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# AC478—BLOS Strategy & Roadmapping for UAS

Update to F38 at 2020 Fall Virtual Meetings

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Streamline Designs

www.astm.org

# About AC478 on BLOS Strategy

- Formed in 2019 to focus on setting a robust strategy for a standards-based approach to BVLOS
  - Move away from tactical solution
  - Unlock certification/approval pathways
- Core group of about 18 active participants, pretty much all from Committee F38
- Overall Vision (Condensed Version)

  *Routine, commercial operations are enabled through a clear and regulator-accepted, standards-based path to system and operational approval for any operation where the Unmanned Aircraft (UA) may not be visible to the Remote Pilot (RP) or within [direct] radio line of sight.*

  *The functions and/or topics needed in supporting standards are clearly identified and prioritized with a plan and sequence for their development.*

# About AC478 on BLOS Strategy

- Scope of Work
  - Beyond visual or radio line of sight (near or far). This is generically called “BLOS”.
  - Civil, commercial operations; not military, public use, etc.
  - Any operational framework (Part 91, Part 107, Part 135, etc.).
  - Mass of the UA is not a factor. Physical size, however, is relevant as it relates to visibility.
  - The outputs should have relevance internationally.
  - The roadmap and strategy should work with or without UAS Traffic Management (UTM). For the purposes of this work, UTM is one possible mechanism to deliver functions needed for BLOS operations.

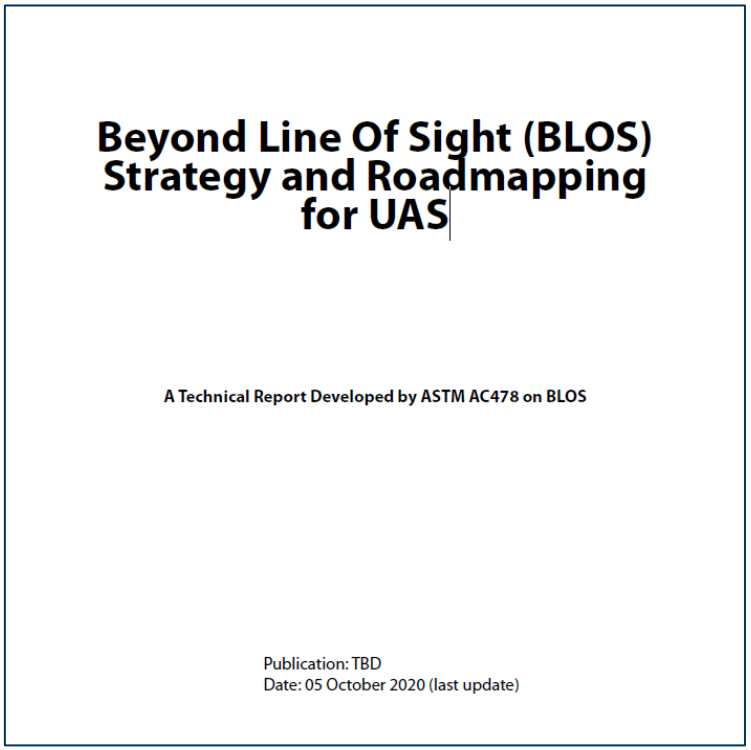
# Timeline and Activities

- Sept-Dec 2019
  - Characterize the problem statement
  - Establish working frameworks, terminology, concepts, and deliverables
  - Evaluate existing BVLOS standard
- 2020
  - Build out deliverables
  - Publish initial strategy and standards roadmap with at least near-term coverage
  - Begin outreach to new standards development
- 2021-Q1
  - Publish ASTM Technical Report: “Beyond Line Of Sight (BLOS) Strategy and Roadmapping for Unmanned Aircraft Systems (UAS)”
  - Work through initial strategy implementation plan with F38
  - Regulator engagement
- 2021-Q2+
  - Outreach to standards task groups
  - Refinements to strategy and roadmap

