NASA Advisory Council Aeronautics Committee Report

Ms. Marion Blakey
Chair
NASA Headquarters
March 29th, 2017

Aeronautics Committee Membership

Ms. Marion Blakey

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NASA Aeronautics

NASA Aeronautics Vision for Aviation in the 21st Century

6 Strategic Research and Technology Thrusts

T1 Safe, Efficient Growth in Global Operations
- Enable full NextGen and develop technologies to substantially
- Reduce aircraft safety risks

T2 Innovation in Commercial Supersonic Aircraft
- Achieve a low-boom standard

T3A ST T3B VL Ultra-Efficient Commercial Vehicles
- Pioneer technologies for big leaps in efficiency and environmental performance

T4 Transition to Alternative Propulsion and Energy
- Characterize drop-in alternative fuels and pioneer
- Low-carbon propulsion technology

T5 Real-Time System-Wide Safety Assurance
- Develop an integrated prototype of a real-time safety monitoring and assurance system

T6 Assured Autonomy for Aviation Transformation
- Develop high impact aviation autonomy applications

Areas of Interest Explored at Current Meeting

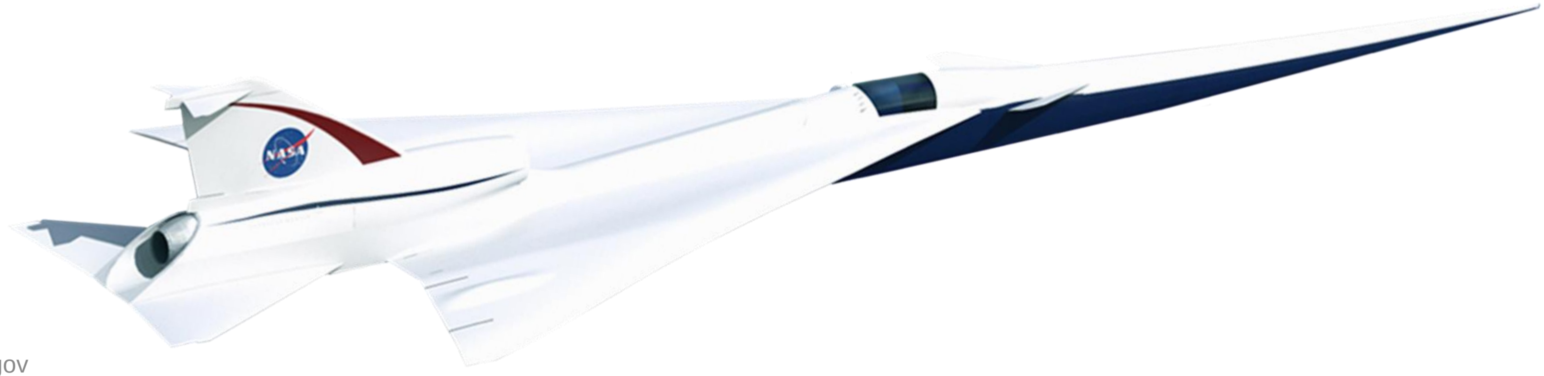
Topics covered at the Aeronautics Committee Meeting held on March 22, 2017 at NASA Headquarters, Washington, DC:

- New Administration and Transition Update*
- ARMD integrated strategy for UAS
- On-Demand Mobility (ODM) Research Strategy*
- UAS/ODM Planning and Integration Discussion*
- Advanced Composites Project (ACP)

* These topics have related findings provided by the Aeronautics Committee

New Administration and Transition Update

- The transition team has shown a strong support for NASA and genuinely wants to learn more about what NASA aims to do
- The NASA ARMD meeting with the transition team has been very productive. Some of the topics of interest have been:
  - UAS technology
  - X-planes
- The budget blueprint was released on Thursday, March 16th, 2017 but the actual budget will be released on or around May 15th.
- Overall positive reception toward budget results for NASA.
- At the blueprint level, Aeronautics can start the Low Boom Flight Demonstrator which is included in the blueprint budget language.



