Digitalizaton delivers smarter GT service

by Harry Jaeger

Digitalization has become the latest buzzword in the industry. GTW decided to take a look at the "digital revolution" to see just what it can mean to owners and operators of their gas turbine-based power generating assets.

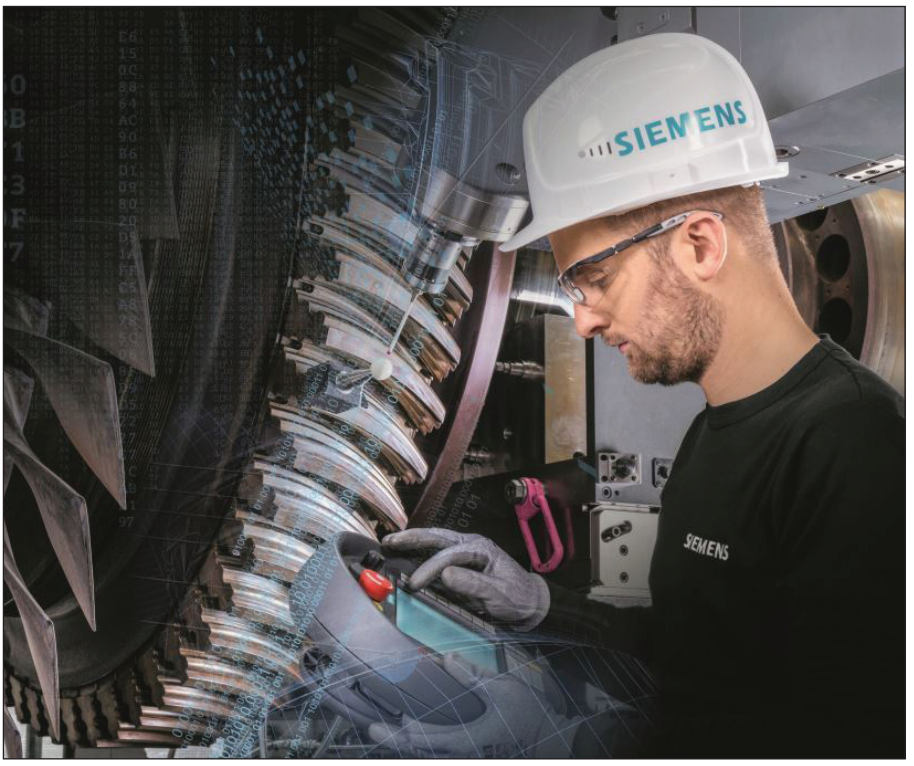
In one way or the other, the world has been "digitalized" for many years. Whether at home, at work or at play, our lives have become completely intertwined with the world of digital technology. It's all around us and its changing at a rapid-fire pace. Just when we think that we have the latest in smart technology, something else comes along that's even smarter.

So What's New?

Gas turbine and combined cycle controls were successfully "digitalized" more than 30 years ago. Just like any other high-tech device these powerful systems have been going through mod after mod, incorporating all of the latest technology and bells-and-whistles, along the way.

So, when the major gas turbine OEMs started their new advertising campaigns recently, all touting their various versions of a digital transformation or the digital revolution, *Gas Turbine World* ventured out to dig into it to see what can be found beneath all of the hype and hyperbole that might be translated into something practical for the industry.

We asked Siemens Power Generation Services, for one, just what their digitalization program means to plant owners and operators in terms of improving the performance and profitability of their gas turbine based assets? Where is the payoff for plant owners who decide to take advantage of Siemens' invitation to join the digital revolution, to connect and sign up for their Digital Services for Energy?

