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## Tech Watch

# Axiom aims to save fuel and increase durability in jet engines

By Rodney H. Brown

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With the recent news of Southwest Airlines canceling more than 600 flights due to fuselage cracks in certain jets within their fleet, a Gloucester company has timely technology to help keep one of the most vital parts of the passenger jet running longer and more efficiently — the engine.

Axiom Inc. is no Johnny-come-lately.

The firm was founded in 1983 as a company that sold measurement gauges, but in the past few years has focused on selling the software, tooling, proprietary assembly procedures, high-precision measurement gauges, training and service needed for precision, repeatable engine assembly processes that reduce vibration.

Surprisingly, at least to most people, very few manufacturers use such modern technology when assembling the engines, relying on experienced technicians using manual measurement tools and the assembly plans from the manufacturer, according to Donald W. Lohin, president and CEO of Axiom.

"It's ironic that in what most people think of as a high technology industry — aerospace — they are still using 1950s technology for the most part," he said.

According to Lohin, when the parts for a jet engine core are assembled, the technicians are given the specs for the maximum amount of "run out," that is the tiny amount of play to either side a part can have around the central shaft. By comparison, Axiom's process measures for the true rotational center of the assembled engine core and has it assembled based on that centerline, reducing the "run out" and thereby reducing vibration and increasing efficiency.

The benefit to the airline, beside the fuel consumption reduction and cost saving that results, is that the engine can have a longer "time on wing" — it can be used longer in flights before it has to be taken down and refurbished.

The secret sauce for Axiom is the mathematics in its predictive applications software, which determines that best assembly procedure based on the rotational center. The algorithm at the heart of the software was developed at MIT by Kamal Youcef-Toumi, the co-director of the Department of Mechanical Engineering at the Cambridge school.

The 12-employee company is seeing its greatest traction in the engine shops that do both the initial assembly work and the refurbishing — both contractor shops and internal shops for engine makers or airlines such as Delta.

"Delta Tech Ops, they are our largest commercial customer," Lohin said. "They use our assembly process on four out of their six engines and we are talking about their fifth engine. They are eager to move forward."

Other customers include Swiss International, which does much of the work on Airbus engines, and engine maker Pratt & Whitney, the aerospace and defense engine unit of Hartford, Conn.-based conglomerate United Technologies Corp. In fact, Swiss International recently sent Axiom an engine that was having troubles and had been to five engine shops already, with no clear answer to what was wrong. Within days, Axiom identified three major problems using their tools and software. Lohin said that Swiss International probably sent it

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along thinking that even Axiam would fail.

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"We find most of our customers have this attitude," he said. "Nobody wants to change the way they do it even if they have serious problems. People usually come to us after they have exhausted all alternatives and then we find the problem for them."

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Axiam sells its service based on the size of the engine, and how much of the engine it works on — just the engine core or the whole engine including the casing. For the engine core product for a large commercial engine it costs an engine shop about \$2 million to buy the whole setup, including software, tools setup and service. For smaller engines used in such craft as private jets the package is around \$500,000, Lohin said.

The market for Axiam is huge, as shown by the competition that is already in place from the engine makers themselves, which have discovered what IBM Corp. learned long ago — that service and support is where the money is.

"One of the little-known secrets of the aerospace worlds is that GE, Pratt & Whitney and Rolls Royce — all of them — have more revenue in service and support today than in selling new engines," Lohin said.

That, of course, also means that competition facing Axiam is also large and well-funded. General Electric Co., for example, does about 15 percent of all the engine assembly and refurbishing in the world at this point, Lohin said. While Lohin doesn't see any of the big engine makers seeking to acquire them to eliminate competition, he does think an acquisition by a large independent engine shop might be in the future.

"For the right price we could be bought and we feel that at some point someone will do this," he said.

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