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

- Lower Acquisition Cost
- Lighter Materials
- Reduced Fuel/Energy Costs
- Innovative Structural Concepts
- Reduced Environmental Impact
- Optimized for Producibility
Commercial Aerospace Challenges

- Large non-recurring investments drives desire for risk-sharing partners
- Highly complex products – creates partnering challenges
- Cyclical Production
- Regulatory agencies’ comfort level with new technologies
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
Volume of structural composites for commercial applications is now far outpacing defense applications.
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
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

First Flight – Fall 2011
Future Technology Enablers

Multi-functional materials

Structural

Electrical

Thermal

Acoustic

Modeling & simulation of structural performance

Novel architectures for performance improvements
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
Materials & Structures Technologies will continue to play key roles in next generation, innovative aerospace products