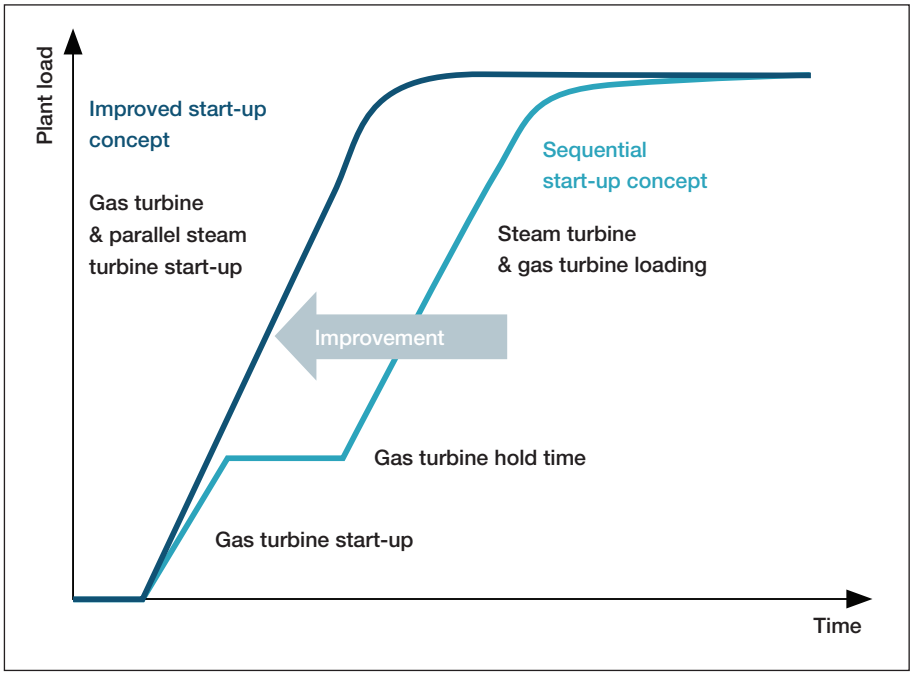


Flexible maintenance. Some operators want to participate in a smarter, data-driven flexible maintenance schedule

Smarter with data

What we learned was that while the data already exists, it's what Siemens and its customers can do with all that data, via the company's advanced data analytics, domain expertise and high-tech tools, that provide the insights that lead to the greatest customer value. Since only a small portion of the enormous amount of data being collected is actually being used in the day-to-day operation of the plant or in condition monitoring of the equipment, the idea is to recognize the potential benefits that can be realized by putting all this data to better use.

So, it is a transition to data-driven services that is new, different and smarter



Improved start-up. Optimization of a plant's starting profile is getting more and more attention

compared to the traditional usage-based gas turbine services that has been the industry standard for about as long as gas turbines have been accepted as a prime mover by electric utilities, non-utility generators and industrial users.

That said, it would appear that they are talking about offering a portfolio of "smart data-driven services" that can be tailored to a customer's specific needs and operating profile.

"Knowing the value of the huge amount of data available from an operating plant, and from an operating fleet of plants, is the key," says Aymeric Sarrazin, Senior Vice President, Controls and Digitalization for Siemens Power Generation Services Division. "It gives us the opportunity to unlock potential improvements in plant performance, availability, operating costs and, at the end, customer profitability."

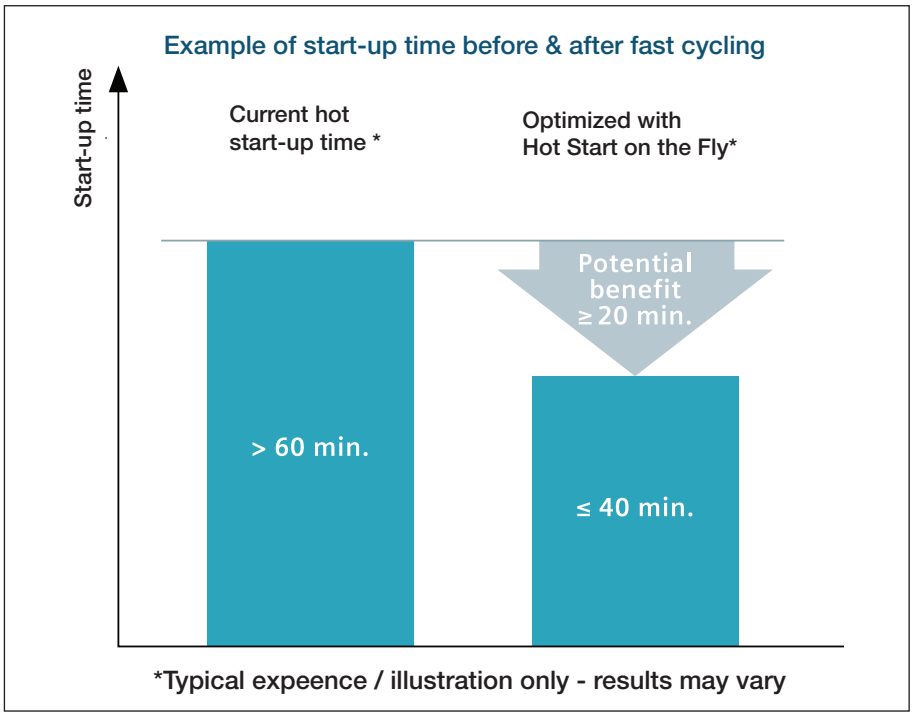
Digitalization in this context, then, means putting available digital information to work for the owner. "What we can do as the OEM," says Sarrazin, "is to add our in-depth engineering knowledge of a particular gas turbine model, and combine it with both machine and proprietary data, to turn all of that data into actionable insights to optimize a customer's operations."

