the upcoming of innovative platforms to increase the utilization of products, equipment and assets. Lack for standardization across software platforms has been the major concern for data cross-flow and integration.

CFE: What is the first thing plant managers should do to prepare for IIoT in their facilities?

SHIVASWAMY: Information technology and communication infrastructure in the most of the plants needs to be improved for complete implementation of IIoT modules.



Click the video below to view a video provided by ICONICS



CREATING VISIBILITY IN THE PLANT A MAJOR BENEFIT OF IIoT

Sal Spada of ARC Advisory Group delivers a view of information management at CFE Media Webcast.

With the existing network of sensors and gauges on the plant floor today, getting data has not been the issue. The challenge for manufacturers is to analyze that information to allow manufacturers to make better plant floor decisions, said Sal Spada, research director for ARC Advisory Group during the June 2 CFE Media Webcast on the Industrial Internet of Things (IIoT).

Part 2 of CFE Media's year-long series on IIoT focused on information management. The on-demand version of the Webcast is now available online.



The Webcast is sponsored by Beckhoff, Epicor, Kepware, Red Lion and Rittal. “With the Industrial Internet of Things, we have seen already companies are identifying a machine not operating properly or inefficiently, or the way the operator is performing at the machine,” said Spada. “So that’s a critical part of the Industrial Internet-creating that visibility.”

Spada said the information gathered by machines is reaching into all parts of the manufacturing operation, including machine design. “Machinery operators are actually gathering information to improve the next generation of their own equipment,” Spada said during the Webcast.

Rather than just collecting random data, or overloading operators with too much data, the analytics tools at the core of IIoT are helping bring focus to what’s really happening on the plant floor. “Quite a bit of it is

about knowledge discovers, or machine learning, which is the term used in this particular market,” Spada told the CFE audience. “There are a tremendous number of analytical tools being created today. What’s driving the market today in terms of knowledge discovery is that companies want to create larger numbers of data sets utilize these analytics.”

And the end result? Spada said the proper analytics, used properly, will “reduce the time to identifying problems in production operations to (allow manufacturers to) start up more quickly in new product development or to take faster corrective actions.”

TO VIEW THE IIoT WEBCAST FROM MARCH 31, 2016, VISIT:

www.plantengineering.com/media-library/webcasts/2016-webcasts/33116-webcast.html

IIoT WEBCAST SERIES 2016, PART TWO: INFORMATION MANAGEMENT FOR IIOT: YOUR QUESTIONS ANSWERED

More answers about information management for IIoT, the topic of a June 2, are provided by speaker Sal Spada. Topics include single-phase circuits and power generation.

Modern manufacturing plants collect enormous amounts of information each day. The difficult part has been managing that information flow, and more importantly, making better use of that information flow to affect change within the plant. The promise of the Industrial Internet of Things (IIoT) is the ability to use modern data management and storage tools to deliver actionable data to workers at all levels of the plant when they need it. Those answering questions below are:



Sal Spada, Research Director, ARC Advisory Group.

Additional answers from Spada follow below, related to using information management for the IIoT.

QUESTION: WHERE SHOULD I START WITH IIoT?

SAL SPADA: The answer really depends on whether you design and product machinery or you are a manufacturer. For the machine builder the opportunity is in providing the aftermarket services. So it is critical to develop the secure connection to the machine so that customers are not concerned with security of their plant. For the manufacturer, the starting point is also securing the plant. The benefits of IIoT are only available if the plant equipment secure. The point is that you will be moving large volumes of data to the Cloud for analysis, which needs to be moved securely.

QUESTION: HOW WILL THE IIoT IMPACT THE OIL & GAS INDUSTRY?

SPADA: IIoT promises to raise the availability of equipment in the field by incorporating predictive maintenance into most operator's business practices. Today, most operators use scheduled maintenance practices. Implementations of IIoT are now targeting the predictive maintenance side because they have the compute power in the cloud to perform the analytics. In the O&G industry there are an enormous number of large motors, which would be one of the first target applications for leveraging IIoT.

QUESTION: HOW WILL THE IIoT INTERACT WITH SUPERVISORY CONTROL AND DATA ACQUISITION (SCADA) SYSTEMS? WHAT ARE THE CHALLENGES THERE?

SPADA: SCADA systems could be incorporated as a potential gateway for data storage before it is moved to the cloud. The concept of gateways with edge analytics is now becoming a mainstream technology. It may be a natural evolution for a SCADA system to perform localized analytics.

QUESTION: YOU MENTIONED MAINTENANCE AND MOVING FROM REACTIVE TO PREDICTIVE TO PREVENTIVE. HOW WILL IIoT HELP THAT TRANSITION?

