FAA UAS Integration Research Plan

Presented to: REDAC SAS Subcommittee

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Section 2211: Unmanned Aircraft Systems Research and Development Roadmap

- **2016 Reauthorization Requirement**
  - *Summary: FAA, NASA, and stakeholders in industry and academia shall develop a roadmap of the cost estimates, planned schedules, and benchmarks, including specific tasks, milestones, and timelines for integrating UAS into the NAS. The roadmap shall include how to use research and development, assessments of abilities to integrate the UAS, and update on the advancement of various technologies.*

Full Text: https://www.congress.gov/bill/114th-congress/house-bill/636/text/pl

FAA UAS Integration Research Plan

- **Major Sections of the Plan**
  - Alignment to FAA's Strategic Priorities
  - FAA's Applied Research Approach
  - UAS Integration Landscape
  - UAS Research Collaboration & Partnerships
  - UAS Research Functional Areas
  - UAS Research Domains
  - Operational Capabilities Towards Full UAS Integration
    - Timelines reflecting Completed, In Process, Planned and Needed UAS Research
  - Conclusion

Alignment to FAA's Strategic Priorities

Federal Aviation Administration

FAA Strategic Priorities

- Make aviation safer and smarter
- Deliver benefits through technology and infrastructure
- Enhance Global Leadership
- Empower and innovate with the FAA's people

FAA Priority Initiatives

- Risk-Based Decision Making
- National Airspace System Initiative
  - Integrate new entrants
- Global Leadership Initiative
- Workforce of the Future

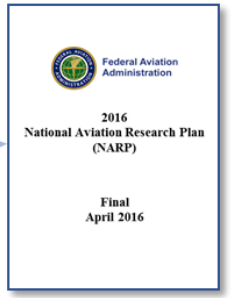
UAS Strategic Priorities

- Safety
- Adaptability
- Global Leadership

UAS Integration

Five-year UAS Integration Approach

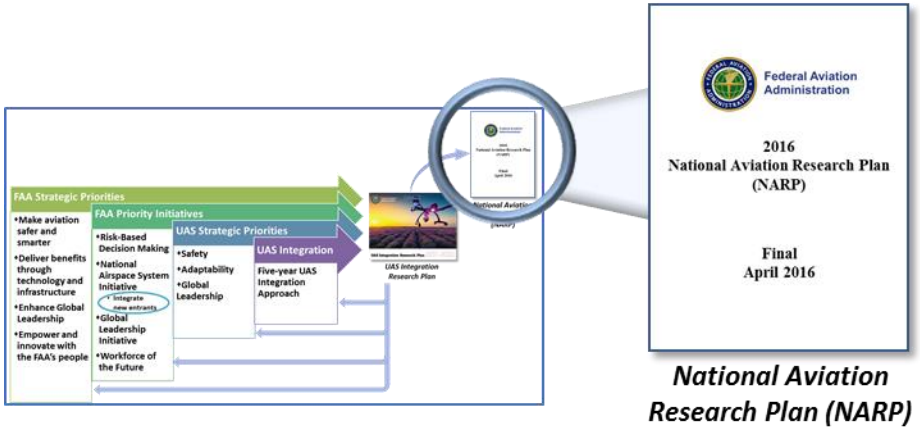
UAS Integration Research Plan



National Aviation Research Plan (NARP)

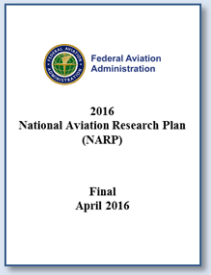
The UAS Integration Research Plan aligns with FAA Strategic Priorities and Initiatives and informs the NARP

National Aviation Research Plan: Alignment of Research Planning Framework and Terminology



National Aviation Research Plan (NARP)

