GENERAL DYNAMICS

Gulfstream

3D Electronic Model Based Type Design

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Gulfstream

GULFSTREAM COMPANY OVERVIEW

Gulfstream®

A GENERAL DYNAMICS COMPANY

Gulfstream 50 Fifty Years Aviation Leadership

GENERAL DYNAMICS

Aerospace
$6.0 Billion

Leading market positions in Business Aviation and Aircraft Services, Land and Amphibious Combat Systems, Information Systems, and Shipbuilding and Marine Systems

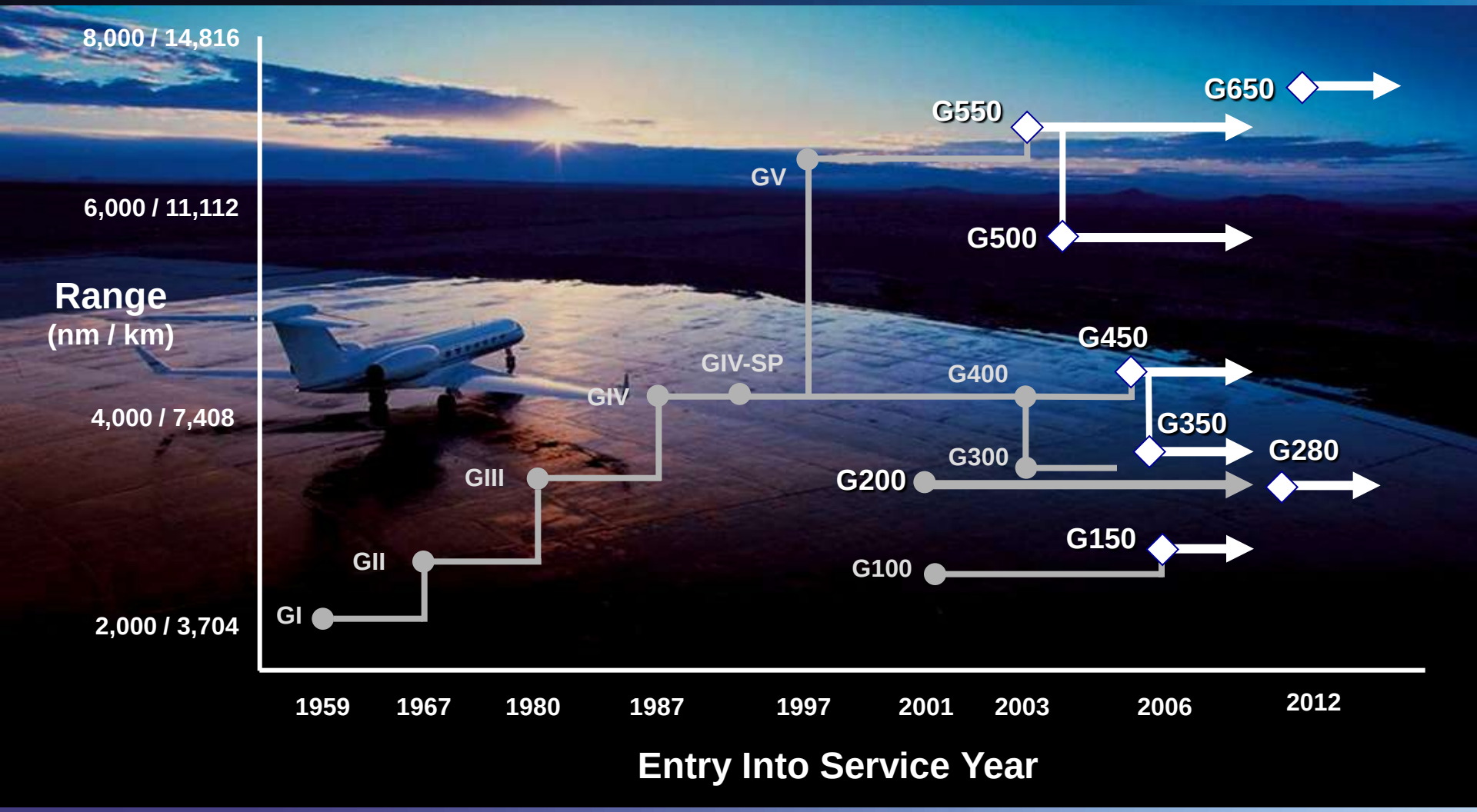
Our Business and Our Strategy

Gulfstream sets the World Standard in Business Aviation

50 years of satisfying the world's most demanding travelers with...