SPADA: One of the biggest challenges in predictive maintenance is the limited amount of compute power available on the equipment or machinery. IIoT ecosystems will leverage cloud computing infrastructure to analyze data streams from machinery. Furthermore, the same machinery being utilized in other plants will

be used for comparisons. A larger database of information from a broader range of equipment will give machine builders better models of their machines, thereby being able to predict potential failures.

QUESTION: WHERE ARE THE DANGERS IN SHARING INFORMATION IN THE CLOUD? IS IT SECURITY, THE POTENTIAL LOSS OF INTELLECTUAL PROPERTY, OR ARE THERE OTHER AREAS OF SECURITY MANUFACTURERS SHOULD BE CONCERNED ABOUT?

SPADA: Most companies I speak to are concerned with losing intellectual property. Production methods are a competitive advantage and the risk of exposing production processes is one of the biggest concerns.

Edited by Chris Vavra, production editor, CFE Media, cvavra@cfemedia.com.

THE PROMISE AND THE RISKS OF IIoT AND INDUSTRY 4.0

The concept of the Industrial Internet of Things (IIoT) and its European equivalent, Industry 4.0, continues to grow. The promise of these strategies is to bring data together to deliver actionable results and improve productivity, but the reality of plants today is that there is widely disparate use of sensors and monitors. Many other plants simply aren't that far along in the manufacturing process.

A recent study by Ubisense, a global enterprise software solutions company, found there is a continued use of manual systems in plants. Among the findings of the study:

- 40% have no visibility into the real-time status of their company's manufacturing process.
- More than 80% rely on human observation to support process improvement initiatives.
- 85% of quality issues are caused by worker errors.
- Nearly 10% of manufacturers spend half their day looking for equipment and products.
- Almost 15% of manufacturers don't prioritize product repairs.

Adrian Jennings, vice president of manufacturing industry strategy for Ubisense, discussed the study's findings and its implications for discrete manufacturing with CFE Media:

CFE MEDIA: You work with a lot of customers in all areas of manufacturing. Were there any surprises from the results of the study?

JENNINGS: On the face of it, the survey was somewhat surprising: 10% of respondents waste at least half of their day searching for lost items; 40% have no real-time process visibility; and 50% don't

keep fastener tightening records. However, the reality is that this reflects my experience when visiting all kinds of assembly plants globally.

I think people have a general belief that assembly plants are rather advanced technologically, and that's just not the case. The picture people imaginatively involves legions of robots happily welding and spraying in high-volume car plants. But out there on the assembly line, and in other, lower volume plants (tractors, backhoes, street sweepers, Dreamliners) the scene is quite different. The reality is that manufacturing plants are still dominated by manual processes and in that light, the survey results are not surprising at all.

CFE: What are the biggest barriers for manufacturers to implement Industry 4.0? How many of those barriers are human and how many are financial?

JENNINGS: I should preface my answer by saying that I don't think anybody in the automotive vertical is implementing Industry 4.0 today, and precisely because there are some formidable barriers. It's tempting to think of any kind of computer controlled process as "Industry 4.0" since we've been persuaded to believe that 4.0 is all about cyber-physical systems. But we are also told that Industry 3.0 refers to the introduction of microprocessors and computerized control—and what is that if not a localized cyber-physical system?

I think it's critically important to understand that Industry 4.0 is about scale of integration, which is why it is wrapped up with the Internet of Things. The underlying paradigm shift is that people will

have real-time, detailed knowledge of the status of the entire value chain—from order to fulfillment—so that production can be agile and reactive to different issues and drivers.

With that definition, I think there are four critical barriers to Industry 4.0 adoption: networks, security, skills and culture. Perhaps networks and security go hand in hand since they are closely related. In terms of networks, in order to crunch data based on widely distributed process sensors, you need the network infrastructure to get all that data to one location.

The first problem is getting it from line side to a server, and that's no small task. Wireless networks today are not widely used in mission-critical applications since they are not robust enough, and wired networks are costly to install. Many plants just don't have the infrastructure to distribute data inside the plant, let alone between plants and suppliers on a global basis.

It's at that level that security concerns become an issue too: Industry 4.0 requires high-bandwidth, low-latency, mission-critical reliability over global, secure networks—networks built and managed by Telecom operators outside of the control of automotive OEMs.

