



International Council of the Aeronautical Sciences (ICAS)

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Expanding the Limits of Advanced Materials & Structures

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Discussion Points

- **The Compelling Vision for Improving Materials & Structures**
- **Commercial Aerospace Challenges**
 - Changing the Game – The 787 Dreamliner
- **Defense Aerospace Challenges**
 - Phantom Eye Prototype
- **Our Technical Challenges**

Advanced Materials & Structures



Advancements in materials and structures have been, and will always be, critical to aerospace growth!

The Compelling Need for Improved Materials & Structures



Airlines



Lower Acquisition Cost



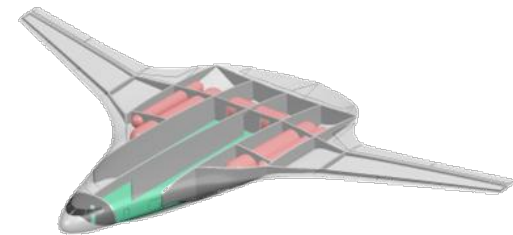
Lighter Materials



Governments



Reduced Fuel/Energy Costs



Innovative Structural Concepts



Reduced Environmental Impact



Optimized for Producibility

Commercial Airframe Structures

- **Emphasis on weight reduction remains a priority**
- **Enabled high-rate production**
- **Next gen products will need a balanced material suite – Composites, Ti, aluminum, steel,...**
- **Continual downward pressure on manufacturing costs**



787 Dreamliner: Cleaner, Quieter and More Efficient



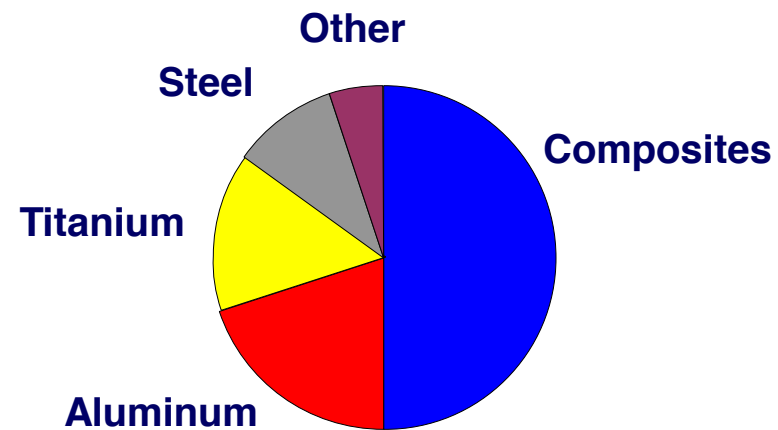
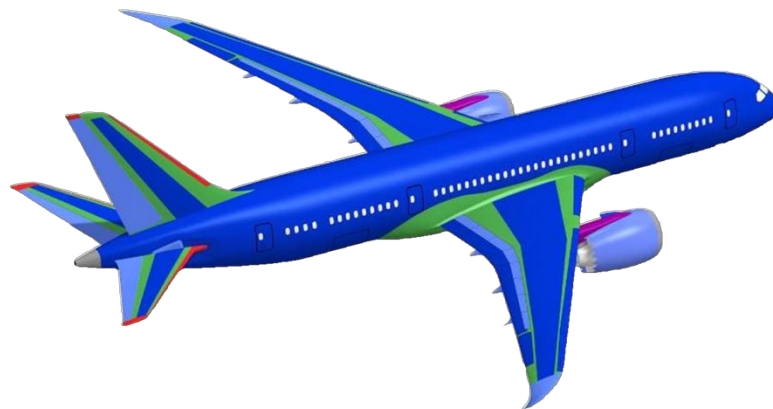
The 787 delivers:

