## 3D PRINTING IN THE AERONAUTIC SECTOR

2023

## AERONAUTIC 3D PRINTING APPLICATIONS



#### Prototyping

Prototyping is one of the most wellknown uses of 3D printing (even if enduse parts are gaining in popularity) and aeronautics was one of the first sectors to adopt the technologies for this purpose.



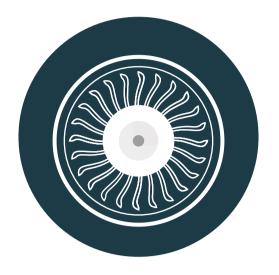
#### **Interior Design**

There are a number of examples of 3D printed parts in the interior of airplanes including ducting, vents, trim, door latch components, seat and arm rest caps and more.



#### Tools

The creation of 3D printed tools has long been known to speed up aircraft maintenance as well as to save valuable time and money.



#### Performance

From Boeing to Airbus, additive manufacturing is playing a large role in the optimization of engine turbines by improving strength to weight ratio for example turbine blades for jet engines which can spin at 2,500 times per minute.



#### Spare parts

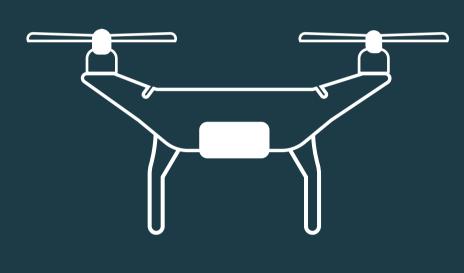
One of the key uses for 3D printing in aviation in particular is the creation of spare parts, especially for those that are no longer in circulation.



#### **Repairing parts**

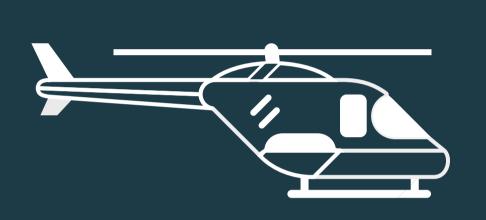
Technologies falling under the Directed Energy Deposition (DED) umbrella are often used to repair parts, notable examples include in aviation where it is faster and more effective to repair a metal part rather than create a new one.

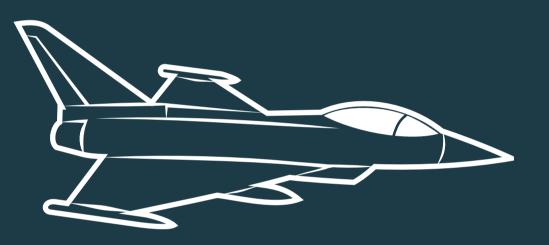
## DIFFERENT AIRBORNE VEHICLES



#### DRONE

The 3D printing revolution improves drones, boosting performance and flight duration. Airbus and the Joint Robotics Laboratory's 50% 3D printed Thor drone demonstrates this through enhanced efficiency, maneuverability, and adaptability for tasks like surveillance and search and rescue.





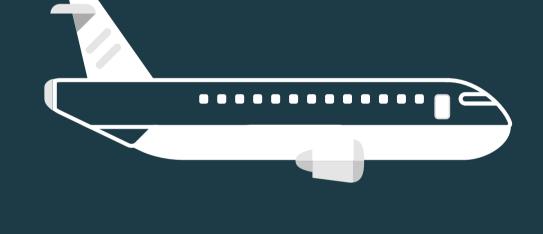
#### HELICOPTER

3D printing has drastically improved helicopter manufacturing, boosting performance and reducing production times and costs. Bell Helicopter's use of 3D printed components in the Bell 525 Relentless showcases how this technology enhances fuel efficiency, durability, and passenger comfort, leading to ongoing advancements in helicopter technology.