UAS Integration Research Plan

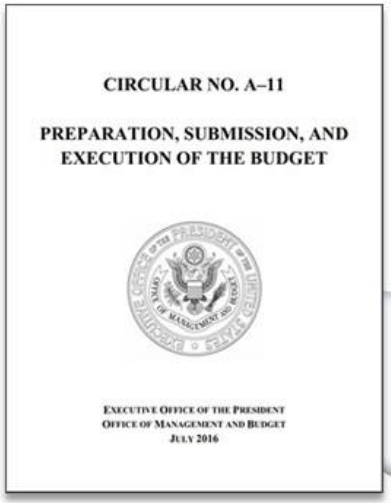


National Aviation Research Plan (NARP)

FAA Strategic Priorities	Outcomes
Operational Capabilities	Goals
Research Activities/Needs	Objectives
Research Results	Outputs

FAA's Research Approach

OMB Circular A-11, Section 84.2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PREPARATION, SUBMISSION, AND EXECUTION OF THE BUDGET

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF MANAGEMENT AND BUDGET
JULY 2016

1. **Basic research**

   Experimental or theoretical work for acquiring new knowledge of the underlying causes and based on observable facts.

2. **Applied research**

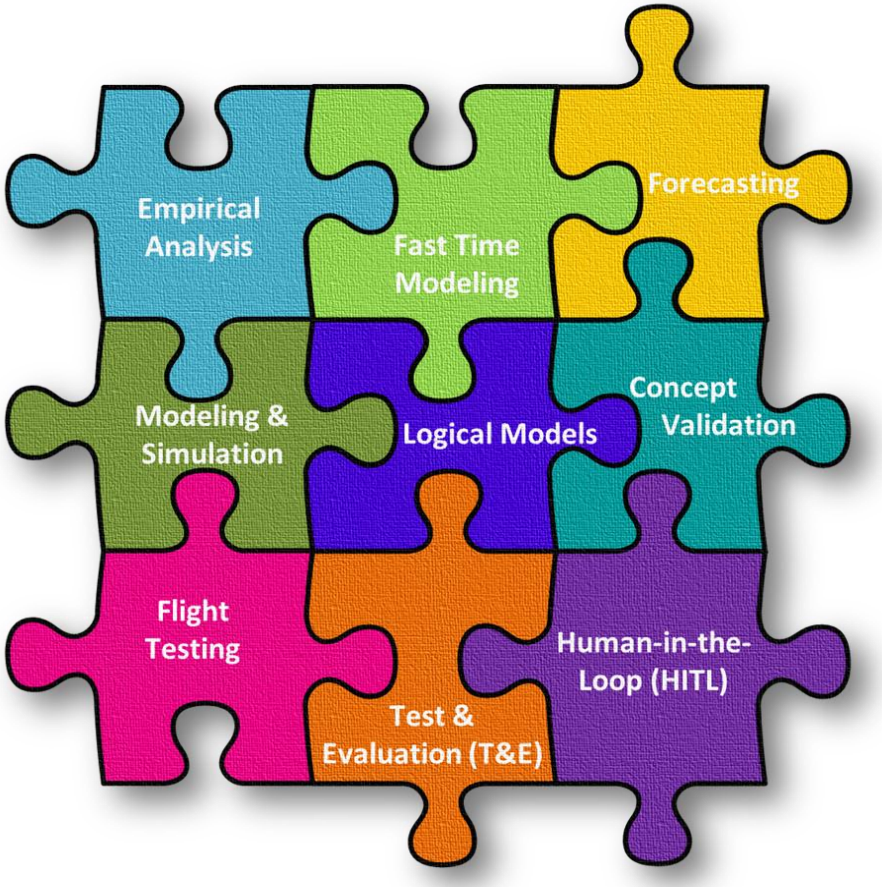
   Original investigation directed primarily towards a specific practical aim or objective.

3. **Experimental development**

   Creative and systematic work directed at producing new products or improving existing products or processes. Experimental development will result in gaining additional knowledge.