20%* Reduction in fuel and CO₂

28% Below 2008 industry limits for NOx

60%* Smaller noise footprint

*Relative to the 767

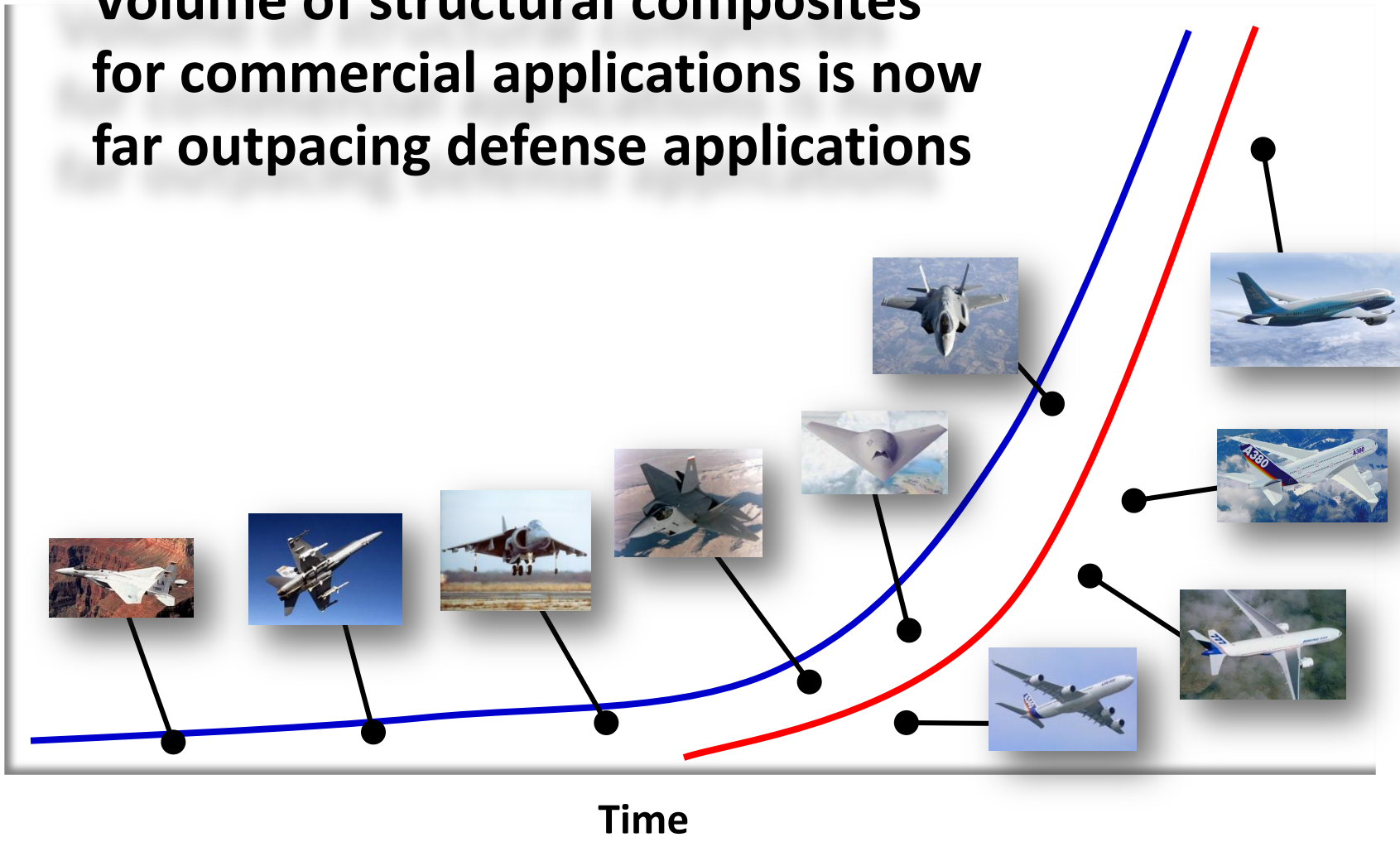


**Advanced materials play a key role in lighter
airframes and more efficient engines**

Structural Composites Changing the Game

Volume of structural composites for commercial applications is now far outpacing defense applications

Volume of Structural Composites in Aerospace Production



What Happened to Increase Commercial Aerospace Composites Usage?

