IIC Quarterly Report: November 2015

The most recent Industrial Internet Consortium (IIC) members meeting was held in Barcelona in conjunction with IoT World Solutions Congress. The latter event attracted 4,500 attendees from 53 countries, who came to hear the 120 speakers in 80 sessions. The show floor had 88 exhibitors, including the IIC pavilion which housed IIC members NEC, Moxa, RTI, Works Systems, Infineon, Tego, EMC, Parstream, Micron and First Line Software. The Testbed area, where several IIC testbeds were demonstrated, generated a lot of interest and excitement among the visitors. This seems a good time, then, to focus on testbeds in this report.

WHAT IS A TESTBED?

A testbed is a controlled experimentation platform, conforming to the IIC Reference Architecture[1], where solutions can be deployed and tested in an environment that resembles real-world conditions. Testbeds explore untested technologies or existing technologies working together in an untested manner. The purpose is to lead to innovative products, services, and methodologies, as well as to generate requirements and priorities for standards organizations.

Going from a concept to testbed is not an overnight process. Testbed sponsors first create a proposal document that covers the basics: names of the sponsors, collaborators and principals; description of the testbed; and how the resulting products will lead to transformational business outcomes—a key objective of the IIC.

The testbed owners next present their idea to the Testbed Working Group, who reviews it to determine its viability. If so, the testbed sponsors create a detailed, formal proposal document and present an amplified description to the Security Review Team.

This team is responsible for defining a process whereby a testbed can declare targeted levels of security in multiple dimensions and receive feedback from the Security Working Group as to whether the desired levels of adherence are likely to be met. They produce a report detailing the "security posture" of the testbed that identifies security roles, threats, and technologies used in the testbed.

The Testbed Working Group provides feedback on the presentation and proposal document. Testbed owners who have (successfully) gone through the approval process are also available to new testbed leaders for assistance and guidance in getting a testbed approved. Testbed sponsors may then revise their proposal in light of the feedback from all parties.

The final step is present to the Steering Committee for approval.

[1] "Conforming" is a too strong a word, given that the reference architecture is "only" a reference. But the idea is that the testbed should have a similar structure to the reference architecture, or have a good reason why not. See also below

IIC TESTBEDS

To date, nine public IIC testbeds have made it through the testbed approval process.

The Track and Trace Testbed was the first publicly-announced IIC testbed in March 2015. With participants from Bosch, Cisco, National Instruments, and TechMahindra, Track and Trace brings the Industrial Internet to the factory floor. Today's factories are highly sophisticated and require exacting work—down to the precise amount of force used to tighten a screw. The tools in Track and Trace will be able to determine its precise location and use and, therefore, will be able to determine the force and work needed to complete a task. In addition, if a tool recognizes that it is being misused, it will promptly power down to avoid accident or injury. Finally, over the two-year project, the testbed participants will look to fine-tune the localization of tools to 30 centimeters, and ideally down to five centimeters. These features increase productivity in manufacturing and contribute to the safety and quality of the goods produced.

The Communication & Control Testbed for Microgrid Applications Testbed is focused on proving the viability of a real-time, secure databus to facilitate machine-to-machine, machine-to-control center, and machine-to-cloud data communications. It combines distributed, edge-located processing and control applications with intelligent analytics and will be developed IIC members Real-Time Innovations, National Instruments, and Cisco. The testbed is unfolding in three phases. Phase one commenced as a proof-of-concept that ensures basic security and performance. Phase two will demonstrate the scalability of the Microgrid Communication and Control Framework in a simulated environment. The final phase will demonstrate the testbed in a real-world situation.

The goal of the International Future Industrial Internet Testbed (INFINITE) is to develop software-defined infrastructures to drive the growth of Industrial Internet products and services. INFINITE uses Big Data to create completely virtual domains with Software-Defined Networking, and to make it possible for multiple virtual domains to securely run via one physical network. IIC members EMC Corporation and the Cork Institute of Technology lead the effort in partnership with Vodafone, the Irish Government Networks, Asavie and Cork Internet Exchange. The testbed will unfold in two phases in Ireland. In Phase One, three geographically dispersed data centers will be interconnected into a reconfigured network. In Phase Two, INFINITE will be applied to a "Bluelight" use case that will allow ambulances to connect to a hospital's system securely and relay information while in route. See "Testbed Programs" below.

