PIONEERING the INDUSTRIAL INTERNET

GE has transformed itself into the world's leading digital industrial company, and its GE Digital group is playing an integral role in leading this charge by providing companies with valuable insights to manage assets and operations more efficiently. But that is just the start. According to Jeff Immelt, chairman and CEO of GE, "If you went to bed last night as an industrial company, you're going to wake up this morning as a software and analytics company."

To learn more about what the company is doing, **Rob Harwood**, ANSYS industry director, spent time talking with GE Digital Chief Marketing Officer **John Magee**.

Harwood (RH): We hear a number of buzzwords and phrases industry, such as Internet of Things, Industry 4.0 and Industrial Internet. Can you shed some light on the differences between these terms?

John Magee (JM): The Internet of Things is all about the technology trend of connecting physical devices over the internet in the same way that we have been connecting people for the past several years. This could be everything from a personal fitness device to your sprinkler system to a power plant to a jet engine. So when you think about the Internet of Things, it really is applicable across a broad swath of the economy. The Industrial Internet is the part of the Internet of Things that focuses on complex, capital-intensive equipment that powers

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the global industrial infrastructure — everything from transportation to healthcare to power generation. This is where GE is focused. Industry 4.0 is an initiative that has some similar technology objectives, but its center of gravity tends to be in Europe and focuses on manufacturing and automation systems.

RH: How is this type of connectivity different from traditional forms of equipment monitoring that companies have been doing for a long time?

JM: We can now put sensors in places they have never been before and embed compute capability into places never previously reached. The cost models are falling into place not just for super-high–value assets, but for every pump, motor, valve, machine or piece of hospital equipment, and these cost models can be broadly optimized across all of that equipment. And, we can more readily marry this sensor data with a broader set of digital data about the asset, so we can become much more predictive and prescriptive and much less reactive.

RH: Do you see opportunity to leverage the power of the Industrial Internet across all industry sectors?

JM: We have been very bullish on the potential for the Industrial Internet to transform not just the industries that GE plays in today, but others such as autonomous vehicles, intelligent cities,

logistics, agriculture and more. All of these areas are ripe for optimization and for new ways of doing things. So across the board, there is a lot of potential for optimization and new business models made possible by the Industrial Internet.

RH: Integrating sensor data from a connected asset with other organizational data about that specific asset — such as that information held by engineering (CAD, simulation, PLM, etc.), manufacturing, operations and maintenance, marketing and sales, and others — brings the possibility of a digital twin. Can you expand on this concept?

JM: One of the most powerful tools for bringing all this organizational data together is something called a digital twin. This is a software representation of every physical asset out there so that we can understand everything about it — from the time it was manufactured, to its performance in service, to the way users interact with it, to how it performs under different conditions, and much more. We are no longer talking about a digital blueprint of an ideal design of a generic class of assets, but an actual real-time digital twin of each specific asset.

RH: Can you give a practical example of a digital twin at GE along with some of the benefits you have realized?

JM: At GE, we have piloted the tools, technologies and processes needed to create a digital twin and have put these into practice in our own manufacturing and design service businesses. For example, for jet engines we create the digital twin model at the time of design and engineering, and that same model is used through all phases of product development and asset life-cycle management. We now have all of the data. That lets us do very predictive things around maintenance and operations. By working with our airline customers, we can help them operate more effectively, and the net result has been improved internal efficiency for GE and substantial benefits to our customers, who are subsequently able to operate their equipment and operations more effectively.

RH: To create the digital twin requires a new way of collecting and integrating digital information from multiple sources. How is GE handling that?

JM: From an information and technology perspective, managing, creating, modeling and supporting digital twins is different from traditional business computing platforms. For enterprise resource planning systems, there are relational databases, and we can model the different ways we record

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information around orders and employees and transactions. We not only need all of that for the Industrial Internet but we require the ability to capture these digital twins and their nested hierarchical data structures. There is a new approach for tools and for the way we process information, and we must also map the asset models to sensors that collect the data feeding into that twin. Then this information can be holistically provided to users who access the twin information and to developers who build applications against those twins. It requires a whole new kind of industrial platform to really take advantage of the benefits of digital twins.

At GE, we saw early on that to go faster with the Industrial Internet and to accelerate what we are doing in healthcare, in transportation and in power, we would need new kinds of tools. And for us that led to the development of what we call the Predix platform. Predix is a software platform for building, managing and monetizing Industrial Internet applications, and it includes a number of unique capabilities optimized for the requirements of the Industrial Internet as opposed to the broader Internet of Things.

RH: To enable a digital twin to become predictive and prescriptive, accurate modeling and simulation that is connected to the Predix platform must be important. Can you explain this connection?

JM: One of the big opportunities with the Industrial Internet is the ability to have enough data about operations, equipment, assets and people to be able to do predictive modeling and to ask what-if questions. Modeling and simulation, therefore, become hugely important tools once we have the data. The secret sauce to actually achieving innovation is to be able to marry the physics-based models with

statistical and machine-learning approaches, so you get the best of both worlds. With a physics-based model, you can now understand what the parameters are, discover the normative patterns, and you can go much faster. You do not need as much data to really gain key insights. This means that we can give decision-makers the right information to be able to understand the trade-offs required to operate capital-intensive infrastructures, to achieve business value for their operations and to make the right decisions.

RH: ANSYS and GE have worked together for a long time. How important are partners and an ecosystem to being successful in the Industrial Internet and digital twin space?

JM: ANSYS has been a great partner for us by providing the modeling and simulation capability, working with the Predix team, integrating with the Predix platform, and using the data we collect to provide that decision-making insight.

RH: The Industrial Internet and the concept of the digital twin are still new or unknown quantities for many. What advice would you give to those about to embark on the journey of digital industrial transformation for their business?

JM: We are working with a lot of our industrial customers on their own transformation, and we actually use a transformation playbook based on best practices that we have developed. There are a few key takeaways:
- Match up the technology with the business values — so having the right stakeholders at the table early on is important.
- Take an architectural approach in which you think about not just one or two applications but, if you are really going to trans-

form your business, what your overall platform strategy is going to be to manage the data, to collect the data, to analyze it, to deliver all these applications that you want to be able to deliver and how that is going to interoperate with your infrastructure.

With our Predix platform, those are things we have had to think about ourselves as we have ramped up GE across all of these large, diverse businesses — and that is where we are now: working with customers to help them on that journey. ∧
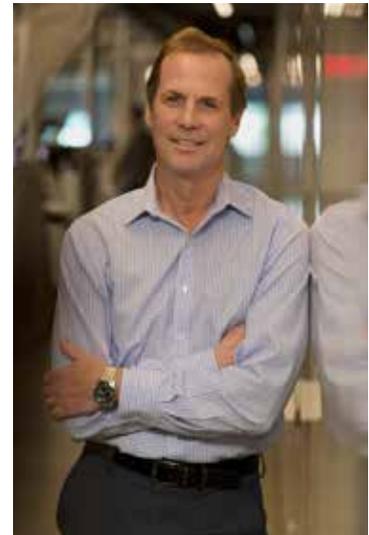
About John Magee

John Magee is the chief marketing officer for the Predix platform at GE Digital. He leads product marketing, developer relations, and training and enablement programs to help Predix customers realize the full potential of the Industrial Internet. He has over 22 years of experience in enterprise software; prior to GE, he held executive management positions at Oracle, Symantec and EMC.