- **Performance & Operational Flexibility**
- **Comfort & In-Flight Productivity**
- **Safety & Security**
- **Reliability & Exceptional Quality**
- **Unmatched Product Support**

Gulfstream Product Evolution



Gulfstream Product Line

G150, G280 range with 4 passengers / G350 – G650 range with 8 passengers
G150 shown with optional Enhanced Vision System (EVS)

Gulfstream®

Gulfstream Current Manufacturing Facilities

Nearly 4.8 million total square footage with more than 11,500 employees

Long Beach, California

Completions

Paint/Stripping Facility

335,000 ft² (31,123 m²)

Mexicali, Mexico

Sub-Assembly

Support and Spares

335,000 ft² (31,123 m²)

Appleton, Wisconsin

Completions

Paint/Stripping Facility

275,200 ft² (25,567 m²)

Dallas, Texas

Completions

Paint/Stripping Facility

403,561 ft² (37,492 m²)

Savannah, Georgia

Corporate Headquarters

Major Assembly, Engineering, and Completions

Paint/Stripping Facility

3,181,074 ft² (295,531 m²)

Brunswick, Georgia

Completions

110,070 ft² (10,226 m²)

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3D Model Based Type Design (MBTD)

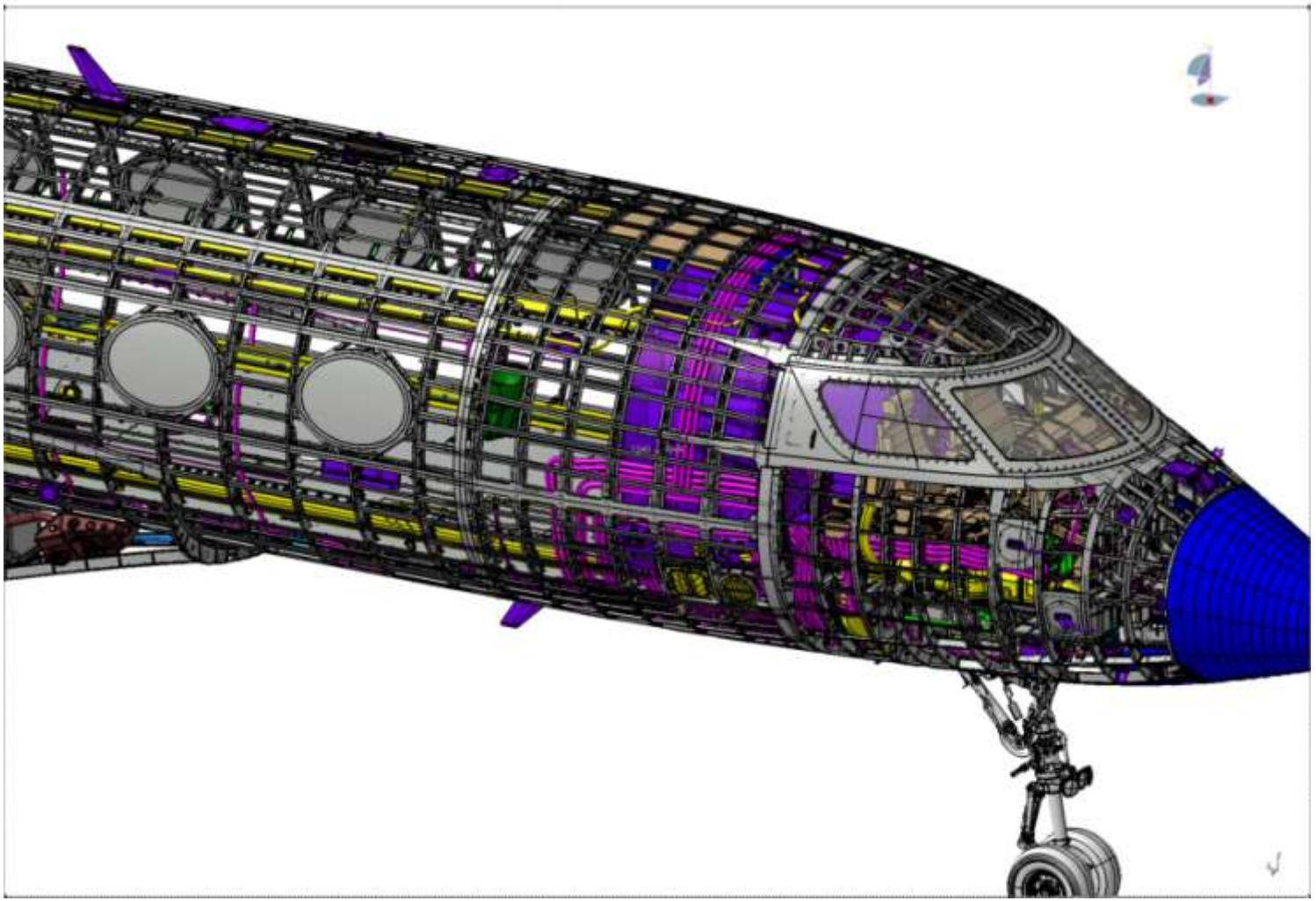
- Gulfstream's approach to outfitting an aircraft had historically been low volume, highly custom, hand built interiors
  - Relied on highly skilled craftsmen to interpret engineering drawings with limited content
- As sales increased, a significant change to the business model / process was needed to support higher volume production
- Developed and FAA-certified the industry's first, and currently only, electronic 3D MBTD system
- 3D MBTD approach used to design and manufacture our flagship product, the G650

