

GE-9X Demo Core Test Bed Engine Development

Challenge

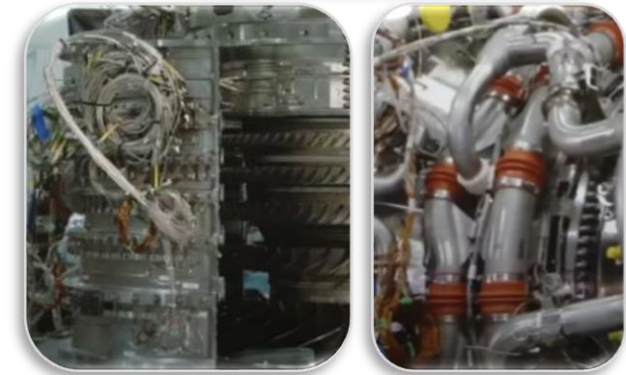
- Tight reschedule & budget
- New high temperature Material
- Complete Module Ownership – HPC & Engine External Module

Cross-Section Development
Hot2Cold Analysis
Rotor Thrust Balance
ANSYS, UG, VisMockup
Additive Manufacturing
Vibration Analysis

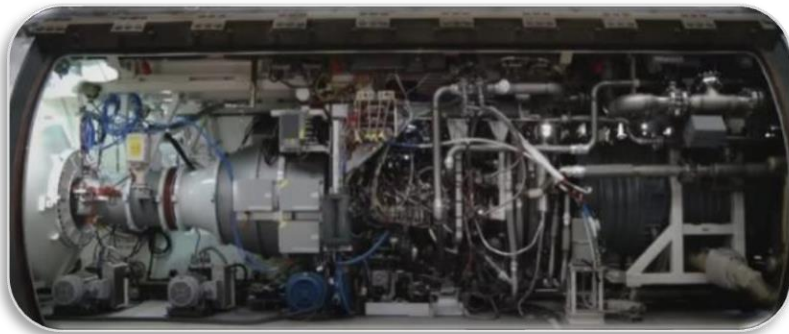


Solution

- Early Cross-Functional engagement
- Detailed Design of HPC & Engine External Module
- 250 + Parts, Mfg., Engine Test Monitoring
- Global Leadership Award (Out of 7 GE sites)



GE-9X Test Setup



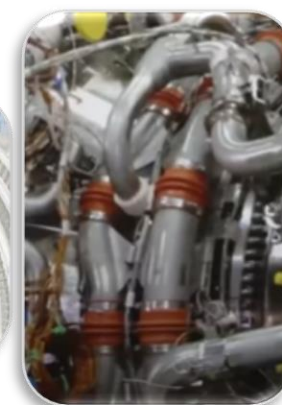
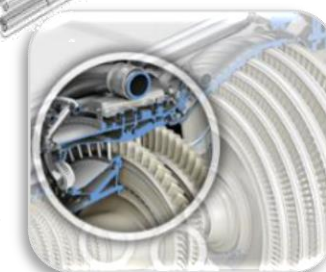
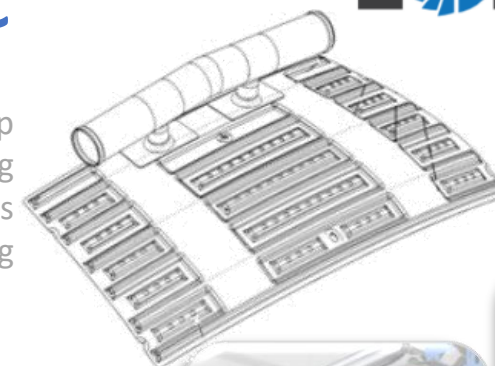
Benefits

- Delivered Hardware at **1/3** the cost of GENx Test Engine
- **\$3 M** Cost Avoidance to GE
- 3 Patents for GE

Concept to Completion - HPC & External Module Ownership

GE-9X FETT, SETT HPT & LPT ACC

ANSYS, UG, VisMockup
Additive Manufacturing
Vibration Analysis
Component Testing



Challenge

- Lesson learned from field failure
- High EGT
- Complete hardware Ownership

Solution

- Early engagement with Manufacturing shop
- Reduced 250 parts to 175 parts
- Eliminated tooling with 3D Printed hardware for FETT
- FAR33 Compliance rigor right from beginning
- Developed laser welding process (eliminated brazing)

Benefits

- **\$250K** Cost Avoidance to GE
- 2 Patents for GE

GE-9X Engine



Concept to Completion – HPT & LPT Active Clearance Control

GE Catalyst™ Engine NPI Development

Challenge

- Aggressive Weight & Cost Target
- No GE legacy Engine experience
- Engine Architect from clean sheet of paper