Committee Finding for ARMD AA – Overarching Plan

The Committee finds that the current NASA Aeronautics research portfolio is relevant and forward leaning, much more so than in the past. The Committee endorses the path that ARMD is taking and recognizes that it is headed in the right direction. NASA Aeronautics portfolio has a promising future in meeting National needs, and it is vital that ARMD continue to build strong partnerships with other government agencies and industry.

ARMD Integrated Strategy for UAS Introduction

Purpose

Develop a cohesive ARMD Full UAS integration strategy across NASA Aeronautics Programs

Scope

Focus on what is needed to enable full integration of UAS for civil / commercial operations within the NAS by ~2025.

- Top level strategy that assesses stakeholder needs, FAA UAS integration Strategy, Concept of Operations, Implementation Plans, etc.
- Leverage information from Government-wide R&D Analysis (ExCom) and FAA R&D Roadmap

Outcome

A Vision, Strategic Plan and Communication Strategy for:

- Routine UAS access within the NAS
- Concept for transitioning UAS access advancements towards the integration of highly autonomous systems and on-demand mobility

Enabling Full Integration of UAS for civil / commercial operations within the NAS by ~2025

Background

- UAS Airspace Access Community Needs Assessment
  - NASA completed an internal assessment and gap analysis in 2015
  - NASA stood up an Independent Team in the fall of 2016 to evaluate NASA's internal assessment and to conduct an independent needs/gaps assessment by engaging multiple stakeholders across the UAS community
- NASA is committed to working closely with the FAA, other government agencies (OGAs) and the stakeholder community to insure that NASA investments address critical integration challenges while providing significant benefits to the US Taxpayer
- The two NASA Aeronautics Programs with most UAS-related research worked together to develop a cohesive framework and strategy for achieving full integration of UAS into the NAS, addressing strategic Thrust 6 - Assured Autonomy for Aviation Transformation (briefed in January 2017)

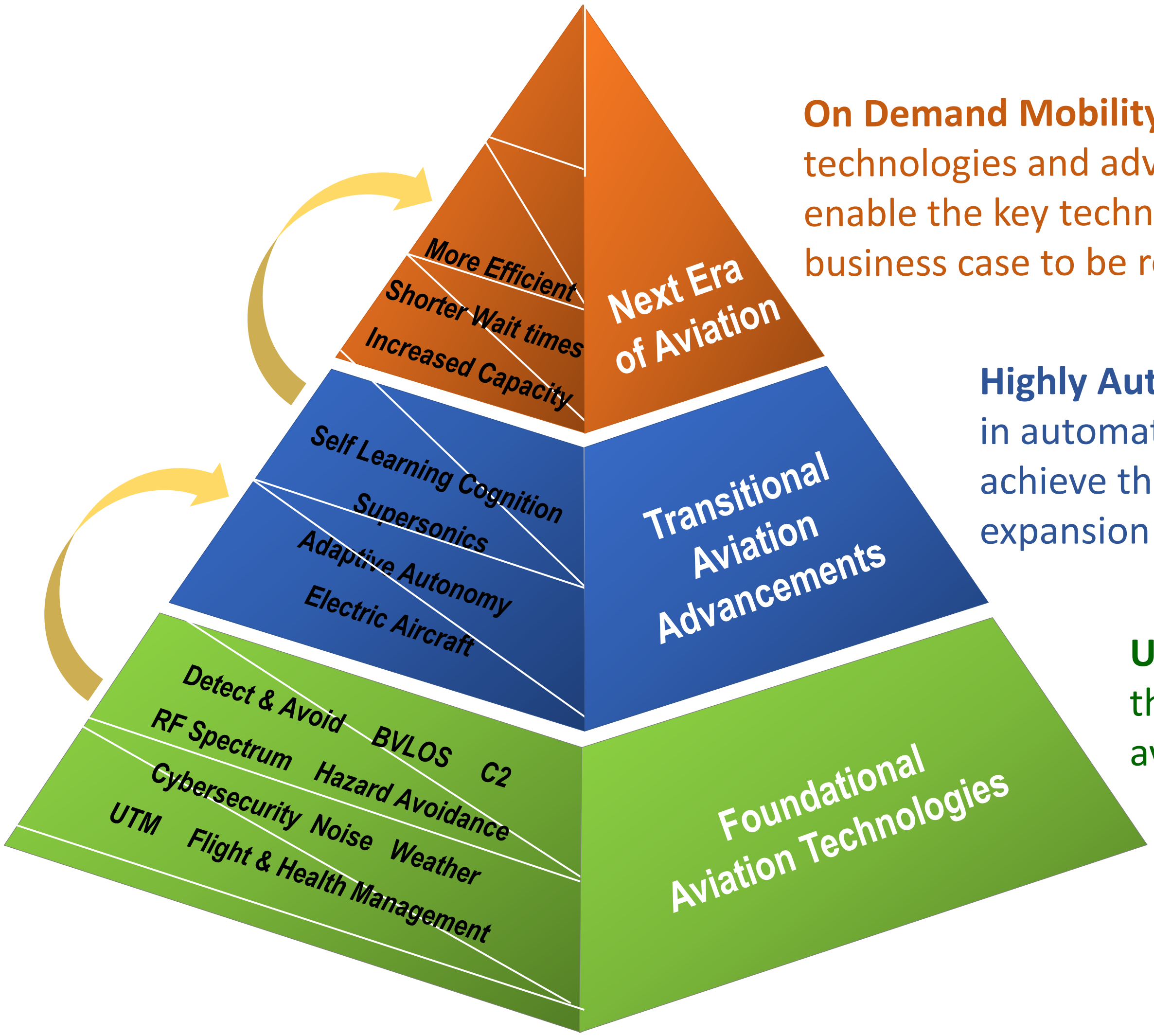
Full UAS Integration Vision of the Future

