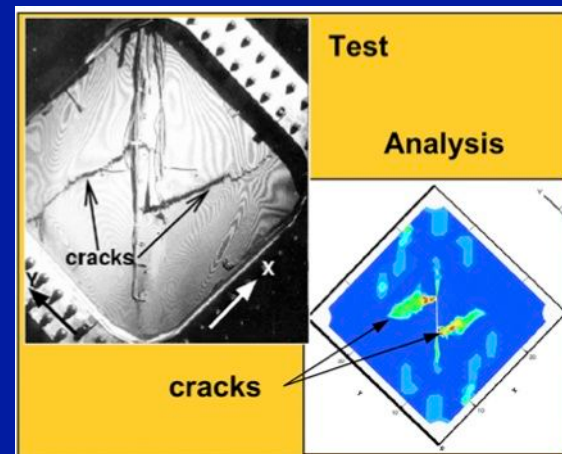
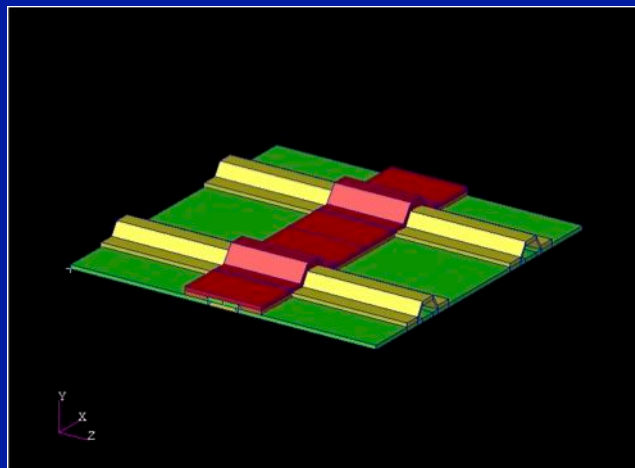


Advanced Composites Project Update



Richard Young, Project Manager
Stan Smeltzer, Deputy Project Manager
Host Center: Langley; Partner Centers: Glenn, Ames, Dryden

Briefing to the NAC
Aeronautics Committee
July 29, 2014

Relevance to National Need



- **From FY14 President's Budget Request**
 - Focus on reducing the timeline for development and certification of innovative composite materials and structures, which will help American industry retain their global competitive advantage in aircraft manufacturing



Boeing 787

GE Genx



Lockheed Martin F-35



Northrop Grumman
Fire Scout



Airbus
A-350 XWB



Comac C919 (China)

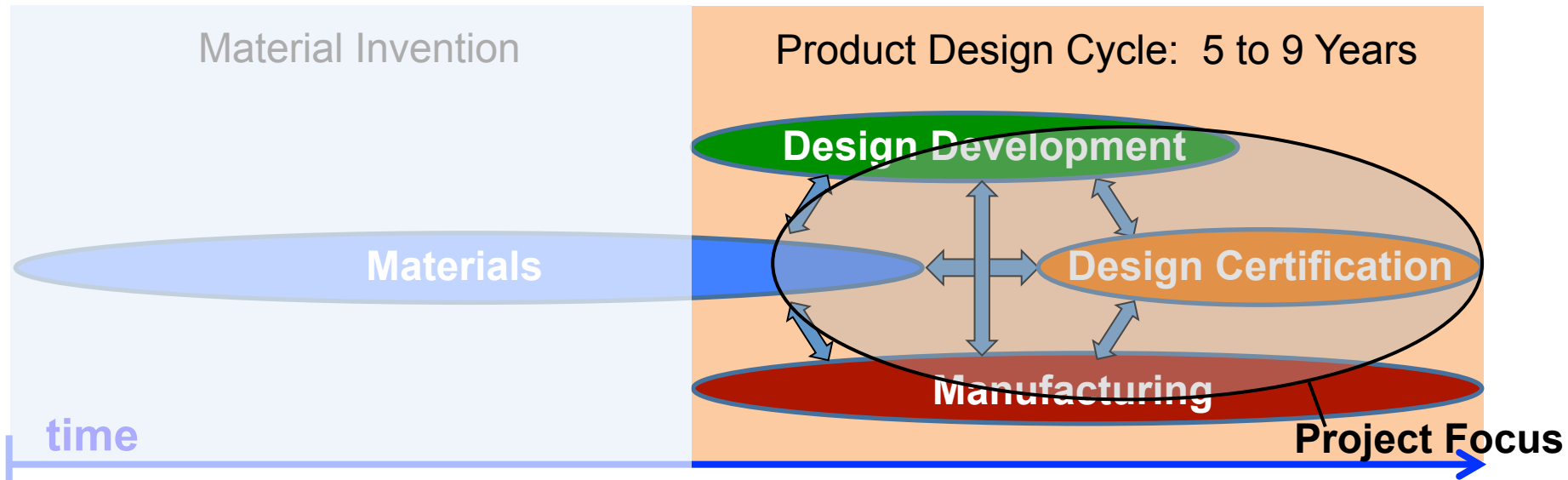


Bombardier
C-Series

Sukhoi Superjet 100
(Russia)



Project Goal



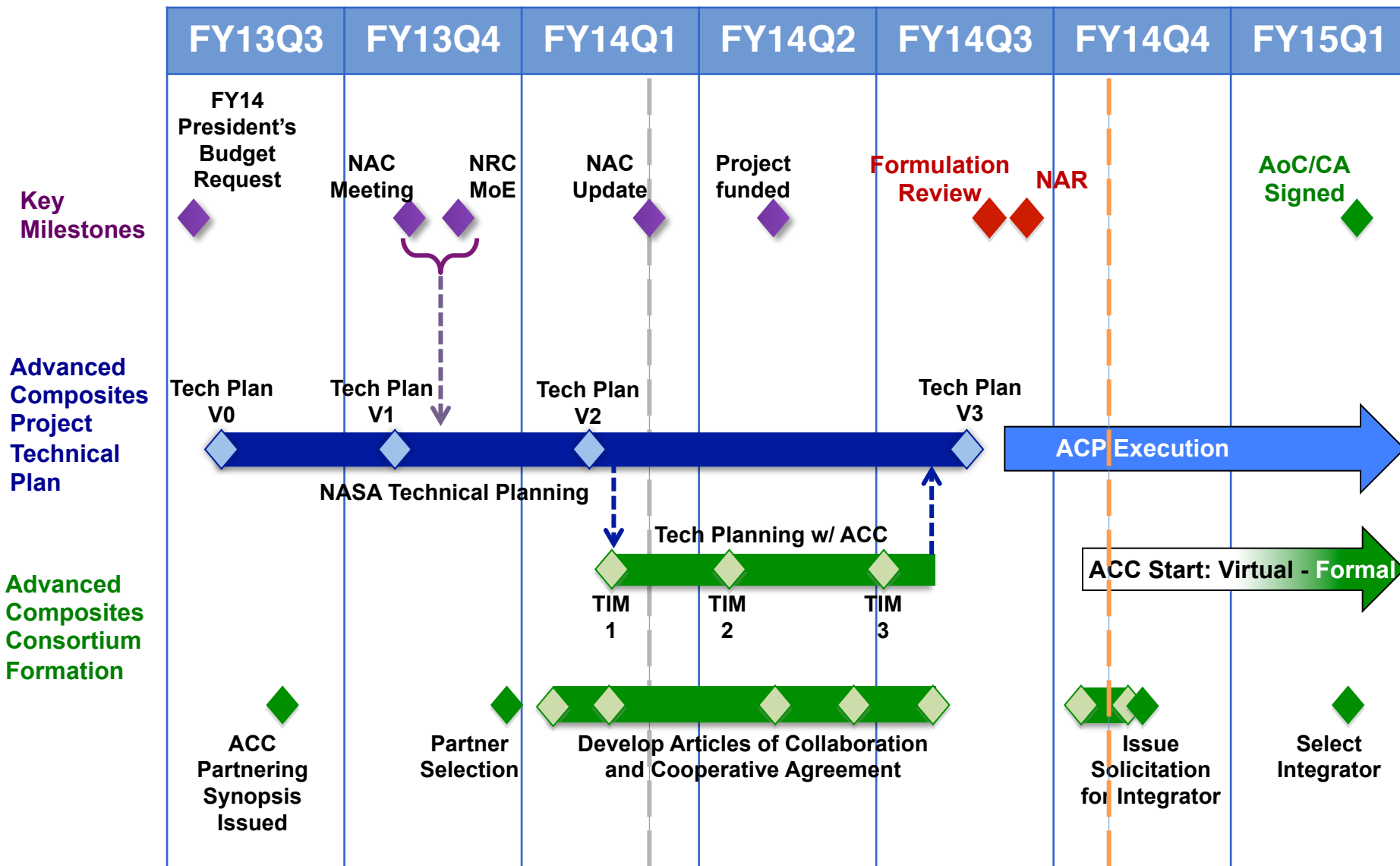
Why Slow

- Complexity: construction, failure modes, variability
- Strength and life not predicted reliably
- Design and manufacturing coupled
- Empirical and iterative methods

Goal: Reduce product development and certification timeline by 30%

- Baseline Model
- Tall Poles: validate with case studies sub-component / component level
- Systems Analysis

ACP / ACC Formation



Outline



- Project Technical Plan and Management Structure
- Consortium Formation
- Results of Recent Reviews at NASA HQ
 - Project Formulation Review
 - Non-Advocate Review of Consortium as PPP
- Path Forward

NASA Project Planning with Partner Input

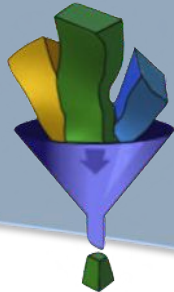


Portfolio Formulation

Community Needs

1. Material qualification databases
 2. Progressive damage modeling
 3. Design coupled to manufacturing
 4. Bonding and bond qualification
 5. Manufacturing tooling and molds
 6. Accelerated certification approaches
 7. Material durability and aging
 8. Education of workforce
- Systems Engineering

Apply Filters



Tech Challenges (v1)

1. Efficient Design
2. Streamlined Certification
3. Progressive Damage Modeling
4. Enhanced Manufacturing
5. Systems Assessment