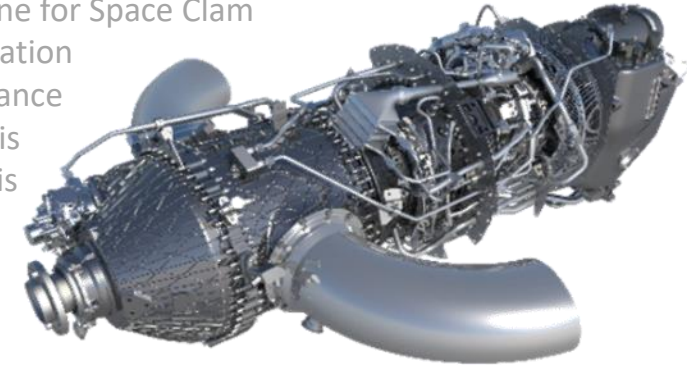
Solution

- Engine Architecture Concept Development
- Drove Weekly Airframe & Module Meetings
- FAR33 & FAR25 Compliance right from beginning
- Ownership of 300+ Parts, 9 Engine Test Monitoring

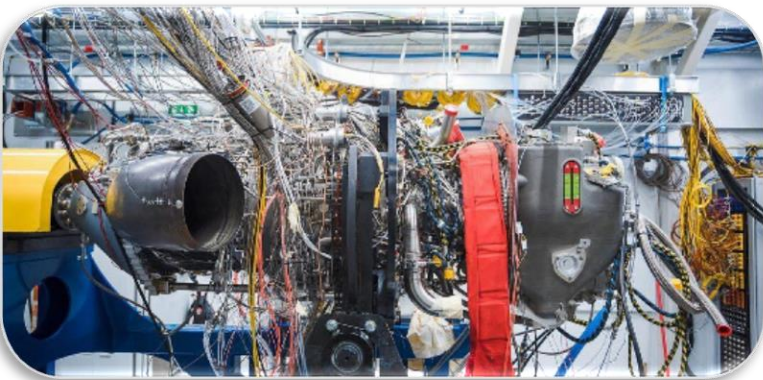
Benefits

- Delivered all test Engine with FTY ~ 1 & OTD ~ 100%
- \$6 M Cost Avoidance to GE
- 15 Patents & Publications for GE

3D Mockup Engine for Space Clam
Cycle Design iteration
Rotor Thrust Balance
Hot2Cold Analysis
Vibration Analysis
Maintainability
Additive Mfg.
Certification



GE Catalyst™



Concept to Completion – Engine Architecture

RR TRENT XWB Engine NPI

Challenge

- Aggressive Schedule
- New Global team & contractors
- HP & IP Module Ownership (no prior experience)
- New vendors

3D Mockup Engine for clearance Check
Vibration Analysis
Life assessment
GD&T, Drawings
Certification

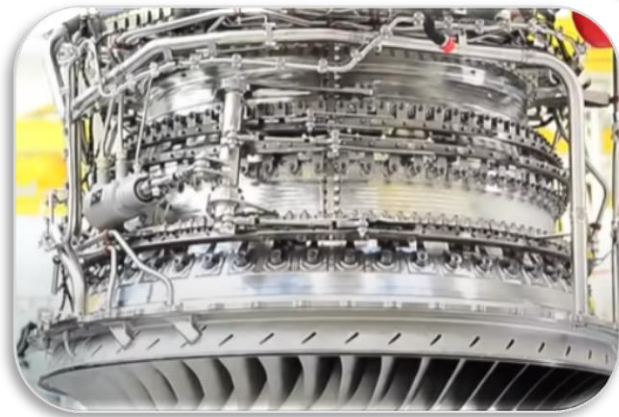


TRENT XWB TRF

Solution

- HP & IP Module Hardware Ownership
- FAR33 & FAR25 Compliance
- Ownership of >100 Parts and Mfg. processes
- Standardization of Utility hardware
- Part consolidation (from welded assembly of 10 parts to single casting)

TRENT XWB HPC



Benefits

- Delivered 100+ Drawings with FTY ~ 1 & OTD ~ 95%
- Developed 2 Productivity improvement Tools
- \$200K Cost Avoidance to RR

Detailed Design to Certification – HP & IP Module Static Parts

Engine Alliance GP7000 Certification

Challenge

- Restricted information access
- FAR33 Learning (Casings, Shaft, Frames)

Solution

- Legacy certification report study
- FAR33 Compliance
- Standardization Analysis processes
- Developed Analysis Quality checking tools

Vibration Analysis
Life assessment
Certification



Representative Images

GP7000 Engine



Benefits

- Delivered 5 certification with FTY ~ 1 & OTD ~ 100%
- Developed 10 Standard Analysis Practices
- \$100K Cost Avoidance to Engine Alliance

GP7000 FAR33 Compliance of 5 Major Hardware