Manned and unmanned aircraft will be able to routinely operate through all phases of flight in the NAS, based on airspace requirements and system performance capabilities.

Long Term Vision Considerations

- In order for NASA to remain a leader in aviation, the "routine UAS access" roadmaps should be balanced against long term vision considerations (not necessarily tied to today's state of the art)
- Evolutionary Technology Development: leverages systematic development and provides a high probability of achieving the end state (e.g., switchbacks to the top of the mountain)
- Revolutionary Technology Development: new revolutionary technologies are a higher risk to rely on, but provide a shorter path to the end state if achieved (e.g., climb straight up the cliff to the top of the mountain)

Achieving the Next Era of Aviation

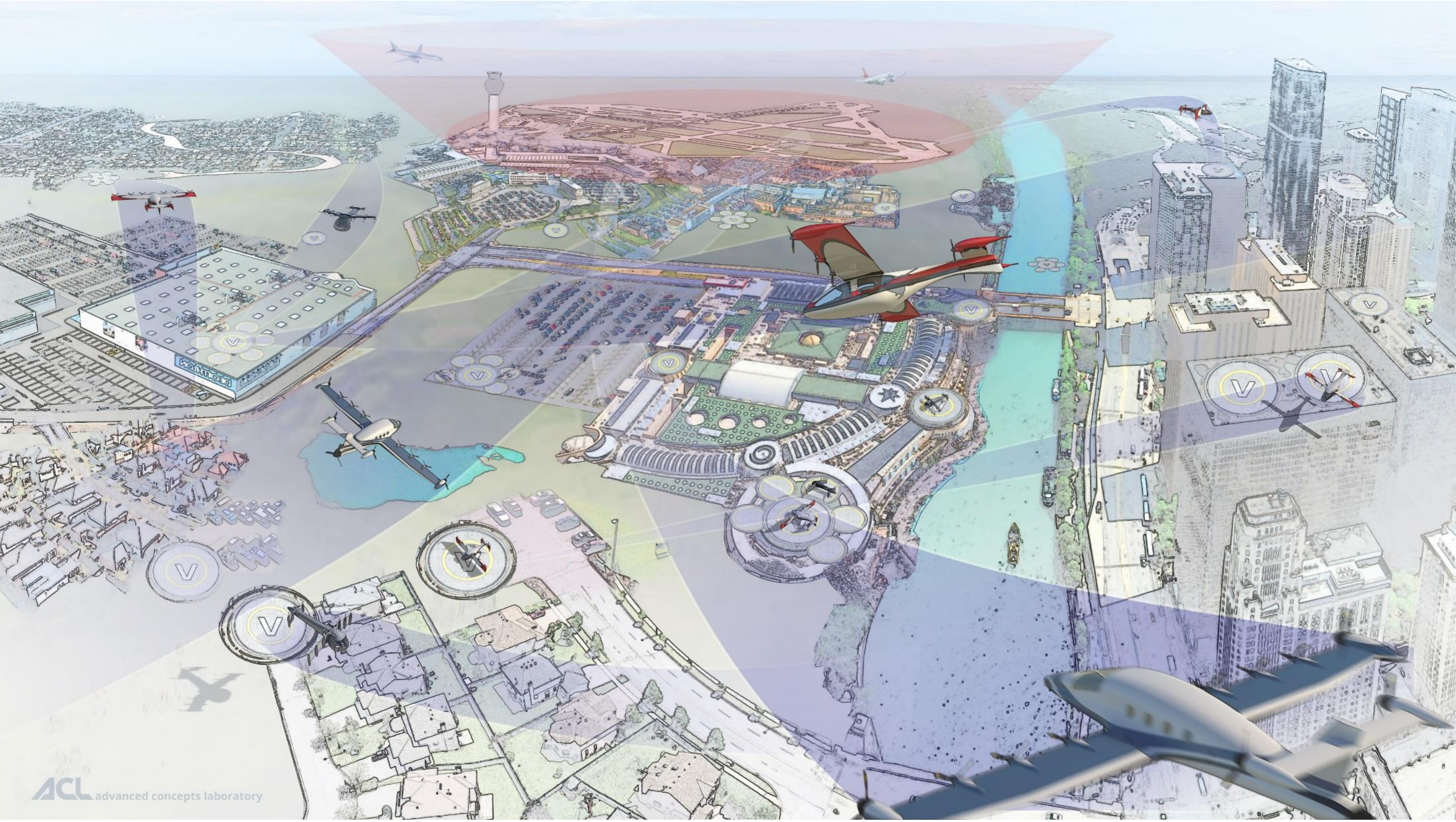


On Demand Mobility - ODM will leverage UAS technologies and advancements in automation to enable the key technologies needed for the ODM business case to be realized

Highly Autonomous Systems – advancements in automation will open the door for UAS to achieve their full potential and market expansion

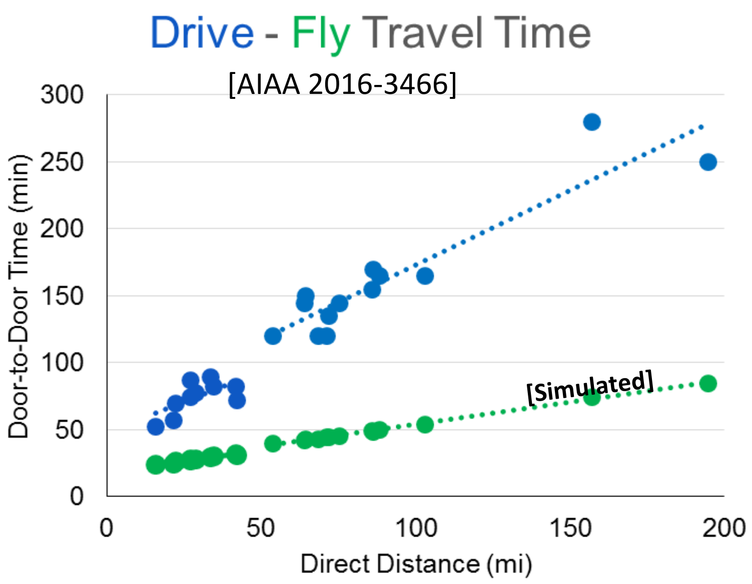
UAS Integration - UAS Integration is the foundation for the revolution of the aviation industry

