Integrating the IIoT

How the Industrial Internet of Things will help system integrators deliver on the promise of the connected enterprise

by John Boville
and Tony Lane
Schneider Electric

Executive summary

Whether they are employed by automation end users, third-party engineering firms, or vendors, system integrators (SIs) will be key players in implementing the Industrial Internet of Things. As more industrial devices become digitized and capable of sharing operating information universally, SIs will be better equipped to augment their increasingly valuable device connectivity skills with new skills in knowledge integration. IIoT-enabling technology that will help SIs flourish is already here, but leveraging it will require new models of collaboration among all participants. The result will be more opportunity to deliver higher value, with higher productivity, security, and ultimately profitability.

What's the Big deal?

Anyone involved in industrial integration projects over the past three decades or so might wonder what the IIoT fuss is all about. They have likely been connecting devices to each other for years, serving information out to achieve production, quality, and other objectives — on and off premises.

What's different starting now, however, is that every asset in the enterprise can potentially have an internet connection, capable of exchanging real-time information easily with a rapidly growing number of other digitally connected things, most of which are not yet participating in the digital world. In this scenario each device could host a mini-database, with built-in services and query capabilities. Controllers, pumps, building control systems, work orders, maintenance diagrams, commodity price trackers, satellite location trackers and much else all play together with standard points of access. Valuable information from field operations can travel up the enterprise, even to the C-suite, improving opportunities for effective decision-making and strategic execution all along the way, with a speed and economy not previously possible.

Water treatment plant operators who, for example, might traditionally rely on SCADA technology to monitor flow levels, tank levels, temperatures, and other variables, might now benefit from knowing whether it is going to rain or not. Instead of deploying free-standing barometers, they might connect their SCADA system to weather.com or factor in peak-demand energy pricing directly from their energy provider's website. Knowledge about the timing of a pending downpour could then affect decisions about emptying holding tanks. To give a production example, real-time production data from multiple sites can now be collected across the cloud to provide wider sets of data to support decisions about profitability control, quality management, and plant safety, and share it more immediately with people who can affect the outcomes.

As awareness of the possibilities grows, demand for IIoT applications is strengthening. A 2016 Schneider Electric global survey[1] of more than 2,500 business decision-makers outlined a growing consensus that the IIoT makes increasingly good business sense:

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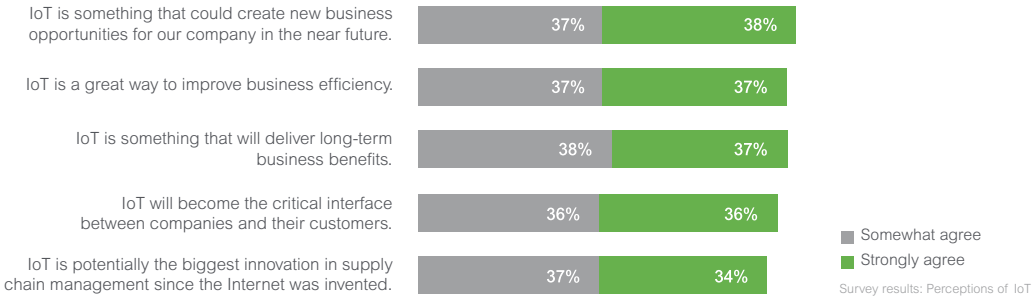

At a minimum to realize these benefits, innovation must take place in the following three areas:

- Exploiting unused areas of connectivity and analytical technology
- Extending focus from system integration to knowledge integration
- Creating new models of collaboration among end users, third party integrators, and automation integrators

Making the connections

Whether employed by automation end users, third-party integration firms or technology vendors, a key part of the system integrator's job is ensuring reliable communications among devices. While the concept of objects communicating with each other is relatively new beyond the plant floor, industrial system integrators have extensive experience in device connectivity. They have lived through the evolution of numerous protocol "standards" — Modbus, HART, ProfiBus, FOUNDATION Fieldbus, etc. — and know too well that even system technologies designed to the same standard do not interoperate as well as intended.

Moreover, automation users have assented to the fact that no single standard will emerge as the "true" standard. To attain all important reliability, many simply default to purchasing all technology from a single vendor whose products are more optimized for end-to-end connectivity. To achieve any multivendor interoperability requirements, they turn to multi-protocol solutions, such as the Field Device Tool (FDT) or OPC UA. Moreover, as the need to exchange data with business, operations, supply chain applications, and other applications emerges, Ethernet is gaining ground as the network of choice.