# AC478 Initial Deliverables

## Deliver a report containing:

- Strategy and framework concept to establish robustness, scalability, flexibility, and compatibility with regulatory frameworks
- Essential Functions identification and definition
- Common operational scenarios as test cases for the framework
- Standards development roadmap for BLOS
  - Strategic sequencing for standards development for essential functions aligned with reasonable time horizons
  - Consideration of priority of market demands and market relevance of functions
- Draft Terms of Reference (TOR) for standard development needs
  - 'Prime the pump' for standards task group work within F38
- A plan for regular maintenance and updates to the report and roadmap



# Strategy Concept and Framework

- Robust
  - Far-ranging use cases demand robust underpinnings.
  - Purely tactical solutions are not likely to deliver for the whole industry and may not be right-sized for varied operations.
- Modularity through “Essential Functions”
  - Systems engineering approach to boil down the fundamental needs into a *right-sized* set of “Essential Functions” that can be standardized.
  - “Essential Functions” are all potentially relevant to any BLOS operation.
  - A set of “ingredients” that span both system and operational aspects.
- Scalability & Flexibility
  - Performance measures of Essential Functions must be defined and standardized *without* prescribing the limits of acceptability for a particular CONOPS.
  - Avoids highest/least common denominator problems.
- Implementation Agnostic
  - Method of achieving functional performance is not prescribed.

# Strategy Concept and Framework

- Transparency
  - System manufacturers and operators report their performance for specific functions transparently in accordance with standardized definitions so that the outcomes are more universal.
- Pathway to Certification/Approval through Assignment of Functions and Performance
  - Needed Essential Functions and level of performance for each function can be selected on an as-needed basis based on the operation/CONOPS desired (risk overlay).
  - Compliance to the applicable standards to the performance level deemed acceptable by regulators creates a standards-based pathway to approval.
  - Regulators are provided a list of ‘ingredients’ (functions) and performance measures to conduct risk evaluations for managing safety. Over time, industry can develop Standard Practices for the application of common use cases as ‘recipes’ that use the right amount of the right ‘ingredients’.

# Essential Functions (Current)

## High-level functions that may be needed for any given BLOS operation

1. Handoff from one pilot to another
2. Link handoff
3. Command system/aircraft
4. RPIC system status notification
5. Aircraft & airborne hazard avoidance
6. Terrain & obstacle avoidance
7. Alerting other airspace users to contingency situations
8. Geo-awareness
9. Maintain operations within limitations
10. Provide cybersecurity
11. Positioning assurance
12. Navigation
13. Time synchronization
14. Remote ID
15. Autonomy & automation
16. Risk evaluation
17. Ability to land safely
18. Weather
19. Path-planning within the rules (4D trajectory)
20. Contingency planning

# Current Status

- Technical Report is 60-70% complete (current draft is ~52 pages)
- Remaining development:
  - Terms of Reference (about 40% complete)
  - Sequencing of roadmap
  - Additional graphics to illustrate key concepts
  - Final review, editing, and scrubbing
- Initial discussions with ASTM about publishing Technical Report have been initiated. Will ramp up in Dec/Jan.
- Goal is to wrap up development work by end-of-year.
- Focus on publishing in 2021-Q1.
  - Original goal was November 2020 F38 meetings.

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# AC377 Autonomy Design and Operations in Aviation - Overview

## ASTM F38 Meeting

## November 4, 2020

www.astm.org

* This material represents the views and positions of the presenter and not those of ASTM International and/or the entire ASTM F38 Committee