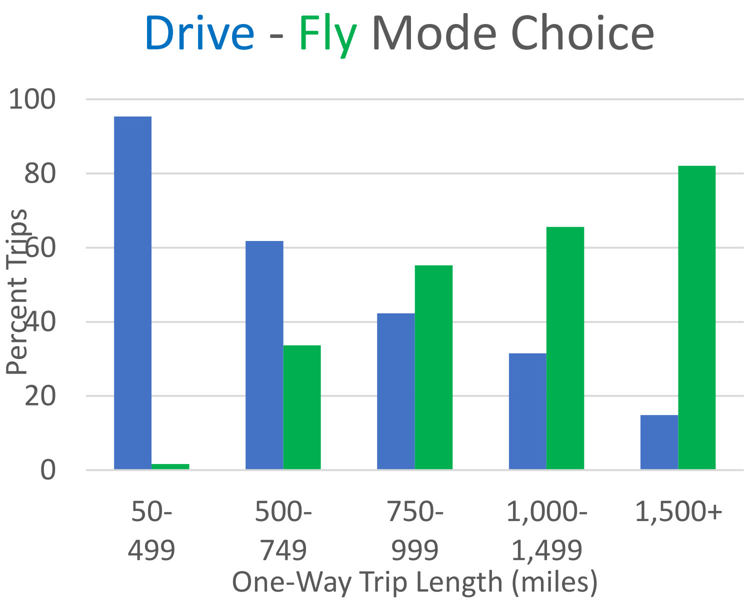
On-Demand Mobility (ODM) Research Strategy



Definition of ODM

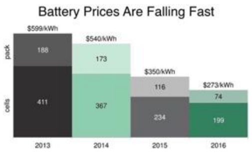
- *Transportation* where users have access to immediate and flexible air travel
  - Users dictate trip origin, destination, and timing
  - 1-9 passengers or equivalent payload
- ~3-4x faster than cars & hub-spoke over ~20-500 mile range





- Currently, cars operate 12x more trips of 50+ miles and >500x more vehicle miles than air travel
  - ODM can bring aviation into our daily lives
- *Emerging industry efforts are focusing on a range of aircraft types and operations* to enable
  - Trips that are not time/cost effective with current air transport, or
  - Have the potential to alleviate city congestion, or other benefits

ARMD’s Strategic Mega-Drivers Converge in ODM



Potential NASA Role & Early Research:

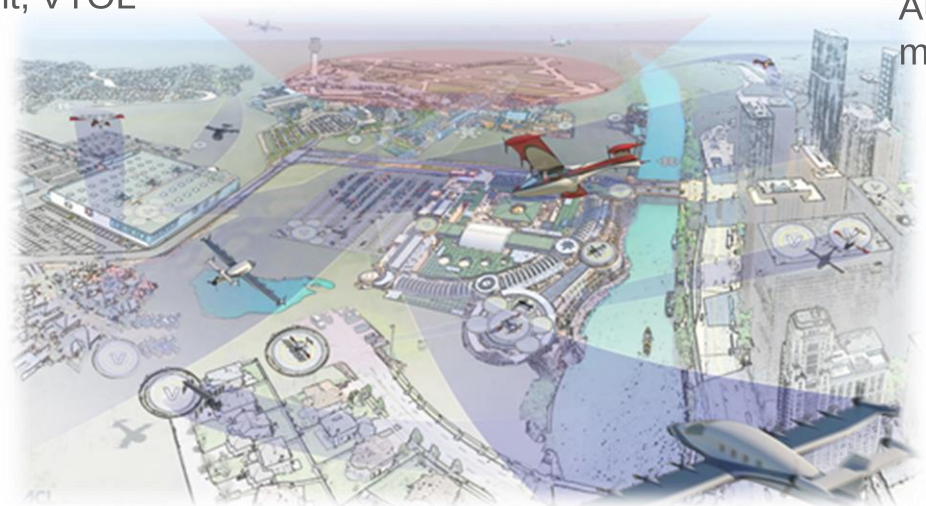
Develop, Validate, and Demonstrate

Primary NASA roles – architect, integrator, technologist, partner

- Build on NASA's leadership, expertise
- Develop system concept that's *deployable* & *scalable*
- Establish and build stakeholder partnerships
- Promote vibrant application space for NASA & external investments
- Integrate aircraft, autonomy, and system

DEP Enabled Small Aircraft
Safe, quiet, efficient, VTOL

Simplified Vehicle Operations
Autonomy and interfaces for manned, self-piloting aircraft



Urban Aviation System Architecture & NAS Integration
Ground and flight guidelines & procedures for high-capacity, urban aviation

