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Advanced Analytics

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As an engineering company, GE has always done math, and done math well. But in many cases, there's no fixed formula for how our assets will be impacted by operational, environmental, or maintenance changes over their long lifetimes—for how an engine will behave in a patch of turbulent air, or how wind turbines will interact with each other during a storm—because the real world is full of chaos. But it's only in the real world that you can truly see what's happening.

Analytics are a way of seeing. They give us the ability to find patterns amidst chaos. They allow us to understand what's happened in the past, forecast what's to come in the future, and make informed decisions that bring about the changes we desire. And change, dramatic change, is at the heart of industry today.

Industry is transforming due to the big data and mobile technology revolutions that have happened in the consumer world. The Industrial Internet is a new vision for industry, where data-generating smart machines outfitted with sensors, software, and wireless communication converge with advanced analytics to give people meaningful insight into industry's most intractable challenges and cutting-edge opportunities.

Data is the light source of this vision, and GE is bearing the torch by not only designing and manufacturing smart, data-centric machines, but also by bringing together the best and brightest minds in software development to turn data into actionable information. GE Software, founded in 2011 with a one billion dollar investment, is developing a robust platform for the Industrial Internet called Predix as well as advanced analytics solutions in areas such as energy and transportation.

“ The gap that we’re trying to fill, and really complement the engineering side of GE, is understanding, through data-driven analytics, the chaos of the world that our equipment operates in,” says Anil Varma, data science leader for GE Software. “The question becomes, how do you do analytics on the operational data that comes off of our equipment, taking into account all the data about the environment and the way the customer operates the equipment over decades of life?”

To better understand how advanced analytics help us see and gain insight, it helps to know what we are looking for.

Most frequently, industrial analytics have been used to monitor asset health and identify problems. As with Bently Nevada’s expertise in vibration monitoring and diagnostics, many analytics target the health of individual assets, not only for safety reasons in cases such as jet engines, but also because asset failure directly relates to inefficiency, lower production, revenue loss, and maintenance expense. The types of analytics developed early on for this purpose were of two classes, descriptive analytics and predictive analytics.

Descriptive analytics essentially summarize raw data. Take a complex device like GE Aviation’s GEnx engine. You could, in theory, take each stream of vibration sensor data and analyze it individually. This approach would be incredibly inefficient though, because you’d need as many people as sensors to do it, since there’s only so much information a single person can process. Descriptive analytics aggregate all that sensor data to provide a general picture of, for instance, the vibrational dynamics of the engine.

> Predictive analytics take this information one step further, applying statistics, modeling, and machine learning to forecast potential future states of a device and predict problems well in advance of failure. Predictive analytics are the staple of the Industrial Internet and are at the heart of GE’s Predictivity solutions.

And yet, prediction alone doesn’t completely fulfill the promise of the Industrial Internet. Information has little power unless it can influence decision making. And this is where GE’s approach to advanced analytics comes in.

If you compare GEnx, first produced in 2006, to GE90, the world's largest turbofan engine introduced in 1995, GEnx is designed to output much more data than GE90. Applying analytics to that additional data can happen in a few different ways.

" You have two choices. You could use the same measurements that you had previously, but maybe the resolution is higher, but you're basically back to where you were," says Dustin Ross Garvey, lead machine learning researcher at GE Software. "Or you can see how new sensors combine with things we've measured historically to make better decisions. As you add more and more signal, you're getting more and more observability."

Having greater, more varied, and better data opens up the possibility of answering a much wider and more interesting range of questions that directly impact productivity. Instead of focusing exclusively on failure prevention, there's an opportunity to focus on performance and actively make decisions to improve production based on data.

GE Oil & Gas's hydraulic pumping systems, for instance, are outfitted with sensors that can measure the efficiency and flow rate of the pumps. Knowing whether or not a pump is operating inefficiently or is about to fail is important, but advanced analytics can be developed to answer questions in a more positive direction, analyzing efficiency on a field level, identifying which wells are the most productive, assessing the water cut of particular wells, and recommending decisions that can improve production for the entire field.

When analytics are applied to recommend courses of action to decision makers, they are known as prescriptive analytics. If predictive analytics are the Industrial Internet's staple, prescriptive analytics are its endgame. All the efforts of smart machines and big data are designed to ultimately influence and improve decision-making by harnessing the power of ubiquitous data.

GE is at a stage where operationalizing big data to reduce failure and increase uptime is a standard part of our approach to advancing the Industrial Internet, whether in aviation, energy, healthcare, or transportation. Now, with advanced analytics, the focus is shifting toward answering value-driven questions. How do customers increase overall production? How can various assets work together to make a process more efficient? How can a customer choose the asset least likely to fail among the fleet for a high priority task? What new opportunities can we generate by combining multiple structured, unstructured, asset, system, and environmental data?

Answering these kinds of questions requires scaling up from the level of individual assets to looking at entire fleets and systems, and growing analytics from predicting outcomes to prescribing solutions. The world may be chaotic, and there might not be a single formula to describe how an engine will behave in the real world, but with the rise of advanced analytics the real world is getting a lot more knowable.

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