Vet & Refine



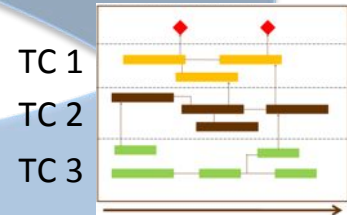
Tech Challenges (v2)

1. Predictive Capability
2. Rapid Inspection
3. Manufacturing Process & Simulation

Team Validation & Tech Roadmaps



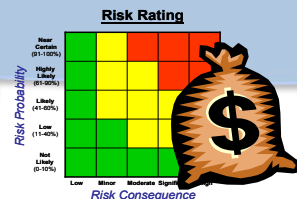
Phase I Execution



- Content, ROM \$, time

Manage Portfolio

- Cost/Benefit/Risk Analysis
- Down-select



Execute & Evaluate

- Fabricate
- Test
- Analysis
- Timeline model

Team-Developed Detailed Technical Work Packages



	2009-2010	2011-2012	2013-2014
Personnel	\$ 337,500	\$ 75,000	
1st Price	\$ 80,875	\$ 18,750	
2nd Price	\$ 67,500	\$ 15,000	
3rd Price	\$ 56,250	\$ 12,500	
4th Price	\$ 45,000	\$ 10,000	
5th Price	\$ 33,750	\$ 7,500	
6th Price	\$ 22,500	\$ 5,000	
7th Price	\$ 11,250	\$ 2,500	
8th Price	\$ 0	\$ 0	
9th Price	\$ 0	\$ 0	
10th Price	\$ 0	\$ 0	
Total	\$ 337,500	\$ 75,000	



Recommended Phase II Portfolio

Identify Community Needs



Portfolio Formulation

Advanced Composites Workshop (May 2012)



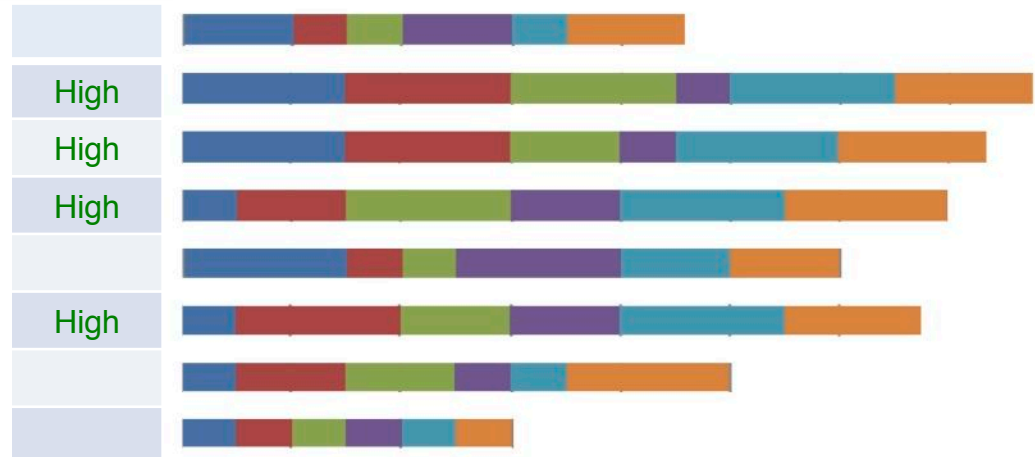
Community Needs

NASA SME: Impact
High, Med, Low

Industry:
Impact

Industry Partner Survey

1. Material qualification databases
2. Progressive damage modeling
3. Design coupled to manufacturing
4. Bonding and bond qualification
5. Manufacturing tooling and molds
6. Accelerated certification approaches
7. Material durability and aging
8. Education of workforce



Vet and Refine (cont.)

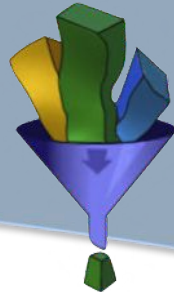


Portfolio Formulation

Community Needs

1. Material qualification databases
2. Progressive damage modeling
3. Design coupled to manufacturing
4. Bonding and bond qualification
5. Manufacturing tooling and molds
6. Accelerated certification approaches
7. Material durability and aging
8. Education of workforce
- Systems Engineering

Apply Filters



Tech Challenges (v1)

1. Efficient Design
2. Streamlined Certification
3. Progressive Damage Modeling
4. Enhanced Manufacturing
5. Systems Assessment

Vet & Refine



Tech Challenges (v1)

1. Efficient Design
2. Streamlined Certification
3. Progressive Damage Modeling
4. Enhanced Manufacturing
5. Systems Assessment

Rapid Inspection

NASA Advisory Council AND NRC-organized Meeting of Experts

- Project is too broad
- End of program: usable efficient products
- Recommend Accelerated Validation – more than certification, and not omitting steps
- Suggested unifying theme - certification by integrated analysis and test; validated tools
- Tool integration through manufacturing physics is critical. Key part of certification and validation is to understand variability.
- Inspection of Composites as a driver

Technical Challenges (v2)

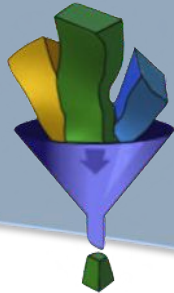


Portfolio Formulation

Community Needs

1. Material qualification databases
2. Progressive damage modeling
3. Design coupled to manufacturing
4. Bonding and bond qualification
5. Manufacturing tooling and molds
6. Accelerated certification approaches
7. Material durability and aging
8. Education of workforce
- Systems Engineering

Apply Filters



Tech Challenges (v1)

1. Efficient Design
2. Streamlined Certification
3. Progressive Damage Modeling
4. Enhanced Manufacturing
5. Systems Assessment

Vet & Refine



Tech Challenges (v1)

1. Efficient Design
2. Streamlined Certification
3. Progressive Damage Modeling
4. Enhanced Manufacturing
5. Systems Assessment

Tech Challenges (v2)

1. Predictive Capability (Design and Certification)
2. Rapid Inspection (includes bond strength)
3. Manufacturing Process & Simulation
- Systems Engineering Task

Rapid Inspection

Team Validation and Technology Roadmaps

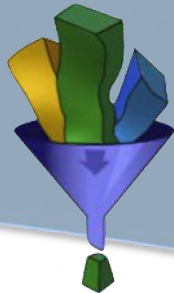


Portfolio Formulation

Community Needs

1. Material qualification databases
2. Progressive damage modeling
3. Design coupled to manufacturing
4. Bonding and bond qualification
5. Manufacturing tooling and molds
6. Accelerated certification approaches
7. Material durability and aging
8. Education of workforce
- Systems Engineering

Apply Filters



Tech Challenges (v1)

1. Efficient Design
2. Streamlined Certification
3. Progressive Damage Modeling
4. Enhanced Manufacturing
5. Systems Assessment

Vet & Refine



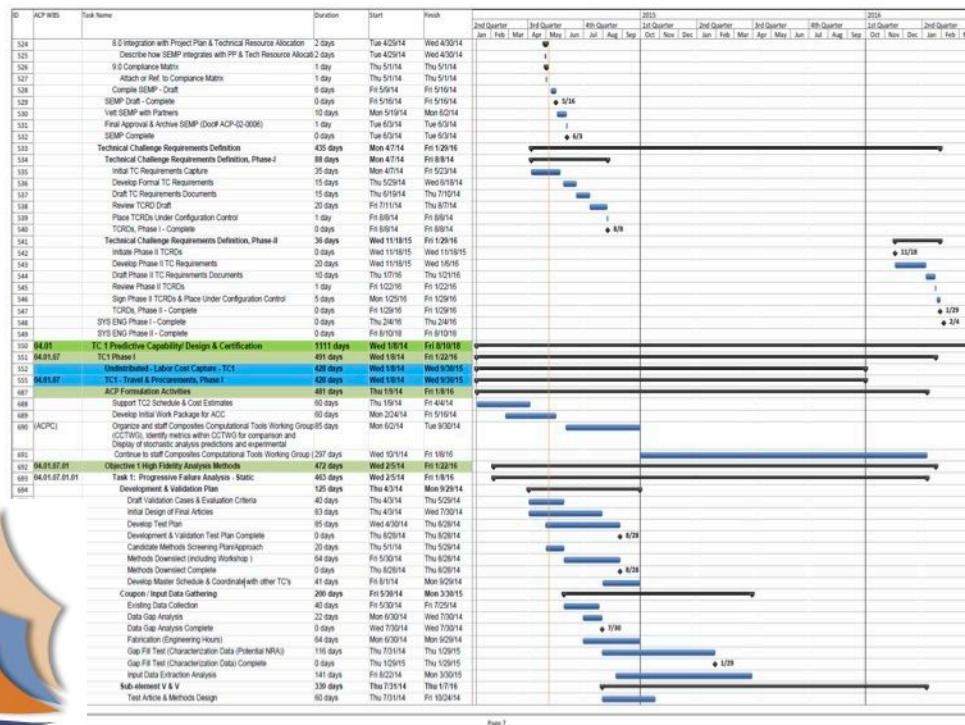
Tech Challenges (v2)

1. Predictive Capability
2. Rapid Inspection
3. Manufacturing Process & Simulation

Team Validation & Tech Roadmaps



- Content, ROM \$, time

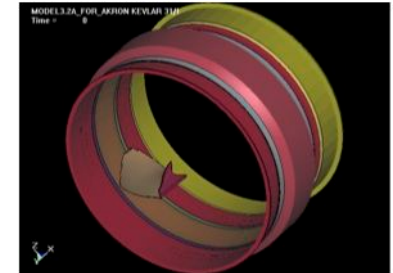
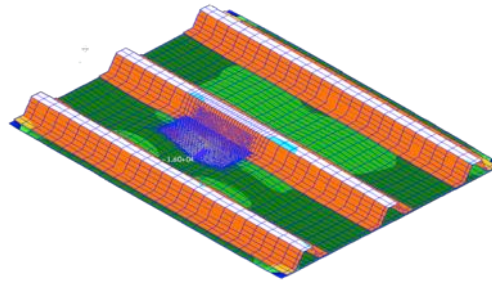