Device integration protocols for the IIoT

All of these issues are important to baseline operation of the IIoT, which brings with it its own set of device-to-device communication protocols. In a detailed overview of emerging IIoT connectivity standards, ***Electronic Design*** magazine explains the current situation:

"Devices must communicate with each other (D2D). Device data then must be collected and sent to the server infrastructure (D2S). That server infrastructure has to share device data (S2S), possibly providing it back to devices, to analysis programs, or to people. From 30,000 feet, the protocols can be described in this framework as:

- MQTT: a protocol for collecting device data and communicating it to servers (D2S)
- XMPP: a protocol best for connecting devices to people, a special case of the D2S pattern, since people are connected to the servers
- DDS: a fast bus for integrating intelligent machines (D2D)
- AMQP: a queuing system designed to connect servers to each other (S2S)"

According to ***Electronic Design***, these standards are already widely adopted. However, echoing what has happened on the plant floor, the magazine says that confusion is already emerging:

"… there are at least 10 implementations of each. Confusion is understandable, because the high-level positioning is similar. In fact, all four claim to be real-time publish-subscribe IoT protocols that can connect thousands of devices. And it's true, depending on how you define 'real time,' 'things,' and 'devices.'"[2]

As more devices begin communicating with each other across the cloud, a common communication platform could emerge for all devices. But even if we did get there, connectivity history tells us that the path will not be uncluttered, and industry will continue to rely on the skills and judgment of system integrators for many years to come.

While standards may evolve and change, the plant control system hardware on which

Controlling the edge

integrators rely to automate edge transactions changes more slowly. In fact, once they are installed, PLCs, PACs, SCADA systems, and distributed control systems can function for 20 or more years, so when upgrading or deploying new systems, it is critical to implement those that have the maximum IIoT readiness available today. This includes at least the following characteristics:

- The power and bandwidth necessary to handle increasingly growing volumes of data and the complexity related to real-time interactions among multiple devices
- Ethernet connectivity to enable exchange of information among production optimization, financial, operations, and supply chain applications
- Cybersecurity protection, to prevent cyber intrusion at the deepest control levels

Deploying control systems with these capabilities, supports the expansion of system integration to the new age of knowledge integration. The stage is set for the SI to be at the forefront of this evolution, helping clients select systems that will sustain production value for years to come. This will entail, in part, an ability to merge traditional IT and control engineering disciplines.

Integrating knowledge

As connectivity options expand and basic connection problems are solved, the next step is converting the data that moves across those connections into actionable knowledge. Where much of system integration has focused on the control system, the IIoT will shift focus to using the information content of the drives, sensors, and other devices that are networked across it to make smarter, more insightful decisions based on combining hard control logic with live commercial data.

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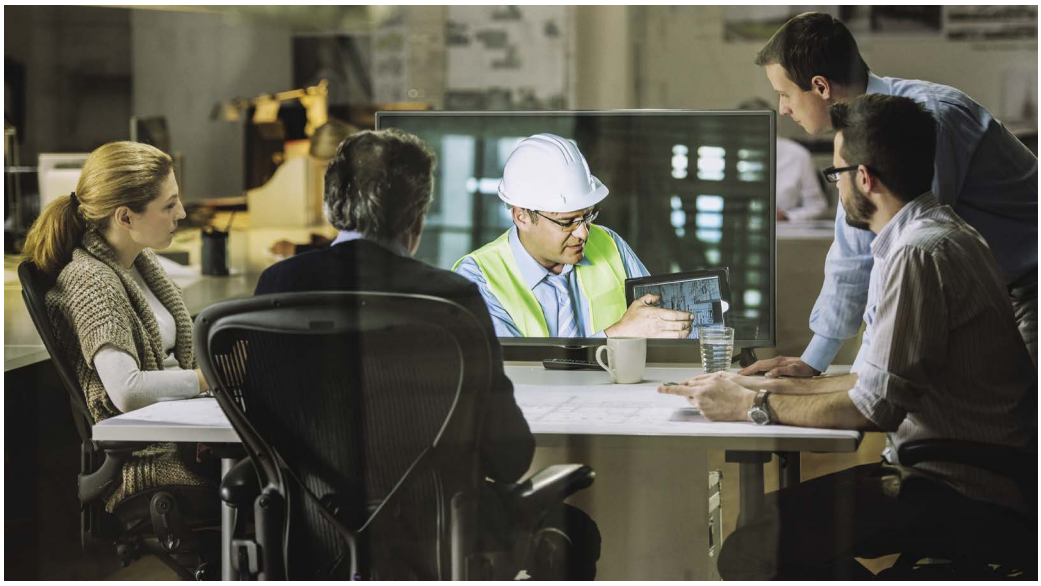
So in addition to having information about how many pounds of sugar or barrels of oil may have been produced in a day, integrators will also be expected to help answer questions like "how much energy did we use this past week to refine a barrel of oil or sugar and what might account for any differences?" Putting data in this context converts it to the information and knowledge that can drive intelligent decision-making. It also provides the feedback that can track real progress and continuously improve processes. With better information about what has changed, we can improve the process. And as more devices become integrated with the internet, you could also factor in trends from multiple plants, as well as other issues that would impact energy consumption, such as temperature changes and real-time pricing.