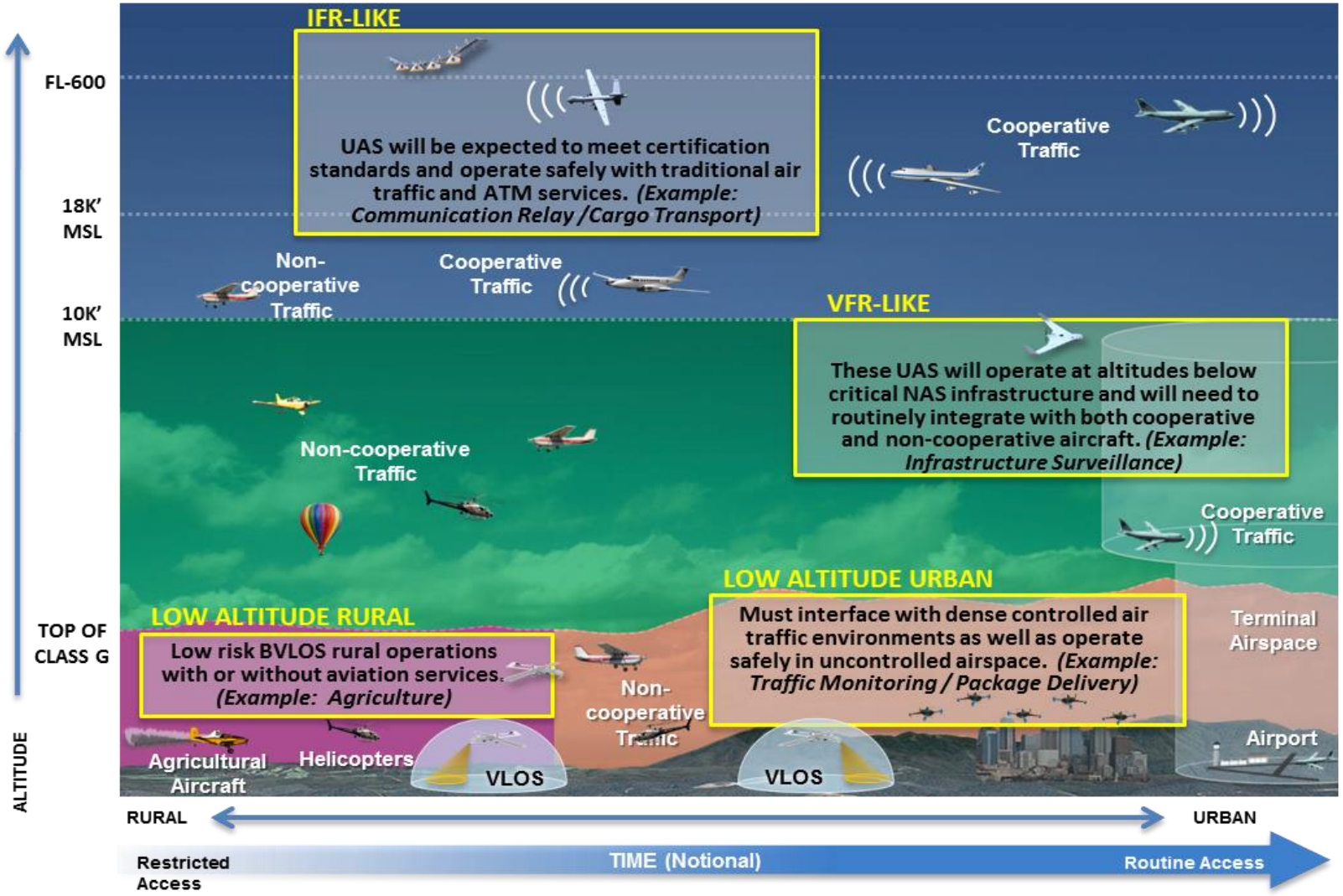
FAA's Applied Research Methods

What is applied research?

