



# GE Additive

**CONCEPTLASER**

a GE Additive company

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**Arcam EBM**

a GE Additive company



**AP&C**

a GE Additive company

# Our ecosystem, built around our customers

## Machine modalities

- **Concept Laser**, Direct metal laser melting
- **Arcam EBM**, Electron beam melting

## AP&C Materials

- Advanced materials
- Powder supply
- Tested and validated

## Consultancy solutions

- AddWorks Materials Solutions
- AddWorks Disruptive Design Solutions
- AddWorks Industrialization

## Software

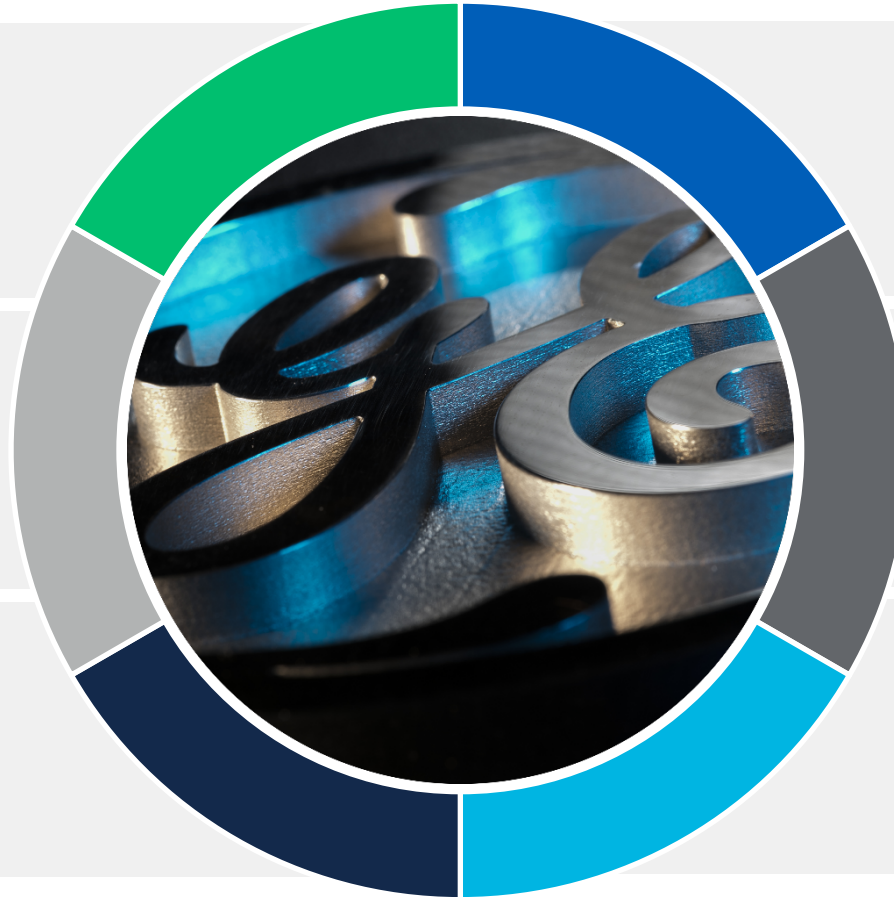
- Predix
- GeonX

## Customer Experience Centers

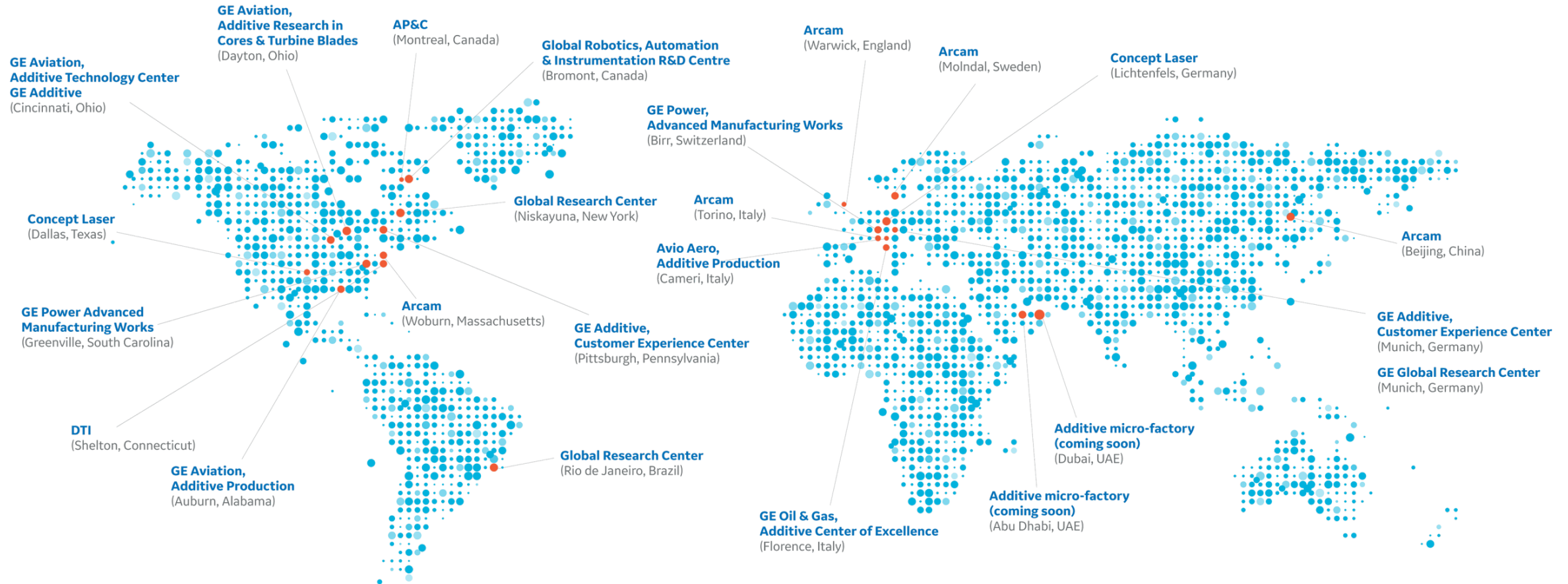
- Pittsburgh, PA
- Munich Germany

## GE partner companies

- Baker Hughes, a GE company, Non-Destructive Testing (NDT)
- GE Capital, Financing solutions
- GE Global Research
- GE Power, Uninterrupted Power Supply (UPS)



# Building a global network to support our customers



# Consumer barriers to adoption

- Where to start? Which parts/systems make sense?
- Difficulty developing a business case for A.M.
- Financial constraints
- Lack of **additive** design/material aptitude
- Do not have the ability / know-how to print parts
- Certification/qualification process know-how



# AddWorks™

## Disruptive design solutions

AddWorks™ helps your organization successfully navigate its additive journey.

