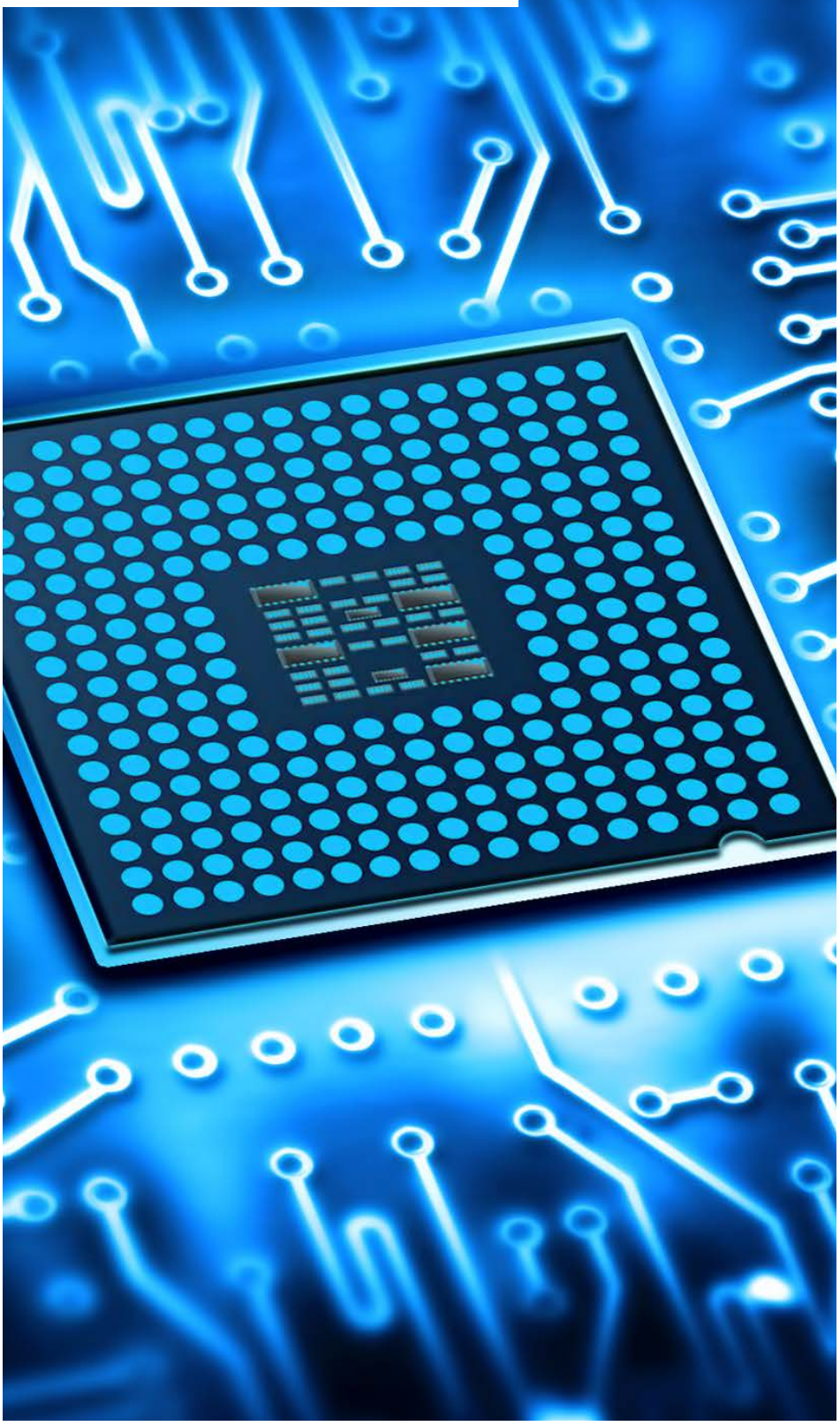
Steps Towards Revolution

The Industrial Internet is changing everything. Here's how to make sure you don't get left behind.