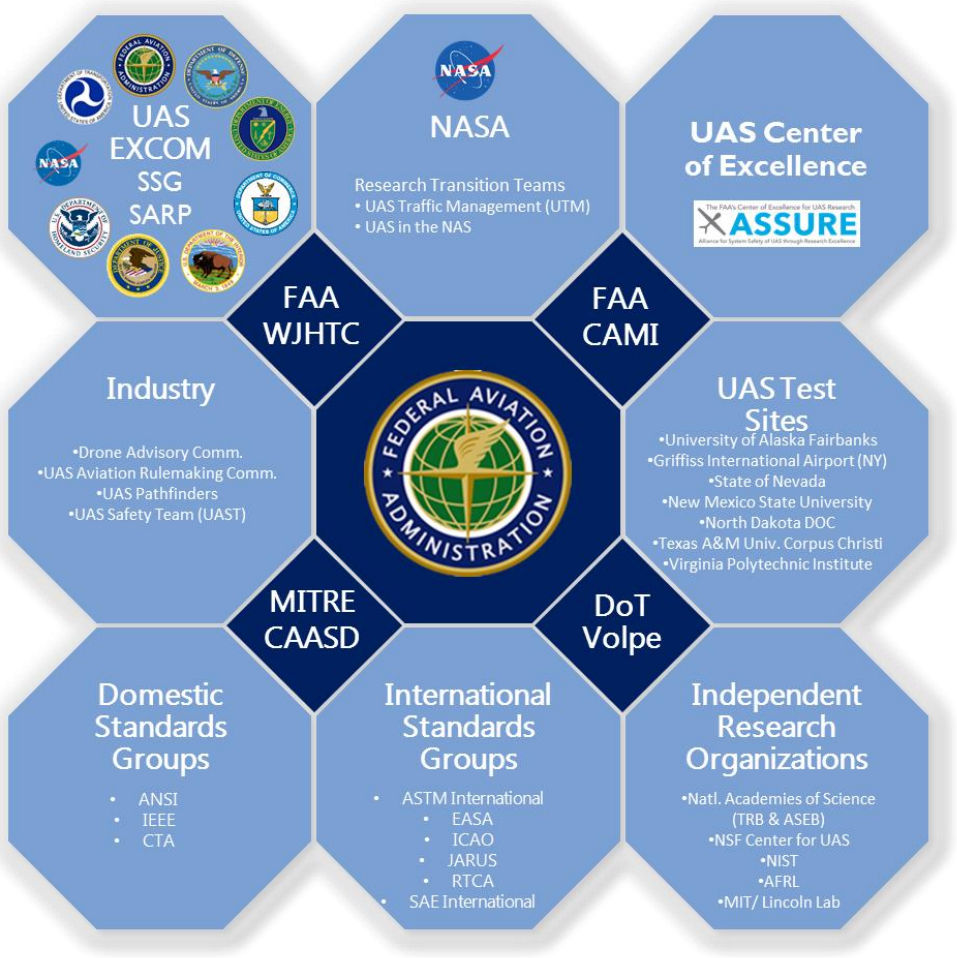


Applied research is directed towards a specific practical aim or objective.

UAS Integration Landscape



UAS Research Collaboration & Partnerships



- *AFRL: Air Force Research Lab*
- *ANSI: American National Standards Institute*
- *ASEB: Aeronautics and Space Engineering Board*
- *ASSURE: Alliance for System Safety of UAS through Research Excellence (FAA's Center of Excellence for UAS)*
- *ASTM: American Society for Testing and Materials*
- *CAASD: Center for Advanced Aviation Systems Development*
- *CTA: Consumer Technology Association*
- *EASA: European Aviation Safety Agency*
- *EXCOM SSG: Executive Committee Senior Steering Group*
- *FAA CAMI: Civil Aerospace Medical Institute*
- *FAA WJHTC: William J. Hughes Technical Center*
- *ICAO: International Civil Aviation Organization*
- *IEEE: Institute of Electrical and Electronics Engineers*
- *JARUS: Joint Authorities for Rulemaking on Unmanned Systems*
- *NIST: National Institute of Standards and Technology*
- *NSF: National Science Foundation*
- *SARP: Science and Research Panel*
- *TRB: Transportation Research Board*

