

Foundations of Digital Transformation

While the Industrial Internet of Things has been a buzzworthy phrase for the past few years, many in the industrial and manufacturing arenas still lack a deep knowledge of the foundations of digital transformation. This collection will help correct that. Here find a library of required reading on the IIoT, exploring the origins of this revolution, digging deep into the various components and applications, and providing you the tools you need to take advantage of this unprecedented opportunity.



SmartIndustry

TECHNOLOGY REPORT

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Unleashing the potential of connected products and services

World Economic Forum report traces the emergence of the Industrial Internet of Things and the outcome economy, qualifies opportunities and risks, and offers recommendations for industry stakeholders

■ The World Economic Forum's IT Governors launched its Industrial Internet initiative at the organization's Annual Meeting 2014 in Davos, Switzerland. Over the course of the following eight months, the project team developed a guiding framework and conducted a series of research activities, including in-person workshops, virtual working group sessions, interviews of key thought leaders, and a survey of innovators and early adopters around the world. The resulting Industry Agenda report, produced in collaboration with Accenture, is entitled "Industrial Internet of Things: Unleashing the Potential of Connected Products and Services." The 40-page report can be downloaded in its entirety from the World Economic Forum website at <http://www.weforum.org/reports/industrial-internet-things>.

The report makes our *Required Reading on the Industrial IoT* list for its concise and comprehensive rendering of the how the Internet of

Things revolution that has already reshaped business-to-consumer industries will dramatically alter manufacturing, energy, agriculture, transportation and other industrial sectors of the economy over the

next 10 years. These industries account for nearly two-thirds of the global gross domestic product (GDP), the report notes.

This latest wave of technological change will bring unprecedented opportunities, along with new risks, to business and society, the report contends. It will combine the global reach of the internet with a new ability to directly control the physical world, including the machines, factories and infrastructure that define the

modern landscape. However, like the internet was in the late 1990s, the Industrial Internet is currently in its early stages. Many important questions remain, including how it will impact existing industries, value chains, business models and workforces, and what actions business and government leaders need to take now to ensure long-term success.

The report's authors argue that the Industrial Internet is indeed transformative. It will change the basis of competition, redraw industry boundaries and create a new wave of disruptive companies,

THE INDUSTRIAL INTERNET WILL CHANGE THE BASIS OF COMPETITION, REDRAW INDUSTRY BOUNDARIES AND CREATE A NEW WAVE OF DISRUPTIVE COMPANIES

just as the current internet has given rise to Amazon, Google and Netflix. However, the vast majority of organizations are still struggling to understand the implications of the Industrial Internet on their businesses and industries. For these organizations, the risks of moving too slowly are real.

Further, disruption will come from new value creation made possible by massive volumes of data from connected products, and the increased ability to make auto-

mated decisions and take actions in real time. The key business opportunities will be found in four major areas:

- Vastly improved operational efficiency (e.g., improved uptime, asset utilization) through predictive maintenance and remote management
- The emergence of an outcome economy, fueled by software-driven services; innovations in hardware; and the increased visibility into products, processes, customers and partners

measurable results to customers. Such outcomes may range from guaranteed machine uptimes on factory floors, to actual amounts of energy savings in commercial buildings, to guaranteed crop yields from a specific parcel of farmland.

Delivering such outcomes will require new levels of collaboration across an ecosystem of business partners, bringing together players that combine their products and services to meet customer needs. Software platforms will emerge that will better facilitate data

of executives we surveyed believe that the growing use of “digital labor” in the form of smart sensors, intelligent assistants and robots will transform the skills mix and focus of tomorrow’s workforce.

While lower-skilled jobs, whether physical or cognitive, will be increasingly replaced by machines over time, the Industrial Internet will also create new, high-skilled jobs that did not exist before, such as medical robot designers and grid optimization engineers. Companies will also use Industrial Internet

BUSINESS WILL SHIFT FROM PRODUCTS TO OUTCOME-BASED SERVICES, WHERE THEY COMPETE ON THEIR ABILITY TO DELIVER MEASURABLE RESULTS TO THEIR CUSTOMERS

- New connected ecosystems, coalescing around software platforms that blur traditional industry boundaries
- Collaboration between humans and machines, which will result in unprecedented levels of productivity and more engaging work experiences

capture, aggregation and exchange across the ecosystem. They will help create, distribute and monetize new products and services at unprecedented speed and scale. The big winners will be platform owners and partners who can harness the network effect inherent in these new digital business models to create new kinds of value.