Technical Challenges



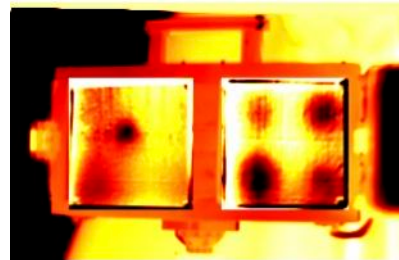
Predictive Capabilities

- Robust analysis reducing physical testing
- Better prelim design, fewer redesigns



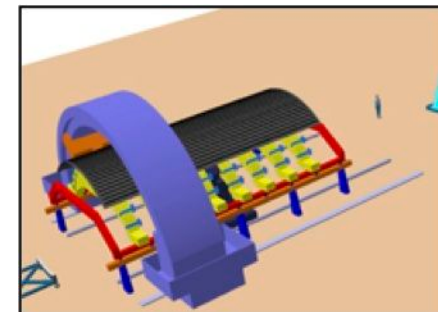
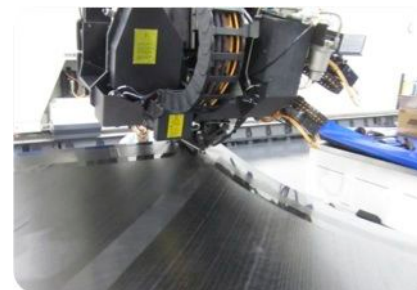
Rapid Inspection

- Increase inspection throughput
- Quantitative characterization of defects
- Automated inspection



Manufacturing Process & Simulation

- Reduce manufacture development time
- Improve quality control
- Fiber placement and cure process models



Technical Challenges



State of Practice

Benefit

Predictive Capabilities

- Robust analysis reducing physical testing
- Better prelim design, fewer redesigns

- Analysis insufficient for strength or life with damage; must test
- Gaps prelim design and tests; redesign

- Reduced testing
- Expanded design space
- Less risk; fewer redesigns

Rapid Inspection

- Increase inspection throughput
- Quantitative characterization of defects
- Automated inspection

- NDI cannot quantify various defect types
- Skilled or subjective interpretation of data
- Manual disposition / transfer to analysis

- Rapid disposition
- Reliable data
- Improved input to damage models
- Better feedback to manufacturing

Manufacturing Process & Simulation

- Reduce manufacture development time
- Improve quality control
- Fiber placement and cure process models

- Unable to predict fiber placement & cure induced defects; trial and error iterations
- Part variability
- Rework / redesign

- Fewer iterations
- Fewer defects
- Less redesign
- Shorter time to develop

TC1- Predictive Capabilities

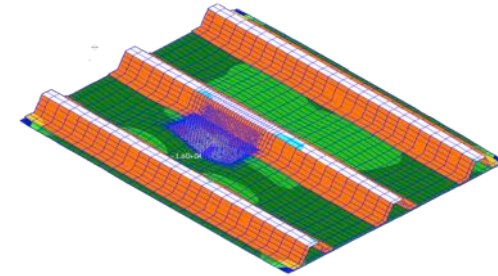


GOAL:

Develop new and improved analytical methods and rapid-design tools to reduce composite structural design cycle time and testing effort during the development and certification process

APPROACH:

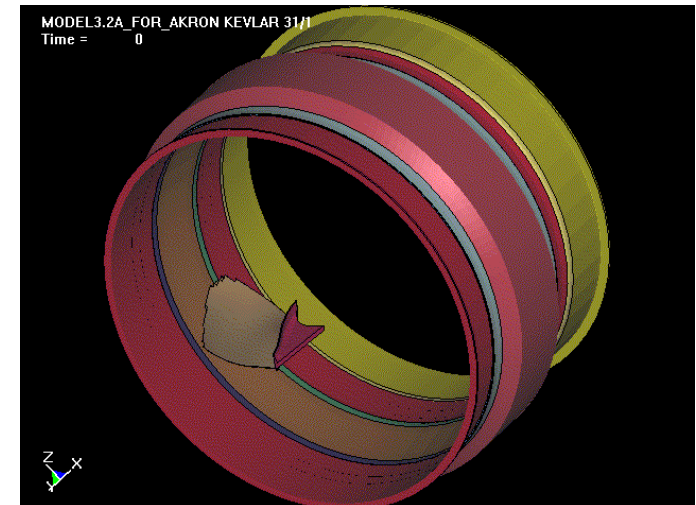
- High Fidelity Analysis Methods
 - Progressive failure analysis for residual static strength of airframe components
 - Transient dynamic failure analysis of engine and airframe components subjected to high-energy impact events
 - Progressive fatigue failure analysis of airframe and dynamic components
- Rapid Design Tools
 - Assess state of the art and gaps
 - Develop new / improved methods



Experiments document damage progression



Validate new improved predictive models



TC2 - Rapid Inspection

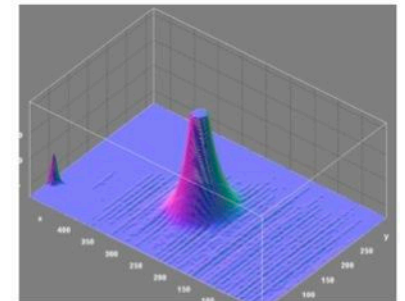
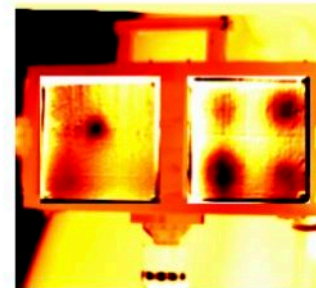
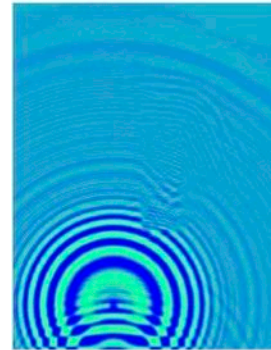


GOAL:

Increase inspection throughput through the development of quantitative and practical inspection methods, and data management methods and tools

APPROACH:

- Rapid Quantitative Characterization of Defects
 - Assess SoA inspection and data interchange
 - Determine critical defects
 - Develop validated tools for quantitative characterization
 - Develop data transfer interfaces
- Automated Inspection Techniques
 - Technique identification for automated processes
 - Establish baseline SoA to compare improvements
 - Rank candidate tools and analysis methods for automation
 - Develop automated inspection hardware & software tools



TC3 - Manufacturing Process & Simulation

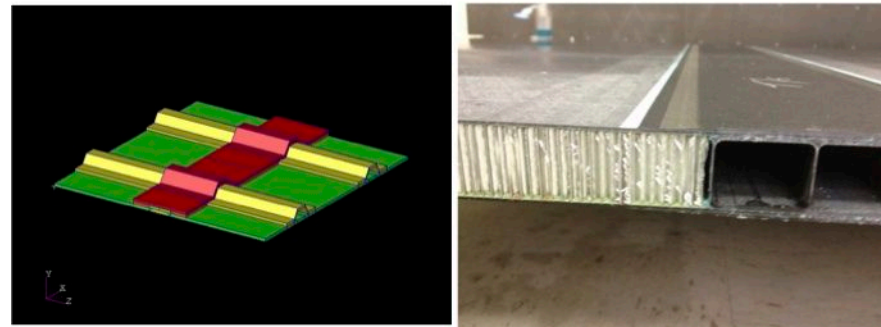
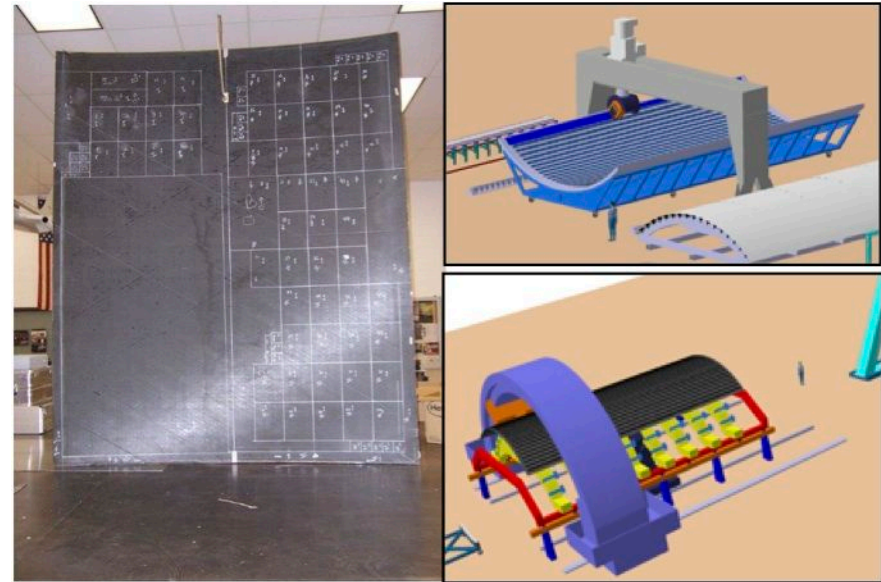


GOAL:

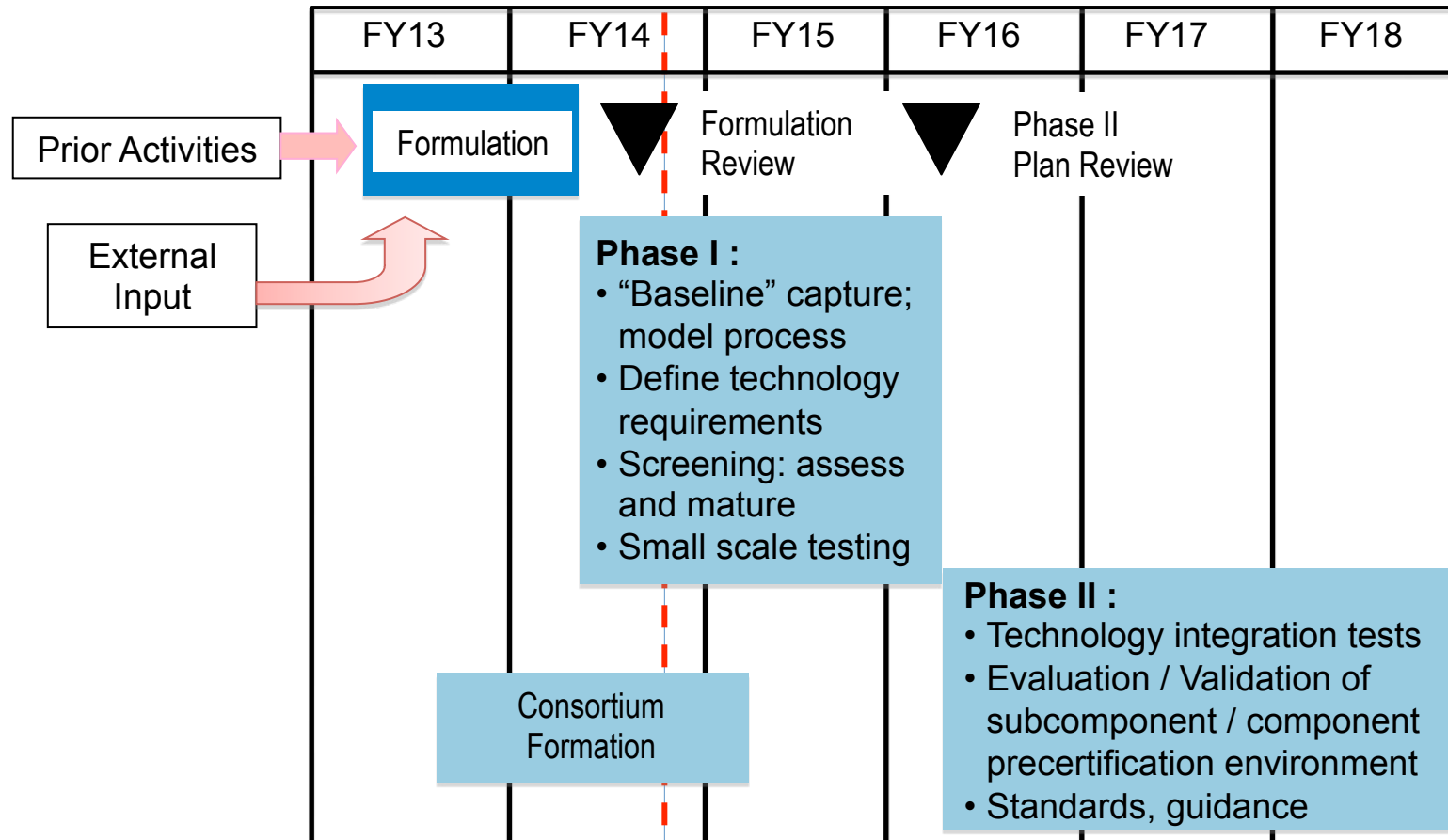
Enhance manufacturing processes through automated technologies, improved process quality control standards, and developed computational tools to predict processing defects, leading to fewer design iterations and reduced production certification timeline

APPROACH:

- Automated Fiber Placement (AFP) Predictive Tools
 - Design for manufacturability (DFM) software
 - Physics-based AFP process model
 - Effects of AFP defects
- Improved Quality control for Bonded Structure
 - Process model to predict co-cure / co-bond defects
 - Improve joint reliability with automated surface prep
- Cure process modeling
 - Cure process models to predict defects and internal stresses in composite structure
 - Sensitivity of laminate quality to material variation
 - Integrate physics-based AFP and cure process models with DFM software framework to interface design and fabrication process

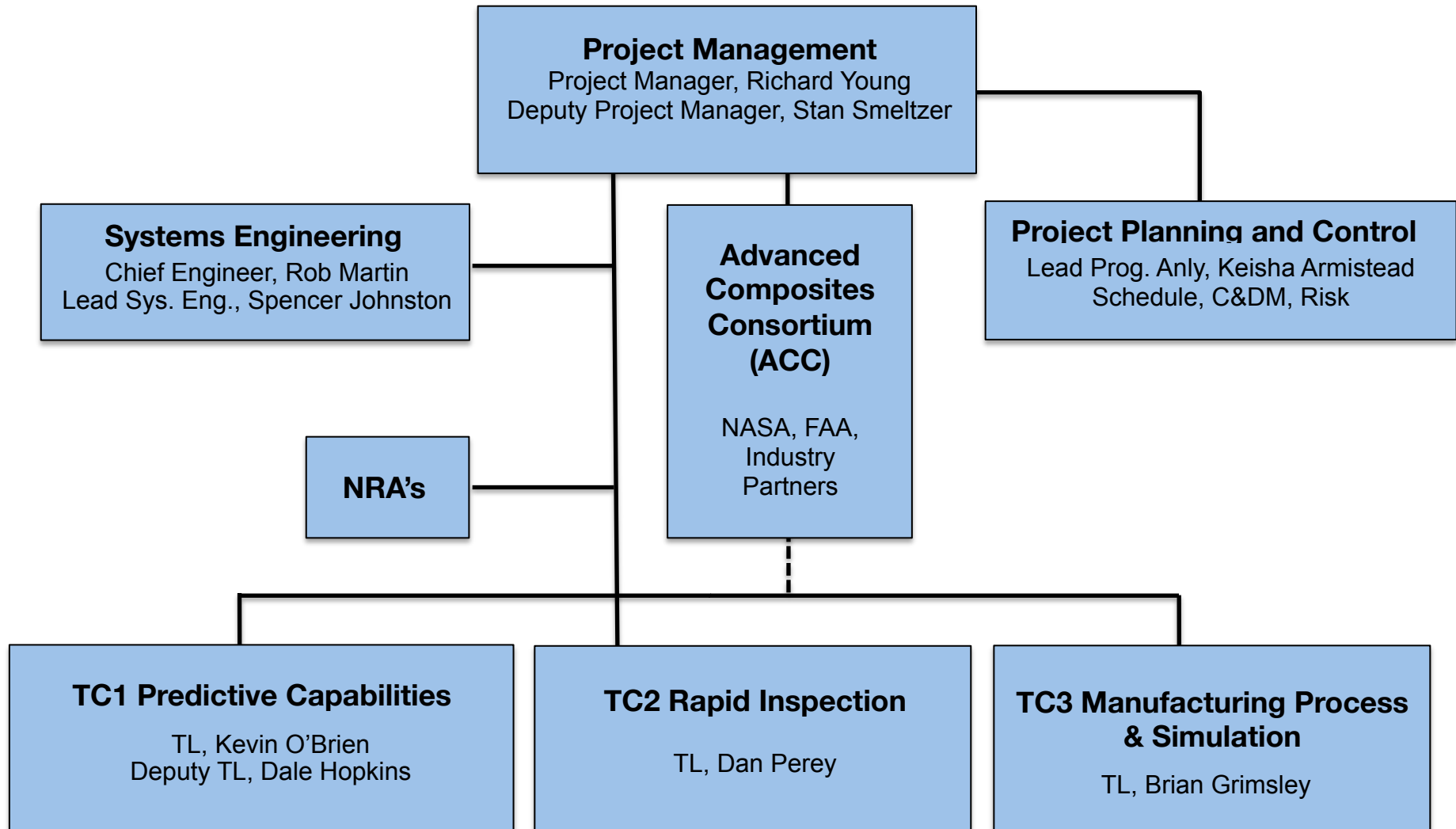


Project Flow



ACP Budget	\$25 M	\$25 M	\$28 M	\$29 M	\$25 M
ACC Portion	\$10 M	\$11 M	\$9 M	\$10 M	\$12 M

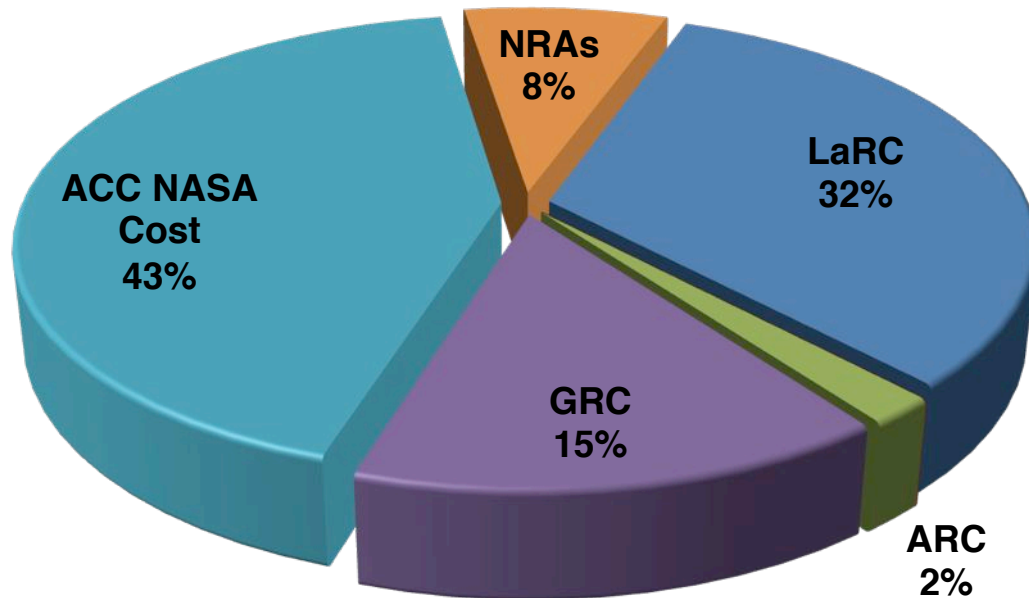
ACP Organizational Structure



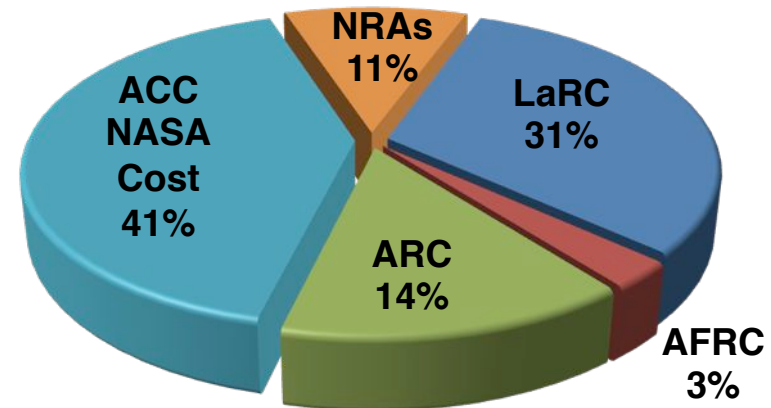
Tech Challenge Phase I Estimates by Center