Of course, the customer owns his own plant data, he explains, but the OEM has access to huge volumes of additional data from a global fleet of similar machines particularly those operating in similar conditions, as well as information from reports submitted by Siemens' world-wide staff of field engineers who service those machines.

"We recognize that data alone is not nearly as powerful for generating operational and financial benefits as data combined with domain expertise," said Tim Holt, incoming CEO of Siemens Power Generation Services. "With our vast experience and deep know-how, Siemens is pioneering digital services in the energy industry to create game-changing value for our customers."

Armed with such wealth of information, Siemens says that the customer could benefit from innovations in plant service portfolio such as:

- Flexible Long Term Service Agreements ("Flex LTP")
- Market-driven performance optimization
- The Digital Twin
- Beating the degradation curve

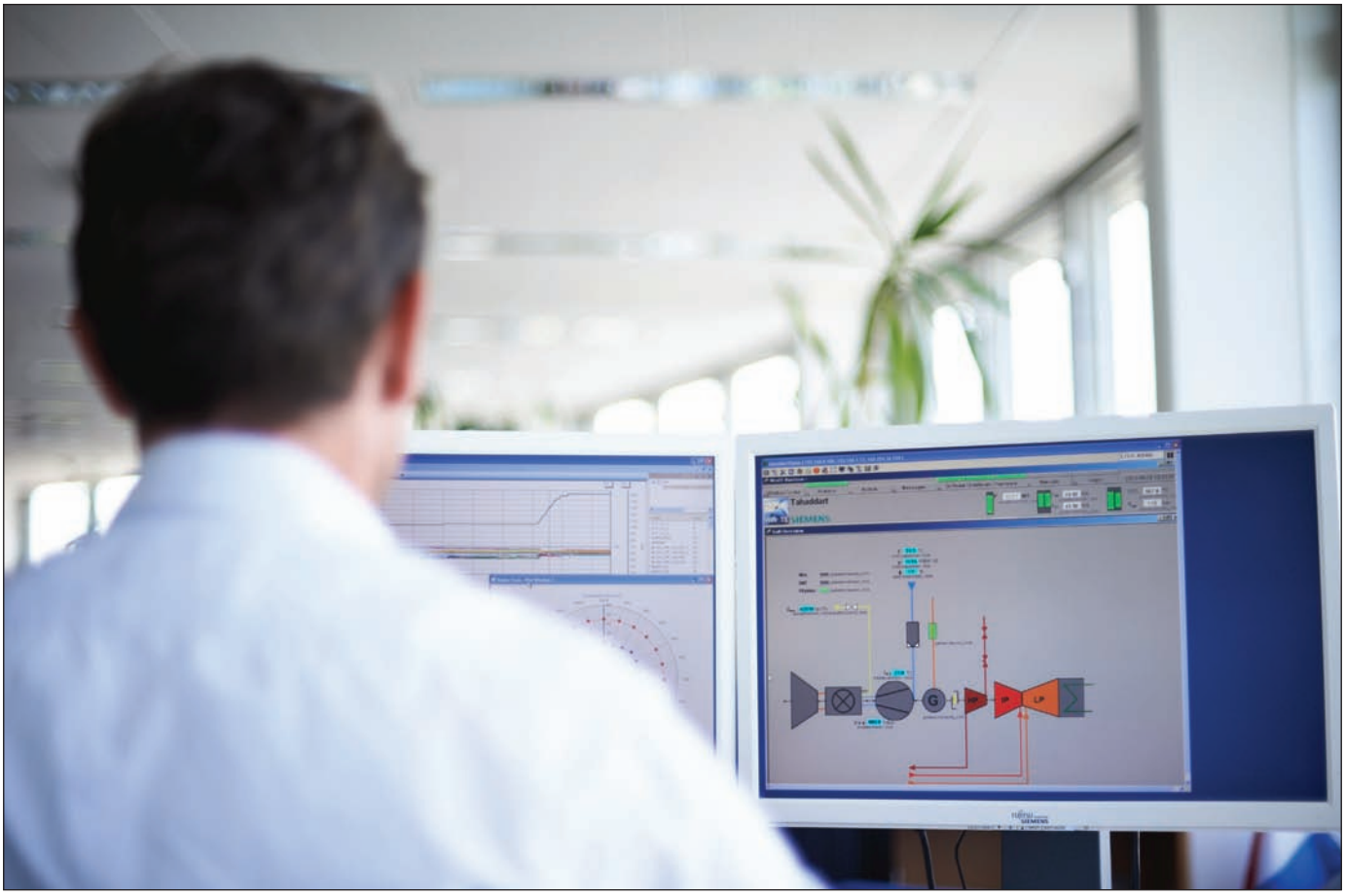


Potential benefits. Example of start-up before and after cycling upgrade

A data-driven flex plan

Traditionally, scheduling gas turbine maintenance has been a rather cut-and-dry and rigid process. The intervals between the various levels of inspection and maintenance (combustor, hot section, major overhaul) have typically been based on a unit's operating profile. This has been the industry-wide accepted practice.

Peaking units are maintained based on the OEM-specified number of accumulated start/stop cycles; base-loaded



Remote diagnostics. Siemens can look at both gas turbine and combined cycle plant operating metrics to see which parameters can be adjusted, with low risk, to restore power or efficiency, or both

units on how many baseload operating hours. Maintenance for mixed-use units, such as cycling combined cycle plants, is scheduled based on the number of "Equivalent Baseload Operating Hours" (EBOH), which follows a time-proven formula set down as gospel by the OEM, i.e., that so many start/stop cycles equals so many EBOH, atypical hours equal some factor (>1.0) times actual operating hours, and so on.

But what happens when a customer would like to participate in a smarter, data-driven flexible maintenance schedule?

"We have customers under LTSAs who will request that we look at the data to consider extending a maintenance interval during a period of high energy demand," explains Karen Ratcliff, Siemens' Power Generation Services Head of New Business Models with a focus on Digital Services. Maintenance is usually scheduled for the off-season 'shoulders', but prolonged summer or winter peak periods, extend the high-revenue season. A delay in a scheduled maintenance outage can mean substantial income to a power producer.