#### FIGHTER JET

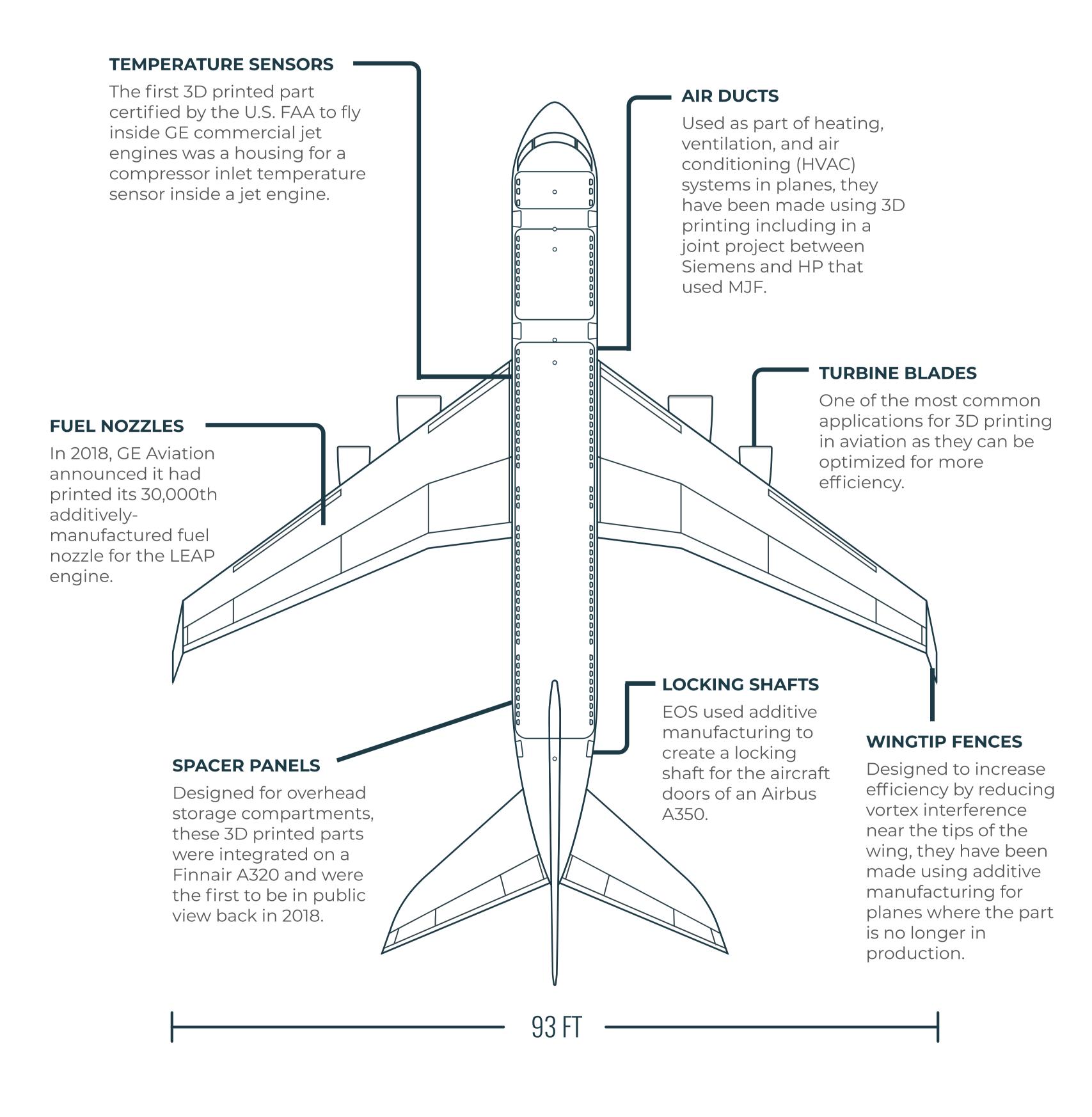
The United States Air Force (USAF) is at the forefront of leveraging 3D printing to improve military aircraft operations, evident in projects like the "Rapid Sustainment Office." Rapid production of replacement parts for aircraft like the F-22 Raptor and B-1B Lancer enhances operational readiness, significantly reducing downtime and costs while extending the service life of aging aircraft. Another example is the XB-1 from Boom Supersonic which included 21 3D printed parts, made by VELO3D.