What is 3D MBTD?

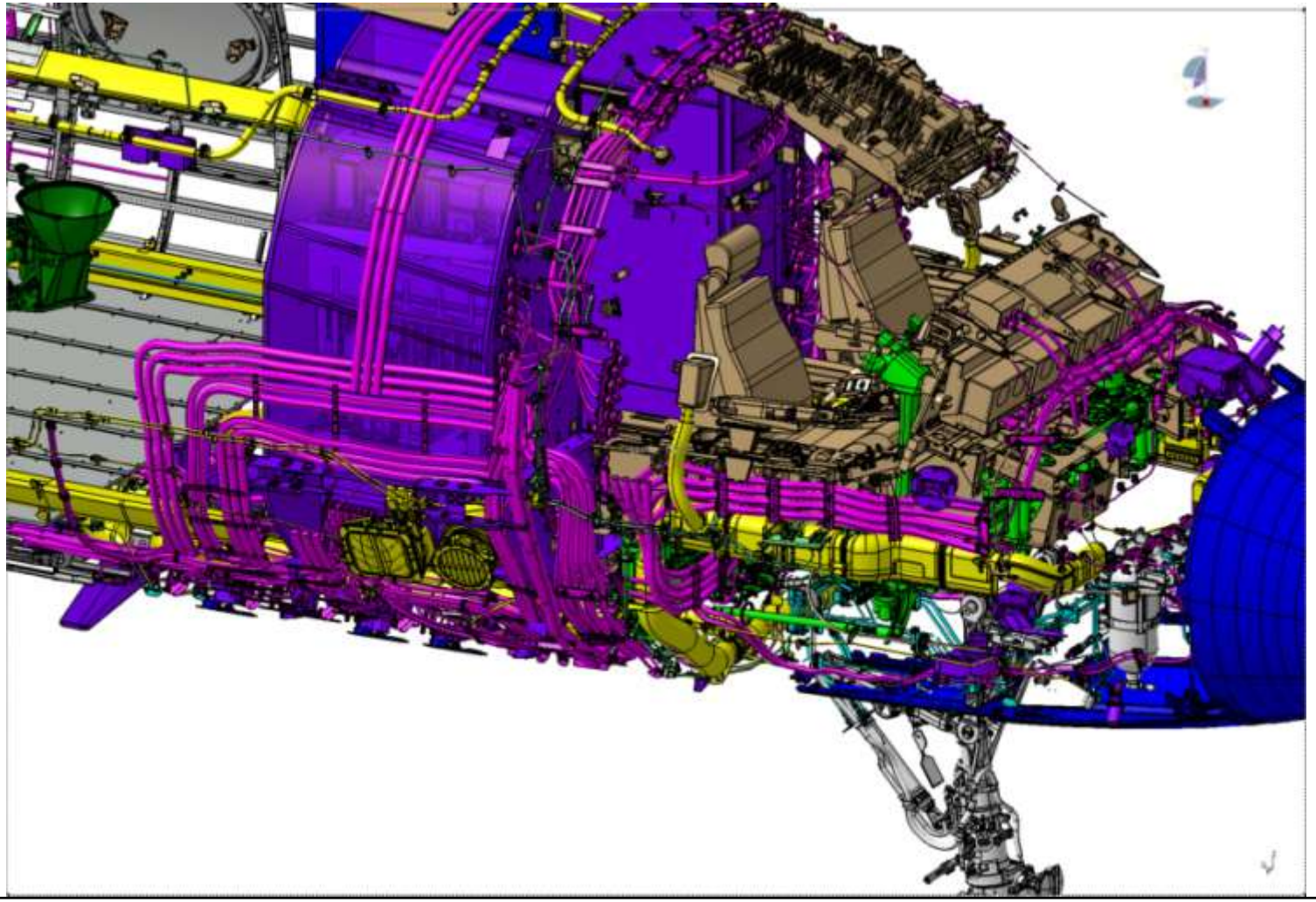
- True 3D electronic representation of the aircraft
  - Includes fasteners, hardware, veneer, hoses, etc.
- Deployed to all users in the process
  - Engineering, Manufacturing, Quality, Purchasing, Product Support, etc.
  - Supply Base
- Relies on geometry versus text
  - No dimensions on the models
  - Users interrogate models for relevant dimensional information