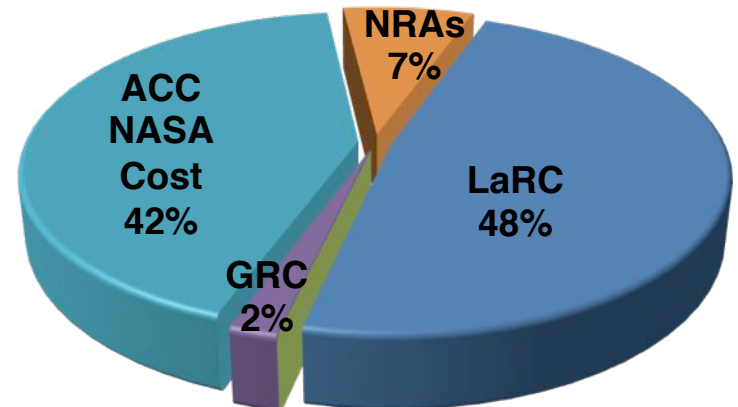
TC1 \$25M



TC2 \$10M



TC3 \$11M



Role of NASA and Partners



NASA Role

- **Fundamental understanding** of the science and physics
 - Polymer Chemist, Material Scientist, Damage Mechanics, Structural Mechanics
 - Invention of composite raw material forms, processing methods, and fabrication technology
 - Relation of processing parameters to physical measures and material performance
- **High fidelity** analysis and experimental methods
- **Independent validation** of methods
- **Coordination** of, and **participation** in, Working Groups

FAA Role

- **Advice** with certification aspects
- **Safety implications** and **practicality** in application

Industry Role

- **Understanding of requirements**
 - Common defects and damage
 - Practical operational requirements
 - Experience in application
- **Design and manufacture production quality** characterization and validation **test articles**
- Applied research expertise
- Execution of validation testing and data sets for analysis
- Development of **standard practice for adoption** by industry

Academia Role

- Expertise in **software development**: damage models, process models, data processing
- Formulation and maturation of progressive damage analysis methods

FAA Engagement



- FAA Composites Team: expertise in the substantiation and validation of structures
 - **Certification:** Larry Ilcewicz, Cindy Ashforth, Lester Cheng, Melanie Violette, Rusty Jones
 - **FAA Tech Center:** Curtis Davies, William Emmerling
 - **Outside experts** utilized by FAA: Designated Engineering Representatives (**DERs**), Designated Manufacturing Inspection Representatives (**DMIRs**) and consultants, to assist in technical evaluation of proposed means of compliance with regulations
- FAA membership in ACC
- FAA will support ACP and ACC by providing input on certification aspects
 - Needs and requirements
 - Safety implications and practicality in application
 - Leverage FAA efforts and expertise
- **FAA participation will not assure future FAA approval of any products that use methods or techniques developed, unless the FAA officially adopts the outcomes**

ACP Influence on Industry Standards & Processes



Current Standards and Guidance

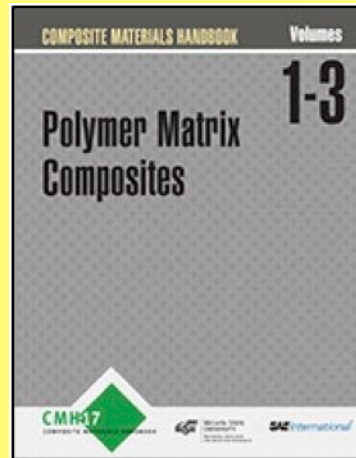
Future Regulatory Documents

AC 20-107B

U.S. Department of Transportation
Federal Aviation Administration

Subject: COMPOSITE AIRCRAFT STRUCTURE
Date: 11/10
Initiated by: ACP-100
AC No: 20-107B
Change:

- Purpose of this Advisory Circular (AC).** This AC sets forth acceptable means, but not the only means of showing compliance with the provisions of Title 14 of the Code of Federal Regulations (14 CFR) parts 23, 25, 27, and 29 regarding conventional type certification requirements for composite aircraft structures involving the regulated materials, e.g., carbon and glass fiber reinforced plastics. Guidance information is also provided on the closely related design, manufacturing, and maintenance aspects. The information contained herein is for guidance purposes and is not mandatory or regulatory in nature.
- To Whom this AC Applies.** The audience of this AC may include applicants, certificate approval holders, parts manufacturers, material suppliers, maintenance, and repair organizations.
- Cancellation.** AC 20-107A, Composite Aircraft Structures, dated April 25, 1984, is cancelled.
- Related Regulations and Guidance.** The current content herein applies to normal, utility, acrobatic, commuter, and transport category aircraft type certification under Civil Aviation Regulations (CARs) 1, 4b, 6, 7, and 14 CFR parts 23, 25, 27, 29, and it is produced in compliance with 14 CFR part 21, § 21.321, or 21.344 as may be appropriate. The version of 14 CFR parts 23, 25, 27, and 29 applicable to each paragraph of this AC are listed in Appendix 1. Other supporting guidance referenced in the AC is also provided in Appendix 1.
- General.**
 - The procedures outlined in this AC provide guidance material for composite structures, particularly those that are exempted from the normal design and testing requirements of the Federal Aviation Regulations (FAR) for showing compliance with certification requirements of civil composite aircraft. This circular is published to aid in the evaluation of certification programs for composite applications and to reflect the current status of composite technology. It is expected that this circular will be modified.



ANE-2006-33.94

Federal Aviation Administration

Memorandum

Date: 4/20/06
To: SEE DISTRIBUTION
From: Manager, Engine and Propeller Directorate, Aircraft Certification Service
Prepared by: Jay Turello, ANE-110, 791-238-7111 or Jay.Turello@faa.gov
Subject: **ACD009** Use of Structural Dynamic Analysis Methods for Blade Containment and Rotor Unbalance Tests (ANE-2006-33.94.2)

- Purpose**
This policy provides guidance for evaluating the use of structural dynamic analysis methods to show compliance with the requirements of Title 14 of the Code of Federal Regulations (14 CFR, 33.94) "Blade containment and rotor unbalance tests". This policy specifically addresses compliance with paragraph (a) of § 33.94 for engine design and configuration changes, and follows on model certification of the same type. This policy is derived from extensive Federal Aviation Administration (FAA) and industry experience in evaluating compliance with the relevant regulations. This policy does not create any new requirements, and does not specifically address new model type certification.
- Background**
This policy is superseding "Use of Structural Dynamic Analysis Methods for Blade Containment and Rotor Unbalance Tests", policy number ANE-2005-33.94.80, dated March 8, 2005. The policy provided guidance for evaluating the use of structural dynamic analysis methods for compliance with the requirements of § 33.94. Application of the policy has shown the need for additional detail to define certification procedures, Engine and Aircraft Certification Office (EAO) and ACO coordination, define analysis methods, and define the steps involved in engine modeling and validation. We changed the policy by adding sections (c) Certification Plan, (d) Engine Modeling and Analysis Methods, and (e) Engine Model Validation. Also, throughout this policy the modified engine is referred to as a derivative engine.
Engine manufacturers are developing and using various structural dynamic analysis methods to support both engine certification and aircraft manufacturer certification activities relevant to the § 33.94 blade out test requirements. These structural dynamic analysis methods

JSSG-2006/2007C

DEPARTMENT OF DEFENSE
JOINT SERVICE SPECIFICATION GUIDE



AIRCRAFT STRUCTURES

This specification guide is for guidance only.
Do not cite this document as a requirement.

C/N/A

FSG 150

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

ACP

FAA

LSDYNA

AWG

Influence Future Revisions:

- AC 20-107B – Composite Structure Guidance
- CMH-17 (revised annually)

Provide input to drafts:

- 14 CFR Part 25 – Damage tolerance and Hybrid testing
- AC 21-26 – Q.A. for Fabrication of Composite Structures
- Bonded Structure Repair Best practices
- FAA Best Practices for Bolted Composite Repair
- Advanced Composite Maintenance (Part 147)
- Blade Containment and rotor Unbalance Tests (Part 33)

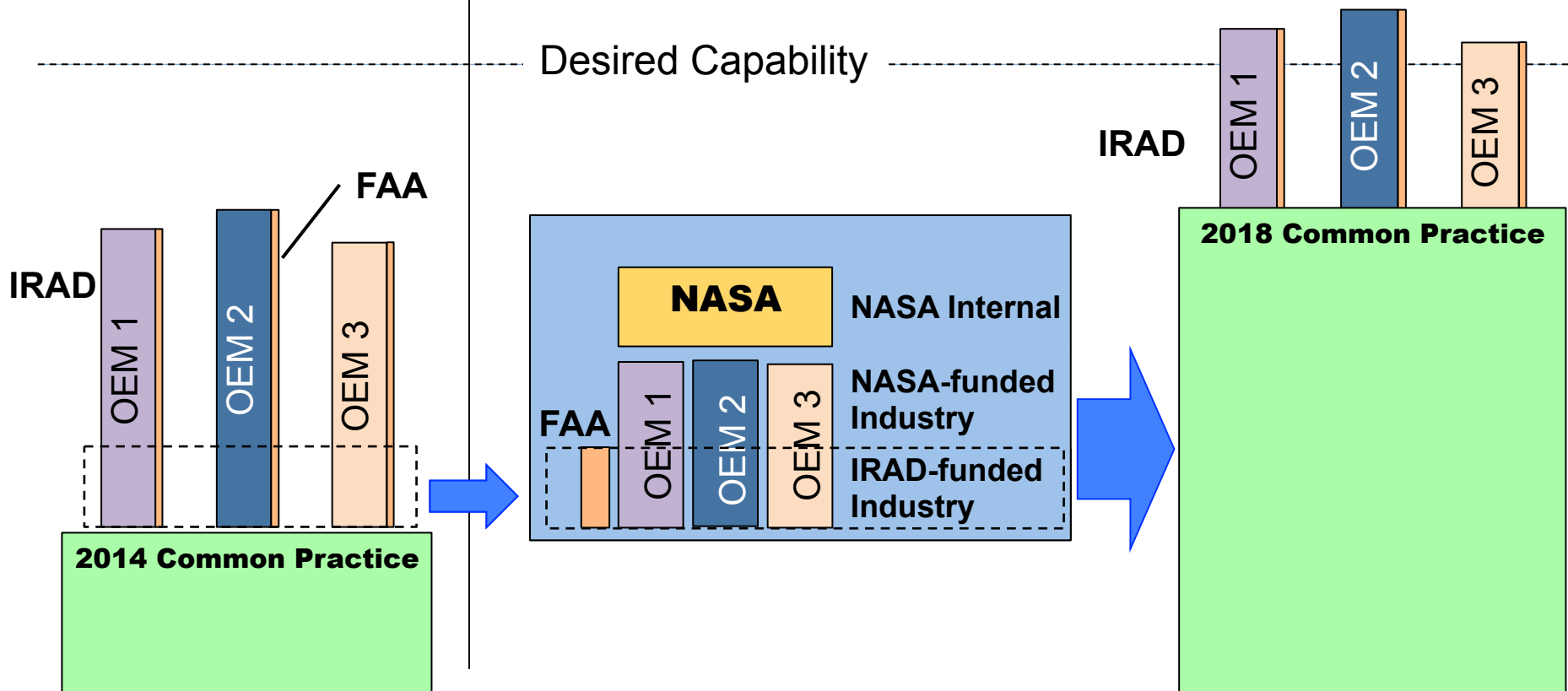
Why Collaboration?