# ASTM AC377
## Started Fall 2017

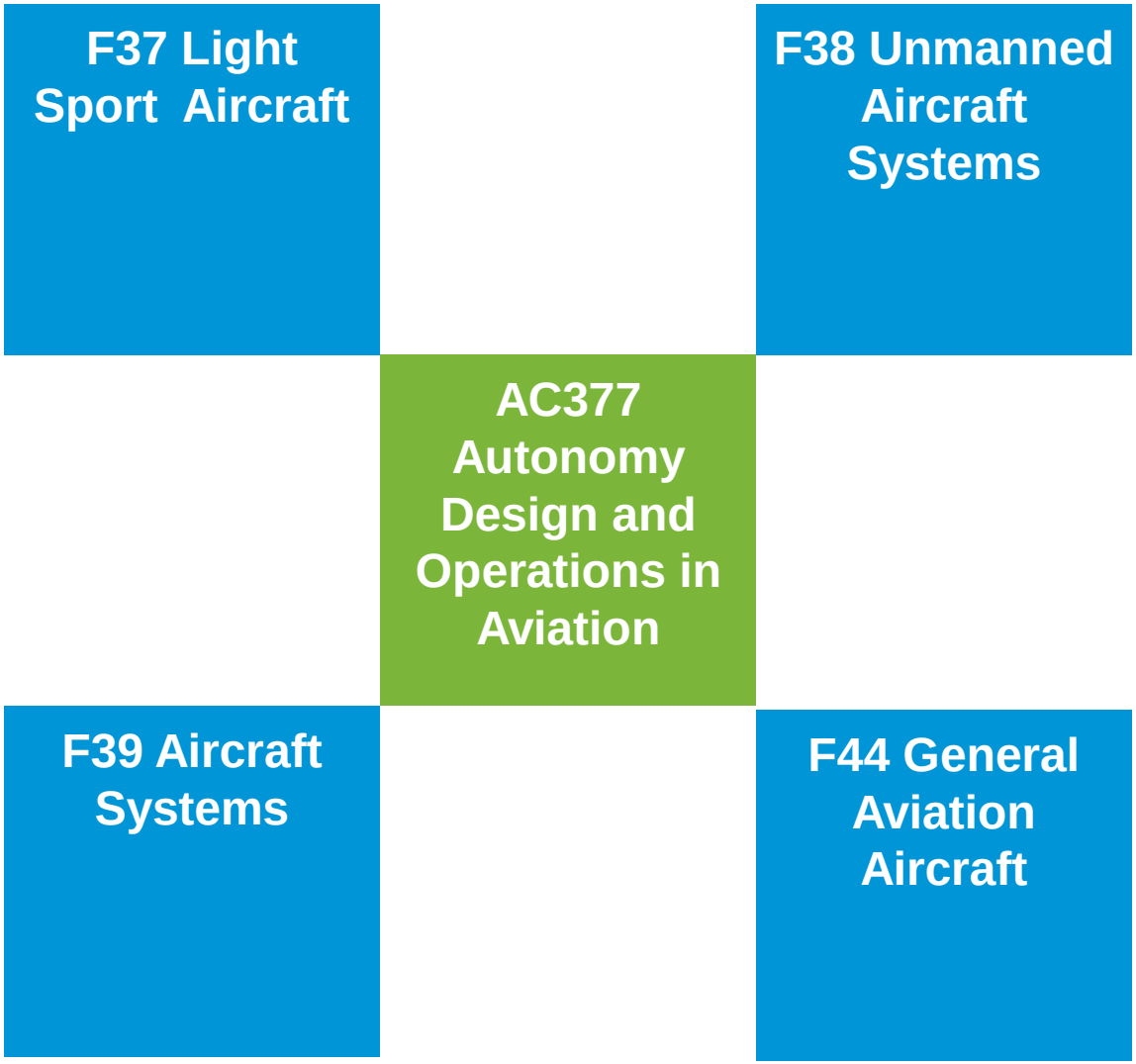
## Motivation:

- Autonomy has great promise to improve safety and transform aviation
- ASTM Standards should be consistent with respect to automation and autonomy

## Task Group Objectives:

– Develop a short and long term strategy towards aviation autonomy standards within ASTM
– Cross Cutting Task group
– Develop terminology
– Develop guidance regarding roles/classes of automation for hardware, software and human interaction
– Make recommendations regarding standards needs and appropriate technical committee to develop and manage the standards.
– Identify appropriate subject matter experts