ODM Observations

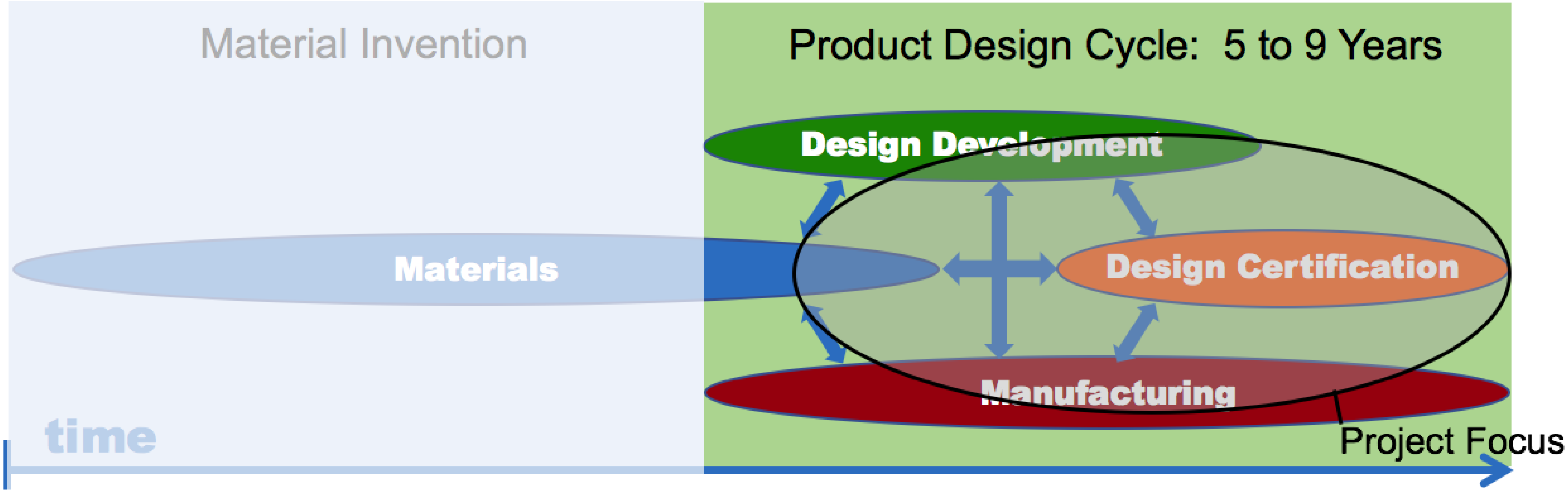
- **NASA is well positioned + respected within ODM community**
- **Community moving quickly: wants our help; can't wait**
    - Silicon Valley optimism + fail fast, learn fast
    - Large organizations with significant burn-rates
    - Plenty of hype: we need to engage smartly + quickly

Committee Finding for ARMD AA on On-Demand Mobility (ODM)

The Committee is encouraged by ARMD's investigation into concepts and technology for On Demand Mobility (ODM). Although this field is in the early stage of development, the Committee recognizes and agrees with the high potential of this emerging market. The Committee recognizes that there is a fundamental question that needs to be answered regarding the roles of government vs. industry. NASA should not try to duplicate anything that industry is doing but focus on the most compelling areas that need to get accomplished by the government. The market is going to drive development of air vehicles but new infrastructure, certification and operational concepts, particularly in light of developments in artificial intelligence and autonomy, will be needed for the industry to flourish. In order for the U.S. to stay competitive and lead in this technology, the Committee believes that NASA needs to focus future work on these other areas in order to help the industry and the public. The Committee encourages NASA to partner with industry to learn a new way of thinking in a fast moving technology field. At the same time, NASA maintaining focus on infrastructure, certification, specifically as it pertains to autonomous systems and operational concepts.

Advanced Composites Project (ACP)

Focus on reducing the time to develop and certify composite materials and structures, helping American industry retain their global competitive advantage in aircraft manufacturing.



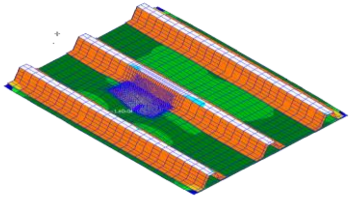
Goal: Reduce product development and certification timeline by 30%.

