PIECE BY PIECE

An SBIR-supported modeling tool keeps aircraft fleets running smooth

In the 1960s, the Air Force, in conjunction with RAND Corporation, developed a digital modeling technology that could assess the capabilities of large aircraft fleets and allow the fleets to maintain their operations in an efficient manner. The original Logistics Composite Model (LCOM) was created using an early binary programming language. Decades later, while the core of LCOM was still working well, the user interface and setup were badly outdated. Updating and rehosting the model was going to be a huge undertaking for the U.S government.

Looking for a solution, the Department of Defense (DoD) went to the Small Business Innovation Research (SBIR) program. Frontier Technology, Inc. (FTI), an aerospace and defense company based in Dayton, Ohio, was awarded a contract to evolve the LCOM model and build it into an assessment tool kit (ATK).

To understand the complexity of the evolved technology, D.C. Conroy, Vice President of FTI, boils it down into terms analogous to bicycle repair. “If you were to apply the model to a complicated bicycle, it would help you understand what type of tools and spares and skills you would need to repair it,” he said. “Imagine if you have a quick release on your flat tire, it’s very easy to get that tire off and repair it. If you don’t have quick release, however, you need wrenches and it

take a lot more time. If you have a flat tire on the back and there are six different sprockets back there, that adds a whole new layer of complexity where you might need to remove the chain or other parts to fix it. That gives you an idea of how LCOM ATK helps us model the repair system, along with the time and skills needed to make those repairs."

In DoD applications, the model works in a similar way. A fleet of aircraft might run smoothly in California where the 70-degree temperatures provides a benign environment. But once the aircraft system is deployed overseas to a hot, windy, sandy climate, the reliability curve changes, becoming less predictable and interfering with the number of overall mission flights, or sortie generation rate. Certain environments also introduce corrosion impacts.

"If you had 21 aircraft operating in that new environment, some of those aircraft will become less mission-ready and that will impact the overall readiness of the mission," Conroy said. "In a worst-case scenario, the operational guys might cannibalize one of the other aircrafts for spare parts. We've seen it happen where we weren't able to predict accurately what spare parts were needed. The LCOM model makes sure you have the right number of spares in the right place with the right skills to make the repairs so that you maintain your sortie generation rate at the needed level."

The LCOM ATK models the different parts, the reliability of the system and the failure modes of the system. In other words, it predicts what is going to break. "So, we can start to ask the question: 'If we know the system is going to break in these particular ways, what type of skills and expertise will the government need to repair the system and how will long will it take to get the system back to operational?'" Conroy said.

FTI's LCOM ATK technology can support data from a number of sources and integrate it with a variety of tools, providing a clearer picture of performance, affordability, and logistics, improving the war-readiness of operational systems. In the beginning, however, handling the data was no walk in the park.

The resulting technology, as supported by the SBIR program, has transitioned to use across DoD.

"Any model is constrained by how difficult it is to get data into the model," Conroy said. "For LCOM it was very difficult to format the data and set up a run with all the initialization parameters and assumptions required."

In addition to streamlining their data, FTI developed other tools under SBIR that can be used separately from LCOM but are best used in synthesis. To take one example, the Integrated Sustainment Wargaming Analysis Toolkit (ISWAT) is used by Warfighters during war games wherein simulated scenarios prepare warfighters for real life.

"ISWAT brought logistics realism into war gaming for the first time," said Greg Boughton of the Air Force Life Cycle Management Center. "In war games,

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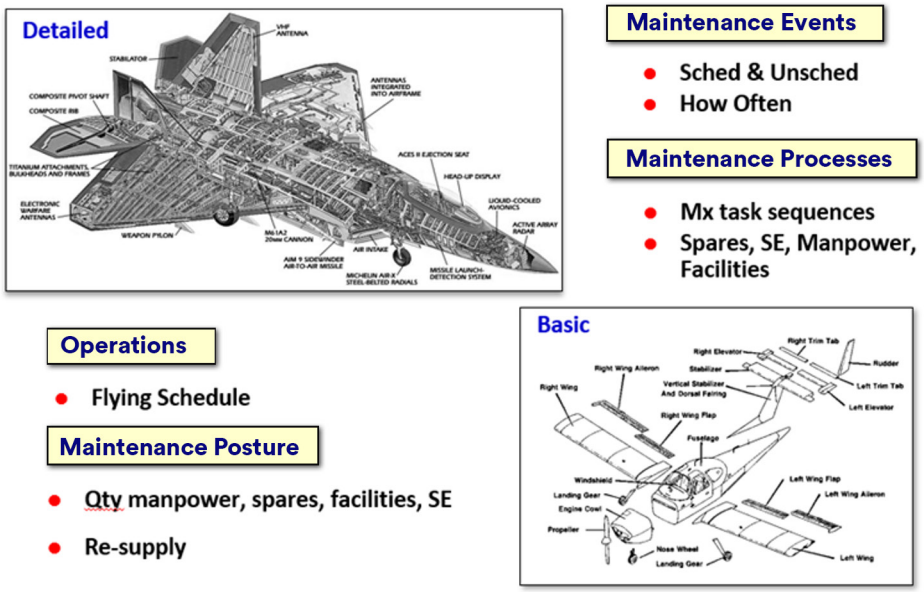

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we look at the aspirational aspects of scenarios but we forget that it takes fuel and parts and repairs in order to get things to operate the way they are supposed to.

"Technically, you might be able to fly 10 two-hour missions in a day. But logistics realism would say, no that's impossible," Boughton added. "You cannot physically do that because it takes time to recover your airplanes on the ground. Things break. And so, while 100 percent of your aircraft might return, not all of them are going to be able to go back up because some of them will have to be repaired or need an engine change."

ISWAT integrated such logistics into a dashboard. The players themselves can see when they don't have spare parts, and it forces critical thinking---the kind that would be highly beneficial and even lifesaving in real war scenarios.

FTI's work has led to additional research into decision support—not just trying to maintain a sortie generation rate but also trying to understand courses of action. Phase 2 of the SBIR saw the integration of other tools, such as cost estimation and risk analysis utilities. LCOM is the core technology that deals with logistics, reliability, maintainability and supportability, but Phase 2 focused on getting all of these tools to communicate with each so warfighters could figure out, for instance, how much it actually costs to support the equipment they wanted to buy based on a lifecycle analysis.

"As additional funding was added to the contract, we were able to show prototypes of how these tools worked together," Conroy said. "LCOM was the core super technology but the other technologies were leveraged as we transitioned into the Phase 3 of the SBIR. You can use these tools separately but their combined value is where the technology becomes significant."

The resulting technology, as supported by the SBIR program, has transitioned to use across DoD. The system has been used by the Army, Navy, Air Force, Marine Corps, Special Operations Command, Missile Defense Agency and more.

Boughton now talks about SBIR in glowing terms. "The fact that the SBIR program involves small businesses that are motivated to solve problems and prove their value makes it easier for the company and DoD to work together on innovative technologies in a successful way."

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