"It pays for that customer to participate in our new Flex LTP option," she says. In such cases, Siemens would not only apply its knowledge of the specific unit and parts life, but also its global database and its engineering expertise to analyze the risks involved in giving the green light to run past the scheduled maintenance date. If there are no particular danger signs in the data, Siemens would develop a flex plan for maintenance in collaboration with the customer to meet customer's needs.

"Since Siemens usually takes the parts risk in LTSA contracts, the whole idea is to establish a risk/reward relationship for both us and the customer," Ratcliff continues.

Apparently, according to Ratcliff, the same goes for a customer's request for a go-ahead to run in a short-term over capacity mode to increase production at times of high energy prices on the grid.

Meeting process needs

As another example of how the OEM's knowledge of a given machine and of the available data defining it and its family of machines digitally, Sarrazin told about a South American industrial customer who depends on their smaller-frame Siemens units to keep its very energy-intensive process on line.

The customer came to Siemens with a request to support its objective of keeping its process running continuously for 3.5 years (that's 42 months – and more than 32,000 hours).

"At first," says Sarrazin, "that seemed to be totally out of the realm of possibilities, especially if Siemens was going to be responsible for any replacement parts between scheduled maintenance shut downs."

But Siemens took on the challenge and came up with a plan to offer some

very unusual flexibility. "Our engineers turned to a digital model of the gas turbine hot-section to enable the analysis, reviewed operating history, examined the global fleet data base, and looked at ways to increase hot-section parts life to enable such a prolonged period of continuous operation," said Sarrazin.

"We were able to assess the customer's challenges, match that with powerful insights gained from data analytics and come up with an out-of-the-box solution that worked for them. We agreed to a 3.5 year inspection interval if the unit was throttled back to 93% of full load power and gave the option of additional load utilization at a different price point," he continued.

