The Industrial Internet at Work in Heavy Industry:

Putting Together a Winning Team

A Q&A with **Andy Henderson**, Advanced Manufacturing Engineer at the GE Gas Turbine Plant in Greenville, SC, and **Vic Kingery**, GE Manufacturing Industry Director

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You'll often hear that the key components for an Industrial Internet strategy are people, data and machines. Arguably people are the most critical to successfully transform your company to a digital industrial. So who are the players needed—both within your organization and outside—and how can you ensure they work well together to achieve the vision of the Brilliant Factory?

To answer questions on the players needed to implement the Brilliant Factory, we asked two GE manufacturing experts: Andy Henderson, advanced manufacturing engineer at the Gas Turbine Plant in Greenville, SC, and a 2016 SME Outstanding Young Manufacturing Engineer; and Vic Kingery, GE manufacturing industry director, an industry veteran with over 30 years of expertise in both manufacturing and IT.

Q: It's clear that for successful Industrial Internet adoption, you need team members from both Operations and IT. Who's critical?

Andy: The entire operations staff is critical. They are the end-users of the software tools. This includes everyone from production associates or operators up to the plant manager. IT infrastructure support is also critical. Many existing plants will need upgrades to their legacy IT infrastructure to handle the new demands of the Industrial Internet.

Before we answer that question, we need to define the Brilliant Factory.

Above all, the Brilliant Factory is part of a journey, one that many companies have been on for years. The key difference with the Brilliant Factory is the focus on machine data as a critical part of what GE calls the "digital thread." The digital thread connects data from product design, sourcing and supplier management through production, logistics/distribution and service, and ultimately back into design. The result is the ability to see performance and output in real time. At the machine level, this requires embedding sensors and leveraging software to gather data and enable insights. Acting on these insights drives productivity and performance, along with significant improvements in products and services.

A major reason for adopting the Industrial Internet is to increase businesses profitability. In a manufacturing environment, this happens when users on the shop floor leverage the insights derived from the connectivity and data to make improvements to the production process. They must understand their role and buy in completely for adoption to occur. A complete top-down push will not be successful.

However, if the workers on the floor are engaged, but management is not participating, adoption will not be successful. The upper level managers must be willing to adjust their metrics and apply new metrics in light of the new analysis and operational details. By holding the production teams accountable, we can make use of things like Overall Equipment Effectiveness or new ways of looking at quality or driving out cycle time.

Q: What issues have you had with adoption?

Andy: I've seen times when the production associates, the people running the equipment see this data gathering as Big Brother looking over their shoulder, so they're slow to adopt. We've dealt with that through education—by assuring the workers that they're not being micro-managed. We're trying to ensure that leadership has the information they need so they can take appropriate action to help the production associates remedy issues that keep us from being more productive.

At the end of the day, everyone wants to do a good job, to produce parts, to go home and feel good about the tasks they completed that day. We want to deliver insights that enable this.

Q: How does IT fit in?

Vic: The IT team has a variety of constituents. The CIO has the overall responsibility for corporate architecture, ensuring that the components of the enterprise stack are solid, and the strategy and roadmap support not only brilliant factories, but the overall business outcomes of the enterprise.

Most organizations have constituents on the IT team focused on application enablement, on support, on dev-opps, with individual objectives for each one of those constituents. Dev-opps in a brilliant factory centers on security, networking and wireless capability. They work closely with the operational technology teams, solving problems on the factory floor in addition to managing the company's IT assess. Application teams look more at the integration up and down the enterprise stack of applications. Database and analytics teams focus on overall enablement of analytical capabilities.

Andy: We were fortunate that higher level IT management bought into the idea of transforming our plant into a brilliant factory. We have several IT guys embedded in our team, right across from the

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functional team. One is responsible for infrastructure. When we connect a new data source or start gathering data from databases, he ensures we have the appropriate infrastructure to do that—whether we need physical wiring and switches or virtual area networks and firewalls or data servers to install applications and launch databases. The other IT person is responsible for server and software availability. Together they make sure that the IT system is capable of meeting the operational needs and that it is ready to serve.

Q: Was transforming to a Brilliant Factory in Greenville an upper-level management decision?

Andy: Actually, no. It started with a conversation between a cell leader and myself. I needed data to support analyses of manufacturing processes. We had some brainstorming sessions about acquiring the data and the systems we could build. We started laying out a path with some assumptions about the value we could realize and sold this to higher level management.