Alex Cannella, News Editor



The revolution goes by many names: machine-to-machine communication, smart manufacturing and the Industrial Internet, to name a few. In Europe, the prevailing term is Industry 4.0. In Germany, where that phrase was coined, the government is putting down €200 million to cultivate a lead in the industry. The McKinsey Global Institute estimates that its potential economic impact will be almost $4 trillion (or more) by 2025. Enthusiastic evangelists will tell you that the Industrial Internet is the most important advance in their industries that they've seen in their decades-long careers.

But, then again, this is the *Fourth Industrial Revolution* we're talking about. It has to be that important to live up to its name.

Make no mistake: the Industrial Internet is already here, and industrialists are adopting it in droves. An Infosys report recently found that 54 percent of businesses surveyed had already begun adopting the Industrial Internet, and of that 54 percent, a little over a third have fully implemented the new tech. Everybody from the Department of Defense to NASA are investigating how they can use the Industrial Internet, and if you aren't thinking about it yet, you should, too.

Brave New World

From the advent of steam power that brought about the first industrial revolution to the widespread adoption of computers in the '70s that characterized the third, the term has been reserved solely for leaps in efficiency so great that they rewrite the status quo and are utilized across the board, and the Industrial Internet looks like it deserves its place as the next big thing.

So what exactly is the fourth industrial revolution about? It encompasses multiple technologies that have al-

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ready been seeping into the workplace over the past decade. From cyber-physical systems to the advent of big data and the Internet of Things, all the different tech that constitutes the Industrial Internet contributes to a common cause: the interconnectivity and self-regulation of machinery and assembly lines. In a sense, Industry 4.0 and the Industrial Internet are an embracement of the direction the industrial world has already been moving in.

Machines will be able to monitor their own condition and give early warning for everything from when the oil gets low to when vital parts are on the verge of failing. By putting sensors in machinery and allowing them to constantly monitor themselves, we allow them to in turn give technicians more information more quickly than an entire team of dedicated professionals could ever hope to.

While there are some differences in application between the two (foremost being that Industry 4.0 is by Germans for Germans, while the Industrial Internet is more global and headed by American companies like GE and AT&T), they focus on most of the same emerging technologies and are used interchangeably by many people. From instantaneous communication between devices to self-regulating machines, their goal is the same as any other advance in the industry: reducing downtime and cutting costs.

"It's a whole paradigm shift," Jane Cahill, director of business development for Orbis America, said. "How people are working now and how they can use technology will really enhance the automation. It's very exciting."

Orbis is one of many businesses already offering both Industry 4.0 products and consulting services on the Industrial Internet. Their main product is the Orbis Multi-Process Suite, a modular product based on SAP technology. They've only just released the suite in America this year, but they've been implementing and evolving it in Germany since 2012. Orbis has seen numerous places where the Industrial Internet could be applied.

In particular, Cahill recounts an automotive industry producer from Alabama. When the company's machines went down, the maintenance staff often lost valuable time due to paperwork.

"The current team was taking maintenance calls, filling out the work order by hand, having somebody sign off on it by hand and then putting this data, which is simple data entry, into an Excel spreadsheet at the end of the shift so that they had some record of who worked on what machine, how long it took him or her and what parts they used," Cahill said. "All of that can be done and posted automatically in SAP now without a human being even having to do that if they use our software tools."

The bedrock for the Industrial Internet is the Internet of Things which, as its name might suggest, is a system where physical objects such as the varying robotic parts of an assembly line can communicate much like we people do on the Internet. The idea is that by allowing machines to transmit, pool and interpret data, we can make them more self-sufficient, reduce downtime and make the manufacturing process more streamlined.

One of the most literal examples of machine-to-machine communication is the use of RFID tags in assembly lines. Siemens and several other companies are using systems that utilize the tags on products to allow for a fully self-regulating production line. Under this system, a manufacturer could send a bottle or box through the production line with an attached RFID tag that contains specific instructions on how the product should be made. Everything from how to make the product to what label should go on the box is in the code. Each station on the assembly line reads the code for instructions, and at the end of the line, a final robot double-checks the product against the code to ensure it was made correctly.

Instead of programming a robot to do something a hundred times, then reprogramming it to do something else, this technology would allow businesses to pre-program how to make a dozen different products and make each at will, making small and varied orders more feasible and inventory management more precise. Alternatively, if you make a product with optional parts or multiple sizes, you could program the same machine to make each type.

