



Aviation's Big Questions

Robert A. Pearce
Director, Strategy, Architecture, and Analysis Office
Aeronautics Research Mission Directorate
September 26, 2014
NRC Aeronautics Research and Technology Roundtable



Convergent Aeronautics Solutions:

A New Seedling Approach

Focus on Big Questions

Focus on major system level questions and challenges that require NASA and the aviation community to think beyond current concepts, architectures and relationships

Maximize Economic Benefit of UAS

Can we safely and unobtrusively integrate UAS's into urban environments?

Zero-Emission Air Transportation
On-Demand Aviation

Develop Questions and Challenges with the Aviation Community

Conceive New Multi-Disciplinary Solutions

Multi-disciplinary NASA teams develop proposed new “convergent” solutions focused on proving feasibility and value of concepts

Convergent Electric Propulsion Technology

Proposal for Significant Reduction in Energy Consumption

Fund Rapid Feasibility

ARMD funds 1 – 3 year feasibility R&D for the most promising and innovative solutions that have the potential to be game-changers for the aviation community.



Proposed Convergent Solutions

Partnerships, Experimentation & Analysis for Feasibility

Review with Aviation Community / Transfer or Terminate

Each project will be reviewed in depth initial and criteria for success will be established. Efforts are transferred into Mission Programs, out to the aviation community or are documented and terminated based on how well the criteria were met.

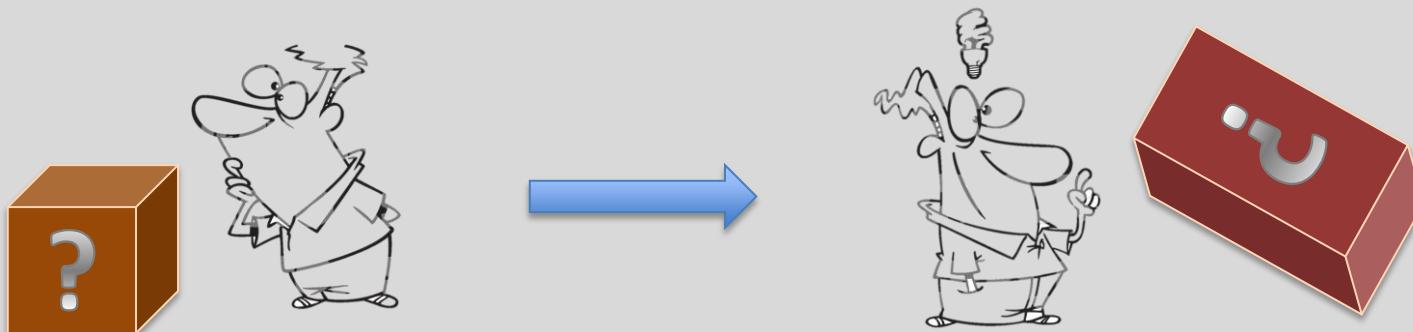


Demonstration, Dissemination and Transfer



The Big Questions Philosophy

- Strong desire to change how we look at our research questions.
 - Otis Elevator example: How do we get rid of the equipment room at the top of the shaft? vs How do we design a more efficient elevator?
- How do we make the change?
 - By encouraging the re-conceptualization of solutions to aviation challenges
 - By looking at our aviation challenges from a different perspective
 - By changing the scope of the challenge
 - Integrate or converge domains
 - By enforcing constraints rather than trying to remove them.
 - Can we solve the problem within the current constraints by looking at the problem differently?





NASA Aeronautics Six Strategic Thrusts



Safe, Efficient Growth in Global Operations

- Enable full NextGen and develop technologies to substantially reduce aircraft safety risks



Innovation in Commercial Supersonic Aircraft

- Achieve a low-boom standard



Ultra-Efficient Commercial Vehicles

- Pioneer technologies for big leaps in efficiency and environmental performance



Transition to Low-Carbon Propulsion

- Characterize drop-in alternative fuels and pioneer low-carbon propulsion technology



Real-Time System-Wide Safety Assurance

- Develop an integrated prototype of a real-time safety monitoring and assurance system



Assured Autonomy for Aviation Transformation

- Develop high impact aviation autonomy applications



Big Questions Prototypes

- **BQ: Can we make a small airplane as easy to fly as a car is to drive, but as safe as commercial airline operations?**
- **Context:** General aviation safety is still very poor despite many improvements in pilot displays and the implementation of significant automation. Safety is associated with high levels of pilot skill, which is hard to for many to maintain when operating an aircraft in a non-professional capacity. Safety is generally attributed by the industry to be the major hurdle for greater utilization of general aviation aircraft in the transportation system.

- **Associated Thrusts:**



Safe, Efficient Growth in Global Operations



Autonomy for Aviation Transformation

- **BQ: Can we 4D manufacture an aircraft (3D printing plus automated assembly)?**
- **Context:** Aircraft manufacturing is a capital intensive industry that requires significant numbers of aircraft be built over many years (decades) to recoup investments. However, aircraft operations could be much more efficient if aircraft were tailored for specific markets. Highly flexible and automated additive manufacturing and assembly could potentially enable high levels of aircraft customization without incurring the high fixed tooling costs for each unique aircraft configuration.

- **Associated Thrusts:**



Autonomy for Aviation Transformation



Ultra-Efficient Commercial Aircraft



Discussion

- What are the aviation challenges?
 - What areas do you think we should focus on to find big questions?
 - Do you have ideas on what the big questions are?
 - What areas need a new perspective approach to be solved, or result in game changing