The IT challenge is critical, and it's not simply financial. The vast majority of plants are shop-floor driven with strategic direction on control systems driven by process engineers on the line. IT is a supporting function and is rarely seen as an area for investment in its own right. Industry 4.0 is a seismic shift; it is without question the “IT-ification” of



manufacturing. If the production process is truly to be driven by real-time intelligence from sensors throughout the supply chain, then IT will take on a central, leading role all the way to the devices on the line. That's a big shift in thinking for most people and requires a long-term view of IT infrastructure as a strategic investment rather than the incremental cost of any controls project.

The other cultural issue is about willingness to change. Industry 4.0 is truly a revolutionary idea and it will open up huge opportunities for people ready to embrace it. Let's remember though that it is not about technology adoption; the technology is simply a tool. Rather, Industry 4.0 is about a whole new way to approach production, and the automotive industry is rightly cautious about big new ideas.

When you are pushing out 400 cars in a single shift or bolting wings on an airliner, there's no room for risk-taking, and that breeds a healthy level of caution. Industry 4.0 will shatter long-held notions about how to control processes and create a level of flexibility that goes against generations of experience. Technology adoption alone cannot change the bottom line unless the potential for change is embraced throughout the organization.

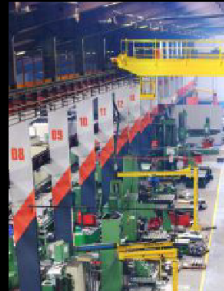
CFE: For your customers already implementing Industry 4.0, where have they seen the biggest benefits?

JENNINGS: I mentioned that I don't think anyone in automotive manufacturing is fully adopting Industry 4.0 yet, but many are on the path. I want to make a distinction between the end-to-end cyber-physical systems of Industry 4.0, and local cyber-physical systems that are adding value to a single process or physically close set of related processes. Let's call these "cyber-physical islands" and frame them either as advanced Industry 3.0, or embryonic Industry 4.0 depending on your preference.

MORE IIoT



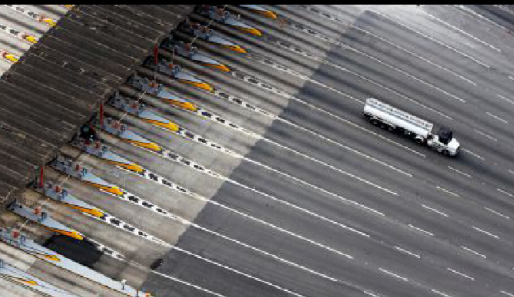
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LINE	ITEM	QUANTITY	BAR	COUNT	TRAVEL TIME	PERCENT
1	100	100	100	100	100	100%
2	200	200	200	200	200	100%
3	300	300	300	300	300	100%
4	400	400	400	400	400	100%
5	500	500	500	500	500	100%
6	600	600	600	600	600	100%
7	700	700	700	700	700	100%

Ubisense is certainly in the business of enabling cyber-physical islands and our customers are seeing big benefits as a result. There are many examples, so I'll just pick two to illustrate the point:

One of our solutions virtualizes the product identification process—a common function required at many locations along an assembly line. Traditionally, this is performed either manually, using barcode scanners, or automatically, using RFID or other fixed infrastructure. By removing barcode scanners, our customers have eliminated a significant amount of process waste, enough to actually reduce the number of workstations on the line.

By doing away with fixed ID infrastructure, other customers have been able to significantly reduce the cost of line rebalancing—the continual process-shuffling burden that always has engineers working the weekends.

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Another solution completely virtualizes the entire workstation, creating process control zones in software that attach themselves to the product and entirely replace the traditional fixed workstation. Once virtualized, the workstation can vary in real time in reaction to product variation, task overrun and many more of the increasing number of variables in plants.

One customer has benefited from the ability to give workers a few extra seconds of process time when needed, avoiding a large number of short line stops throughout the day. Another has used the idea of a virtual workstation to create overlapping processes, with one new third-row seat process riding on top of three existing processes.

CFE: Talk about the challenges for manufacturers trying to deal with the issues of Big Data. How can they do a better job of managing data to better understand the metrics?

JENNINGS: Big data analytics is a skill set that simply doesn't have a foothold in most plants. Until now, data analysis has been at the local level, often constrained to single processes or a small set of related processes. The data analytics tools are also non-specialized – you only have to look at the printouts on most plant notice boards to realize that Microsoft Excel is the leading analysis tool. Finding trends and triggers in a mountain of seemingly unconnected data is a very different challenge, more in the domain of the NSA than manufacturing.

Manufacturers will have to decide whether to outsource their analytics (creating another layer of cybersecurity issues) or hire a whole new skillset from other industries. Both options have their challenges, but probably outsourcing is the farther reach: “software-as-a-service” and “analytics-as-a-service” sound reasonable, but if Industry 4.0 is to be embraced in all its end-to-end, real-time con-

nectedness, then “production-planning-as-a-service” and “process-control-as-a-service” will have to be considered, too. The implications for cybersecurity and performance SLAs under such a model are immense.