Another of the Industrial Internet's main focuses is in the field of predictive maintenance. Right now, most maintenance is reactive. Technicians might check the oil level every now and then, but unless a machine grinds to a halt, no one's about to halt production to go digging through its guts

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and make sure a gear isn't fracturing or a brake pad hasn't worn down. At best, most companies do standard, periodic maintenance and have replacement parts on hand if something does go awry.

The Industrial Internet looks to revolutionize that entire process. Machines will be able to monitor their own condition and give early warning for everything from when the oil gets low to when vital parts are on the verge of failing. By putting sensors in machinery and allowing them to constantly monitor themselves, we allow them to in turn give technicians more information more quickly than an entire team of dedicated professionals could ever hope to. Maintenance would become more proactive and comprehensive than ever before.

Big Data rounds out many of the Industrial Internet's advances. Manufacturers can analyze their entire history of production and pick out patterns of everything from specific issues that could be improved upon to unexpected markets they're appealing to. For example, a car manufacturer could look across all its various car lines and identify which cars broke down the most consistently. From there, they could look at a list of all the reported ways those specific cars failed and see what's causing them to fail, be it a single part that wasn't quite up to snuff or a larger issue.

And so on and so forth, the manufacturer could continue digging deeper for as long as there's data to continue delving into, identifying points of improvement that would have been invisible before by computing sums of data so vast that they're impossible for an actual person to analyze.

America's Initiatives

Currently, the US is one of the leading nations when it comes to the Industrial Internet. Research and development is keeping pace with other leading countries in the field. Right now, there are two primary initiatives spearheading the effort: the Industrial Internet Consortium (IIC) and the Digital Manufacturing and Design Innovation Institute (DMDII).

The IIC is, according to their website, an "open membership, international not-for-profit consortium that is setting the architectural framework and direction for the Industrial Internet." They were founded in 2014 and are headed by AT&T, Cisco, GE, IBM and Intel. The IIC's main mission is to be a focal point for organizations, institutions and businesses interested in the Industrial Internet to get together and develop a common dialect and some standards. Different working groups in the IIC do everything from overseeing testbeds to spreading awareness about the Industrial Internet.

One of the IIC's contributing members, Belden, has been in the Industrial Internet game since before it had a dozen buzzword names and has had the unique opportunity to watch it develop from the start.

Everybody from the Department of Defense to NASA are investigating how they can use the Industrial Internet, and if you aren't thinking about it yet, you should, too.

"We see a number of things that are changing," Jeff Lund, senior director of product line management at Belden's Industrial IT Division said. "I think of the changes as occurring across two axes, horizontally within the control systems and vertically within the business.

"Horizontally within the control system, what we see with the Industrial Internet is that the use of industrial internet technologies is penetrating deeper and deeper into control systems, displacing legacy protocols and technologies and hardwired systems. In IIoT terms, you can think of us as connecting more and smaller things – moving from the connected factory (one big thing), to connected machines (more and smaller things), to connected controllers, and eventually to connected sensors and controllers. With each step the number of things grows by an order of magnitude or more.

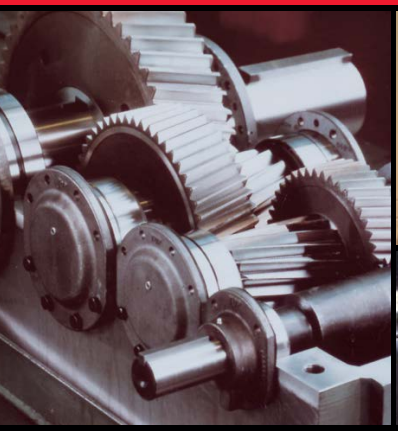
"Vertically within the business, what we see is a move toward more and more integration between business systems and the data flowing into and out of industrial control systems – what is often called IT/OT integration. Big data and analytics are also part of this trend. The overarching theme is that the data within control systems that has historically been used just for the operation of the system itself also contains a wealth of useful information that when made available to business systems can be used to drive a wide range of new efficiencies (better asset utilization, lower energy consumption, better supply chain management, etc.), along with other cost savings and revenue enhancements (predictive maintenance, manufacturing as a service, etc.)."