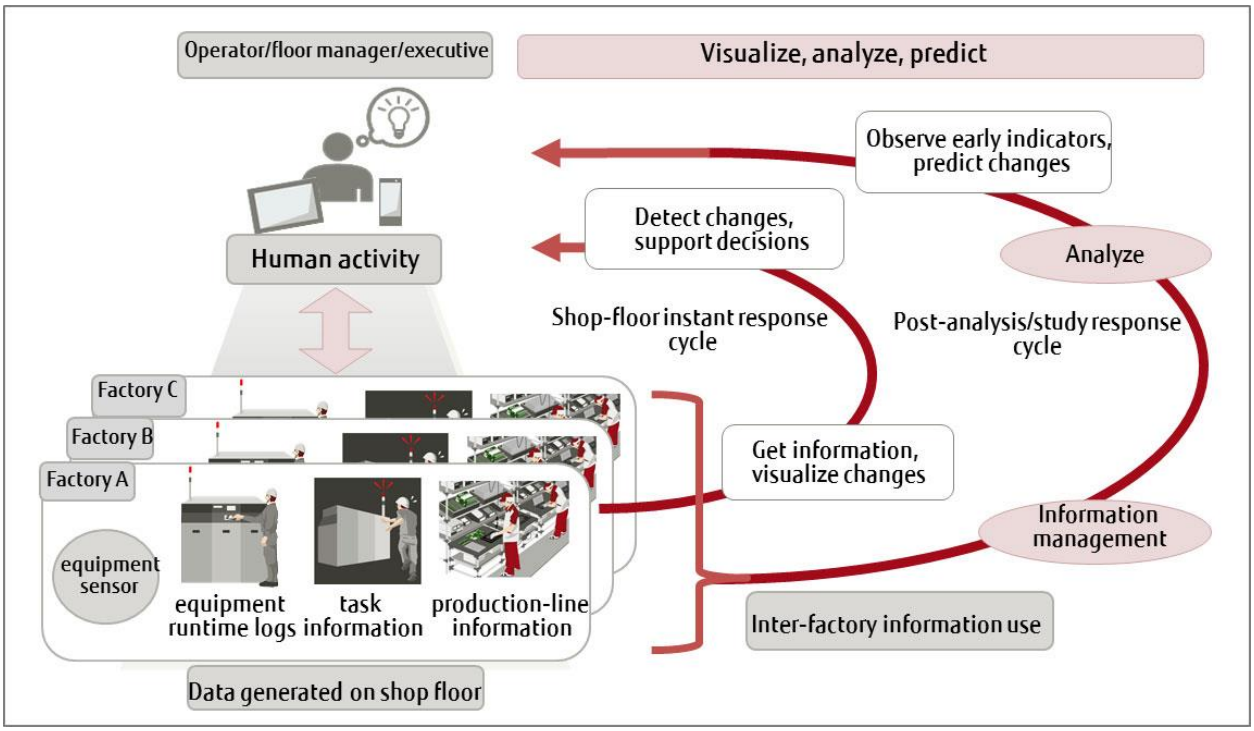
The Condition Monitoring & Predictive Maintenance (CM/PM) Testbed by IBM and National Instruments will demonstrate the value and benefits of continuously monitoring industrial equipment to detect early signs of performance degradation or failure. CM/PM will use modern analytical technologies to allow organizations to detect problems and proactively recommend actions for operations and maintenance personnel to correct them. This has the potential for significant savings on maintenance and repair expenses, as well as reducing the cost and lost productivity of downtime caused by equipment failures. The testbed will initially be deployed to a power plant facility where performance and progress will be reported on selected, key equipment. Additional equipment will be added and new models will be developed over time.