Independent efforts

- Past progress slowed by competitive secrecy, even for fundamentals

Collaborative Research

- Leverage funds, expertise, lessons; robust, reduce risk, gain acceptance
- Generic case studies to establish industry standard methods



Outline



- Project Technical Plan and Management Structure
- Consortium Formation
- Results of Recent Reviews at NASA HQ
 - Project Formulation Review
 - Non-Advocate Review of Consortium as PPP
- Path Forward

Advanced Composites Consortium (ACC)



- Founding members:
 - NASA, FAA
 - Bell, Boeing, GE Aviation, Lockheed Martin, Northrop Grumman, P&W
- Other members to be added
- 50/50 cost sharing
- Collaborative research tasks with multiple partner teams
- NASA funds through Cooperative Agreement with “Integrator”, member who represents other members, dispenses funds through partnering agreements

Executive Steering Committee



Technical Oversight Committee



Cooperative Research Teams



- Shared vision
- High gov't value
- Data / Inventions shared by performing members
- Leverage resources
- Real issues

ACC Operation to Achieve Project Goals



Technical Planning

- TIMs develop team plan: ACP and Industry partner technical representatives
- Brainstorm potential content
- Develop technology roadmaps

Tactical Execution

TOC develops RFP: Informal team-building

CRTs form & develop Project Work Plans

Project Work Plans eval. by TOC

ESC review & approval

Integrator establishes Partnering Agreements

Quarterly progress review by TOC

Work complete; products delivered

Example ACC Work Activity (Notional)



TC1: PDA Static – Phase I

Objective: Quantify by test/analysis
Correlation, capability of current SoA
PDA methods

CRT Members: NASA, Boeing,
Lockheed, Northrop,
Software Co., University

Cost Share

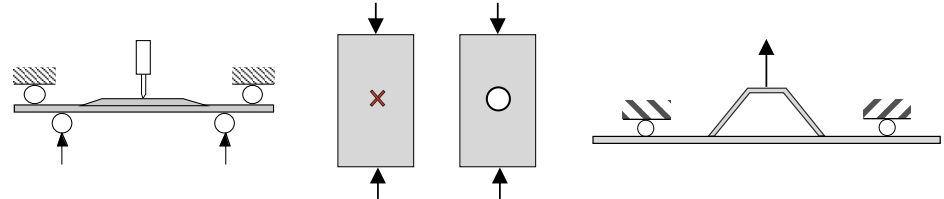
Contributions: OEM 1: Material, design, manufacturing of test specimens
OEM 2, 3: Background data: material characterization;
Conduct test: coupon and sub-element specimens
Software Co: Analysis methods, tech support

Activities:

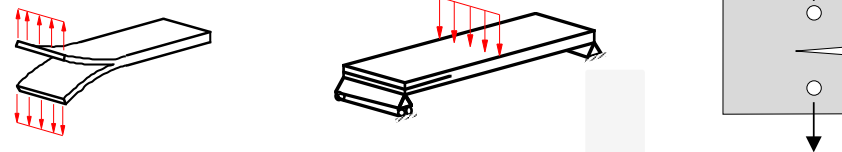
- NASA and OEMs define cases, design validation test articles
- NASA, OEMs, Software, University, identify modeling approaches; conduct analyses

Output: quantified performance of methods; ID of most promising for development

Sub-elements



Coupons



NASA Proposed Process to Add ACC Members

- ESC controls size and composition of ACC by vote of two-thirds of its members
- ESC may open membership to new members based upon desire or need
- New member applications obtained by:
 - Invitation from ESC
 - Solicitation in FedBizOpps: general or focused based upon need
- Evaluation Criteria (same as original Partnering Synopsis)
 1. Technical expertise in design and manufacture of composites for aerospace applications
 2. Funding: willingness and ability to cost share on collaborative research projects
 3. Certification experience with composites with the FAA or DoD certification offices
 4. Technology experience in identified High-Payoff Technology Focus Areas
 5. Partnership experience
- Decisions based upon Criteria, with consideration of meeting the Project Goals, and strengthening the ACC while maintaining a manageable team size
- Tier I members meet all criteria; become members of ESC and TOC
- Tier II members do not have to meet all criteria; become members of TOC only
- ESC vote not to admit member may be overridden by NASA at its sole discretion

ACC Formal Documents



Articles of Collaboration (AoC)

- Defines ACC functional structure
- Governs all ACC work content
 - “Work Activities” (NASA funded)
 - “Projects” (no NASA funds)
- Signed by all current and future Partners

Cooperative Agreement (CA)

- Governs “Work Activities” (NASA funded)
- Specific terms between Gov’t and Industry
- Signed by NASA and ACC Integrator

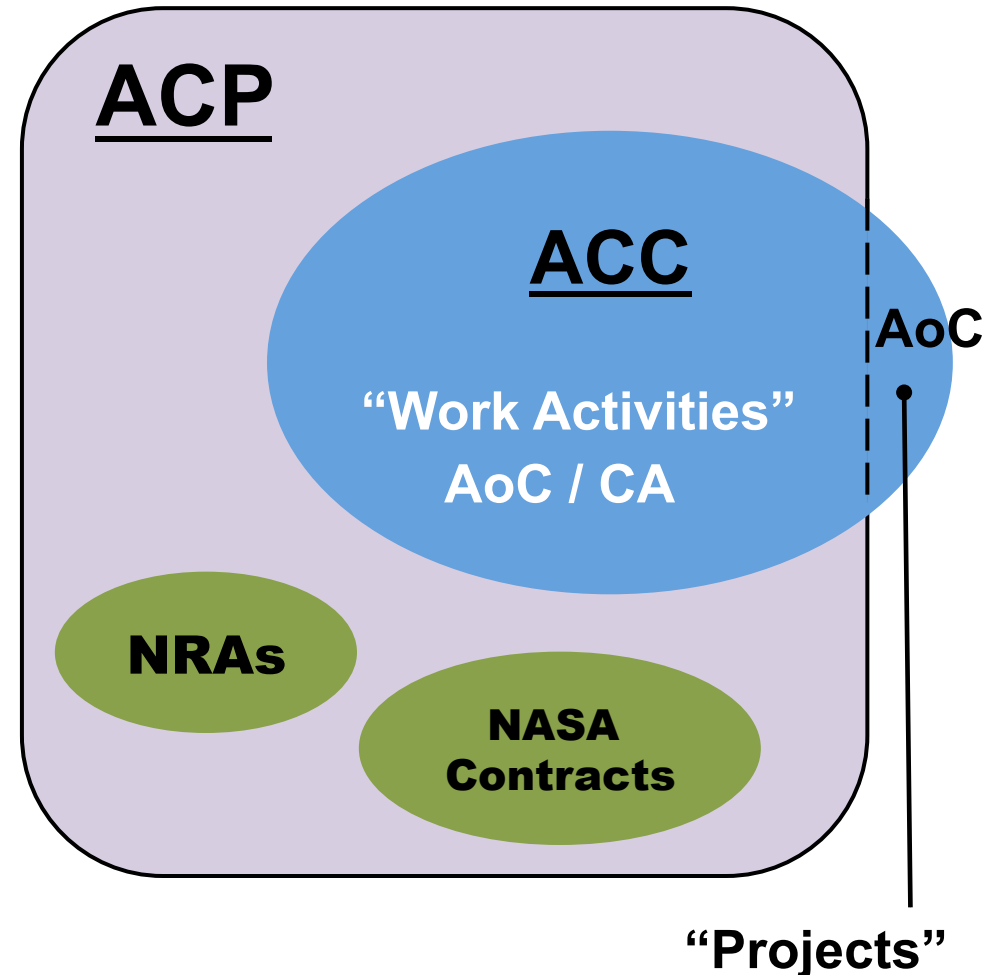
Documents Referenced in CA

- Program Operating Plan (POP)
- Project Evaluation Process (PEP)

STATUS as of May 28, 2014:

- AoC, CA: Negotiations complete, passed Corporate review
- POP, PEP: Drafted
- Integrator selection: **Selected partners failed to nominate Integrator**

Document Applicability



Data and Invention Rights



Articles of Collaboration

- Background (pre-existing)
 - Contributed
 - Industry CRT Members grant to other CRT Members a non-exclusive, irrevocable, **royalty-free**, paid-up, worldwide license to use as necessary to enjoy the specified rights in Project Technology
 - Reserved
 - Identify to TOC and note restrictions; TOC reviews for sufficiency of disclosure
 - Industry CRT Members agree to grant upon request by other CRT Members a **royalty-bearing**, non-exclusive license to use and further disclose as necessary to enjoy the specified rights in Project Technology
- Project
 - CRT Member owns entirety if solely developed under Articles
 - If jointly developed – jointly owned
 - Each Industry CRT Member grants other Industry CRT Members a non-exclusive, irrevocable, **royalty-free**, paid-up, worldwide license to use, make, have made, sell, offer to sell, import, reproduce, make derivative works, distribute, publicly display and perform