CFE: If a manufacturer is looking to implement 4.0, what’s the first thing he should do?

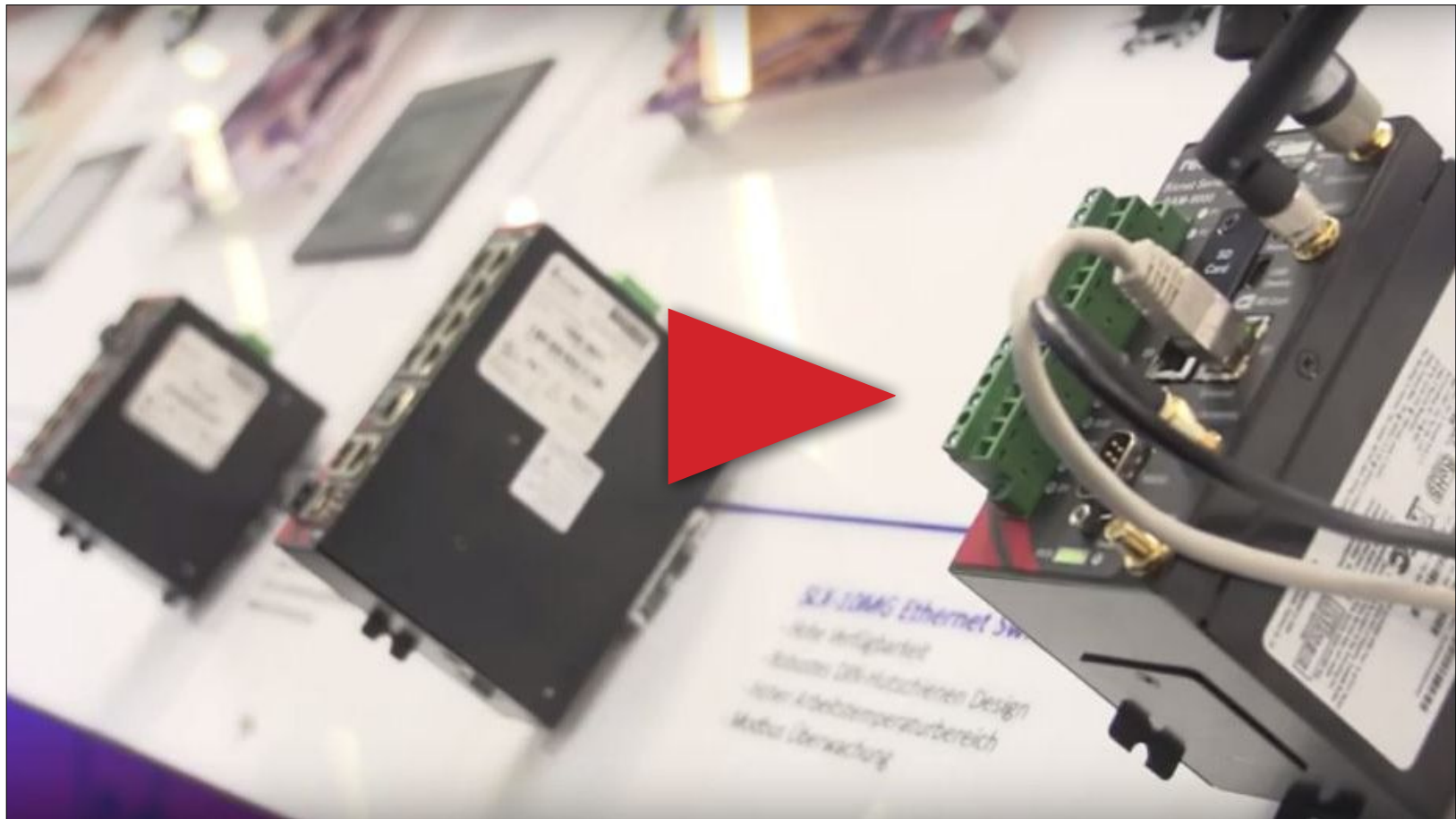
JENNINGS: Stop! I joke, but only partly. Industry 4.0 comes with a warning: choking hazard. It is a very big thing with potentially huge benefits and my advice is to try to swallow it in bite-sized chunks. I talked about cyber-physical islands and, whether you consider those to be late-stage Industry 3.0 (like I do) or early-stage Industry 4.0, they are absolutely the correct stepping stones that people should be considering today.