UAS Research Collaboration & Partnerships

- **FAA Internal Collaboration**
  - FAA William J. Hughes Technical Center (WJHTC)
  - FAA Civil Aerospace Medical Institute (CAMI)
  - MITRE Center for Advanced System Development (CAASD)
  - DOT Volpe, National Transportation Systems Center
- **Interagency Collaboration & Partnerships**
  - UAS Executive Committee (EXCOM)
    - EXCOM Senior Steering Group (SSG)
    - EXCOM SSG UAS Science and Research Panel
  - NASA
    - UAS in the NAS
    - Low Altitude UAS Traffic Management (UTM)

UAS Research Collaboration & Partnerships *(continued)*

- **The FAA's Center of Excellence for UAS Research (ASSURE)**
- **UAS Test Sites**
- **Independent Research Organizations**
  - National Academies of Science
  - National Science Foundation Center for UAS (NSF C-UAS)
  - National Institutes of Standards and Technology (NIST)
  - Air Force Research Lab (AFRL)
- **Industry**
  - Cooperative Research and Development Agreements
  - Partnerships for Safety Program
  - Drone Advisory Committee (DAC)
  - UAS Advisory and Rulemaking Committees (ARC)
  - UAS Safety Team (UAST)
  - Pathfinders

UAS Research Collaboration & Partnerships *(continued)*

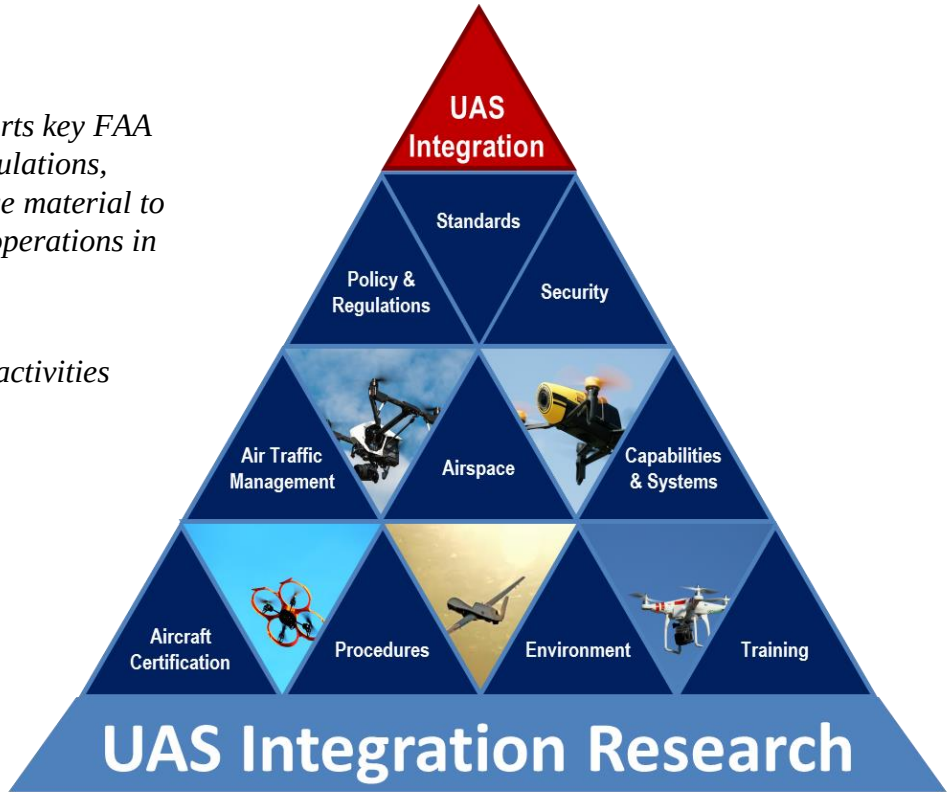
- **Domestic Standards Groups**
  - American National Standards Institute
  - Institute of Electrical and Electronics Engineers
  - Consumer Technology Association
- **International Standards Groups**
  - ICAO
  - Joint Authorities for Rulemaking on Unmanned Systems (JARUS)
  - Civil Air Navigation Services Organization
  - North Atlantic Treaty Organization Flight in Non-Segregated Airspace (NATO FINAS)
  - International Telecommunications Union
  - European Organization for Civil Aviation Equipment (EUROCAE)
  - RTCA
  - SAE International
  - ASTM International