This summer, at the Industrial Internet Summer Conference in Niskayuna, NY, GE unveiled the High Speed Network Infrastructure testbed. The network uses high-speed fiber optic lines to support Industrial Internet initiatives, transferring data at 100 gigabits per second to support seamless machine-to-machine communications and data transfer across connected control systems, big infrastructure products, and manufacturing plants. It extends to the wireless edge, allowing testbed leaders to provide more data and analytical results to mobile users through advanced communication techniques. IIC founder GE, installed the networking lines at its Global Research Center. Cisco, also an IIC founder, provided the infrastructure needed to give the network its national reach. IIC members Accenture and Bayshore Networks are currently demonstrating the application of the High-Speed Network Infrastructure for power generation.

The Asset Efficiency Testbed from Infosys, Bosch, GE, IBM, Intel, and PTC monitors, controls and optimizes critical industrial assets in a holistic manner, taking into consideration operational, energy, maintenance, service, and information efficiency, to enhance their overall performance and use. The design will make it possible for the testbed to be applied to multiple solutions. The testbed will launch in two phases. In the first phase, the testbed will involve a moving asset, in

this case, aircraft landing gear. The focus of this phase will be on the creation of the stack and the integration of technologies. In the second phase, the testbed will address fixed assets, such as chillers, with the goals of finalizing the architecture and providing easy access to the system through open interfaces.

The Factory Operations Visibility & Intelligence (FOVI) Testbed concept made its debut on the testbed floor at the IoT Solutions World Congress in Barcelona this September. IIC member Fujitsu Limited leads the work on this testbed. IIC founding members Intel and Cisco are also collaborating on the in-factory testbed edge infrastructure. The testbed will provide a cloud-based platform that integrates factory sensor and operational data to enhance the visibility and analysis of key manufacturing processes, thereby enabling the improvement of operational efficiency. This testbed will leverage the results of two, separate, proof–of-concept applications of FOVI already completed in Japanese factories. It will produce a generalized solution, with open interfaces that has a factory floor simulation capability for testing.



Also appearing on the floor at the IoT Solutions World Congress was the Edge Intelligence Testbed from IIC members Hewlett Packard Enterprise and Real-Time Innovations. Many emerging industrial IoT applications require coordinated, real-time analytics at the "edge," using algorithms that require a scale of computation and data volume and velocity previously seen only in the data center. The primary objective of this testbed is to accelerate the development of edge architectures and algorithms by removing the barriers that many developers and smaller IIC members face—access to a wide variety of advanced computer hardware and software, configurable to resemble state-of-the-art edge systems directly at very low cost to the developer. This will be a cloud-based, self-service test facility for other testbeds to use as a foundation when building their own testbeds. See "Testbed Programs" below.

Our most recently announced testbed, the Industrial Digital Thread, is a collaboration between IIC members Infosys and GE. Field engineers and service teams often lack the data and digital insights needed to assess, troubleshoot, and determine work scope for the large industrial assets when performing corrective and preventative maintenance activities. The goal of this testbed is to give each machine and individual part a digital "birth certificate", track them through their lifetime, and make sure that this information is available to field engineers and service teams. It will be implemented in multiple phases. Phase 1 focuses on assembling the software stack, establishing the architecture and connectivity, and addressing one use case concerning premature wear. In subsequent phases, this testbed will be able to support multiple use cases in design, manufacturing, services and supply-chain optimization.

TESTBED IMPLEMENTATION

Testbed implementation is the responsibility of the testbed sponsors. However, the purpose of an IIC testbed is to produce results. Accordingly, each quarter each testbed produces a short report detailing progress.

Of particular interest is how well the IIC Reference Architecture applies—and where it doesn't. Accordingly, the Testbed Working Group is also collaborating with the team that worked on the IIRA. This collaboration with the Architecture group allows them to assess how useful the IIRA is for developing testbeds, assess the degree to which a testbed has used the IIRA and potentially, even impose a process to ensure that the IIRA is adhered to some degree.

Also of interest are the "Items to Resolve" and "Help Needed" sections of the progress report. These identify opportunities for other members to participate in the testbed effort by providing their skills, services or products to address these issues.