Vic: Sometimes when the corporate team is not involved with a bottom-up effort, it can be siloed and less effective at scaling across the enterprise. On the other hand, if it's a top-down effort, it can be seen as the "initiative of the year."

When both the IT and OT teams are involved, as Andy described, that's when the power is unleashed. You have the visibility, transparency and responsibility all up and down the chain of command and execution.

Andy: You also need to realize that the "Brilliant Factory" is a moving target because the state of industry keeps improving. I don't think you can point to a set of technologies or a set of applications and say, That is a brilliant factory. Just as soon as you do, someone will implement something slightly different, slightly better and you'll say, "That's even more brilliant." You have to keep transforming.

Q: What are the three key attributes you would look for in an external partner?

Andy: I think the #1 requirement is how well the provider understands manufacturing. It's great to know how to build a software stock and how to architect an IT system, but you must be able to translate that to producing parts faster, cheaper and with higher quality.

We have equipment that's been around for 40 or 50 years, with either no communication or very specific protocols and ways to communicate. The provider has to have intimate knowledge in that space to be effective. They need to know what data is important, how to gather it, and how to translate that data into value for the manufacturing enterprise.

Vic: There are a lot of software startups that provide good tools, but they also need industry experience and the ability to articulate what the business impacts will be. Many of our customers ask us how a digital transformation will improve their business and they're looking beyond the normal examples of 1% inventory reduction and 10% cycle time reduction, for example. They're getting much more educated and want very specific answers to that question now. A partner must be able to articulate and execute on critical outcomes for customers.

Q: Should you also look for software solutions specific to your industry?

Vic: Software specific to your industry's needs can definitely be an asset, but the real power is combining it with a platform, a framework for creating applications that will ultimately connect people and machines and data. A good example is the cloud-based Predix platform for the Industrial Internet. Companies should look at the entire enterprise architecture holistically, as a system where each part impacts all the others.

Andy: This is just my view, but I think the importance of Predix is the ecosystem. Any developer, anywhere, can create an application that uses the Predix platform. It allows Jim-Bob's machine shop, where they've implemented a new way of looking at quality data, to create a software tool and deploy it on Predix. If Jim-Bob is on to something, I can start using his application, because there's an ecosystem that's out there. Anyone can contribute. I think that's powerful, in the same way Android and IOS have revolutionized the way we think about our personal devices.

Q: What else should an external partner be able to provide?

Vic: A sound security solution. Research shows that most CIOs don't believe their businesses are ready to manage cyber attacks. Current IT security solutions protect data, not assets—which means that the machines you rely on are at risk. So an external partner must be aware of the specific risks that Industrial Internet adoption poses and have a solution to protect data and assets across the enterprise.

Andy Henderson, Advanced Manufacturing Engineer, GE Power

Andy Henderson works at GE's Gas Turbine Plant in Greenville, SC. He was recently named an SME Outstanding Young Manufacturing Engineer for 2016. Andy received a bachelor's degree in mechanical engineering from the Georgia Institute of Technology in 2006 and doctorate in automotive engineering from Clemson University in 2012. Between receiving his bachelor's degree and graduate school, he was a diesel engine test engineer with Caterpillar Inc. at its tech center in Peoria, Illinois. Since joining GE, Henderson has focused on integrating new technology with manufacturing operations to improve processes. He has provided thought leadership around GE's Brilliant Factory efforts.

Vic Kingery, Manufacturing Industry Director, GE

Vic joined GE in 2015 after 10 years with SAP as chief business architect with the Center of Excellence for Advanced Manufacturing and Operations. Vic has focused on MES, MOM, PLM, EH&S and EAM systems in discrete and process industries, including automotive/heavy truck, industrial machine and components, oil & gas, utilities and aerospace & defense. Vic developed and authored a next-generation reference architecture model for Enterprise Operations Management that includes the Industrial Internet and Machine to Machine (Industry 4.0), social media contextualization, big data and analytics, cloud, mobility and in-memory database technologies.

Vic is an expert in lean manufacturing processes and experienced in Six Sigma systems. Prior to SAP, Vic worked with IBM. Vic started his career in manufacturing with steel fabrication and processing, working his way up from production operator to plant manager and VP of Quality. Vic studied computer science at Parks Technical College, quality systems at Madonna University and earned an Executive MBA program through Michigan State University's Extension program.

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