UAS Research Functional Areas

UAS Integration Research Functional Framework

UAS integration research supports key FAA mission functions to publish regulations, policy, procedures, and guidance material to support safe and efficient UAS operations in the NAS.

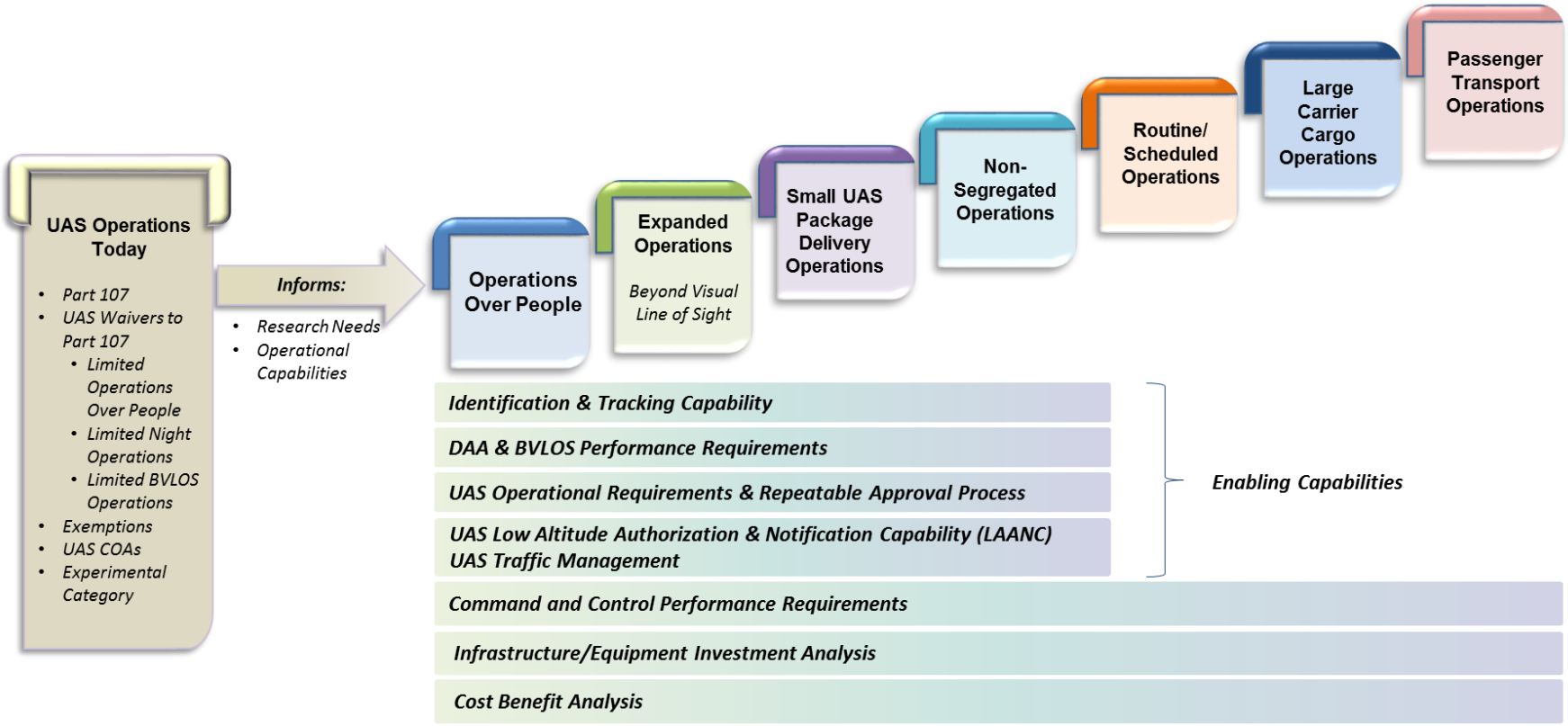
Ongoing and planned research activities inform these functional areas.