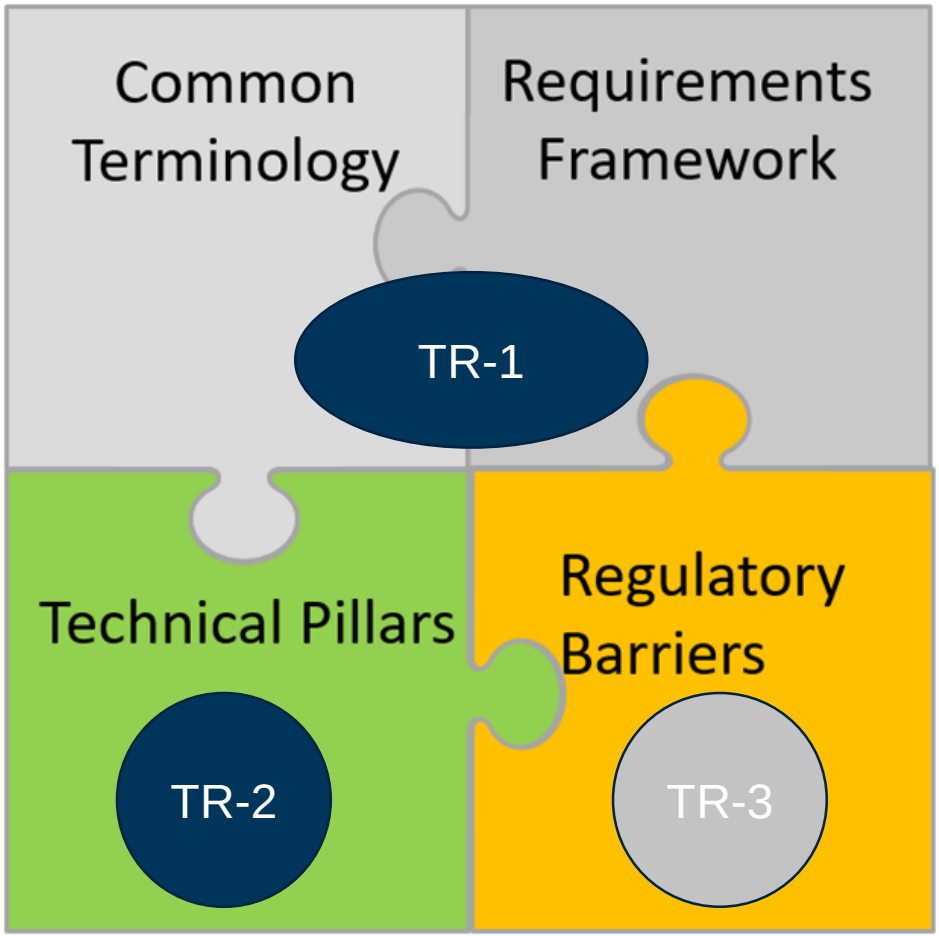
# AC377 advises ASTM Standards Committees




**4 Areas of Focus for AC377:**

- **Terminology**
- **Requirements framework for certification**
- **Design "pillars" of autonomy**
- **Regulatory barriers**

# AC377 produces Technical Reports with recommendations




Bring stakeholders together from industry, government, academia, research, operations, etc.

Build consensus recommendations regarding autonomy for standards committees

Publish recommendations in the form of Technical Reports:

- Terminology and Requirements Framework – 2019
- Technical Pillars – 2020
- Regulatory Barriers - 2021

# Common Terminology

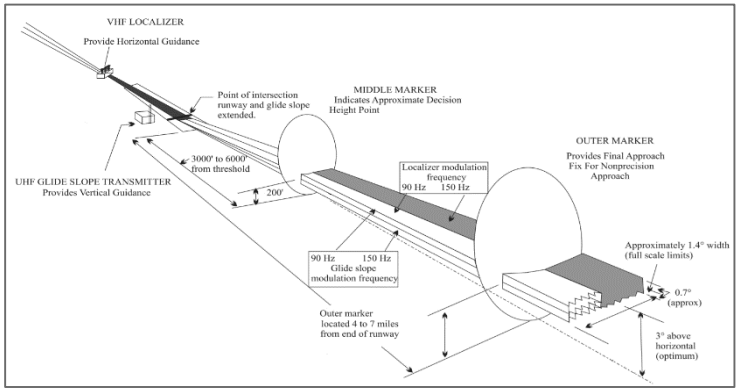
"Language, and primarily written language, is the prerequisite for our modern technology" – Wolfgang Teubert

- Goal:  Promote consistent standards development and reuse
- Reviewed multiple government and industry sources of terminology and definitions
- Wrote own definitions as a last resort
- Produced definitions for 51 terms

**What about Levels of Automation?**

# Key Terms from Report

- **Automated or Automatic System:** Hardware and software that automate a pre-defined process without the need for human intervention, an individual may monitor and override.