You don’t need real-time process data from your Tier 2 supply base in order to make great strides in quality and throughput in the plant. A growing number of available solutions apply sensors to islands within the plant and deliver a strong ROI through process visibility and smart controls. These solutions can be fairly large projects with similarly large ROIs, but they can be managed locally and with no dependence on third parties for networking, cybersecurity and data analytics.

My advice is this: build your cyber-physical islands today, and connect them all tomorrow. Once these islands are running and creating value, the impetus to connect them together will be strong, and the ROI obvious. Before then, the end-to-end-connectedness-of-all-things simply holds great promise and high risk.



Click the video below to view a video provided by Red Lion



IIoT VIDEO: SEE ON-MACHINE SENSOR VALUES IN REAL TIME VIA APPLE IPAD

See the Industrial Internet of Things (IIoT) video that shows Mike Campbell, executive vice president of PTC, describing and demonstrating the blending of the cyber-physical world with the real world at NIWeek 2015.

In an Industrial Internet of Things (IIoT) demonstration using a mountain bike tricked out with sensors and instrumentation, ThingWorx, a PTC business, revealed how an operator might see an industrial machine's metrics in real time by looking through a mobile human-machine interface (HMI) or wearable HMI, such as a head-mounted, hands-free display.



The Aug. 5, 2015, NIWeek keynote demo drew applause as Mike Campbell, executive vice president of PTC, showed John Graff, NI vice president marketing, how ThingWorx 3-D solid model technology and National Instruments (NI) hardware and software can widen IIoT capabilities. The demo started with the 3D model of the bike and then showed the values on the model (see photo).



HEADS-UP DISPLAY, CRITICAL MEASUREMENTS

On the actual bike, values updated in real time through the Apple iPad display after clicking on a 2D code, showing live updates of speed at the front wheel, fork displacement, pedal speed, steering angle, acceleration, and other attributes. These could be critical measurements on a manufacturing line, machine tool, packaging machine, power generating plant, oil and gas operations, or other facilities or equipment, linking the cyber-

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physical world to the real world. The NI myRIO embedded hardware fastened to the Santa Cruz mountain bike was programmed with NI LabVIEW system design software.

Graff called the on-machine live display of measurements in real time a “great example of the disruptive impact Internet of Things can have.”

NIWeek was in Austin, Aug. 3-6.

Mark T. Hoske, content manager, CFE Media, Control Engineering, mhoske@cfemedia.com



POWERING THE INDUSTRIAL INTERNET OF THINGS

The Industrial Internet of Things (IIoT) is often presented as a revolution that is changing the face of the industry in a profound manner. However, in reality, it is an evolution that has its origins in technologies and functionalities developed by visionary automation suppliers more than 15 years ago.

Although an evolution, the changes to the industry will be far-reaching. The good news is that end users and machine builders can now leverage their existing investments in technology, smart devices, and people while taking advantage of available new IIoT technologies. Introducing IIoT solutions using a “wrap and reuse” approach, rather than a “rip and replace” approach, will enable greater business control. In addition, this measured approach will drive the evolution toward a smart manufacturing enterprise that is more efficient, safer, and sustainable.

A HISTORY OF INNOVATION

The IIoT first started with Ethernet use on the plant floor at the sensor level, and the use of IP address technologies as a way to converge information technology (IT) systems with operational technology (OT) systems. Now, employees from the factory floor to the executive suite can access any production information worldwide through a Web browser, enabling fast and informed decisions at all levels.

By embracing open-system architectures and Internet technologies, we can challenge the proprietary networks that have tried to dominate industrial automation at all levels of the manufacturing environment. These proprietary networks complicate the control infrastructure, make it more expensive, and, in a real sense, take away the automation buyer’s right to choose. We can

eliminate these proprietary networks in favor of open and universally available Ethernet, TCP/IP, and related technologies. Currently, there are more Ethernet nodes installed daily than any of the proprietary fieldbus networks annually. This broad-based support, together with its use as the media for the information revolution, ensures continual improvements in speed, security, and reliability—attributes that are critical to the industrial environment.

Today, we can link the systems of the manufacturing environment to the people that need access to the information. It's just that simple, but also very important to the successful operation of a manufacturing enterprise. From the sensor to the CEO, the information-enabling properties provide the right information to the right place at the right time.

Riding the wave of technology generated by the Internet, we can use the inherent and intuitive properties of Web-enabled tools to envision a factory where employees at all levels are empowered to access information from anywhere in the world. Use of this commercially open technology provides a uniform and consistent structure throughout the enterprise.