- Identifies positive use cases (better performance and/or cost-reduction)
- Co-designs parts/introduces disruptive design
- Prints prototypes and small-run production
- Begins cultural transformation & training
- Develops adoption roadmap

[www.geadditive.com](http://www.geadditive.com)



# Direct Metal Laser Melting (DMLM)

- Machine types for every application
- Field of application from Rapid Prototyping up to integration in the production environment
- Build space from small (50 x 50 x 70 mm<sup>3</sup>) to large (800 x 400 x 500 mm<sup>3</sup>)
- Laser power of 100 watts up to multilaser solutions
- Supreme Quality in Mechanical Engineering
- Innovative Quality Monitoring Systems
- Safety and ease of use as top priority
  - Machine design in accordance to ATEX directives
  - Spatial separation of process and handling chamber

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**M Lab cusing 200R**



**M LINE FACTORY**



**M2 cusing Multilaser**



**X LINE 2000R**



# Electron Beam Melting (EBM)

- High power (3,000 W)
  - Allows for high melting capacity
  - High productivity
- No moving parts in the EB-gun
  - Extremely fast & accurate beam control
  - Power & focus continuously varied
  - Enables EBM MultiBeam™
- Vacuum process
  - Clean & controlled environment
  - Allows processing reactive materials
- Hot process (650 °C for titanium)
  - No residual stresses
  - No heat treatment
  - Faster melting