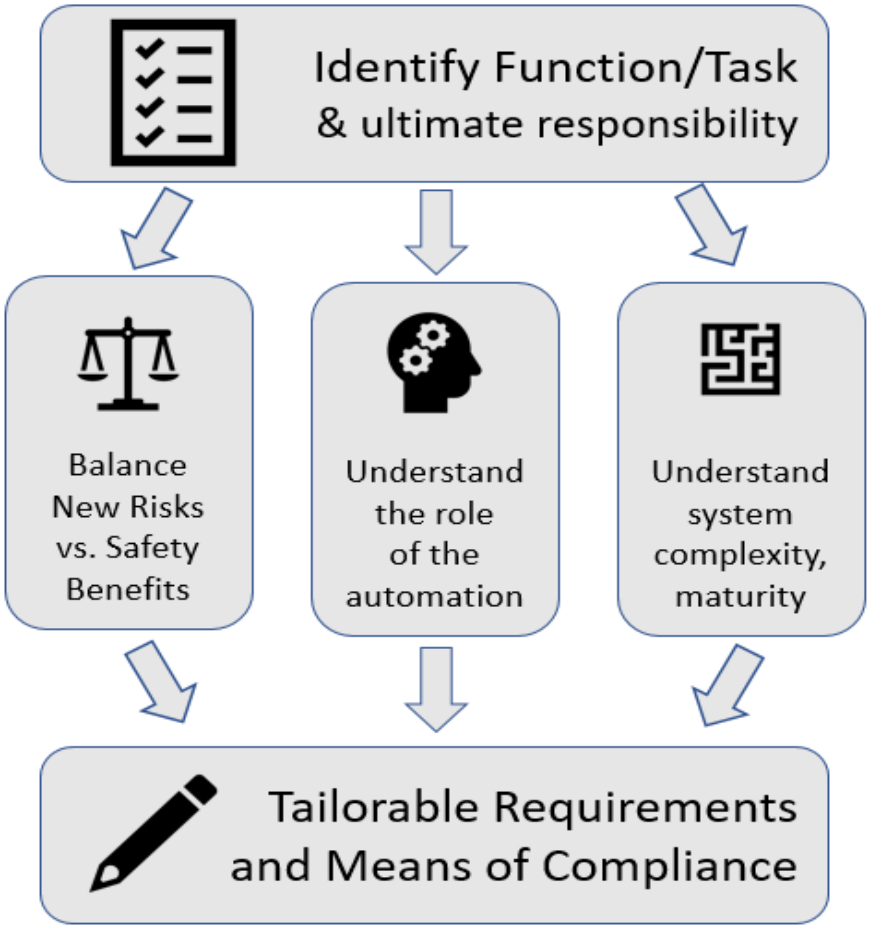



Example: Cat III Landing System

- **Autonomous System:** Hardware, software, or a combination of the two, that enable a system to make decisions independently and self-sufficiently. Autonomous systems are self-directed toward a goal governed by rules and strategies that direct their behavior.