With thin client architectures supported by embedded and dedicated servers, individuals can create a virtual connection and retrieve information regardless of computer type or operating system. This acceleration of IIoT will fuel the innovation.

EMBRACING THE TECHNOLOGY

Next-generation devices will drive the value of IIoT. Today, there are smart devices that are fully online, driving efficiency and productivity within the machines and on the factory floor. For the first



time, there are products where the Ethernet has been built into the backbone of the PLC, allowing third parties to develop modules using the standard Ethernet protocol and hardware layer. This also facilitates the IT-OT convergence, making a PLC that is truly ready to play in the IIoT architecture.

Another great example of embedding intelligence in “things” is what we call smart-connected products. The next generation of motors and drives are Ethernet-connected; thus, for the first time, they are able to provide operational insight to plant managers at a device level. Energy-management calculations, diagnostics, pump-curve information, etc., become easier than ever to monitor and act on. As a result, smart-connected products can do a lot of data analysis locally without overloading the higher-level systems, which are either on-premise or in the cloud. Additionally, the integration of dynamic QR codes into drives allow managers to quickly troubleshoot a failed drive and get it back online in the shortest time possible for improved asset performance. For example, by using the cloud and QR code technology to store critical information—such as calibration records—plant managers are able to retrieve them quickly during serious situations. This innovation drives simplicity to reduce repair times. While the value of the QR code changes depending on the status of the drive, if we have a default on the drive, any user with a smartphone or tablet can read the QR code and download information from the Internet to resolve the issue. Having a range of variable speed drives is an innovative concept that can meet any machine-performance requirement.

Modernizing our plant systems through upgrades to these next-generation technologies and devices will allow both OEMs and plant managers to take full advantage of the power of the IIoT.

SMART MANUFACTURING ENTERPRISES

By embracing the power of new smart devices, we can begin to realize the future of manufacturing, or the smart manufacturing enterprise. The smart manufacturing enterprise is made up of smart machines, plants, and operations—all of which have higher levels of intelligence embedded at the core. The linked systems are based on open and standard Internet, Ethernet, and cloud-enabled technologies that ensure secure access to devices and information. This allows Big Data to be processed with new, advanced analytics tools and for mobile technologies to drive greater business value. This, in turn, enables improvements to efficiency and profitability, increased cyber security, innovation, and better management of safety performance with reduced carbon dioxide emissions impact.

Because the IIoT is a large and complex concept, it is useful to divide the subject into smaller subtopics. This is useful not only because it makes the subject easier to understand, but also because the topics are moving at different speeds in terms of market availability and maturity of key standards.

With this in mind, we can break the subject into three areas where smart manufacturers will need to excel:

Asset-performance management: Deployment of cost-effective wireless sensors, easy cloud connectivity (including wide-area networks, or WAN) and data analytics will improve asset performance. These tools allow data to be easily gathered from the field and converted into actionable information in real time. This will result in better business decisions and

forward-looking decision-making processes. The cost-effectiveness of wireless/cloud solutions will result in an acceleration of typical applications, such as condition-based monitoring, preventive maintenance, energy management, etc.

Augmented operator: Future employees will use mobile devices, data analytics, augmented reality, and transparent connectivity to increase productivity. As fewer skilled workers are left behind to man core operations due to a rapid increase in baby-boomer retirement, younger replacement plant workers will need information at their fingertips. That information will be delivered in a real-time format that is familiar to them. Thus, the plant evolves to be more user-centric and less machine-centric.

Smart-enterprise control: IIoT technologies will enable tight integration of smart-connected machines and smart-connected manufacturing assets with the wider enterprise. This will facilitate more flexible and efficient, hence profitable, manufacturing. Smart-enterprise control can be viewed as a mid- to long-term trend. It is complex to implement and will require the creation of new standards to enable the convergence of IT and OT systems.

The industry of the future is open for every organization regardless of its size and its current business focus. Through simplification, we can make the complexity, created by digitization and the connected world, manageable. To master the key challenges of IIoT, we must integrate the most-diverse standards, systems, devices, and technologies in a smart way.

Ralf Neubert is senior director of innovation and technology for Schneider Electric's industry business unit.

CASE STUDY: TEFAL SAS CUSTOMER SUCCESS STORY

ABOUT TEFAL SAS

Tefal SAS, headquartered in Rumilly, France is a subsidiary of Groupe SEB, a “world leader in Small Household Equipment”. Groupe SEB, which estimates it sells six products across the globe per second (adding up to 200 million products sold every year throughout 150 countries), has approximately 25,000 employees spread through 29 manufacturing sites worldwide. Tefal’s Rumilly location employs approximately 1,850 people within 160,000 square feet of building space, with an additional 160 employees in Tournus, France within 21,000 square feet.