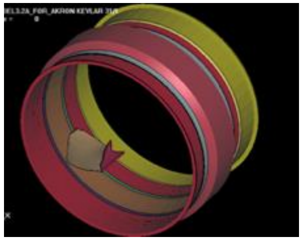
Scope:

- Aeronautics vehicle applications
- Existing material systems
- Finite (5 yr) project duration
- Community team approach

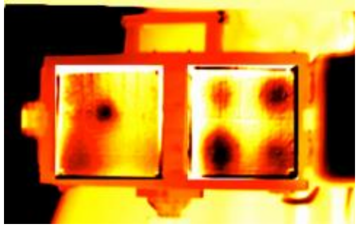
ACP Technical Challenges

TC 1 - Accurate Strength & Life Prediction
Develop validated strength and life prediction tools with known accuracy for complex composite structures and standardized procedures for their reliable use.

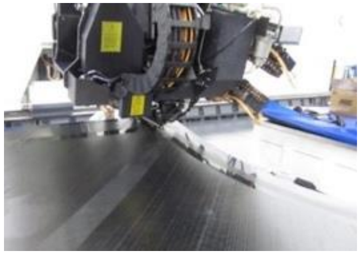




TC 2 - Rapid Inspection & Characterization
Develop and demonstrate NDE systems and enabling technologies to fully inspect and rapidly disposition findings in complex composite structures.



TC 3 - Efficient Manufacturing Process Development
Develop and demonstrate new computational methods to relate manufacturing parameters to defect formation, and connect to commercial design and analysis software to allow structural optimization while resolving predicted manufacturing issues.



Systems Engineering task: to guide development and integration

ACP Technical Challenges

TC 1 - Accurate Strength & Life Prediction

Develop validated strength and life prediction tools with known accuracy for complex composite structures and standardized procedures for their reliable use.

Impact:
- Reduce design iterations
- Reduce validation testing
- Certification: earlier planning and shorter duration

TC 2 - Rapid Inspection & Characterization

Develop and demonstrate NDE systems and enabling technologies to fully inspect and rapidly disposition findings in complex composite structures.

Impact:
- Increase throughput, better quality control; more information early
- Faster development of inspection
- Enable design for inspectability

TC 3 - Efficient Manufacturing Process Development

Develop and demonstrate new computational methods to relate manufacturing parameters to defect formation, and connect to commercial design and analysis software to allow structural optimization while resolving predicted manufacturing issues.

Impact:
- Fewer iterations and quality issues
- Greater process control, aides in Production Certification
- Accounting of manufacturing constraints improves preliminary designs, reducing rework

Systems Engineering task: to guide development and integration

Team Approach: NASA and Partners

NASA
- Technology
- Science
- Team building

Academia
- Fundamentals
- Fresh ideas
- Future Workforce

Industry
- Real issues
- Expertise
- Tech Transition

FAA
- Advice on Certification
- Safety implications

Advanced Composites Consortium (ACC):
public-private partnership for collaborative gov't – industry research

NASA Research Announcement (NRA): open competition

Advanced Composites Consortium

Approach:

- Solicit partners to form with NASA and FAA a public-private partnership (PPP)
- Assemble multi-member government-industry cooperative research teams around common challenges, with costs and products shared by team members
- Pre-negotiated IP terms for collaboration

Benefits of PPP

- Assembles highly skilled diverse team representing multiple stakeholders
- Connects government research and industry needs
- All stakeholders bring individual strengths and share benefits of outcomes
- Leverages resources including expertise for maximum advancement
- FAA provides unified guidance and receives Industry coordinated approaches
- Promotes tech standardization and acceptance

