

Northrop Grumman Integrated Systems Implements a Process and Estimation Tool to Ensure Engineers Are Prepared for Joint Strike Fighter Production

Northrop Grumman, F-35 Joint Strike Fighter (JSF) program

Under the F-35 Joint Strike Fighter (JSF) program, the world's leading aerospace companies have partnered to deliver the most advanced family of combat aircraft ever built. Lockheed Martin Corporation was selected to build more than 3,000 of the stealthy, supersonic aircraft for the U.S. Air Force, Navy and Marine Corps, as well as the United Kingdom's Royal Air Force and Navy. The F-35 Systems Development and Demonstration (SDD) program, in particular, raises the bar of technical challenges higher than that of any aircraft program in history. Yet the F-35 team is hitting its milestones, finding the development challenges at this stage and getting it solved.

Northrop Grumman Corporation's Integrated Systems sector is one of two "tier one" partners (along with BAE Systems) on the Lockheed Martin team. Realizing several years ago that Northrop Grumman engineers would soon be facing an enormous task in the production of the F-35, Soumen Saha, Northrop Grumman's F-35 Integrated Product Team (IPT) Lead for Affordability and Continuous Improvement and Mike Fisher, Manager of Operations Business Proposals, believed that Northrop Grumman's engineers should utilize a standardized tool to address the tasks of performing cost trade-offs, forecasting, creating job targets, setting standards, and much more. "We knew that standardizing on a tool would facilitate communication, keep everyone on the same page, and avoid a lot of conflicts." The time savings in communications alone could directly translate into substantial cost savings. But, "having the most versatile estimation tool for aerospace manufacturing at everyone's fingertips was where the real value was," said Saha.

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Choosing the right tool

The Composites Affordability Initiative (CAI) Team was established in 1996 by the Air Force Manufacturing Technology (ManTech) Division of the Air Force Research Laboratory (AFRL). When ManTech began CAI, its charter was to bring down the costs associated with the manufacture of composite structures, considered essential to high-performance aircraft advancement. Beginning in 1996, as a member of the CAI team, Saha led a government-industry

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cost team comprised of the Air Force Research Laboratory's Materials and Manufacturing Directorate, the Air Vehicles Directorate and the Office of Naval Research, along with prime aerospace contractors Northrop Grumman, Boeing, Lockheed Martin and General Electric. Initially, one of the participating companies planned on creating a new cost-estimating tool related to the development and fabrication of composite aircraft structures. However, the CAI team felt that Galorath Incorporated, a commercial software company, should develop a plug-in to its SEER-DFM (Design for Manufacturability) model as a majority of the features and functionality the team was looking for from a software perspective were already contained in SEER-DFM. In addition, being a commercial software product, it would be continuously updated and maintained. The CAI team collaborated to create a cost model that would be accepted across the aerospace industry as well as the Department of Defense.

The participating companies supplied process and cost data to develop industry accepted cost standards. Galorath utilized this data to develop specific modules describing the process steps, their variables and related costs. The resultant product provides a direct cost model including 25 existing and emerging composite fabrication and assembly processes, as well as some state-of-the-art metal processes such as high speed machining and Super Plastic Forming-w-Diffusion Bonding. This model was chosen as the direct cost module of the Composites Affordability Initiative Cost Analysis Tool (CAICAT) which encompasses the assessment of Indirect and Support costs. Because of ease of use and rapid response, it enables

increased trade studies which results in cost reductions by identifying the most affordable composite airframe structural concepts earlier in the design phase with greater dependability than previously possible.

“SEER-DFM with the CAI Plug-in is the heart of our cost evaluation on the F-35,” stated Saha.

“Assessments of cost for assembly and composite operations come out of the plug-in, and it provides the totalness and versatility that is required in aerospace engineering that was not available before.” Both Northrop Grumman and Lockheed Martin engineers for the F-35 program had established SEER-DFM as the “tool of

choice.” It is being used daily to perform trade studies and as an affordability tool.



JSF IEs Abby Norris (left) and Johanna Wonsowicz routinely work with SEER-DFM to support the Duct and Duct Mate work scope.

Convincing management

In 2001, Saha and Fisher initiated SEER-DFM-w-CAI Plug-in across all functions within Northrop Grumman Air Combat Systems (ACS) as a “Single Process Initiative” (SPI), for all manufacturing estimates. Toward the end of 2001, Northrop Grumman's Management Council, the Defense Contract Management Agency (DCMA) and the Department of Defense approved SEER-DFM. Northrop Grumman management determined that SEER-DFM should be used on all new programs where the greatest cost savings could be realized and incorporated into existing programs where possible. The F-35 program was the first program to go into full-scale production subsequent to the approval of the “Single Process Initiative.” The task now changed from tool selection to implementation.

