



Aerospace

Ready for Flight: Additive Manufacturing Technology in Aerospace

Kip Hanson | Feb 04, 2020

Aerospace shops, commercial and in the government, are leaning into additive manufacturing. We look at why and also how all parts shops can prepare for a future that incorporates 3D printing on the shop floor.

Of all the additively manufactured parts produced each day, those made for the aerospace industry may be having the most significant production impact. Why? Additive manufacturing, or 3D printing, is a relatively expensive process, and is therefore easier to justify in a market where the stakes are, literally, quite high.

At the same time, the aerospace industry stands to gain the most from lightweight yet strong components. And as notable examples have shown over the past few years, the ability to combine what would otherwise be dozens of separate components into a single, 3D-printable part not only reduces downstream machining and assembly costs but simplifies the supply chain as well.

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Patrick Dunne

Vice President of Advanced Application Development, 3D Systems Inc.

The Potential Advantages of Additive Manufacturing in Aerospace

Even so, 3D printing remains a relative newcomer to the manufacturing world. Questions remain about material integrity, part inspection and certification costs.

Aerospace designers and engineers grapple with optimizing products for a process with virtually unlimited design freedom, while shops everywhere wonder: Is this for us?

Christopher Barrett thinks it very well could be. The president and founder of consulting firm 3DDirections, Barrett works with machine shops and others considering an investment in 3D printing

equipment. For one current project, he's working with the U.S. Air Force to study the viability of 3D printing versus traditional manufacturing.

"This is part of MAMLS [Maturation of Advanced Manufacturing for Low-Cost Sustainment], a program funded by the Air Force Research Laboratory," he explains. "Together with an America Makes team, they are evaluating a series of parts currently being used on aircraft, asking the question, 'What does it take to qualify these components for 3D printing?' My role is to help evaluate the costs compared to traditional manufacturing processes."

Learn how an aerospace startup successfully deployed additive manufacturing in our article "How to Take a 3D Printed Part to Market in Aerospace."

Aerospace's 3D Printing Challenge: Recertification of the Manufacturing Process by the FAA

Cost is actually a small part of the equation in aerospace, Barrett says. In most instances, the best way to leverage 3D printing's enormous capabilities is to design parts specifically for the layer-by-layer manufacturing process, something that is next to impossible to do with legacy components.

"The problem here is the requalification process," he says. "How much the part costs or how quickly it can be delivered is somewhat irrelevant if you have to go back to the Federal Aviation Administration for certification because you changed the design or deviated from an approved manufacturing process."

Despite this, interest in additive manufacturing remains high, especially within the military. Think about it, Barrett says: The ability to 3D print aircraft replacement parts on a ship at sea or parachute a 3D printer into remote areas to help with the repair of damaged equipment offers significant advantages.

For these and other reasons, the Navy and the Army are each evaluating what it would take to make such scenarios a reality. "Part qualification becomes less of a concern in these situations because the primary goal is to get the aircraft or tank—or whatever—up and running again as safely and quickly as possible, something that 3D printing is very good at," Barrett says.

How Additive Manufacturing Streamlines Legacy Machining Processes

Although recertification might make the 3D printing of legacy parts too costly or time-consuming, that doesn't mean additive technology has no role in this environment, adds Patrick Dunne, vice president of advanced application development for *3D Systems Inc.* That's because additive can be used indirectly to produce "sacrificial patterns" for metal investment casting workflows, something that 3D Systems has been doing for more than three decades.

Rather than spending tens of thousands of dollars tooling up for a hard-to-source replacement legacy part and then waiting months for its delivery, a damaged aerospace component can simply be scanned, printed as a pattern, and a new part investment cast within days, for a fraction of the cost.

Because it's still the original design, the same alloy and the manufacturing process remain unchanged. That means there's no need for a new certification process.

This is clearly a game-changer for the segment of the aerospace industry. But what about new aircraft? Satellites? Drones and spacecraft? Just look up, suggests Dunne.

"There are hundreds of different 3D-printed aerospace parts in use today," he says. "These include fuel injectors in rocket engines, environmental control systems for fighter aircraft, brackets on satellites, turbine blades and structural components for commercial aircraft. If you saw the video from SpaceX,

where they completed the final test and certification for human flight, you might know that many of the components used in the SuperDraco rocket engines on that spacecraft were direct metal 3D-printed. It's become a standard method of producing highly optimized, complex components."

Learn Additive Manufacturing by Doing on the Shop Floor

There's a catch, however. Additive manufacturing won't become truly mainstream in the aerospace industry—or any industry, for that matter—until designers and manufacturers gain additional knowledge about 3D printing's strengths, its cost considerations and best practices, and its limitations, Dunne says.

"Just as with any new technology or tool, there's variation with respect to expertise and general know-how," he says. "Those who were early adopters are obviously much further along the curve, but that doesn't mean newcomers should avoid 3D printing, fearing they're too far behind. In fact, some of the best applications are coming from people completely new to the industry, who don't have any preconceived notions about how parts should be designed or manufactured."

It's precisely for this reason that aerospace shops should embrace additive manufacturing technology, even if they currently have little demand for 3D-printed parts, says Dave Veisz, vice president of engineering for **MakerBot**.

The typical factory floor presents countless applications for a 3D printer, all serving to make expensive machine tools and employees more efficient, he says.

Discover how 3D printing is gaining a foothold in manufacturing in our article "The Flexibility Additive Manufacturing Can Add to Your Future."

"Our parent company, Stratasys, is very active in the aerospace field, but MakerBot is more of a tool for shop use," he says. "For any part that requires machining or fabricating, there's a slew of assembly jigs, inspection gauging, workholding fixtures and robotic end-of-arm tooling needed to support manufacturing."

Forward-looking shops have realized that it's far faster and more cost-effective to 3D print these components, Veisz adds. There's also a lot of ***5S-type tooling*** that can be made, further increasing efficiency, as well as prototype parts. It will also play become part of broader adoption of the Internet of Industrial Things (IIoT).

"Our customer Jamco, for example, used one of our ***Method*** printers to produce some functional prototypes for an aerospace customer," he explains. "Another customer—All Axis Robotics—has been very successful at making custom machine parts with our equipment. You might not see the improvement opportunities made possible by 3D printing until you actually have a machine on your floor, but they're definitely out there."

Have you tried 3D printing on your shop floor? We would love to hear about what you have learned.

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