In fact, according to Sarrazin, the engineering digital model equipped the customer with a curve displaying power setting vs. time between inspections. "We left the choice to them, and they decided, with Siemens' agreement, to go for the full 3.5 year option to meet their objective for the plant."

Market-driven optimization

Besides the periodic need for increased flexibility in maintenance scheduling to meet market (or process) demand, gas turbine users are increasingly seeking ways to improve the operation of their units as other "market drivers" come into play. This mainly has to do with becoming more competitive in today's highly competitive power market, where not having an edge on a competitor could mean not being dispatched by the local ISO or power pool operator.

And being high on the dispatch schedule is not just a matter of having the lowest cost of energy. Other factors, including ramp rate and start-up/shut-down emissions, can also often impact whether a unit is going to be called upon to be placed in service – and generate revenue for the owner.

"With today's low fuel cost," says Sarrazin, "you'd think that there is not as much emphasis on efficiency, since operating costs are generally on the low side. But customers always want to optimize performance to get the edge over other similar units on the system. And that's where the Digital Twin comes into the picture."

Siemens offers a customer-specific service wherein the particular gas turbine package (or even a full combined cycle plant) is set up as a computerized replica (i.e., a twin) of the actual plant and that computer model can be tweaked and manipulated to analyze the effect of various parametric changes on overall plant performance.

"These optimization moves are not always that intuitive, and not necessarily in only the gas turbine. We can also simulate the bottoming cycle and balance of plant," Ratcliff points out.

If a plant is not performing as expected, the digital twin can also be used to analyze the problem by replicating the deficiency in the computer, identifying the likely cause and finding ways to correct it or compensate for it.

Computer simulation also allows optimization in terms of emissions profile since there are so many variables involved in today's complex state-of-the-art combustion and emissions controls systems. During local emissions alerts and system-wide emission limits, for example, an adjustment suggested by exercising the plant's "twin" might make the difference between being called to run or not.

"And the gas turbine ramp rate also enters into the dispatch equation," adds Sarrazin. "With the growing amount of renewables on most systems, optimization of a plant's starting profile is getting more and more attention."

This is another use of the digital twin, for example, a Siemens modernization such as the "Hot Start on the Fly" selected from among the growing Flex-Power Services™ portfolio of upgrades, might be determined to be the best way to optimize the unit on this metric of its place on the dispatch schedule.

The degradation curve

As gas turbine owners and operators have to accept from the very beginning of ownership, degradation of performance from a unit's "new and clean" condition is a fact of life that they learn to live with. Once a new unit is tested during commissioning, power starts a downward trend, and heat rate an upward one, and these trends can only be reversed with major maintenance operations.

Some partial recovery from compressor fouling is accomplished by minor maintenance, such as on-line and off-line compressor washing, but there remains some loss that continues to reduce power production and increase fuel usage until the machine is opened for a major overhaul when worn parts and seals can be replaced.

But, what if there was a way to use the digital twin and all of the data at hand to "beat the degradation curve"? This is a question that Siemens is addressing with its digital services team. "We are looking at ways to use operating data from the customer's machine and data available from the global fleet of similar machines to put the digital twin to work in ways that will enable us to learn how we might overcome the impact of normal degradation," says Ratcliff. "We are looking at both gas turbine and combined cycle plant operating metrics to see which parameters can be adjusted, with low risk, to restore power or efficiency, or both," she goes on.

"And," she continues, "the model can often be used to demonstrate that implementation of a certain mod or upgrade at the next maintenance outage would not only restore performance but even result in the unit or plant performing better than new and clean."

"With the steady flow of such mods and upgrades coming out of our technology and innovation group," Ratcliff muses, "it could be seen how a customer who elects to add a digital twin to his toolbox could not only mitigate the losses due to degradation, but even "beat the curve" and have the means at hand to ensure a continually improving power generation asset."

This is all part of the digital revolution in gas turbine services. In addition to digital models that can replicate a given operating unit enabling engineers to tweak and make adjustments that can be implemented in the field, new digital field tools such as an HD borescope camera are being used to feed even more data into the model for analysis.

"We have just scratched the surface," says Sarrazin, "and we are very excited about the many possibilities to turn 'big data' into 'big value' for customers." ■