National Aeronautics and Space Administration

ARMD Strategic Thrust 6:
Assured Autonomy for Aviation Transformation

Roadmap, Part 2: Advancement Strategies

Mark Ballin
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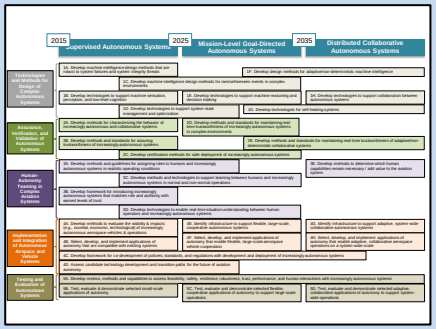
Roadmap Elements

Three parallel and interdependent elements to achieve the Vision

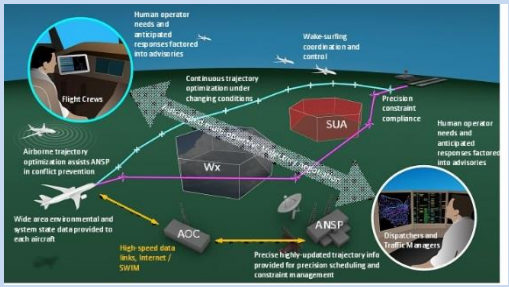


Research Challenges

Technical activities to achieve knowledge breakthroughs and advance aviation autonomy capabilities

Advancement Strategies

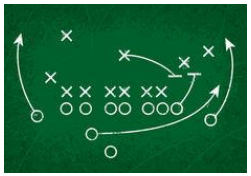
Approaches employed by NASA to achieve aviation autonomy objectives



Mission Products

Targeted NASA and community capabilities that facilitate a viable path toward mature and widespread aviation autonomy

Vision



Advancement Strategies

1. Address critical autonomy barriers that require unique NASA contributions
2. Leverage initial technologies to insert autonomy into operational environments, and then build on experience (Evolutionary Autonomy)
3. Develop and demonstrate radical breakthrough autonomy concepts, technologies, and mission products (Revolutionary Autonomy)
4. Advance autonomy technologies by developing mission products that leverage the explosive growth and rapid development cycles of unmanned aerial systems
5. Leverage large investments in non-aviation autonomy technologies by repurposing those technologies for aviation
6. Provide community coordination and leadership to achieve research advances and implement selected applications

Assured Autonomy for Aviation Transformation
Strategy 1

Address critical autonomy barriers that require unique NASA contributions and leadership

- 1a: Design and behavior of complex adaptive engineered systems
- 1b: System assurance and certification
- 1c: Relationships between humans and machines, including operator and societal trust
- 1d: System requirements and standards to facilitate integration and implementation
- 1e: Methods and capabilities to test and evaluate autonomous systems

Research Themes and Challenges embody Strategy 1

Assured Autonomy for Aviation Transformation
Strategies 2 and 3

Parallel Autonomy Advancement Paths

Strategy 2: Evolutionary Autonomy

- Provide incremental benefits by inserting advanced technology into existing systems
- Gain confidence and refine capabilities from technology insertion experiences
- Specific Objectives:
  - 2a: Provide early direct benefits to users
  - 2b: Address acknowledged aviation safety issues

Strategy 3: Revolutionary Autonomy

- Explore limits of knowledge and capabilities through grand challenges
- Enable future possibilities unconstrained by legacy systems and practices

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Strategies 2 and 3

Autonomy Advancement Paths Comparison

Thrust 6 Strategy 2: Evolutionary Autonomy (EA)

- Opportunity-driven
- Mission-enhancing; mission can be performed without autonomy capabilities, but not as well
- Perform existing functions in new ways using autonomy capabilities
- Push technical advancements through incremental establishment of value. Benefit: leverages stakeholder investments
- Apply autonomy capabilities within existing regulatory, infrastructure, and cultural constraints

Thrust 6 Strategy 3: Revolutionary Autonomy (RA)

- Clean sheet design-driven
- Mission-enabling; mission cannot be performed without making use of autonomy capabilities
- Perform new functions using autonomy capabilities
- Push technical advancements using risk-seeking stretch challenges. Benefit: supports technology breakthroughs
- Advance autonomy with few constraints imposed by legacy systems, legacy infrastructure, regulatory policies, or culture

Strategy 6: Community Coordination and Leadership

Getting Started

- Identify community stakeholders, their different needs and objectives, and their potential roles in civil aviation autonomy
- Establish approach for achieving community goals and objectives
  - Set agenda and identify participants for community meetings
  - Establish appropriate partnership agreements with community stakeholders
  - Form and lead workshops on specialized topics within civil aviation autonomy
- Determine technical areas in which NASA will lead, collaborate, or leverage
  - For “lead” areas, take steps to establish leadership
    - Develop concepts of operations and project plans
    - Identify workforce, facility, and other resource needs
- Provide strawman research agenda (i.e., Strategic Thrust 6 Roadmap) as precursor to developing a national research agenda