# What's next?

- Faster and bigger print machines
- Data Analytics, powered by **PREDIX**
- Materials development solutions
- Additional engineering and design solutions





# Additive Examples

# LEAP fuel nozzle tip\*

**30%**  
COST  
EFFICIENCY  
IMPROVEMENT

**95%**  
INVENTORY  
REDUCTION

**25%**  
WEIGHT  
REDUCTION

**20 → 1**  
PARTS

**5x** MORE  
DURABLE



Source: GE Aviation

\*LEAP is a trademark of CFM International, a 50/50 JV between GE and Safran Aircraft Engines.

Comparison versus TAPS fuel nozzle



# Bionic cabin bracket - Airbus A350 XWB

- Bionic and topology optimization
- Reduced material input and waste
- Reduction in manufacturing costs

**30%**  
WEIGHT  
REDUCTION

Up to **75%**  
COST &  
TIME  
SAVINGS



Project Partners: Laser Zentrum Nord, Airbus Operations,  
Concept Laser



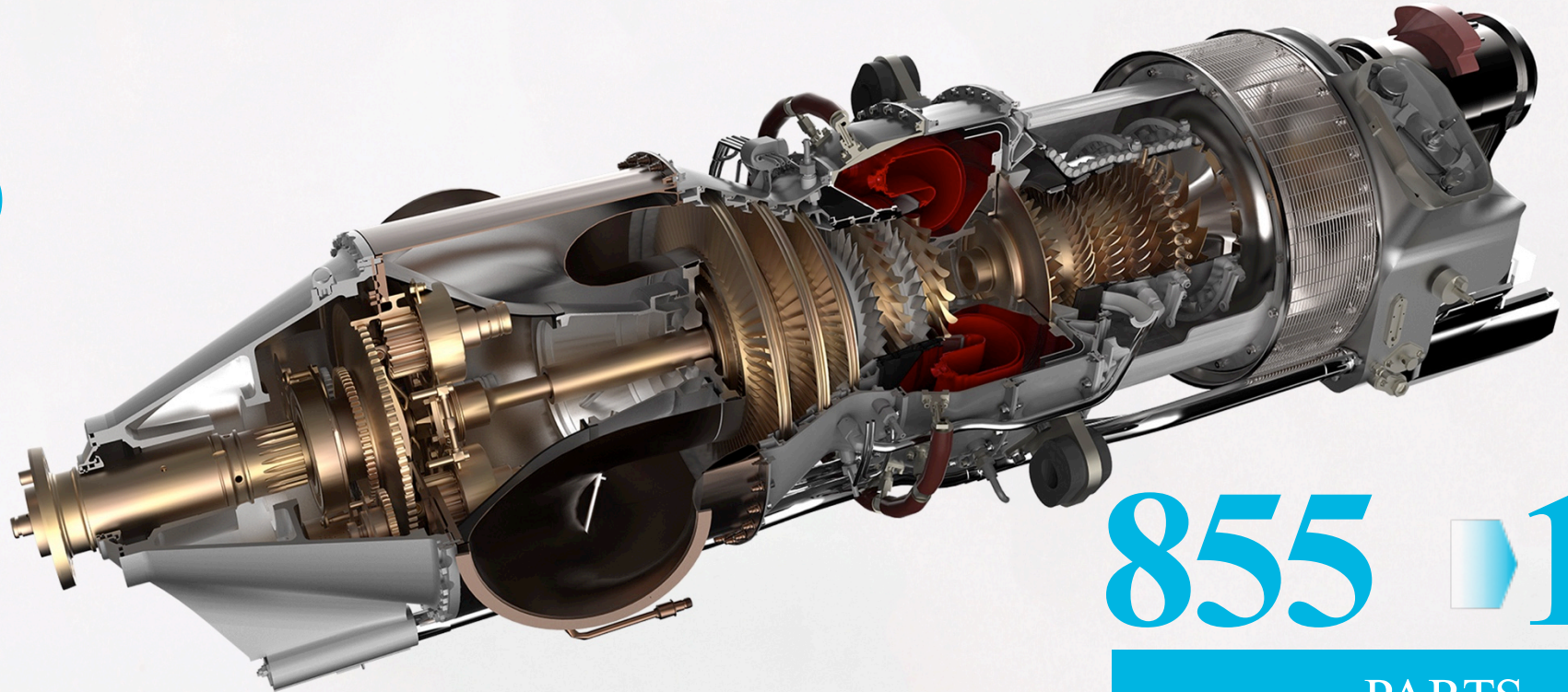
# Advanced Turboprop Engine

Combustor test schedule reduced  
from **12 months** to **6 months**

**5%**  
**WEIGHT**  
**REDUCTION**

**20%**  
**LOWER FUEL BURN**

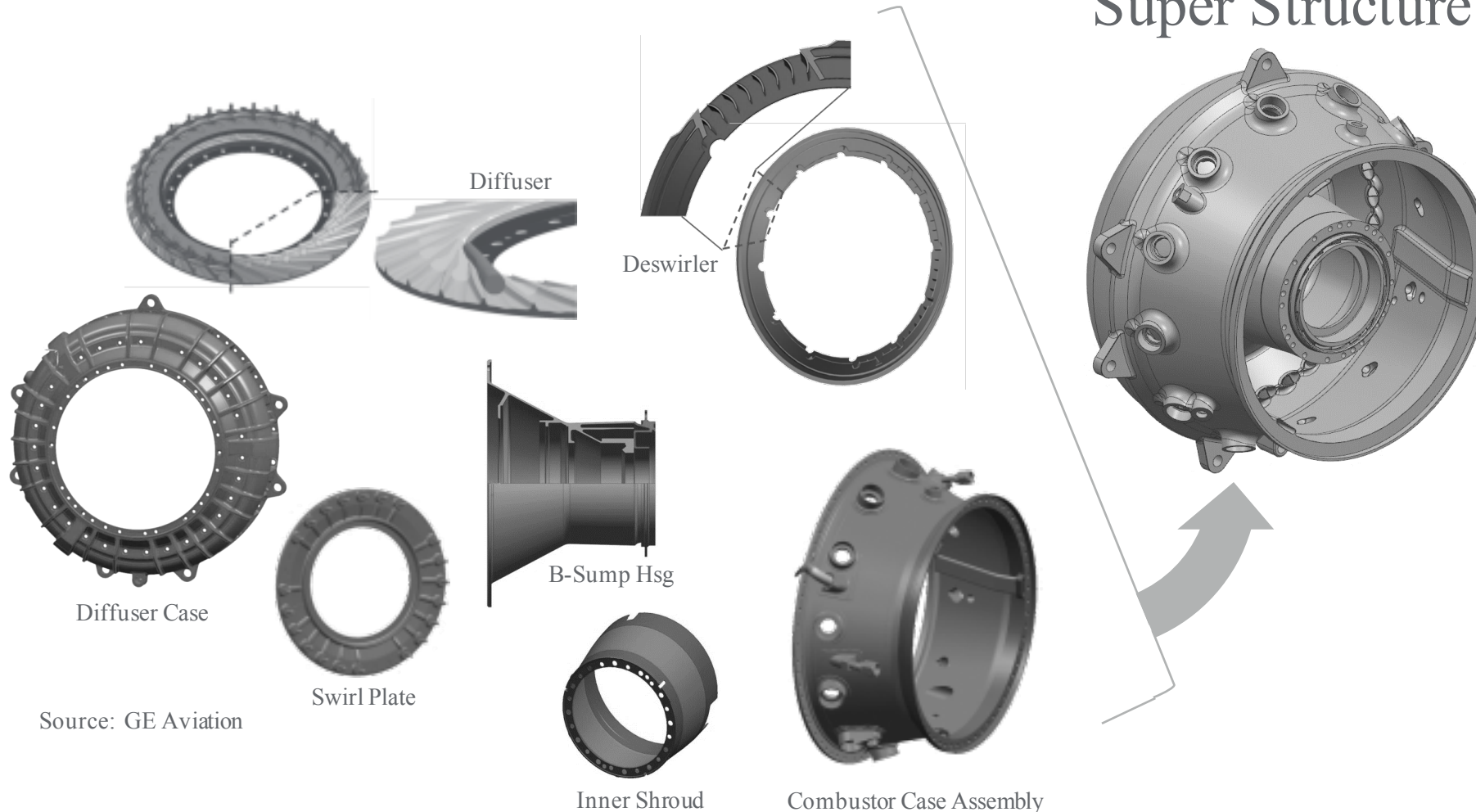
First engine test run complete,  
12/27/17