The report’s authors also propose that the Industrial Internet will drive growth in productivity by presenting new opportunities for people to upgrade skills and take on new types of jobs that will be created. An overwhelming majority

technologies to augment workers, making their jobs safer and more productive, flexible and engaging. As these trends take hold, and new skills are required, people will increasingly rely upon smart machines for job training and skills development.

To realize the full potential of the Industrial Internet, businesses and governments will need to overcome a number of important hurdles. Chief among them are security and data privacy, which are already rising in importance given increased vulnerabilities to attacks, espionage and data breaches driven

RISE OF THE

OUTCOME ECONOMY

As the Industrial Internet gains broader adoption, businesses will shift from products to outcome-based services, where businesses compete on their ability to deliver

A FULLY FUNCTIONAL DIGITAL ECOSYSTEM WILL REQUIRE SEAMLESS DATA SHARING BETWEEN MACHINES AND OTHER PHYSICAL SYSTEMS FROM DIFFERENT MANUFACTURERS

by increased connectivity and data sharing. Until recently, cybersecurity has focused on a limited number of end points. With the advent of the Industrial Internet, these measures will no longer be adequate as the physical and virtual worlds combine at a large scale. Organizations will need new security frameworks that span the entire cyber physical stack, from device-level authentication and application security, to system-wide assurance, resiliency and incidence response models.

Another crucial barrier is the lack of interoperability among existing systems, which will significantly increase complexity and cost in Industrial Internet deployments. Today's operational technology systems work largely in silos.

However, in the future, a fully functional digital ecosystem will require seamless data sharing between machines and other physical systems from different manufacturers. The drive towards seamless interoperability will be further complicated by the long life span of typical industrial equipment, which would require costly retrofitting or replacement to work with the latest

technologies.

In addition, other notable barriers and risks include uncertain return on investments on new technologies, immature or untested technologies, lack of data governance rules across geographic boundaries and a shortage of digital talent. Overcoming these challenges will require leadership, investment and collaborative actions among key stakeholders.

RECOMMENDATIONS FOR STAKEHOLDERS

To seize near-term opportunities, capitalize on the long-term structural shift and accelerate the overall development of the Industrial Internet, the report recommends the following actions:


- Technology providers should begin to inventory and share best security practices, perhaps by establishing a global security commons. They should participate in the development of technology test-beds to demonstrate how solutions from different organizations can work together. And they need to focus on brownfield innovation¹ to support existing equip-

ment in the field, and raise the market awareness on successful use cases and implementations.

- Technology adopters should first reorient their overall business strategy to take full advantage of the latest developments in the Industrial Internet. They also need to identify their new ecosystem partners, and determine whether they should join a partner's platforms or develop their own. Companies that still are new to the Industrial Internet should identify one or two relevant pathfinder applications that can be piloted within the next six months to create necessary momentum and learning.
- Public policy-makers must re-examine and update their data protection and liability policies to streamline transborder data flow. They also need to revisit the current regulations on such industries as utilities and healthcare to encourage investment and the adoption of new digital processes. In emerging markets, governments will need to increase investment in digital infrastructure (e.g. embedded sensors, broadband connectiv-

ity) to take advantage of the leapfrogging potential of the Industrial Internet in accelerating regional economic development. And policy-makers need to learn more about societal and policy implications of the Industrial Internet, and function as role models in advocating and supporting high-potential applications such as smart cities.

- All stakeholders need to work together in three important areas. Industries, governments and academia need to collaborate on long-term R&D to solve fundamental technology challenges related to security, interoperability and management of systemic risks. They need to conduct joint light-house projects to demonstrate the real benefits and raise the

profile of the Industrial Internet among the general public. They also need to implement new training programs, and provide policy incentives to employers and workers to encourage reskilling for high-demand job categories. 

The World Economic Forum report “Industrial Internet of Things: Unleashing the Potential of Connected Products and Services” can be downloaded in its entirety from the World Economic Forum website at <http://www.weforum.org/reports/industrial-internet-things>.

Industry 4.0: A European perspective

PwC’s Strategy& consultancy surveyed 235 German industrial companies to arrive at this portrait of the essential attributes, opportunities and challenges of the fourth industrial revolution

 The fourth industrial revolution—characterized by the increasing digitization and interconnection of products, value chains and business models—has arrived in the industrial sector, write the Munich-based authors of the Strategy& report, “Industry 4.0: Opportunities and Challenges of the Industrial Internet.”