#### COMMERCIAL PLANE



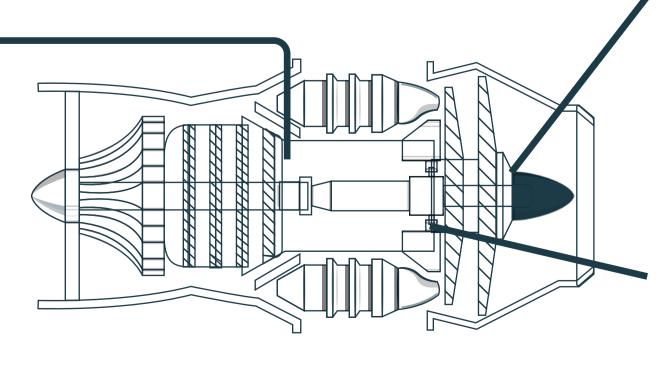
In the commercial aviation sector, 3D printing is widely employed for interior components, brackets, and engine parts. Notably, GE Aviation's collaboration with CFM International resulted in a 25% lighter and more fuel-efficient LEAP engine fuel nozzle, exemplifying the technology's potential to enhance aviation performance and sustainability, with implications extending to drone propulsion for more efficient and environmentally conscious unmanned aerial systems.

## **3D PRINTED PLANE PARTS**



#### HEAT EXCHANGERS

Additive manufacturing has enabled the creation of optimized heat exchangers including for the first time in the Cessna Denali single engine turboprop plane.



#### TAIL BEARING HOUSING

A 3D printed structure from ITP Aero which will be used as a connecting element between the engine and the plane.

#### **MOUNTING BRACKETS**

DMLS has been used to created structural, low-volume metal brackets to mount life-saving systems to the interior wall of a plane.

### **KEY FACTS & FIGURES ON 3D PRINTING IN THE AERONAUTICS INDUSTRY**



The expected worth of the global aeronautics 3D printing market by 2026.

(MARKETS AND MARKETS)

# 90%

Airbus's estimation of the cost savings that are possible on certain parts thanks to the use of additive manufacturing.



The reduction in weight of the 3D printed engine pylon and nacelle components in the Airbus THOR drone.



The assembly time necessary (down from 18 months) to create GE Aviation's LEAP engine fuel nozzle, produced using additive manufacturing and which was able to go from 20 parts to just one.

>300

The number of 3D printed parts included in the engines of the Boeing 777X airplane.

(BOEING)



The time needed for Airbus to re-certify and adapt 3D printed wingtip fence replacement parts for the A320ceo.



The amount that Boeing expect to save per plane thanks to the use of 3D printed parts in its 787s.



The length of the trim and drill tool used for Boeing's 777X commercial jet which at the time was the biggest solid 3D printed piece in the world.

(BOEING)

## TIMELINE

MID <b>1980</b>	Invention of Selective Laser Sintering (SLS) which would go on to be used in printing the first 3D printed aircraft and for other aeronautical applications.
2011	The University of Southampton creates and flies world's first 3D printed aircraft. The Southampton University Laser Sintered Aircraft (SULSA) was printed from wings to the integral control surface with laser sintering.
2015	'Thor' (Test of Hi-tech Objectives in Reality), the world's second 3D printed aircraft took flight for the first time in November. Its entire body was made by 3D printing except electrical engine parts.
2016	Boeing sets a Guinness World Record with a new "trim-and-drill" tool for the creation of the wings of the next-generation 777X jet. At the time, the tool was the largest solid object to be 3D printed in a single piece.
2017	Etihad Aviation Group becomes the first Middle Eastern airline to use a certified 3D printed aircraft interior monitor frame.
2018	Stratasys works with UAS developers Area-I on the creation of 3D printed fuel tank, ailerons, flaps and a control surface for an unmanned aircraft (the Prototype-Technology Evaluation and Research Aircraft (PTERA)).
2020	Honeywell Aerospace announces creation of the first certified, flight-critical engine part using additive manufacturing.
2021	Safran 3D prints a titanium nose landing gear component for use in a business jet.
2022	Optomec and US Air Force sign \$1.5 million contract to develop a metal AM system and process to enable the repair of oversized titanium components notably integrally bladed rotors (commonly referred to as "blisks").
2023	US Marines demonstrate 3D printing in-flight for the first time aboard a U.S. Marine Corps MV-22 Osprey tiltrotor aircraft.

