Sentient works with owners and operators of wind turbines all over the world and models the turbine by looking at the gearbox and the bearings, calculating the earliest point of failure or problems within components

SENTIENT SCIENCE, INC.

When the Department of Defense and other large prime contractors need to know why certain machinery is failing, they call upon a Buffalo-based small business that uses material science-based life predictions to tell them the answer.

PHASE III SUCCESS
Since DigitalClone Live was introduced to the Power Generation commercial market globally, Sentient is monitoring more than 22,000 wind turbines worldwide with $4.3M in revenue in 2015. $17 million in private equity funding is being used to expand supplier and operator network growth in Europe and China.

AGENCIES
DOE, DOD

SNAPSHOT
Sentient Science contracted with DOE and NYSERDA to develop a simple to use tool that could be used by wind turbine suppliers and operators to predict and compare vendors on past and future life for over 30 years, including life extension, remaining useful life and warranty/insurance risk of the vendor specific components.

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Originally developed under the Defense Advanced Research Projects Agency (DARPA) Small Business Innovation Research (SBIR) program, DigitalClone Live has ushered in the new era of advanced material science-based prognostics that can now leverage data already being collected by health monitoring systems and combine it with Sentient's advanced "lifing" models to assess the health and life expectancy of key components within a machine.

Using the software, operators can assess which life extension solutions, recommended by Sentient Science, would best fit within their operations and maintenance budgets and strategies. By providing more time and visibility into asset health, asset managers can lower their cost of O&M and ultimately lower their cost of energy produced.

"Our original work in the aerospace industry really focused on helping customers understand where critical parts were failing and why," recalls Edward Wagner, Chief Digital Officer at Sentient Science. "Often critical components need to be modeled and simulated under multiphysics conditions to understand their reliability within actual field use cases. Our pedigree was to demonstrate our capabilities in very complex tail rotorcraft and other aerospace applications."

This led to work with companies such as Sikorsky, where Sentient worked on issues with Blackhawk helicopters, and a number of projects with Boeing, including fatigue crack initiation prediction tools for rotorcraft gears.

"Although our technology was bred from the DOD SBIR program, the aerospace and wind industries experience similar failure modes in the field, so this enabled us to embark on the project with the Department of Energy (DOE) on extending the life of wind turbine drivetrains," says Ward Thomas, President and CEO of Sentient Science.

Sentient Science's DigitalClone computational testing software is being used to further validate the Adwen 8MW platform drive-train's design and standards

An overhead shot of the gearbox within a Clipper 2.5MW machine

A Phase II SBIR project with DOE began in 2008 and focused on wind turbine health monitoring systems. The goal of the SBIR was to achieve a 13% savings in revenue to make wind a sustainable source of energy. For the project, Sentient looked specifically at the root cause analysis of why the Clipper 2.5MW Liberty turbines were failing after just two years, when they were supposed to last twenty. Sentient simulated a digital model of the turbine to assess gearbox and bearing conditions and estimated potential repair needs to extend life. Sentient's finding helped Clipper operators recoup approximately $92 million in warranty claims across 732 units.

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WARD THOMAS
PRESIDENT & CEO

From there, Sentient did four additional years of validation testing prior to launching commercially in the wind industry in 2013.

Sentient's technology models the turbine by looking at the gearbox and key components, and calculates the earliest point in time that cracks initiate on bearings and gears. This allows operators to move from planned preventative maintenance to predictive health maintenance based on Sentient's lifing calculations. Life extension solutions are then recommended, such as part replacement schedules over 5 years, de-rating the turbines to reduce loading conditions, or assessing the impact of different oils or additives. This insight provides the operator with the information they need to create 24 month rolling O&M plans for better budgeting, to prevent major component failure and to extend asset life.

"Life" is the term Sentient uses for calculating options to extend the life of critical components and systems. Lifing can predict how long a gearbox will last and identify how much time a certain part has left, far in advance of sensor detection. The technology can test an unlimited amount of data points, and run those on high performance computers until cracks initiate and propagate in critical components. Physical tests limit the number of data points, and are extremely expensive. Computational testing complements physical testing by running 99% more data points to reduce the need and expense for hardware testing.

"Our goal is to help the operators achieve a $10/MWh savings based on an $80/MWh cost per turbine." Thomas says. "We help them achieve this through a number of ways, including asset life extension, reducing costs spent on planned and unplanned maintenance, reduced inventory carrying charges, and better risk management."

Today, Sentient has a global presence with 22,000 wind assets under contract in the North American, European and Chinese markets. Sentient helps them reduce the cost of energy by giving operators the capability to increase their uptower replacements by 10%-20% over 6 months to 5 years, which yields a 50% reduction in gearbox failure rates.

In Europe, Sentient has aligned with Adwen to help them design the largest wind turbine gearbox in the world. Adwen, the second largest offshore wind turbine manufacturer, is using Sentient Science's DigitalClone® software to validate the 8MW platform drivetrain's design and standards before major hardware testing. The goal is to make sure Adwen has picked the best suppliers and design options before committing to a final design.

Sentient still utilizes the SBIR program to tackle new endeavors, like its recent contract with the Navy to develop a reliability-centered design framework for additive manufacturing.

"There is not an industry standard on how to test additive manufacturing designs," says Thomas. "Our approach to computational testing of new materials could set the industry standard to qualify these parts, and that will be transformational in the use of additive manufacturing for the aerospace and defense industries."