ICONICS SOFTWARE DEPLOYED

Working directly with ICONICS France, Tefal SAS selected: ICONICS GENESIS64™ HMI/SCADA suite; Hyper Historian™ high-speed, robust data historian; AnalytiX® suite of analytical tools (including the Energy AnalytiX advanced energy management software); WebHMI™ Web-based, real-time automation software; ReportWorX™ enterprise reporting, charting and analysis software; and BridgeWorX™ real-time workflow for data bridging.

PROJECT SUMMARY

Every year, Tefal manufactures around 44 million products in what was a high energy-consuming process. The manufacturing process entails many phases, including cooking, drying and cooling. The energy costs for manufacturing operations could hit as high as eight million euros, split between four million for electricity costs and four million for gas. Considering these numbers, top management at Tefal decided to launch an Energy Efficiency project to reduce manufacturing-related energy costs.



Tefal began the project by making an energy diagnosis, in order to learn real-time consumption levels towards the goal of making improvements leading to energy-related savings. The company had several initial objectives at the launch of their Energy Efficiency project. They wanted a map of their energy (electricity, gas and water) consumption in order to prioritize actions for the higher consuming machines, to use for future comparison of past consumption and to validate the expected financial gains compared with initial estimates. Tefal required the establishment of Energy KPIs to be published to key team members (including the site director, technical director, management controller, manufacturing manager, facility manager and multiple operators) to notify them of energy-related gains. The company also wanted a clear indication of energy/electricity availability in order to prepare for new manufacturing projects, optimize energy contracts and be able to meet French energy regulations.

Tefal sought an energy management system that could be implemented without revising their existing architecture. They aimed to connect the new system to equipment already in place, using standard communication protocols such as OPC, for use of real-time data in addition to archiving and recovery. The planned solution needed to interface with multiple pieces of equipment including Allen-Bradley, Eaton Moeller and Schneider Electric PLCs (via OPC), a Socomec power device (also via OPC) and a Producim MES system (via SQL query in an Oracle database). It also needed to be easy to use, to provide access via Web clients without installation, and to manage different needs including monitoring, reporting, commanding, GEO SCADA/mapping, alarm management and trend management. Tefal's selected solution would also need to integrate with existing Microsoft components (SQL Server, Excel, etc.), manage consumption of electricity, gas and water (including a way to easily add meters), and provide energy cost management capabilities.

“ This transition helps us towards energy efficiency. Digital tools allow us to connect objects, such as gas or electricity meters, in order to follow, in real time, our consumption and to alert company personnel at all levels. ICONICS is a Microsoft partner and this relationship has allowed us to install a solution for our energy management that is sustainable and scalable. This energy metering project, and in particular the installation of ICONICS software, has allowed us to create energy key performance indicators, that are published at each level of the company with needed information. ”

A competing solution was considered, but was rejected due to it being difficult to use (not ergonomic or intuitive), missing the ability to add reports or modify parameters without being an expert, too much reliance on scripting and an inability to switch languages.

BENEFITS OF THE SYSTEM

Tefal ultimately decided upon installing ICONICS software solutions, which now handles data from multiple meters and transformers, as well as energy data coming from the PLCs. Additionally, the system handles manufacturing data from the MES system (for instance, the number of pieces manufactured) to calculate energy consumption per manufactured piece. The energy data from the existing building automation software helps to calculate Degree Days (representing the difference between the average daily temperature for a location and a baseline value (usually around 18° C or 65° F). The data from 245 energy meters, 14 energy-related PLCs, 24 power-related devices and nine manufacturing-related PLCs can be visualized in real-time dashboards via Web clients or stored via data historian.

With its new ICONICS energy management solution, Tefal was now able to automatically accumulate energy consumption by equipment, area and site. The company could now customize dashboards to provide the best information to each different user type (facility/ energy/top management/operator). They could also now connect energy consumption to production and calcu-

late costs (such as energy per piece) and control manufacturing efficiency. Tefal appreciated the built-in quality control, identifying problems with products and having the ability to compare real-time temperatures with expected trends. In addition, Tefal benefits from trend management (including data drill-down) and the ease of use of reports through Excel. Even better, the company has seen a quick return on investment by avoiding equipment energy overconsumption, which has also helped in avoiding overuse penalties by the French government.

SOLUTIONS HIGHLIGHTED

Energy AnalytiX

Energy AnalytiX delivers the back-end calculations, KPI analytics, data historian, reporting and rich visualization that organizations require in order to take decisive action in the management/reduction of utility costs and carbon footprints.