The report makes our *Required Reading on the Industrial IoT* list for the regional perspective it adds to otherwise global trends in technology development and adoption. Indeed, more so than any other country, Germany realized early on that the digital transformation of industry represents an opportunity

and challenge of strategic national importance.

Based on a survey of 235 German industrial companies—including manufacturing and engineering, automotive and process industries, as well as the electronics and electrical systems and information and communications firms—the full 52-page study can be downloaded in full at <http://www.strategyand.pwc.com/reports/industry-4-0>.

Clearly, survey respondents see the digital transformation of their organizations as critical to future success. But the transformation will be neither cheap nor easy. They estimate the share of investments in

Industry 4.0 solutions will account for more than 50% of planned capital investments for the next five years. German industry will thus invest a total of €40 billion in Industry 4.0 every year until 2020. Applying the same investment level to the European industrial sector, the annual investments will be as high as €140 billion per annum, the report estimates.

The first significant driver for the advance of Industrial Internet solutions lies in the opportunity to integrate and better manage horizontal and vertical value chains, write the report’s authors. Companies surveyed expect more than 18% higher productivity over

the next five years. While today only one fifth of the industrial companies have digitized their key processes along the value chain; in five years' time, 85% of companies will have implemented Industry 4.0 solutions in all important business divisions.

The digitization and interconnection of products and services (Internet of Things/services) is a second important driver. It will contribute strongly to ensuring competitiveness and promises additional revenues of 2% to 3% per year on average. When applied to the German industrial landscape as a whole, additional revenues reach up to €30 billion per year. For the European industry sector, additional revenues amount to €110 billion annually.

A third major driver are the newly emerging, often disruptive, digital business models that offer significant additional value to customers through tailor-made solutions. These new business models are characterized by a considerable increase of horizontal cooperation across the value chains, as well as the integrated use and analysis of data. They are therefore capable of better fulfilling customer requirements.

The various opportunities, the large extent of change and the elevated need for investments make the Industrial Internet one of the most important topics for

corporate management. However, the numerous challenges that the transition entails are also not to be underestimated. Besides the partly still unclear business cases for the Industrial Internet at company level, industry standards have to be defined and agreed upon and questions need to be answered, for example, in the area of data protection. The respondents also consider the required qualification of employees at increasingly digitized companies to be a major obstacle.

The report also distills its 52-pages of detailed discussion into the following 10 findings:

1. The Industrial Internet transforms the entire company and must be part of the CEO agenda. Industry 4.0 not only comprises the digitization of horizontal and vertical value chains but will also revolutionize the product and service portfolio of companies—with the ultimate goal of better satisfying customer needs. The potential uses of the Industrial Internet go far beyond the optimization of production technologies. However, exploiting these opportunities requires considerable investment. The topic therefore inevitably occupies a leading position on the agenda of directors and managers of industrial companies.

2. By 2020, European industrial

companies will invest €140 billion annually in Industrial Internet applications.

Over the next five years, the industrial companies surveyed will invest, on average, 3.3% of their annual revenues in Industrial Internet solutions. This is equivalent to nearly 50% of the planned new capital investments and an annual sum of more than €140 billion with regard to the European industrial landscape.

3. In five years, more than 80% of companies will have digitized their value chains.

One quarter of the companies surveyed have already achieved a high degree of digitization of their value chains. However, it is mostly only individual units and isolated applications that have been automated and digitized thus far. The companies expect that 86% of the horizontal and 80% of the vertical value chains will have a high degree of digitization by 2020.

4. The Industrial Internet increases productivity and resource efficiency—an 18% increase in efficiency within five years. The industrial sector is required to produce ever larger quantities using fewer raw materials and less energy. The Industrial Internet allows higher productivity

and resource efficiency and thus creates the conditions for sustainable and efficient production. The companies surveyed anticipate an average efficiency increase of 3.3% per year across all industry sectors due to the digitization of value chains.

5. The integrated analysis and use of data are the key capabilities for the Industrial Internet. Already today the efficient analysis and use of data is of great significance for half of all companies surveyed. Moreover 90% of companies believe that the ability to analyze data will be decisive to their business model in five years. These companies primarily focus on the efficient exchange of data within their own value chain, the digital labelling of the products and the use of real time data to steer their production.