The right information

Which information is integrated depends heavily on the success metrics each user employs to manage their profitability. Where energy consumption may be a key strategic driver in any energy intensive business, automated energy management could be especially valuable for companies in stagnant markets, such as sugar production. With few growth options in sight, optimizing energy management, could be one way to boost profitability.

Advanced applications for real-time process optimization, supply chain planning and scheduling, asset condition monitoring, and numerous other advanced applications have been available for many years, but many companies have shied away from them because of fears that the perceived cost of implementation and training would not be recovered. The IIoT holds the promise, not only of making advanced applications easier to use and access, but also to help them pay for themselves many times over.

In addition to the right edge control technology, a key component of a knowledge



Engineering environment

infrastructure is an engineering environment that makes it easy to create object libraries that simplify integration of information from numerous device types, including drives, intelligent meters, and load sensors, as well as production controls. All such data would be stored in a shared database that enables users to interface directly with a single process element, such as running a pump with a single click. This streamlines operations, while providing object libraries that can be easily modified, refined, and customized for individual processes and users. These objects would also automatically preconfigure the necessary connectivity. In Schneider Electric's Process Expert System (PES), for example, when the designer selects an object representing the device to be integrated, the entire associated software library — including connection protocols — comes with it.

Specifying the IIoT

Automation specifications have traditionally originated with the end user, and this will likely remain the case, but things are moving so fast that many companies may not have the in-house resources to keep abreast of new developments. This is especially true given what Schneider Electric IIoT strategist Greg Conary refers to as the great "crew change":[3]

"Fifty percent of all refinery staff will retire in the next five to seven years, making the millennial generation the largest generation in the workforce by 2025… So within a short time digital natives will make up the majority of the workforce. This means moving from an average workforce age of 50+ to a new guard of 20-somethings who have vastly less experience and very different working practices. Bridging this gap will require digital tools to not only capture the knowledge of older workers before they retire, but also make it available to the new generation in a way that supports their preference for digital work practices — tools such as augmented reality applications, dynamic QR codes and access to easy online support."

The good news for end-users is that their next generation of employees will be digital natives with unique sensibilities capable of producing the innovations that could leverage the possibilities of the IIoT for true competitive advantage. The bad news, however, is many are still too inexperienced to have the understanding of the core fundamental processes that will likely be necessary for true innovation.

Object-oriented engineering tools will help capture and transmit knowledge, but many companies will rely on third-party integration firms and automation vendors to supplement. Fortuitously, the average age of today's SIs is just over 40, positioning them well to bridge the gap between the millennials and the retiring baby boomers.

New service models

Engineering consultants and vendors will also be quite happy to provide guidance, incented by burgeoning opportunities to offer new services and applications that could not have been possible without the IIoT and related infrastructures. Gartner, for example, forecasts that by 2020 more than 80 percent of the IoT supplier revenue will be derived from services.[4] Conary gives an example of a service involving monitoring critical equipment health via secondary sensors and upload data to the cloud:

"This can be very useful for complicated high-performance machinery because the vendor is, in fact, likely to be the expert in the operation of the equipment. It also means that the business does not need to directly employ a specialized, and highly paid, member of staff to wait around and fix an issue when it arises. Alternatively, if a company does want in-house specialists and has multiple sites, they can hire one expert who, through the use of IIoT, can monitor critical equipment at multiple sites."

Exciting times for system integrators

These are indeed exciting times for system integrators. Whether employed in a production or municipal organization, a third party engineering firm or an automation vendor, it is a time to apply their most fundamental integration skills, taking advantage of technology innovations they have been following but have seldom had time to apply. Now they have better tools, more opportunities, and greater potential to forge new business models that take advantage of both.

About the author

John Boville is a marketing manager for Schneider Electric's marketing and innovation group, where he focuses on the Modicon controller line. He has been with Schneider Electric industrial automation for more than 25 years, including implementing market segment strategies for the automotive industry. Prior to joining Modicon, before it became part of Schneider Electric, he served for 12 years in project engineering for CEGELEC Automation as an industrial system designer, installation specialist, and project leader for large automation migration projects. He holds a B.S. in electrical engineering from the University of Bradford, U.K. Keep up with John's latest insight in his blog: http://blog.schneider-electric.com/author/jboville/

Tony Lane leads Schneider Electric's global System Integrators program for the Americas. He manages process automation system integrator partnerships, including assistance with integrating the full Schneider Electric integrated power and process management portfolio. He has also served strategic management positions for Schneider Electric's HMI businesses, including Pro-safe. He received his technical education at the University of the West of England.

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