The Security and Testbed Collaboration Group are in the process of drafting deliverables that will establish a structure for evaluating the level of security adherence in multiple dimensions–criteria against which testbeds can be measured and evaluated. When the Industrial Internet Security Framework is complete, we shall set up a similar group to assess how the advice proffered by the Framework applied to each testbed too. The notion here is continuous feedback. As we said in our last quarterly report, we are working on all areas at once. That puts a lot of emphasis on continuous feedback and collaboration to ensure the work is proceeding effectively.

TESTBED PROGRAMS

So what can be expected from the Testbed Working Group in the future?

A new Testbed Program, the Open Horizontal Testbed Platform (OHTP) has recently been initiated. Its goal is to bring a systematic management approach to the creation of configurable testbed platforms that will embody the tenets of the Industrial Internet Reference Architecture and support a wide variety of vertical, solution-focused testbeds. It will do this by providing foundational ingredients and recipes for the platforms, along with construction guidelines, thereby ensuring that critical testbed tenets, such as Interoperability, Scale, Security, and

Business Opportunities are being realized. This will enable faster development of the vertical, solution-focused testbeds as they reuse, rather than recreate, the testbed platform. The Edge Intelligence and INFINITE testbeds are initial examples of testbeds that have as their goal to provide such platforms.

To learn more about the Testbed Working Group, visit www.iiconsortium.org/wc-testbeds.htm.

OTHER WORK

Other areas of the Industrial Internet Consortium have made progress this past quarter.

The *Marketing Working Group* focuses on growing market awareness and demand for Industrial Internet applications and technologies, including a vertical market focus on the Energy industry (the "Energy Task Group") and a cross-industry focus on security.

The Energy Task Group has created content and focus on Energy with the following activities: It published a white paper on Beyond Digitization: The Convergence of Big Data, Analytics and Intelligent Systems in Oil & Gas; hosted a one-day Industrial Internet Energy Summit in Houston for 140 attendees; ran a one-hour TweetChat with conversations from around the globe; strengthened its liaison with the Smart Grid Interoperability Panel; prioritized its focus around Predictive Maintenance & Prognostics use cases; and began the work to map energy-specific requirements to the previously-published Industrial Internet Reference Architecture. This is just a sample of the activities for one of the focused vertical areas.

The Marketing Working Group also began public conversations about Industrial Internet Security. Working in conjunction with the Security Working Group, they published a short paper on the Industrial Internet Consortium's Approach to Securing Industrial Systems; ran a well-attended half-day Security Forum in New York that featured case study presentations; best practices; and a panel discussion; hosted a TweetChat that generated 6 million impressions in one hour; and began work on a white paper. There will be more on security in the next quarter.

The focus of the *Security Working Group* is now on writing the Security Framework document, which will map out the security requirements of Industrial Internet Systems. There is a large and dedicated team working on this; they plan to publish the paper in the first half of 2016.

The *Technology Working Group* has begun v2.0 of the Industrial Internet Reference Architecture. It also spun out new Task Teams focused on Dynamic Orchestration, OT/IT Convergence, Innovation, and Intelligent and Resilient Controls. There are now 11 Task Groups working under the Technology Working Group.

Finally, there is a new Working Group that is focused on the business strategy and solution lifecycle approaches in the Industrial Internet. We will report more on the progress of this group, in our next report.

Nearly 20 months after it was launched, the Industrial Internet Consortium has made progress on many fronts. The framework for interoperability has been established; security and safety requirements are being defined; multiple testbeds are progressing; and the emerging market is showing more signs of maturity. Things are, indeed, coming together for the Industrial Internet Consortium and its growing, global membership of 216 companies.

The Industrial Internet Consortium is an open membership organization with 216 members from 26 countries, formed to accelerate the development, adoption, and wide-spread use of interconnected machines and devices, intelligent analytics, and people at work. Founded by AT&T, Cisco, General Electric, IBM, and Intel in March 2014, the Industrial Internet Consortium catalyzes and coordinates the priorities and enabling technologies of the Industrial Internet. The Industrial Internet Consortium is managed by the Object Management Group® (OMG®). Visit www.iiconsortium.org.