Amongst other efforts, Belden joined the IIC in July and has already involved itself in several of the IIC's working groups. Though their main focus is the security working group, they've involved themselves with numerous different sections of the IIC, from marketing to testbeds.

"The IIC has been great to work with," Lund said. "It is a very transparent and professional organization. Communication between IIC staff and between IIC members is very open and collaborative and the group is good at working together to get things done."

On the R&D side of things, the DMDII opened this May. With $70 million of backing from the government, the DMDII is working with dozens of partners to further study in almost every field of the Industrial Internet, from cybersecurity to developing Cloud services for CNC machining. In its first year, the institute has greenlit five projects and has another 15 under consideration.

The DMDII is part of a broader initiative being pushed by President Obama, the National Network for Manufacturing Innovation, that is focused on upgrading America's industrial sector through universal technology improvements such as the Industrial Internet. It stands along-







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Future Steps

Despite the flocks of supporters behind the Industrial Internet, the movement's only a few years old and there are still serious issues that need addressing.

Foremost amongst them is the need for standardization. Much of the technology behind the Industrial Internet is heavily dependent on machines being able to communicate with each other, but two machines from different manufacturers that speak entirely different languages will not be able to work in tandem or transfer data. It is imperative that a framework of standards be introduced to ensure that as many different machines are compatible with each other as possible. Otherwise, the potential effects of Industry 4.0 will be severely blunted.

On the flip side, the more standardized the system becomes, the more data people will have access to. Machines could do more than just talk to each other, they could access data from other manufacturing plants. With set standards, datasets could potentially cross over between continents and companies alike.

After a basic framework comes network security. While those buzzwords may summon up images of code-slinging hackers coming to steal your data and make all your newly-interconnected machines go haywire, they actually aren't your main concern. According to an infographic put out by the IIC in October, hackers are actually in the minority when it comes to internet breaches. Only 20 percent of cyber "attacks" were intentional, brought about by a hacker or otherwise. Far more often, the problem could be attributed to malware (30.4 percent), system or software malfunction (38.4 percent) or user error (11.2 percent), and while hackers may be slowly becoming the boogeymen of the internet, the far more common issue is unintentional internet breaches.

Another primary issue will be education and employment. One of the major issues facing the industry today is the lack of educated workers entering the workforce, and the Industrial Internet will only exacerbate this problem. While the Industrial Internet will continue the trend of obsoleting repetitive, manual labor, it will be producing just as many new positions overseeing and maintaining machinery.

The only potential issue? The manual labor workers that are being displaced might not have the training to return to the industry and take up these new, more specialized jobs. A 2012 report from the U.S. Bureau of Labor found that only 18.7 percent of the manufacturing workforce has a bachelor's degree or higher. 45.6 percent haven't had any college experience. And while these numbers are an improvement from previous years and a bachelor's isn't necessarily required to perform the new jobs the Industrial Internet will create, much of the workforce will have to learn new skills to stay in the industry, which means that laying out a framework to get them the knowhow they need will be paramount.

Belden Inc. recommends a five-step approach to understanding and implementing the Industrial Internet of Things.

Willing, but not Quite Ready

Going back to Infosys's report, the Industrial Internet may be on the rise, but it still has a long way to go. Out of 433 companies surveyed in the US, Germany, China, the UK and France, 85 percent of companies are aware of Industry 4.0's potential, but only 15 percent have fully implemented strategies to take advantage of the Industrial Internet's capabilities. A further 39 percent have started taking steps towards implementing Industry 4.0 technologies, but they have yet to accomplish full integration.

A white paper published by Hannover Messe in January revealed similar numbers amongst German manufacturers: 84 percent of manufacturers "believe that Industry 4.0 will provide a new framework to human labor in production," but only 20 percent have a clear picture of what exactly that will entail. The DMDII has reported similar numbers, as well, reporting on their website that "81 percent of U.S. manufacturers acknowledged that digital manufacturing is a key element in their future competitiveness, but only 14 percent said they were ad-

equately equipped today with digital technologies and related expertise."