6. Digitization of the product and service portfolio is the key to sustainable corporate success. Thirty percent of the companies surveyed have already digitized their products to a great extent and expanded their portfolio to include connected and automated services. A mechanically perfect product will no longer be enough to successfully withstand international competition.

More than four out of five respondents—with the exception of the process industry—therefore expect that they will have achieved a high degree of digitization of their product and service portfolio within five years.

7. Digitized products and services generate approximately €110 billion of additional revenues per year for European industry. Companies which have already digitized their product portfolio to a great extent have grown above average in the past three years. Half of the companies surveyed anticipate double-digit growth in the next five years due to the intensified digitization of their product and service portfolio. One in five companies even expects sales to rise by more than 20%. In total, this amounts to an average, incremental sales increase of 2.5% per annum. Compared to all industrial companies in the five core industry sectors, this is equivalent to an annual sales potential of more than €30 billion for Germany.

8. The Industrial Internet paves the way for new, often disruptive digital business models. The Industrial Internet will have a lasting effect on existing business models and will also generate new, digital—

often disruptive—business models. The focal point of this trend comprises increasing customer benefits through a growing range of value solutions (instead of products) and increased networking with customers and partners. The special quality of the digital change lies in the rapid acceleration of the speed of change.

9. Horizontal co-operation allows for improved satisfaction of customer needs. About half of all companies surveyed are already convinced that closer cooperation with value chain partners — combined with increased horizontal interconnection—is of great significance. The importance of this will further grow in the context of Industry 4.0 in light of increased digitization—particularly where new, digital business models have to be established. More than 80% of the companies surveyed believe that closer co-operation and a more vigorous horizontal connection of value chains will play an important role in five years.

10. The Industrial Internet holds various challenges—policy-makers and industrial associations can help. Companies have to master several challenges on the way to becoming a Digital 4.0

champion. The main focus is on high investment levels and often unclear business cases for new Industrial Internet applications. Furthermore, sufficient skills to meet the needs of the digital world must be ensured. Binding

standards must also be defined and tasks in the area of IT security have to be solved. Policy-makers and industrial associations can help with these latter challenges in particular, by advocating uniform industrial standards at

a European or international level and promoting efficient rules for data security and data protection. ■

The Strategy& report, "Industry 4.0: Opportunities and Challenges of the Industrial Internet," can be downloaded in its entirety from the company's website at: <http://www.strategyand.pwc.com/reports/industry-4-0>.

Reference Architecture lays foundation for the IIoT

Industrial Internet Consortium document provides a common language to enable faster Industrial IoT development and a blueprint for standards development

■ Although the Industrial Internet Reference Architecture (IIRA) was ostensibly created to help system developers communicate more clearly with one another, it makes our *Required IIoT Reading* list for its articulate and thorough development of a common vernacular to describe elements of Industrial Internet systems and the relationships among them.

"For the Internet of Things to reach the predicted install base of 50 billion things by 2020, developers need to be able to connect and scale systems quickly," said Shi-Wan Lin, co-chair of the Industrial Internet Consortium Technology Working Group and principal engineer with the Strategy and Technology Office, Internet of

Things Group, Intel, upon release of version 1 last year. "The Industrial Internet Reference Architecture has broad applicability across industrial and other IoT systems to drive that scalability and interoperability within the industry." The full 102-page document is available for download at the Industrial Internet Consortium's website at <http://www.iiconsortium.org/IIRA.htm>.

The Industrial Internet Reference Architecture helps place existing and emerging standards into a common structure, making it easier to quickly identify gaps that need to be filled to ensure interoperability between components. "As a global, non-standard-setting organization, we see this as an

other step towards achieving global standards through collaboration," added Stephen Mellor, chief technology officer, Industrial Internet Consortium.

The Reference Architecture document outlines key characteristics of Industrial Internet systems, various viewpoints that must be considered before deploying an Industrial Internet solution, and an analysis of key concerns for the Industrial Internet including security and privacy, interoperability, and connectivity.

IMPROVISE AND OVERCOME

Of particular note are the IIRA's forward-looking descriptions of increasingly capable systems that are not only integrable but interop-

erable and ultimately composable, revealing both the challenge and potential of next-generation IIoT solutions. Take, for example, the topic of resiliency and the document's development of a military command-and-control metaphor that follow.

Resilience is more than just recovering quickly from pressure, the report's authors write. To be resilient is to be able to take "bitter circumstance in stride" and still

us on how to better effect resilience within Industrial Internet Systems (IISs).

