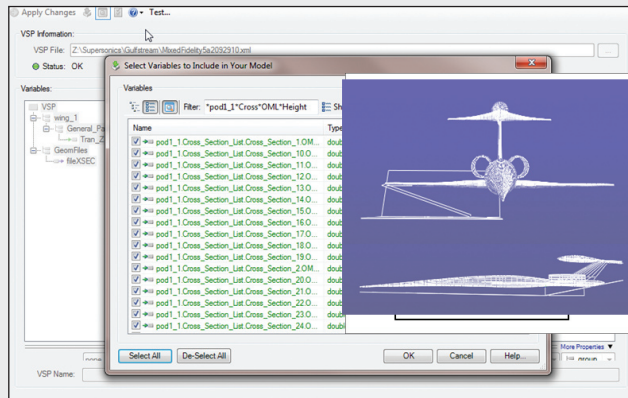


## NASA's ModelCenter® Environment Solves Challenges of Supersonic Transport Aircraft Design

### Challenge: Integration of Diverse, Multidisciplinary Analyses for Supersonic Aircraft Design



Supersonic transport aircraft pose extraordinary design challenges. Tight requirements on a low boom, low drag aircraft coupled with the desire to optimize efficiency, noise, range, and other factors create problems which are uniquely difficult at the conceptual design level. The Systems and Analysis branch of NASA's Langley Research Center recognized that solving these problems requires the integration of diverse and multidisciplinary analyses, from propulsion to noise to aerodynamics.<sup>1</sup> In addition, the design process needs the ability to switch between low-fidelity and high-fidelity computations depending on the specific problem being solved and the maturity of the design within the process.

### Solution: Integrated Design Environment Built with ModelCenter's Process Modeling Mode

To address the problems posed by supersonic transport aircraft design, NASA Langley used ModelCenter's process modeling mode to build an integrated design environment. ModelCenter provided a framework with parallel execution paths and logical constructs to easily switch between low-fidelity and low-fidelity analyses. Entire analyses can be skipped if not needed in a calculation and new paths can be added for revised design codes and modeling approaches. The modeling environment consists of integrated sub-models. Propulsion system calculations use codes such as NPSS (Numerical Propulsion System Simulation) and WATE++ (Weight Analysis). Geometry uses Vehicle Sketch Pad, a NASA-developed parametric geometry engine via a ModelCenter plug-in for attributes such as wing-camber surface design and low-boom design based on target equivalent areas (Ae method). Aerodynamic analysis can use either low-fidelity or high fidelity (CFD) methodology. There are models for low and high-fidelity sonic boom analysis; multi-tiered performance analysis using Breguet range calculations for evaluations at takeoff, transonic conditions, and supersonic cruise; and for

community noise analysis using ANOPP (Aircraft Noise Prediction Program). A low-fidelity structural analysis using NASTRAN is also being added to the integrated environment.

### Benefit: An Advanced and Flexible Design Environment for Supersonic Aircraft

Using ModelCenter, NASA put into place a framework for supersonic aircraft design to better understand the design space, optimize design from among multiple alternatives, and quickly advance design concepts at the conceptual stage. This solution proved its capabilities through various optimization studies on propulsion system and planform design using Boeing's Design Explorer algorithm, gradient optimizers, and Darwin (a genetic algorithm). These algorithms, currently within ModelCenter, are being supplemented with many more along with a framework to enable the introduction of user-based algorithms.

<sup>1</sup> Geiselhart, K.A., Ozoroski, L.P., Fenbert, J.W., Shields, E.W., and Li, W., "Integration of Multifidelity Multidisciplinary Computer Codes for Design and Analysis of Supersonic Aircraft", 49th AIAA Aerospace Sciences Meeting Including the New Horizons Forum and Aerospace Exposition (AIAA 2011-465), Orlando, FL, 4-7 January, 2011.