Production | Aerospace and defense | Improved process performance | Linear / Non-Linear

Application of Novel Additive Manufacturing Techniques for Cost Reduction in Space Launch Vehicles

BLUE ORIGIN

BUSINESS PROBLEM

The upcoming space launch vehicles, like Blue Origin's New Glenn and Boeing's SLS, will be some of the largest ever built. As a result, many parts are large, expensive, hard to manufacture, and hard to transport. To remain competitive, a major challenge for these programs is to identify manufacturing capabilities that could decrease cost, improve schedule, and/or reduce supply chain risk. New technologies presented to the industry require aerospace companies to decide to invest in the technology to bring it up to aerospace quality standards or to teach an existing aerospace supplier the new technology.

APPROACH

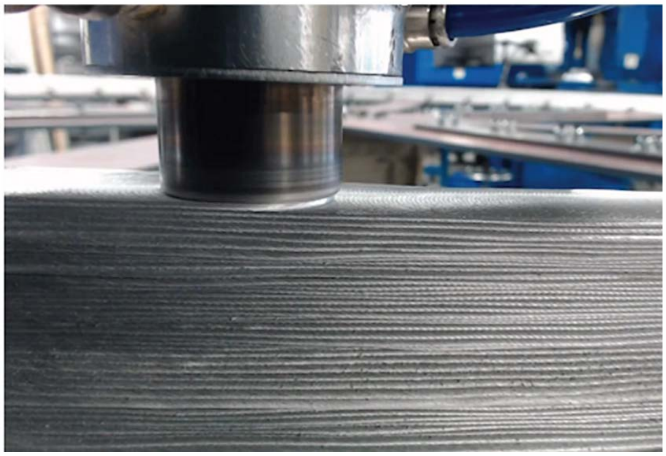
This project evaluated the suitability of Additive Friction Stir Deposition (AFSD). The approach is to first compare the current state to application requirements and identify development risks. Then, the costs and benefits are weighed in a financial analysis. With both in hand, a judgement can be made about whether the potential benefits justify the risks.

DATA SOURCES

Publicly available research on the new technology, additional information from a supplier, and data about the baseline production system.

Data Types and Format

Isolated data points



Author: Tommy Johanson

IMPACT

Additive Friction Stir Deposition (AFSD) builds upon the foundation of Friction Stir Welding (FSW) to expand the manufacturing to new geometries and in new places. Today AFSD is immature, but if the lessons of similar technologies are heeded and the applications are carefully chosen, the potential of this technology for the aerospace industry is significant. The project showed that AFSD can provide a worthwhile return if material property benchmarks can be met. As a result, the recommendation is to proceed with low-cost risk reduction activities that are targeted to these benchmarks.

DRIVERS	Other additive manufacturing methods have had a substantial impact on the business and industry. However, the limitations of these methods meant they were not suitable for large parts of the production process. AFSD addressed some of those limitations but had not been previously investigated.
BARRIERS	The main barrier was funding for additional investigation. R&D is focused on low maturity technology but is more funding constrained and has a long planning cycle. Production funding was more readily available but focused on shorter timelines and higher maturity levels than those required to develop a new technology.
ENABLERS	Flexible working environment: Blue adapted well in response to COVID. I safely toured the main facilities then transited to remote work as conditions warranted. It was apparent remote work was effective for much of the organization, which reduced onsite density for those working on hardware. Supportive culture: Stakeholders across the organization were willing to assist with their time. This was particularly useful for working across silos.
ACTIONS ➡	We conducted a detailed literature review, discussed the technology with inside and outside subject matter expects, and evaluated the Manufacturing Readiness Level (MRL). This led to a risk assessment and phased development plan. We also made a detailed financial analysis for the production fo an existing part.
INNOVATION	Analyses predominantly focused on technical development or financial return, but rarely paired the two due to the focus of separate business units. This work combined both to look at the performance and finances of a low-maturity manufacturing technology.
IMPROVEMENT	The prediction was that the significant cost reduction in material waste would offset development costs if certain performance benchmarks were met. Those performance benchmarks were prioritized as early risk reduction activities.
BEST PRACTICES	Find everyone in the organization with relevant expertise. Get a minimum viable product out quickly to get feedback from all stakeholders. Keep tabs on how far internal products drift from the thesis.
OTHER APPLICATIONS	• Production/prototyping other large aluminum parts • Repair/reinforcement of damaged aluminum parts • Medium-large titanium parts