Example: Autonomous Aerial Cargo/ Utility System

# Requirements Framework

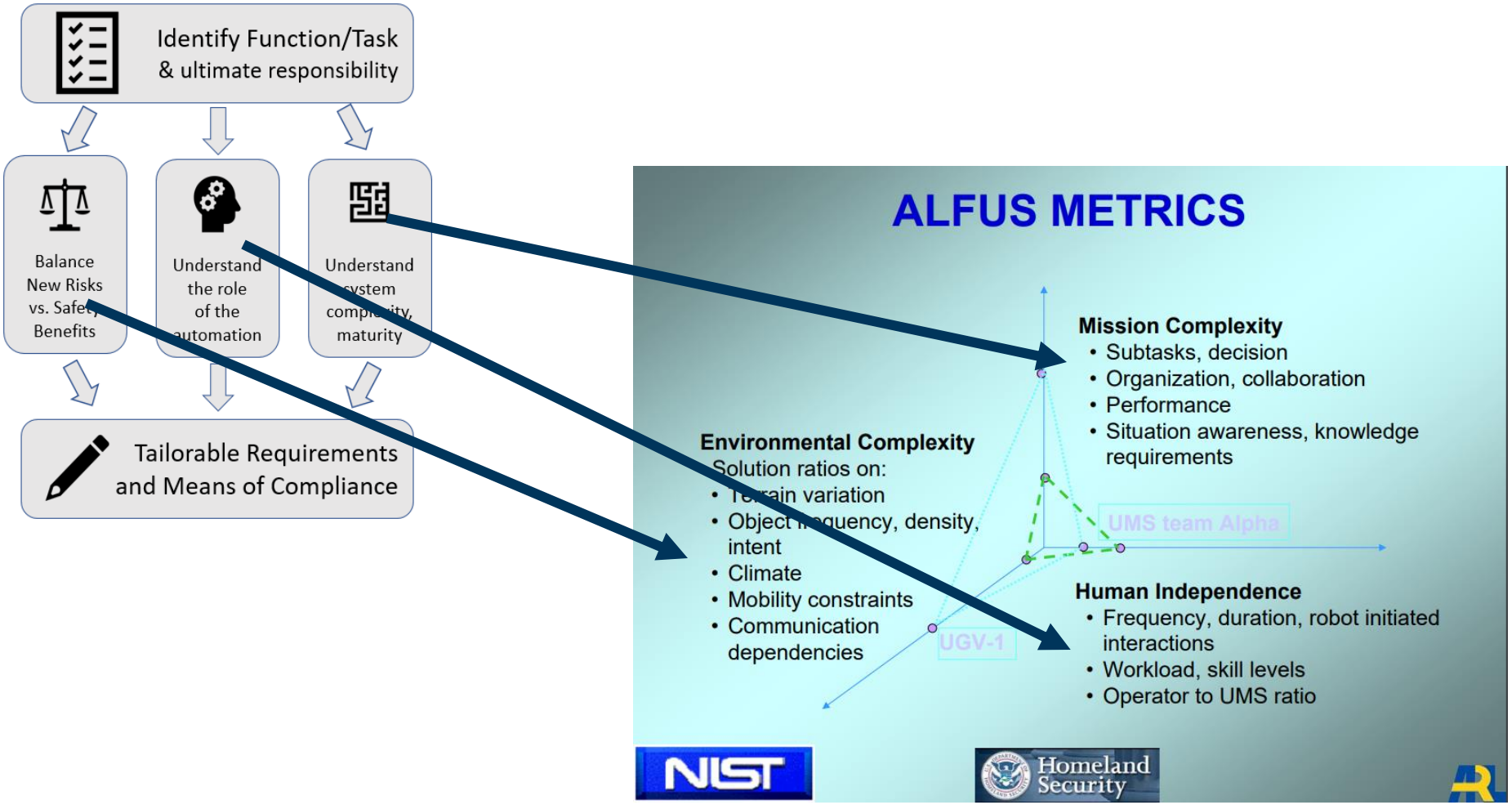



Decompose the function that is being automated

Then look at 3 sets of questions:

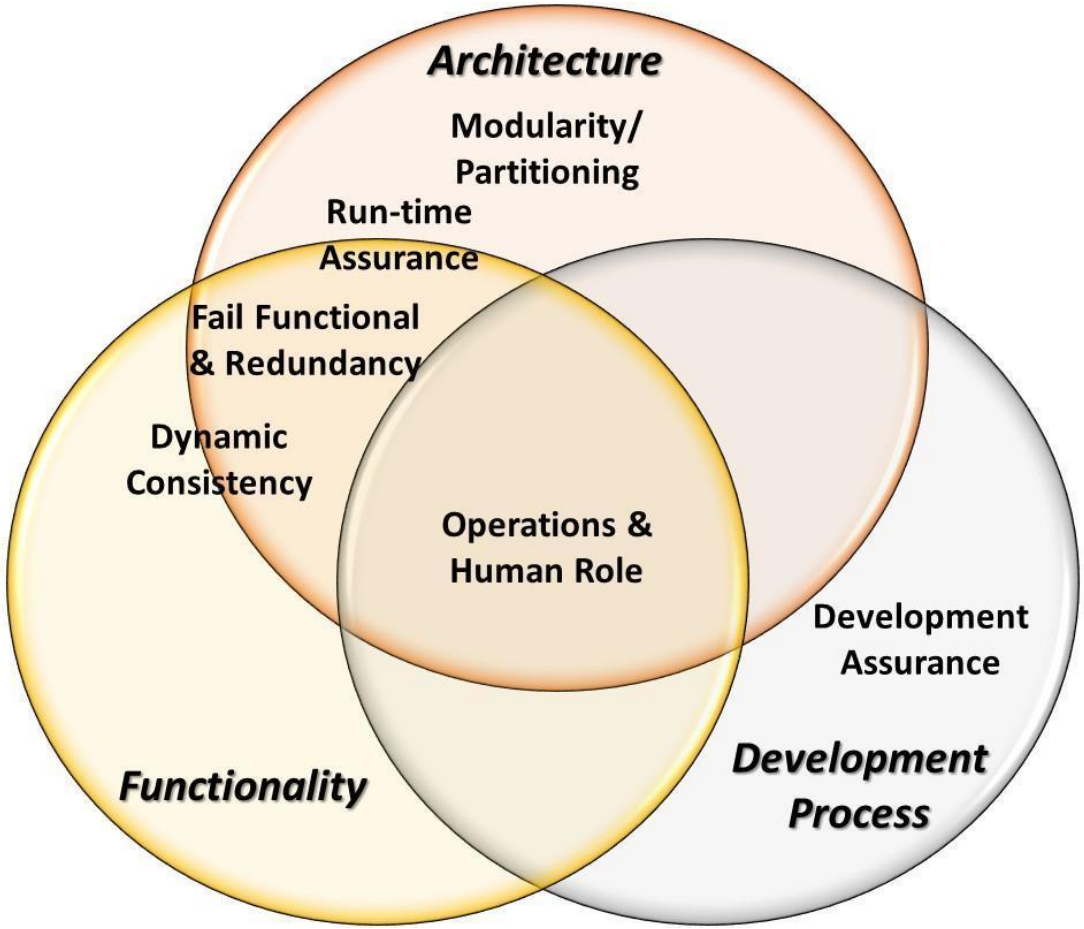
- Risks vs. benefits of the automation
- Role of the automation
- Complexity and maturity of the automation