- **Improved Material Technology**
 - Higher strength fiber
 - Higher temperature, strength & toughness resins
- **Improved Manufacturing Technology**
 - Automated processing
 - Structural Bonding
- **Improved Analysis & Modeling Techniques**
 - Dimensional analysis & control
 - Structural analysis & modeling
- **Increased focus on life-cycle cost**
 - Better corrosion resistance
 - Low cost repair techniques



~50%



~20%



~10%



~8%

787 Productionized Large Composite Structures

Tooling



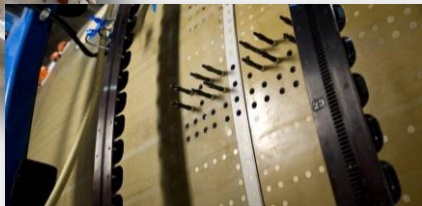
Fabrication Automation



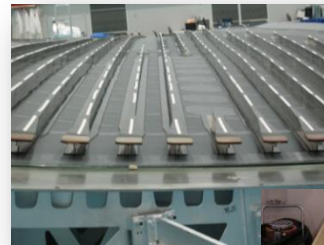
Inspection



Assembly Technologies



Bonding



Repairs



Composites Created Challenges In...

- Design and analysis
- EME shielding
- Heat distribution
- Other material technologies
 - Titanium, Coatings, Fasteners
- Tooling
- Production technologies
- Repair methodologies



The 787 program developed and implemented practical solutions to these challenges

Defense Aerospace Challenges

- Prove it works – “Fly before buy”



- Small production lots



- Adaptable architectures

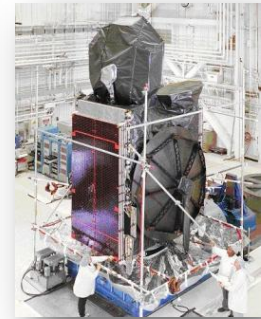


- Foreign participation



Defense & Space Aerostructures

- **Wide range of product types – aircraft, satellites, hypersonics, spacecraft, missiles, helicopters,...**
- **Unique performance requirements – high temperatures, corrosive environments, radiation,...**
- **Long development cycles**
- **Low production rates**



Prototyping



**Out of Autoclave
Composites**



Simple Testing







**Minimal
Tooling**



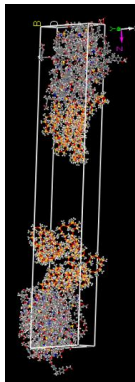

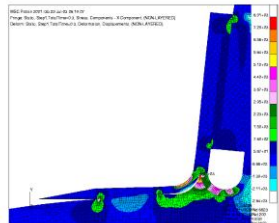
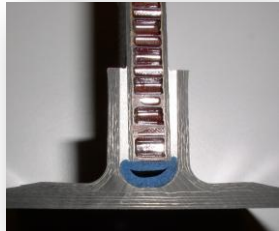
Future Technology Enablers

Multi-functional materials

		Electrical
		Thermal
		Acoustic

Structural

Modeling & simulation of structural performance

Novel architectures for performance improvements

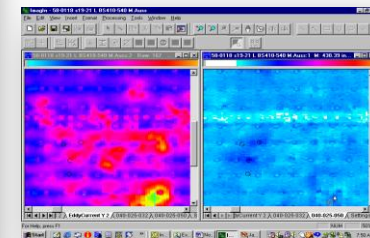
				
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Future Technology Enablers (cont.)

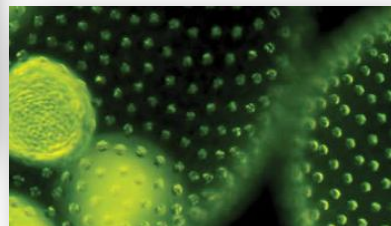
Flexible automation



Distributed and robust Non-destructive Inspection



Environmentally responsive



Surface chemistry



The Challenges for Materials & Structures

- **Speed – need to develop, certify and qualify new technologies faster**
- **Leveraging the materials and manufacturing technologies with advanced configurations**
- **Reducing the environmental impact – to build, operate & dispose**
- **Global partnering**
- **Cost, cost, cost**



Summary



Materials & Structures Technologies will continue to play key roles in next generation, innovative aerospace products