Eliminates paper, design ambiguity and many costs

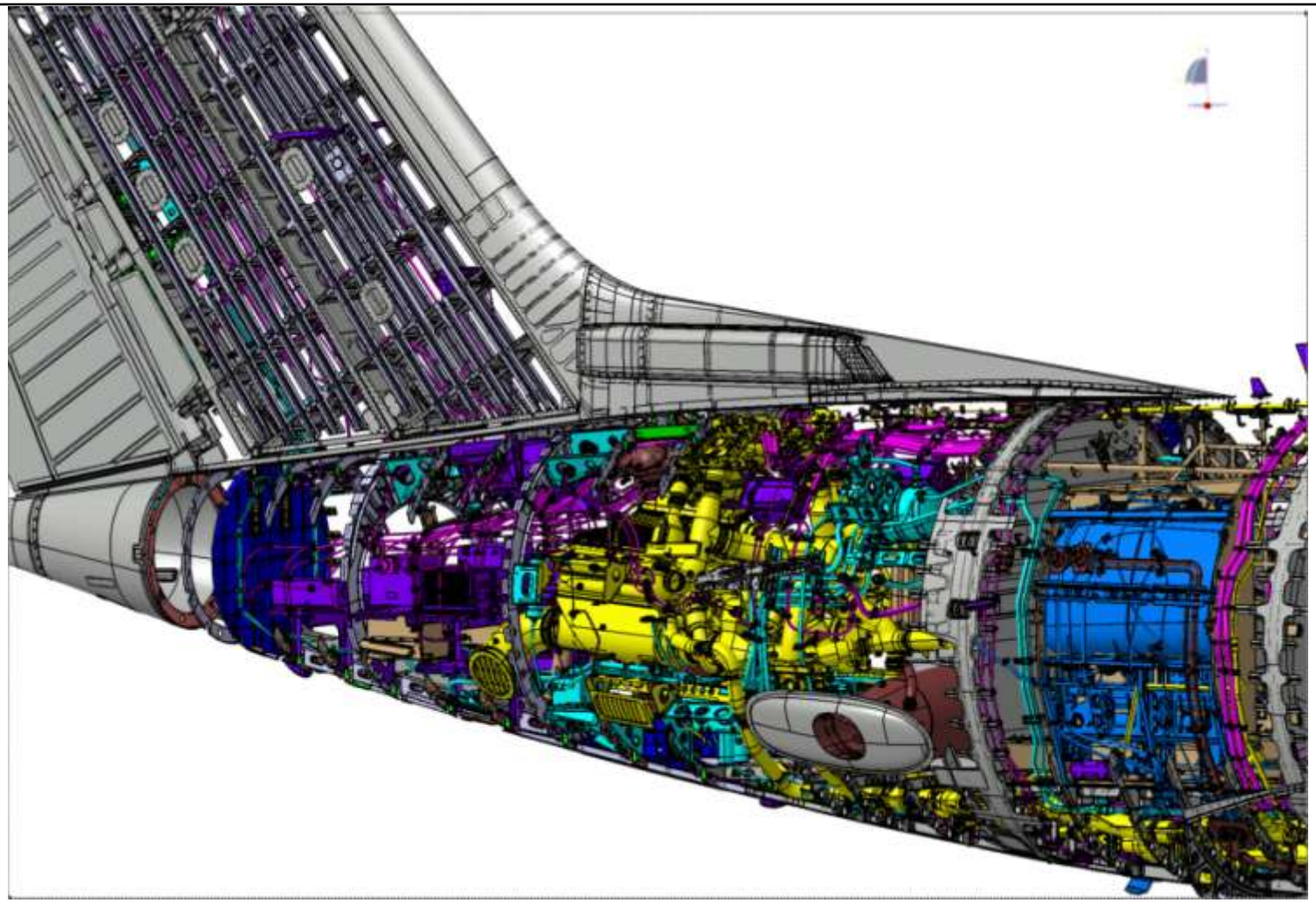
Forward Fuselage



Forward Fuselage - Systems



Aft Fuselage



Catia On The Shop Floor

Underestimated how quickly the technicians would adapt to 3D MBTD

Other Key Initiatives with 3D MBTD

- Standard Parts
  - G650 – greater than 50% reduction in parts and part numbers
  - Outfitting clips, angles and brackets reduced from 400 – 500 to 6
- Configuration by aircraft in 3D
- Highly accurate, on demand BOM's
- Extensive use of NC manufacturing
- Precision Manufacturing

Electronic 3D Model Based environment is an "enabler"

Things to Consider with 3D MBTD

- Life of the Product – Life of the Data
  - Aircraft have a 50 – 75 year life cycle, so the data must “live” for a very long time
  - Software and hardware will continue to evolve during the life of the product
    - How will V5 data work with Vxx?
    - What happens if the software company goes out of business?
    - What hardware will we be using 50 years from now?
  - Data goes corrupt
    - How do you know?
    - How does the user know?

3D MBTD – Integrity, Consistency and Accessibility

- Gulfstream has developed tools, process and procedures to deal with the data issues
  - Data is checked at the bit / byte level every 24 hours
    - We know when data goes corrupt / missing
  - Rigorous process to verify data prior to an upgrade
    - Verify topology and metadata
  - Released content supported by international standards
    - Allows us to move data in and out of applications
  - Managed hardware and software environment
    - Rigorous process to verify applications before they are added to the environment

Impact to the Business

- Final Phase (Outfitting)
  - ↗ Significant reduction in total costs and cycle time
- Initial Phase (G650)
  - ↗ Greater than 50% reduction in parts and part numbers
  - ↗ Initial build results have exceeded expectations
    - Barrel joining
    - Wing to fuselage fit
    - Wing to body fairing fit

Barrel Joining

Wing to Fuselage Join

Wing to Body Fairing

Key Takeaway

- Electronic 3D MBTD is a very “powerful” business model, but you must be aware of, and address the issues with the data, hardware and software

Contact Information

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OUR VISION
Set the standard for business aviation through excellence in people, product, service and financial return