Since its approval Saha has worked with the Industrial Engineering team for use of SEER-DFM as a standards determination tool. Saha felt that unless the tool was used by IE, the use of the tool would be limited and the benefits would be difficult to realize. Bill Parris, Industrial Engineering Manager at Northrop Grumman, is committed to implement the tool first on the F-35 program and then across all other programs under his jurisdiction by year-end. The next step shall be to migrate it to other business units within Integrated Systems. Parris was introduced to SEER-DFM in 2002 and became a super-user on the F-35 program, which convinced him that this was the right tool for Northrop Grumman & Industrial Engineering in the long run.

Rolling out and ramping up

There are nearly 50 people at Northrop Grumman responsible for conducting the day-to-day JSF production program activities. These responsibilities include establishing targets, determining and developing standards, manpower, scheduling, tooling requirements, facilities, proposals, trade studies, supply evaluations and procurement. This last responsibility, also referred to as “should cost,” was the first to see dramatic success with SEER-DFM. Traditionally, procurement solicits bids for jobs from various companies with the lowest price bidder meeting the technology standards receiving the job. With SEER-DFM, Northrop engineers determine how much the part should cost allowing the bidders to decide who could produce the part at that price. “It gives us back power, the power to know how much something is really worth,” states Saha. “Cost is what it really takes to make the product while price is what the customer is willing to pay. In the past, these two have not exactly matched up.”

Until the SPI was approved, six Northrop Grumman engineers used SEER for single point trades. “Using SEER-DFM in a production environment is a different beast,” says Saha. “We had to get 50-60 new ACS users up and running, using SEER-DFM daily, and that number will soon grow to 100. They all have different levels of manufacturing experience, which affects their ability to evaluate the software's output. In production everything must be consistent; have common directions.”

Jesse Patterson, F-35 IE supporting the Lower Assembly IPT, recognized that users were inconsistent in their application of the system. Thus, he initiated a series of user-group meetings to address software issues and application methodology. To date, the user group has met weekly over a period of six months, focusing on a different set of topics each week. Representatives from Galorath are often invited to share their expertise and answer questions. “This is a great way for users to obtain solutions to their software-related issues right from the source,” says Patterson. In addition to discussions on the use of the tool, user group sessions develop guidelines for consistent use across various programs and product lines. Protocols for data customization, storage and archiving are being defined and implemented. Full implementation in the production environment requires documentation of these guidelines and end-user education. Saha believes these guidelines will be invaluable when the Single Process Initiative is approved at the Integrated Systems sector level, allowing another 100 users to receive rapid training and education, which is required.

In order to rapidly achieve user proficiency with SEER-DFM, engineers at Northrop Grumman worked with Galorath technical personnel to cus-

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tomize the training curriculum to meet Northrop Grumman's goals.

Reaping the rewards Northrop Grumman engineers have experienced the benefits of using SEER-DFM. Currently, all data is stored on a central server. Therefore users can access each other's work without having to start at the beginning each time. "I had a relatively new user tell me the other day he had set up a trade study in SEER-DFM and was able to do 15 other trades that same day, whereas in the past, it would have taken him a day to do each one. He was thrilled," said Saha.

Efficiency is one of many features that newer users enjoy. Johanna Wonsowicz, F-35 IE for the Upper Assembly Duct Mate, has been using SEER-DFM for several months. She particularly likes the wide selection of standard reports that ship with the package as well as the ability to "easily create custom reports to draw out specific information when requested." Carmen Chang, F-35 IE on the Center Bay team, is able to import and export data between SEER-DFM and Excel because SEER-DFM is COM enabled. Additional benefits and efficiencies come from

the ease at which SEER-DFM could interface with other systems in use at Northrop Grumman, including Cognition Corporation's Enterprise Cost Management (ECM) software and Vistagy's Fibersim software.

Saha believes the tool enables Northrop Grumman to have greater consistency, efficiency, better competitive positioning, improved customer satisfaction with affordable products delivered on time. "With SEER-DFM we can respond quickly to a change in statement of work and improvements. Changes in this industry take place so fast; it's only with a tool like this that we're able to keep up."

Overall, Saha feels SEER-DFM with the CAI Plug-in will help ACS to achieve cost effective use of all their estimating resources and personnel, whether supporting proposal development, setting job targets or evaluating product enhancement for cost savings.

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