Cooperative Agreement

- NASA obtains at least Government Purpose Rights in data/inventions developed under CA
- Up to 5 year protection on data produced if considered trade secret/privileged/confidential

Cost Sharing within the ACC

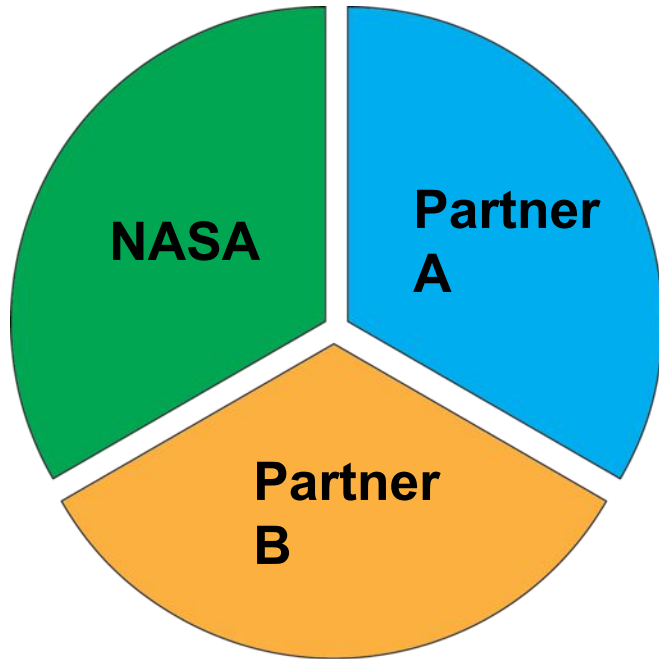


- Cost Sharing defined in the Cooperative Agreement requires 50/50 cost matching for research activities
- Includes Cash and non-Cash (in-kind), by gov't and industry partners
- Informal proposal teaming process allows collaboration amongst team members and identification of best/unique in-kind contributions
- 50/50 cost share requirement will cause the partners to focus their resources on the highest priority topics
- Achieving full magnitude of cost sharing for ACP will be dependent on the available industry partner resources in any given contract year

Cost Sharing Examples: NASA and 2 Partners

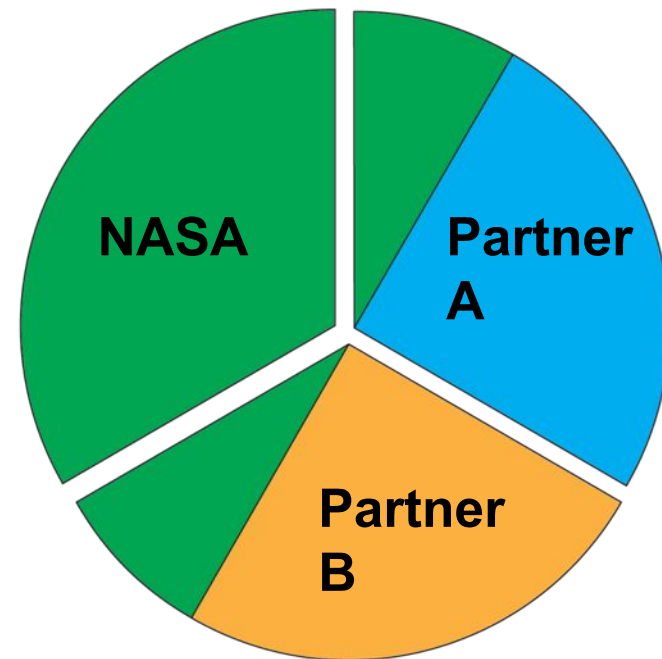


Situation: Partners A and B team with NASA on a \$3M Work Activity with each CRT member equally participating



Work Breakdown (Effort)

\$1M to be conducted at NASA
\$1M to be conducted at Partner A
\$1M to be conducted at Partner B



Contribution per Partner

NASA cost = \$1.5M (\$1M + \$250K to each partner)
Partner A cost = \$750K
Partner B cost = \$750K

Outline



- Project Technical Plan and Management Structure
- Consortium Formation
- Results of Recent Reviews at NASA HQ
 - Project Formulation Review
 - Non-Advocate Review of Consortium as PPP
- Path Forward

Project Formulation Review: May 28, 2014



- **Purpose:** Conduct an internal and external assessment of the Project:
 - technical plans
 - resource allocation plans
 - management plans, and
 - partnership plans
- Independent Review Panel Members
 - Curtis Davies : FAA Tech Center, Research Program Manager, Struct. & Mats.
 - Russell J. (Rusty) Jones : FAA Certification, Senior Technical Specialist NDI
 - Richard Holzwarth : USAF, Project Engineer, Structures Technology
 - William Nickerson : ONR, Program Officer, Sea-based Aviation Struct. & Mats.
- **Outcome:**
 - Passed: Formal transition from Formulation to Execution
 - Initiate technical planning/execution of work with Partners ASAP
 - Actions by December
 - Develop tighter story for Phase I plan and deliverables (team plan)
 - Assess Phase I Schedule
 - Formalize DoD coordination and strengthen FAA partnership

Non-Advocate Review of ACC, June 13, 2014



- **Purpose:** Non-Advocate Review of the Advanced Composites Consortium Approach to Partnership within the Advanced Composites Project:
 - Impact of planned partnership on Project's ability to meet technical challenges
 - Project's ability to negotiate Intellectual Property rights through the ACC
 - Impact of planned partnership on Project's ability to cost share with industry
 - Identify potential risks to Project success
- **Review Panel Members**
 - Stephen Fleming, Georgia Institute of Technology
 - Rhett Jefferies, Pennsylvania State University
 - Ed Morris, America Makes
 - Denise Swink, Independent Consultant
- **Outcome:**
 - Passed: Green light to proceed
 - Address before full ACC operation
 - Consider strong recommendation for independent third party Integrator
 - Develop clear plan to include more partners
 - Ensure IP policy will accommodate potential new partners

Outline



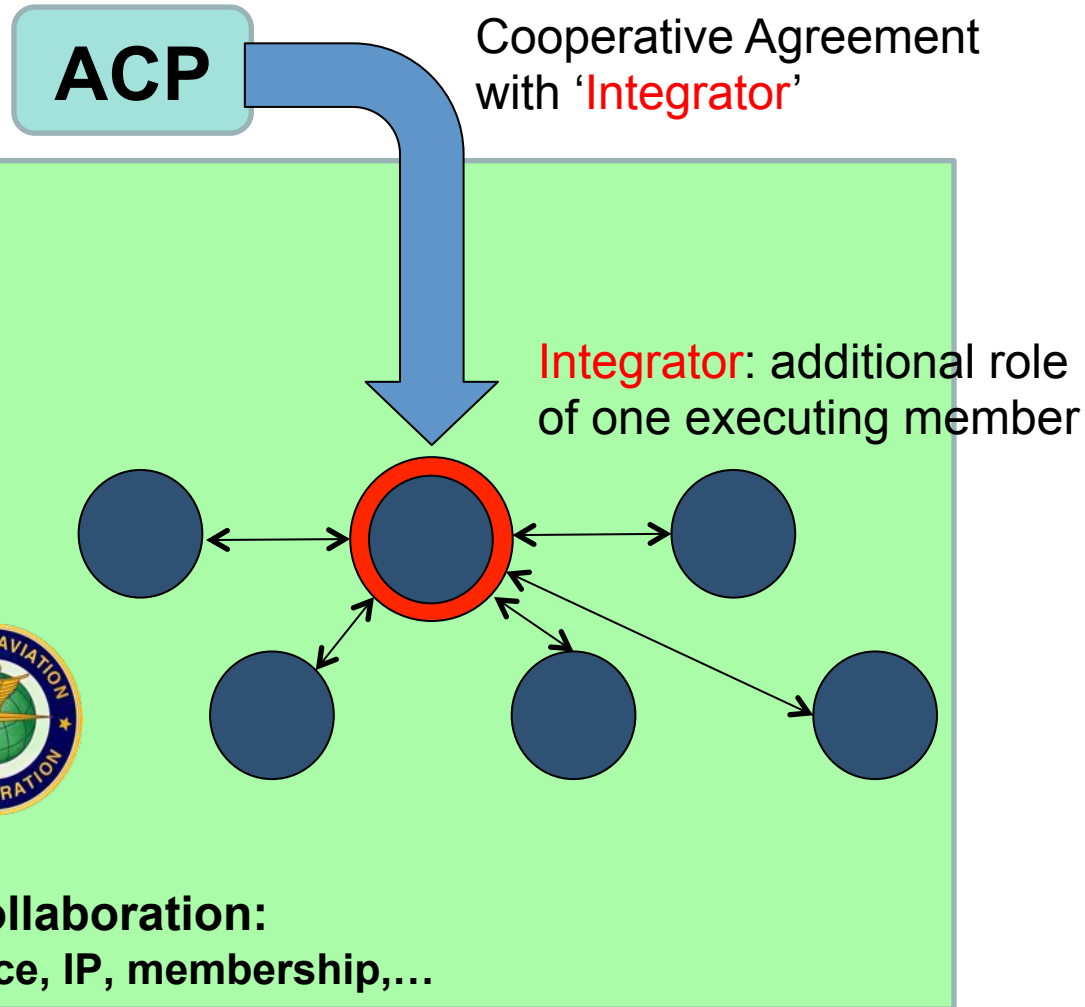
- Project Technical Plan and Management Structure
- Consortium Formation
- Results of Recent Reviews at NASA HQ
 - Project Formulation Review
 - Non-Advocate Review of Consortium as PPP
- Path Forward
 - Strengthening FAA and DOD Relationships
 - ACC Integrator Selection
 - ACP and ACC Green Light