The results mirror Infosys's report. A lot of people want onboard the Industrial Internet bandwagon, but the number of manufacturers actually implementing it is far smaller.

However, this will probably all change in the near future. Infosys's report showed that while businesses may not be implementing the Industrial Internet right this moment, 48 percent of them are taking steps to ensure that they are fully implemented by 2020 and another 32 percent will be in the process of upgrading.

On Your Marks

And as more and more businesses line up to adopt the Industrial Internet, the vital question arises: how do you start your own Industrial Internet program?

And, more importantly, how do you keep from being overwhelmed in the process?

According to both Lund and Cahill, the main strategy is to pace yourself and not try to upgrade everything at once.

"When people think of everything that the IIoT might touch in their business over time it can be a bit overwhelming," Lund said. "Our view is that it isn't really feasible to say that before you can take your first step you must be able to foresee everything you might want to do over the life of your network - which could be decades. Rather, we think the key to building a solid building is to lay a strong foundation, the key to building out an Industrial Internet system is to build a strong network foundation so that your system can adapt to your changing business needs."

Belden's put together a five step process (Assess, Migrate/Update, Proper Design, Protection, and Monitor) that Lund recommends newcomers to the Industrial Internet follow.

Step one, assessing, is all about looking at the current state of your business and figuring out where you want to take it. Identifying where you are and where you want to go can often highlight the difficulties you need to overcome and make your approach much more focused.

"Before you start to build a new system, you need to understand what you already have, what its connectivity (wired/wireless, bandwidth, reliability) and environment requirements are, and what your near term goals are in terms of functionality and data exchange," Lund said. "The end result of the assessment stage should be an accurate 'map' of your network's infrastructure."

After that, the Migrate/Update step is about looking at any existing legacy systems you might already have and can repurpose or upgrade and investigating what kind of bandwidth and equipment requirements you're going to need to meet. The third step, Proper Design, is when Belden recommends taking a step back and making sure your program meets established best practices and standards (like, say, those standards the IIC is striving to create). Step four, Protection, is when you focus on system security (one of Belden's specialties) which, if you remember, has as much to do with making sure your system is accident-proof as keeping hackers out. Belden recommends a risk assessment as a good place to start. Step five, Monitoring, brings the process full circle.

"The last step is a feedback loop into the first," Lund said. "Technology is constantly changing. Security threats are changing. Business needs are changing. Customers need to monitor all of these things and make changes to their system accordingly...IIoT is a journey, not a destination. These are living systems that will evolve over time. The key thing, however, is that if customers follow the process we've outlined and think about things upfront, the infrastructure they deploy today will provide them the solid foundation they need to build on over time."

Cahill recommends starting small. She believes that the best place to start is with a specific application or problem the company's having, something small and, more importantly, measurable.

"What we're really advising people to do is not to try to take on the whole beast at one time, if you will," Cahill said. "Once that return on investment is realized, it's very easy to then grow it and expand it. The product itself is very scalable, and companies then run with it, thinking of all different other applications that they'd be really excited to be able to use it in."

One case study that Orbis supported involved a company's shipping system.

"The company was spending a tremendous amount of money on trucks that were sitting idly by waiting to be loaded at the loading dock," Cahill said. "And the management did not really have a handle on their day-to-day operations. They knew what needed to be loaded and what needed to go out, but they did not have clear vision down to the minute in real-time, as to the progress that was being made with the loading of these trucks."

The solution was for Orbis to develop a program that would follow the packing process and show it all on one screen. The manager would be able to see when trucks were supposed to leave, what needed to go on them, and how far into the loading process the truck was.

"In that instance, [with] a very simple pilot program, that manager was able to determine 'do I let the truck go partially filled? Do I accrue the added overtime...or do I know right then at that second if I need to throw more resources at the problem?'" Cahill said. "That kind of real-time information is essential for people to be able make resource-efficient decisions."

Inevitably, each company will implement the Industrial Internet in its own way based on its situation, but there are numerous options on how to go about upgrading. The important thing to remember is that not only should you jump on the Industrial Internet bandwagon, you also can. **PTE**

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