UAS Research Domains

- **UAS Research Domains represent key challenge areas for the safe and effective integration of UAS operations in the NAS**
- **Within each domain there are research initiatives that address these challenges to help solve the technology issues to support UAS integration.**
  - Detect-and-Avoid
  - Command and Control
  - Human Factors (2016 Human Factors Research Summit)
  - Surveillance
  - Navigation
  - Forecasting
  - Safety
  - Data
  - Reliability

Operational Capabilities Towards Full UAS Integration



UAS Research Timelines - Overview

- **Timelines are broken out by operational capability**
- **Research includes activities captured from research planning documentation including LOB discussions, Roundtable Meetings, and Partnerships**
- **Each research activity is mapped to functional areas and research domains**
- **Research is classified by:**
  - **Completed** – The particular research activity has been completed and results have been delivered by a research performer in a technical report. The research activity may be an initial effort or part of a series of research efforts required to address the overall objective to inform an operational capability. The necessity for additional areas of research or follow-on research phases may have been uncovered during the research activity.
  - **In Process** – The research activity is currently ongoing.
  - **Planned** – The research activity is currently planned by the FAA or a partner organization with a projected start date and period of performance to yield results (noted where applicable).
  - **Need** – Through research activities, roundtable meetings, industry partnerships, daily operations, and outreach, gaps in research are identified. These gaps were not previously identified during the FAA's research planning cycle and may represent follow-on phases to ongoing research, or unanticipated activities identified in response to the dynamically changing UAS landscape. The FAA will work with research partners to determine a path forward for addressing gaps, which may include updating FAA research plans.

Operations Over People Research Summary

OPERATIONS OVER PEOPLE
ONGOING RESEARCH

- Evaluate **collision severity**
- Streamline **operational approval** and **certification** processes
  - Risk-based assessments
  - Risk mitigation strategies
- Evaluate **UAS identification & tracking** technologies
- Enable and conduct UAS **data collection**
- Conduct **human factors** assessments

OPERATIONS OVER PEOPLE
RESEARCH GAPS

- Develop data collection and analytical system for **UAS sightings** information
- Develop UAS **accident and incident reporting** policies and procedures