**855** **➔** **12**  
**PARTS**



# Supply Chain disruption



**10+lbs**

WEIGHT

REDUCTION

**300**  $\rightarrow$  **1**

PARTS

**7**  $\rightarrow$  **1**

ASSEMBLIES

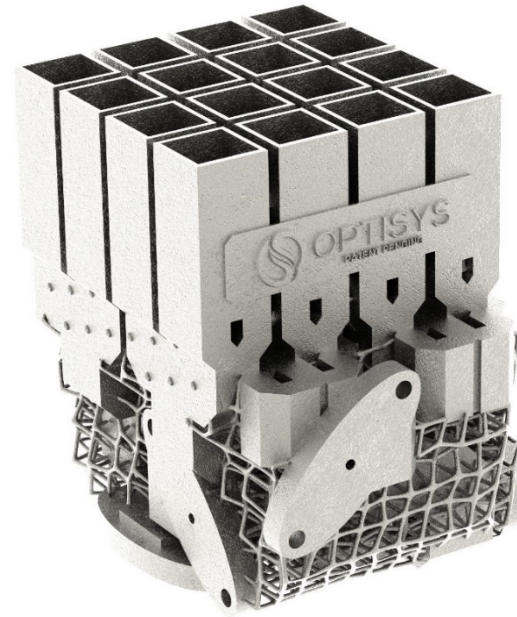
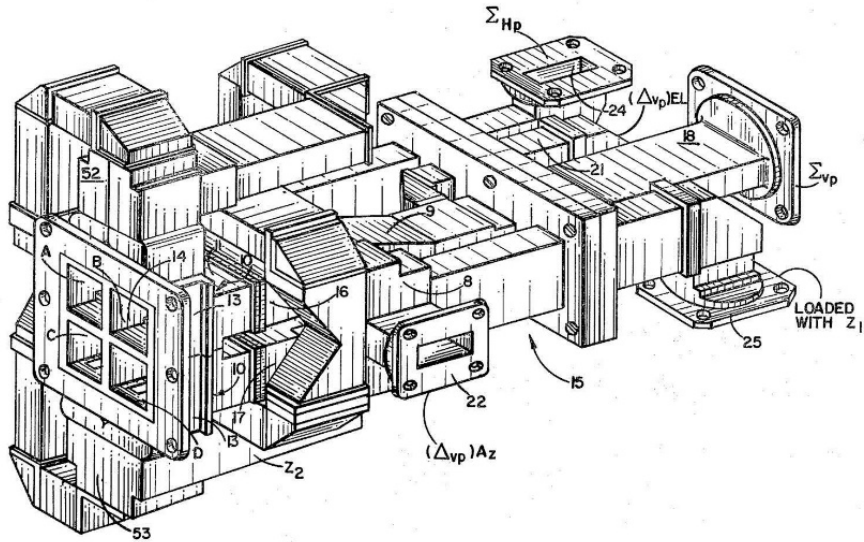
**50**  $\rightarrow$  **1**

SOURCES

Source: GE Aviation



# Reducing satellite antenna components from 100 parts to 1



**95%**  
WEIGHT  
REDUCTION

**11 → 2**  
MONTHS LEAD

**75%**  
REDUCTION  
NON  
RECURRING  
COSTS

“It’s easy to add features to an existing AM design, easier to assemble the finished components and, long-term, you have less testing, maintenance and service when you have fewer parts.” Rob Smith, COO, Optisys