Among the lessons to be learned by IoT system developers from military command-and-control structure and doctrine:

- **Expect to be disconnected from authority.** Mechanisms must be in place to allow the mission to succeed, so some level of decision making on the edge is a requirement. In an

- **Peer-to-peer communication is more important than hierarchical communication.** Changing plans and developing new tasks requires the disconnected units to engage in all parts of command-and-control jointly with their neighbors so they can jointly succeed within the constraints of the commander's intent. Once that intent (and an initial plan based on the strategically available resources)

INDUSTRIAL INTERNET SYSTEM COMPONENTS MUST HAVE A BIG PICTURE VIEW THAT ALLOWS THEM TO RECONFIGURE THEIR OPERATION AND MAINTAIN MISSION-LEVEL PERFORMANCE WHEN UNDER STRESS

"get the job done." It might cost more or not be done as well had less (intentional or unintentional) adversity been present, but it will be done. Resilience is a superset of fault tolerance—and very much related to autonomic computing notions of self-healing, self-configuring, self-organizing and self-protecting.

No other institutions are more involved directly in bitter or adversarial circumstances than the military. No other institutions have a greater dependence on resilience of its organizations and operations to survive and to succeed. Therefore, the current thinking of the military on resilience and the lessons they have learned in the past will inform

IIS, control elements for critical operations must not be dependent on network availability.

- **Good decisions are not made in a vacuum.** Communicate commander's intent so that units in the field understand how their actions fit the bigger picture. The ability to alter plans locally provides a lot more flexibility and resiliency. The implication for IISs is that local control elements must know more than just their own part of the plan. They must have a bigger picture of what they are responsible for that allows them to reconfigure their operation and maintain mission-level performance when under stress.

is communicated, little more needs to be said from higher chain of command until the mission is completed. In IISs, this suggests that components must be autonomous, and able to act independently based on the plan and information from other independently operating components nearby.

- **Take advantage of the hierarchical network to optimize all parts of command-and-control.** Do not use the connectivity, when available, to centralize decision making but distribute information to ensure that whole network becomes aware of changes to local plans so they can get an early start on

changing too. In IISs, this suggests that components must be aware of the behavior of other components. Build a system that does not need the network to work—it only needs it to optimize. This is a given in the ‘fog of war.’ In IISs, this partly follows from being able to run disconnected. However, some functions such as safety, should never be compromised just

because of a network failure. “The Industrial Internet Reference Architecture is an important first step toward establishing new IoT capabilities in the industrial space,” says Bradford Miller, senior scientist at GE and co-chair of the IIC Technology Working Group. “With the IIRA, we are creating new ways to organize industrial applications that move toward a usage-driven, rather than a design-

driven approach. We believe collaboration is essential to achieving Industrial Internet success, and organizations like the IIC help drive best practice sharing through global partnerships with industry leaders.” 

The Industrial Internet Consortium’s Industrial Internet Reference Architecture can be downloaded in its entirety from the IIC website at: <http://www.iiconsortium.org/IIRA.htm>.

Bridge the gap between OT and IT

The convergence of operational and information technologies doesn’t have to be like merging rocket science with brain surgery. Here’s how off-the-shelf tools are enabling the Industrial IoT

“Within a given enterprise are operational technology systems and information technology systems. Both technologies and each set of systems were purpose-built, and neither was designed to work with the other.”

So begins an essential section of the Opto 22 white paper, “Your IoT Primer: Bridge the Gap between OT and IT.” It made our *Required Reading on the Industrial IoT* list for its highly accessible narrative on the parallel evolution of operational technology (OT) and information technology (IT) systems, together with an approachable exploration of the standards, protocols and tools emerging as primary players in a flattened, converged architecture

that brings both world together. The white paper is excerpted below; to download the eight-page document in its entirety search “IoT” at <http://www.opto22.com>.

Both OT and IT function within the enterprise to create output (goods and services), the report continues. To create output most efficiently, they need to work together. But in today’s enterprise, there’s a significant communication gap between OT and IT technologies. Each uses its own methods of connectivity, from the physical connectors and buses that data rides on, to the language each uses to convert bits and bytes into human readable and actionable information. Designed years ago,

OT and IT technologies remain far apart today.