OPERATIONS OVER PEOPLE

Functional Area	UAS Research Activity	FY17	FY18	FY19	FY20	FY21	FY22	Domain
Policy & Regulation	**Streamline Operational Approvals** Develop a proof of concept, data requirements, and administrative processes for provisions of Part 107 waiver process.	FAA: ASSURE						*Safety*
	Streamline Operational Approvals Analyze data from Part 107 waived operations to inform risk-based approval and expanded Part 107 rulemaking.	FAA: ASSURE						*Safety*
	Streamline Operational Approvals Develop the technical data requirements, test methods, and administrative processes for operational approval of sUAS over people within Part 107.	FAA						*Safety*
	Streamline Operational Approvals Develop standardized categories of population/pedestrian densities to facilitate operational approvals for operations over people.		FAA: CAASD					*Safety*
Standards	**Streamline Operational Approvals** Validate sUAS performance and design standards for their applicability and robustness as a certification basis for sUAS (ASTM F38 Committee).	FAA: ASSURE						*Safety*
	Collision Severity Evaluate the severity of sUAS collisions with people and structures on the ground. (UAS Ground Collision Phase I)	FAA: ASSURE						*Safety*
	Collision Severity Develop a test method to determine the potential of injury to a person on the ground upon impact by UAS. (UAS Ground Collision Phase II)		FAA: ASSURE					*Safety*
	Streamline Operational Approvals Develop policy, guidance, and industry standards for both rechargeable and non-rechargeable lithium batteries for UAS	FAA: WJHTC						*Safety*
	Data Collection Analyze UAS safety data from UAS Test Sites.	FAA: WJHTC						*Safety*
Aircraft Certification	**Streamline Operational Approvals** Assess and classify relative **risks** of different small UAS (< 55 lbs.) operational mission profiles.	MITRE						*Safety*
	Streamline Operational Approvals Analyze technical trade-offs for **risk mitigation** of sUAS operations over people (Pathfinder Focus Area 1).	FAA: CAASD						*Safety*
	Streamline Operational Approvals Develop a repeatable, streamlined, **risk-based** approach for small UAS operational approval.	MITRE						*Safety*

Completed: Accomplished; Documented | In Process: Started; Ongoing | Planned: Funded; Not Started Yet | Need: Identified Gap

OPERATIONS OVER PEOPLE

Functional Area	UAS Research Activity	FY17	FY18	FY19	FY20	FY21	FY22	Domain
Training	**Human Factors** Investigate how the UAS operator or supervisor gains confidence with a UAS consisting of an autonomous agent (i.e., managing pre-programmed drones).	NSF: C-UAS						*Human Factors*
Security	**UAS Identification & Tracking** Conduct analysis of existing and emerging technologies to support standards and inform rulemaking for remotely identifying and tracking UAS during operations.	FAA: CAASD						*Surveillance*
	UAS Sightings Develop and maintain a centralized and consolidated data collection and analytical system for UAS sightings information. Conduct trend analysis and process improvements.		NEED	NEED	NEED	NEED	NEED	*Safety*
Capabilities & Systems	**Data Collection** Assess the best system design and capabilities of a web-based portal for operators to enter accident information.	FAA						*Human Factors*
	Data Collection Assess the design alternatives and capabilities for a web-portal for operators to request a waiver to the Part 107 rule.	FAA						*Human Factors*
	Streamline Operational Approvals Develop a capability to provide UAS community with an effective method of requesting/receiving UAS COAs while standardizing and streamlining the COA operational approval process for the FAA reviewer.	FAA: CAASD						*Human Factors*
	Identification & Tracking Identify UAS technical requirements and existing and emerging solutions for identification and tracking.	FAA						*Surveillance*
	Identification & Tracking Enable data collection for remote identification and tracking of UAS. Conduct trend analysis and process improvements.		FAA					*Surveillance*
	Accident & Incident Reporting Develop and implement UAS accident and incident reporting policies and procedures. Conduct trend analysis and process improvements.		NEED	NEED	NEED	NEED	NEED	*Safety*

Completed: Accomplished; Documented | In Process: Started; Ongoing | Planned: Funded; Not Started Yet | Need: Identified Gap

Conclusion

- **FAA UAS research planning cycle begins 2+ years before year of execution**
- **Needs summarized in this plan were realized post planning cycle and result from**
  - Completed or ongoing activities: R&D may yield additional questions or follow-on phases
  - Updates to the FAA UAS integration pathway
    - Evolution of UAS technology and business cases and increasing demand for expanded operations result in dynamically changing UAS integration plans
- **Original estimates of level of effort are not sufficient to address research gaps**
- **FAA will continuously re-evaluate its UAS research program to determine the required level of effort and to account for unanticipated changes**