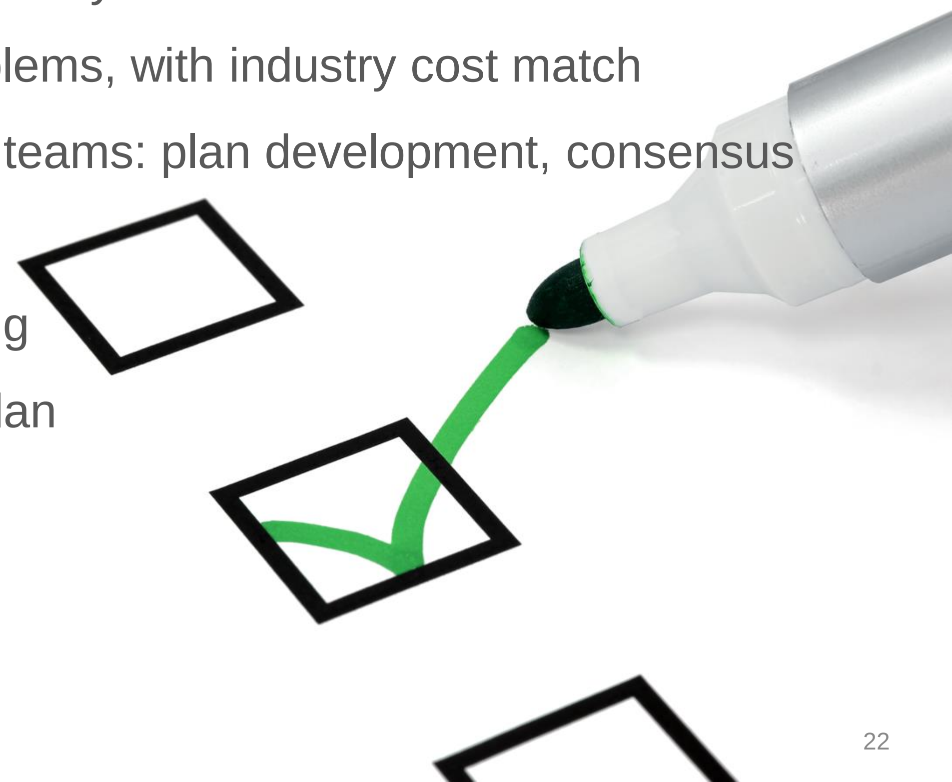
Challenges

- Significant lead-time: consortium formation and multi-member projects
- Partner reliability: resource priorities, corporate dynamics
- Industry cost match may not be realized (IRAD limited, dynamic & competitive)
- Distributed research teams may not be efficient; communication challenge
- Administrative overhead (technical and financial)

Advanced Composites Project (ACP)

Project Manager’s Assessment

- ACP + ACC = unusual opportunity at an important time
  - Tremendous team
    - Talent and diversity
    - Scientists ➔ Practitioners
    - NASA, FAA, Multi-industry, University
  - Sufficient resources on focused problems, with industry cost match
  - ACC enables collaborative research teams: plan development, consensus building, sharing results
- Achieved Phase 1 successes and learning
- Expanded team and approved detailed plan for Phase 2
- Well positioned for execution of Phase 2



2017 NAC Aeronautics Committee Work Plan

SPRING	SUMMER	FALL
ARMD integrated strategy for UAS **(Completed)**	ARMD FY18 Budget	System Wide Safety Assurance Project
On-Demand Mobility **(Completed)**	NAH Planning and Management Status	University Leadership Initiative
Advanced Composites Project **(Completed)**	Low Boom Flight Demonstrator (LBFD)	Autonomy Thrust
New Administration and Transition Update **(Completed)**	Airspace Technology Demonstrator (ATD)	Hypersonics Update

BACK-UP

ARMD Integrated Strategy for UAS Summary

NASA Aeronautics is committed to working with policy makers and regulators to insure safe, secure and efficient comprehensive UAS assess to the NAS for commercial operators

- **This includes working with the FAA, DoD and OGA to provide high, quality, timely research on the barriers to safe interoperability with manned aircraft throughout the NAS**

Acronyms

- ACC – Advanced Composites Consortium
- BVLOS – Beyond Visual Line-of-Sight
- C2 – Command and Control
- DEP – Distributed Electric Propulsion
- ExCom – Executive Committee
- IRAD – Internal Research and Development - the money/investment a company invests in their own research
- NAH – New Aviation Horizons
- NDE – Non-Destructive Evaluation (Other variants that are often used are Non-Destructive Inspection (NDI) and Non-Destructive Testing (NDT).)
- OGA – Other Government Agencies