During a recent keynote address at the *Smart Industry 2015* conference, Richard Soley, executive director of the Industrial Internet Consortium, pointed out that ladder logic diagrams for PLCs used in discrete manufacturing in 1980 are very much like the ones used today. “Worse, though it’s got an internet port on it now, it doesn’t connect to the IT infrastructure of the plant.”

Why not?

CONNECTIVITY COMES FIRST

For decades, industrial products have been designed for long life. As a result of this long lifecycle,

industrial devices installed today use varied physical communication layers, mostly proprietary to their industry. For example, you may have a variable frequency drive on a serial network, a proportional valve on FOUNDATION fieldbus, and a proximity sensor on DeviceNet, each a different physical network.

One of the first steps in connecting legacy industrial systems to the IoT is to provide some type of conversion from these application-specific physical buses to open, ubiquitous physical interfaces such as Ethernet and wireless. We'll also need to aggregate smaller, simpler devices like non-networkable sensors or electric circuits into a networked gateway device, in order to transmit the sensor-level signals onto standard network interfaces and then into the primary internet communications protocol: TCP/IP.

As a result of the purpose-built, application-specific nature of manufacturing and automation systems, the vast majority of devices found on the plant floor today use their own custom and often proprietary protocols to meet application requirements.

While a custom protocol can be useful in a single given application, for example closed-loop process control, it creates yet another hurdle in accessing the data required to realize the benefits IoT offers.

In contrast to OT, IT enterprise networks use the same open stan-

dards and protocols found on the internet. The internet was founded on open communication standards like TCP/IP. Application-specific protocols are layered on top: HTTP/S, SMTP, SNMP, MQTT, and so on.

The internet uses programming languages like Java-Script, Java, and Python and presents infor-

and their numbers are growing at a 30% clip. And all of these devices are generating data. Zettabytes of data. But is it useful data? And are modern networking technologies up to the task of moving that much data across the internet?

The IoT is going to produce increasingly massive amounts of raw data from billions of sensors, actua-

CONVERGENCE WILL DEMAND A FLATTENED ARCHITECTURE AND SEAMLESS COMMUNICATION

mation using technologies like HTML5 and CSS, all of which are open. To realize the promise of the Internet of Things, OT and IT technologies must converge, allowing connection and communication.

Perhaps in the short run, OT and IT can converge using solutions such as protocol gateways, OPC servers, and middleware. In the long run, however, OT/IT convergence will demand a flattened architecture and seamless communication between assets, using open, standards-based communication protocols and programming languages.

IOT AT THE EDGE

As of today, billions of "things" already are connected to the internet,

tors, and devices. How do we sort through the data to filter out what we need—to turn it into actionable information?

The answer lies in edge computing. The majority of IoT devices will be connected at the edge of the network, the place where OT and IT physically converge. The data that OT devices generate must be mined for what is useful to the enterprise and forwarded to cloud computing systems for big-data analysis; useless data must be discarded to reduce bandwidth requirements and noise.

Unfortunately, most of today's OT assets like individual sensors and machines don't have the computing power required to process and filter the data they generate. More intelligent OT assets like

PLCs tend to focus on single-task automation functions and have not been designed to share that manufacturing data with other systems. So the current IoT requires third-party systems that act as data brokers between OT and IT assets.

GIVE IT A REST

The real vision of OT/IT convergence is for autonomous and direct communication—for assets, things, nodes, and servers to communicate directly with each other without the need for protocol gateways, OPC servers, and middleware. To enable direct asset-to-asset or thing-to-thing communication and truly bridge the OT/IT gap, manufacturers will push intelligence down directly into OT assets and


enable those assets with IT communication capabilities, protocols, and languages.

We already see increased device capabilities as OT assets are beginning to be developed from the ground up with IoT applications in mind. Over time, we'll see not only

communication technologies but also increased intelligence, allowing assets on the edge to interpret and filter their own data into information, and then expose it via standard formats documented as web APIs.

To fully realize the benefits IoT has to offer, OT assets will need to be designed with web technologies built directly into them. These RESTful architectures leverage HTTP for interaction, SSL/TLS encryption and authentication for data security, and JSON for data

OT ASSETS WILL NEED TO BE DESIGNED WITH WEB TECHNOLOGIES BUILT DIRECTLY INTO THEM

format. They're available today, and destined for an Internet of Things application near you. 

The eight-page white paper, "Your IoT Primer: Bridge the Gap between OT and IT," can be downloaded in its entirety at the Opto 22 website. Just enter "IoT" in the search box at <http://www.Opto22.com>.