- Quick Deployment to Help Achieve ROI
- Cost Savings through Informed Decisions
- Cost, Consumption and Carbon Reports
- Drill down into Causes of Abnormal Energy Use

CONCLUSION

Tefal SAS selected ICONICS software solutions due to ease of deployment and minimal impact on their existing systems. The company was pleased with the scalability of ICONICS software, as well as with its unified, standardized communication with equipment (meters, compressors, etc.) via OPC technology. Groupe SEB, Tefal's parent company, plans to deploy this solution in their nine sites in France and eventually to their 20 additional sites worldwide.

IIoT AND CLOUD FOR SMES

Managing equipment uptime and reliability in the manufacturing environment is no easy task. Maintenance and operations teams everywhere are challenged with aggressive production schedules, limited maintenance budgets, and scarce resources. This is especially true for small and medium-sized enterprise (SME) manufacturers that may not have the same scale or budget as today's largest manufacturers.

For independent manufacturers with homegrown or client-server-based solutions, there are a number of reasons to consider the benefits of the cloud and the Industrial Internet of Things (IIoT). The biggest rewards of adopting a cloud-based or IIoT-leveraged model include proactive asset management and higher overall equipment effectiveness (OEE).

But implementation alone isn't enough. To maximize output and minimize cost for higher reliability on the plant floor, here are four considerations for making the cloud and IIoT work on your plant floor.

1. ADOPT RUN TIME OR CYCLE-COUNT PREVENTIVE MAINTENANCE (PM): While the automation available with the IIoT and cloud-based solutions can help you implement your PM strategy, calendar-based PM routines (which are the easiest to implement) may not be the most efficient. It can be more cost-effective to schedule preventive-maintenance activities by cycle counts or run time when equipment has a variable utilization schedule.

This is especially true if the PM activity is restorative, such as replacing or reconditioning components to run more effectively with high reliability. Counting the repetitive process cycles or

run time—the number of starts on a motor, the number of hours it is running, or the gallons of liquid a pump is pumping—is more efficient than scheduling by the calendar.

Cloud-enabled solutions can automatically feed the run time or cycle-count data to the computerized maintenance management system (CMMS). This also provides visibility into whether there is too much preventive maintenance and where there are cost-savings opportunities with a more trimmed program.

2. TRACK KEY OPERATING PARAMETERS: Measuring important operating parameters through automated software is essential as it enables effective PM programs to turn into predictive-maintenance programs. By tracking operating parameters such as temperatures, pressures, and quality—all of which represent equipment health—trends can be identified and can even indicate potential equipment failures. Rather than communicate to the asset-management system manually, ensure the software automates data collection and issues corrective work orders so technicians can adequately investigate trends that may indicate a potential failure.

3. USE STANDARD FAILURE CODES: Similar to tracking key operating parameters, using standard failure codes to communicate issues to the technician before he or she goes onsite can increase efficiency and troubleshooting. Production automation software that collects information about the problem and assigns standard failure codes can automatically create corrective work orders for emergency breakdown work. While even the IIoT and cloud can't 100% prevent emergency breakdowns, automation and integration will support more efficient work order generation and identify operating measures that can result in a more productive predictive-maintenance asset strategy.

4. USE DATA TO IMPROVE OPERATIONS: Once automated, create a process to use the data. With the aforementioned considerations in place, equipment data should indicate warnings before equipment failures so you can catch things before they break down. The data also can be used to analyze where there are opportunities to improve operations by:

- Minimizing the need to remove equipment from service for restoration
- Providing the ability to focus on the most-common failures that were identified and coded through the automation.

This is a key benefit. More automation and integration will produce better data and better analysis and should be a key focus area in plant operations.

For example, in a part-casting operation, the number of parts produced is tracked in the production automation software. As the parts are made, the casting form begins to deteriorate and become contaminated. A PM schedule is developed to refurbish the casting form and is best implemented based on the optimum number of parts made before the quality of the part is affected.



Rather than having a technician manually track and enter the number of parts made, IIoT and the cloud enable the production automation software to communicate the cycle counts to the CMMS, which generates the PM work order at the precise time. For plant engineers and maintenance managers, this results in not only reduced labor costs, but also higher OEE, increased uptime, and greater reliability.

Dwayne Divers is director of manufacturing strategy for Dude Solutions.

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Kepware is a software development company that helps businesses connect diverse industrial automation devices and software applications to improve operations and decision-making. Kepware recently released the IoT Gateway for KEPServerEX, which streams industrial data into Cloud and on-premise solutions for real-time analytics.

www.kepware.com



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