Strengthening FAA and DoD relationships

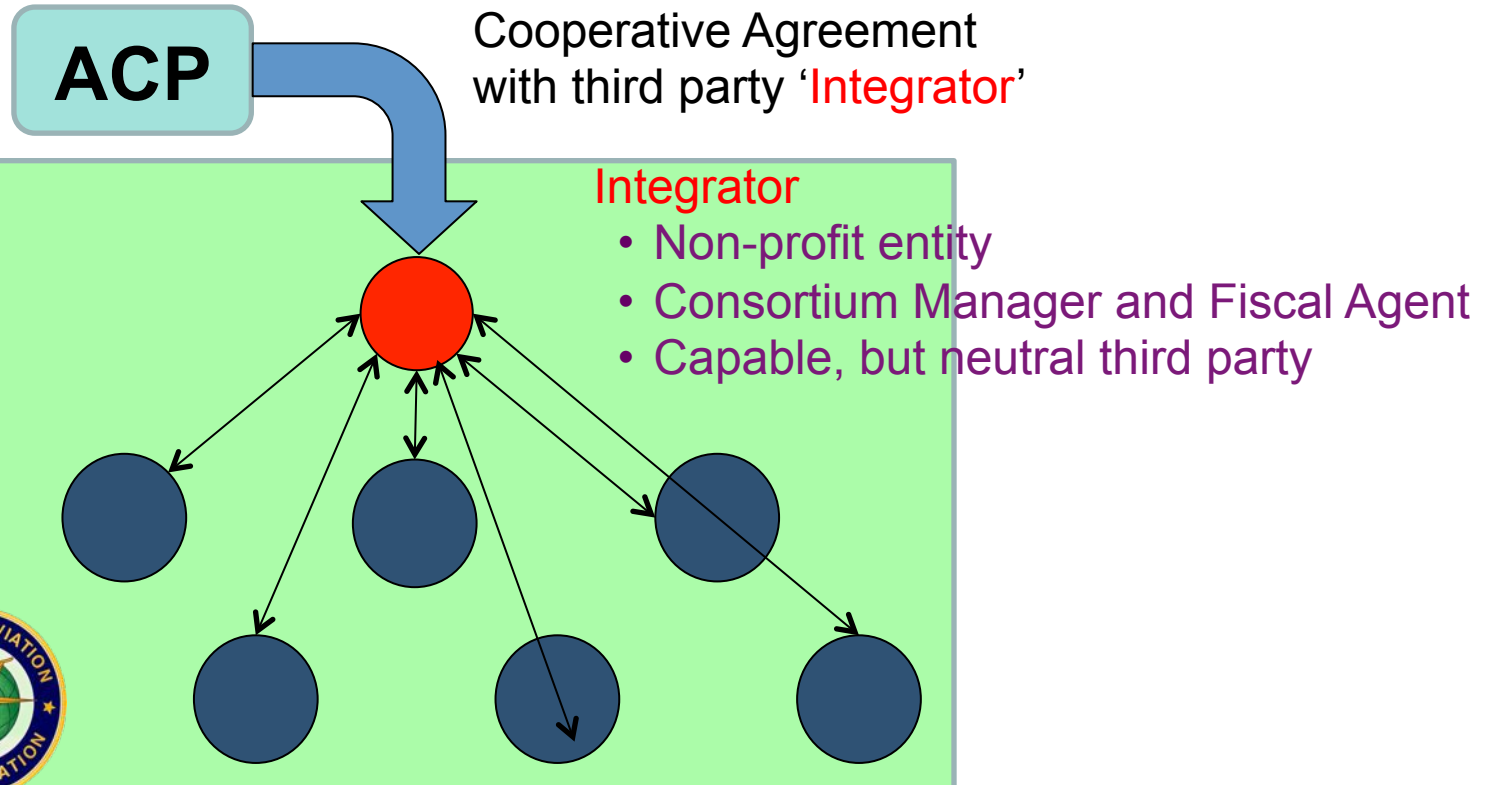


- FAA providing stronger relationship with ACC
 - Secured commitments for personnel to support ACC operation
 - Voting member with representatives on TOC and ESC
 - Minor additions to the AoC to define FAA role
- DoD
 - Continued interaction on AFRL Certification of Composites Initiative
 - Formal coordination on developing: “National Plan for Composite Aircraft Structures R&D - Technology Gap Assessment to Guide National Research & Development (R&D) Efforts Aimed at Structural Certification and Continued Airworthiness”
 - AFRL expressed interest in future ACC membership

ACC Integrator Selection: Original Plan



ACC Integrator: Independent Third Party



Articles of Collaboration:
ACC governance, IP, membership,...

Integrator Selection:

- Modify ACC documents:
 - Commercial firms: provisions unchanged
 - Added provisions apply only to non-profits
- Dec. 1: Award Cooperative Agreement to Integrator meeting project needs

ACP / ACC Green Light

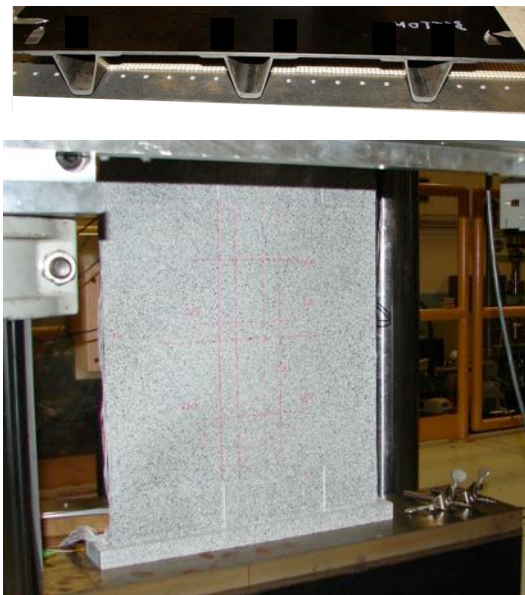


- NASA internal research is underway:
 - Testing and analysis method development
 - Partnership development
 - NRA topics have been drafted
 - SOW's are being issued
 - Facility capability enhancement
- ACC getting underway in next month
 - ACC pre-work: complete POP/PEP
 - Define process for adding members
 - Review/prioritization of technical plans
 - Develop Work Activities and assemble Cooperative Research Teams (CRTs): ready to award
 - Fund under Cooperative Agreement, or
 - Consider using alternative contracts in interim
 - Aug. 11: Initial face-to-face meeting of “Virtual” ESC and TOC

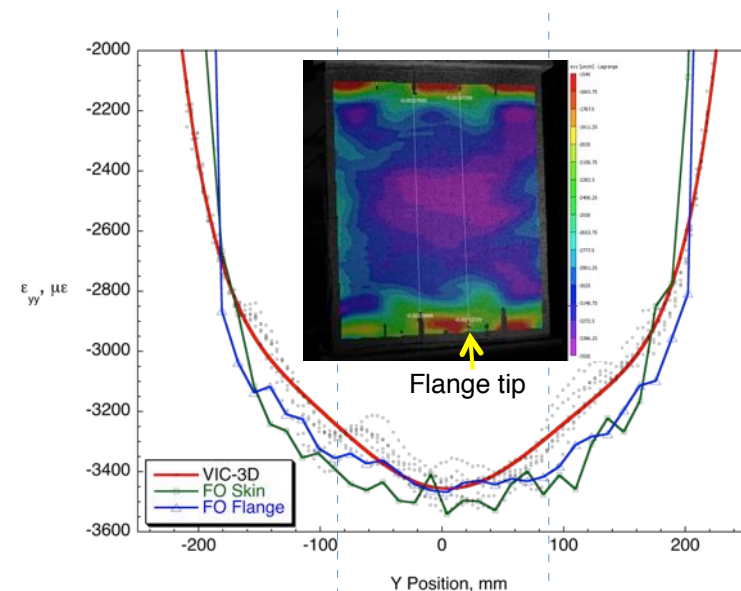
Notable Research Activities



- **Cyclic Testing of Three-Stringer Panel with Barely Visible Impact Damage (BVID), LaRC in partnership with Bell and Sikorsky**
 - Impact/fatigue three-stringer subcomponent. Document growth of damage before failure.
 - 100,000 cycles to 60,000 lbs, and 86,000 lbs completed. Series initiated at 98,000 lbs.
 - During loading, damage monitored using passive thermography, acoustic emission, and fiber optic strain sensors. No damage growth was detected.
 - Will provide validation test data for durability and damage tolerance models AND provide evaluation of multiple NDE technologies for detecting and quantifying damage



3-stringer panel with barely visible impact damage (BVID)



Strains : fiber optic (FO) and digital image correlation (VIC-3D) at flange tip at 98,000 lbs

Notable Research Activities (cont.)



- **Testing of Shielding Concepts for Open Rotor Engines at China Lake Naval Air Warfare Center; GRC in partnership with FAA**
 - Test involved explosively releasing two composite fan blades from a T406 jet engine running at 1120 rpm
 - According to the FAA, this is the first time a test like this has ever been conducted
 - The test was fully successful with the two blades separating at precisely the right time to impact the panels in the desired orientation
 - Blade penetrates 20 ply shield, and deflects off 24 ply shield, as predicted by analysis
 - POC Dr. Gary Roberts

24 ply
Shield

Blades
Rotating at
1120 RPM

20 ply
Shield

Composite blades explosively
released and impact
respective shields

Top blade
deflects off
24 ply shield

Bottom blade
penetrates
20 ply shield

Upcoming Events



- Aug. 4-7 Composite Materials Handbook Working Group Meeting (CMH-17) in Miami, FL
 - Forum – Advanced Composite Structural Developments by Federal Agencies
 - FAA
 - NASA ACP
 - DoD: AFRL and Navy
 - DARPA: Open Manufacturing
 - National Institute of Standards & Technology (NIST)
 - DoE: "Advanced Composites for Clean Energy"
- Aug. 11: First face-to-face meetings of the ACC virtual Executive Steering and Technical Oversight Committees
- Aug. 14: TIM with ACP, Composites for Exploration Upper Stage (EUS) John Vickers, Materials Genome Initiative (MGI)
- Sept. 8-11: American Society for Composites Technical Conference in San Diego
 - Kevin O'Brien Invited Plenary Speaker: *Composite Rotorcraft Structures Durability and Damage Tolerance Research*

Summary



- Advanced Composites Project Technical Plan for Phase I: **Developed / Approved**
 - Focus activities to address three Technical Challenges
 - Roadmap plan: details to be developed by gov't./industry team
- Advanced Composites Consortium approach: **Developed / Approved**
 - AoC / CA Provisions have been negotiated / accepted by founding members. Must be accepted by future members.
 - Integrator: Independent, third-party, non-profit entity
 - Selection and Award to be completed by Dec. 1
- ACP **underway** and ACC is **starting up**
 - NASA internal research in execution
 - ACC meeting, moving out to develop and execute collaborative Work Activities