# Alignment

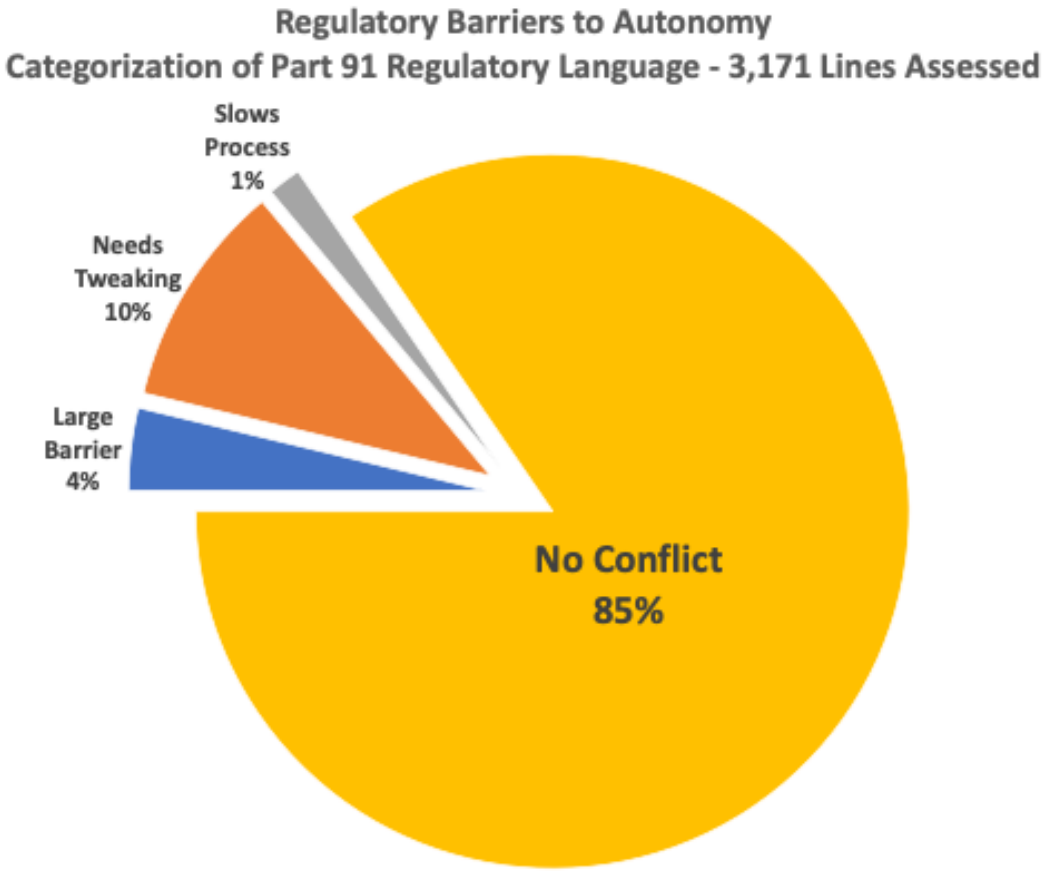

Identify Function/Task & ultimate responsibility
Balance New Risks vs. Safety Benefits
Understand the role of the automation
Understand system complexity, maturity
Tailorable Requirements and Means of Compliance
ALFUS METRICS
Mission Complexity
• Subtasks, decision
• Organization, collaboration
• Performance
• Situation awareness, knowledge requirements
Environmental Complexity
Solution ratios on:
• Terrain variation
• Object frequency, density, intent
• Climate
• Mobility constraints
• Communication dependencies
Human Independence
• Frequency, duration, robot initiated interactions
• Workload, skill levels
• Operator to UMS ratio
UMS team Alpha
UGV-1
NIST
Homeland Security

# Pillars of Autonomy

What are the foundational technologies that can safely enable autonomy?



# Regulatory Barriers




Our aviation system was developed on the assumption of the human performing most of the functions

As functionality is shifted from humans entirely to systems without potential human direct oversight, we must understand the compatibility with the aviation regulatory system

## Plan for TR3:

Current – Make recommendations based on Part 91 findings

Spring 2021 – Finalize report

Summer 2021 – Publish report

# ASTM Autonomy in Aviation Symposium – Sep 2020


- 445 registered
- 223 unique participants
- 28 countries
- 6 continents

# *AC377 Next Steps*

**Roadmapping Effort –**

Identify standards gaps associated with operations crew training and qualifications; systems design and testing; safety case development; and continued safety assurance.

**Possible new standards –**

Symposium identified desire for test method for measuring how well humans interact with autonomy; inquire if F37, F38, F39, or F44 want to pursue this

# *Thank you!*

**Task Group Participation Questions**

Stephen Cook, AC377 Chair
NG Fellow, Airworthiness
Stephen.Cook@ngc.com

**Task Group Operations Questions**

Len Morrissey, Director
ASTM Global Business Development and Strategy
lmorriss@astm.org

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# AC 433

F44.90.01 Advanced Technologies

Gap Analysis and Activity Update

Nov 3, 2020 | Virtual F38 Meeting

Tom Gunnarson| Wisk

# F44.90.01 Task Group on Emerging Technology

Chair: Tom Gunnarson, Wisk

Scope:

- Capture information about emerging technology and trends that could be applicable to future aviation standards development.
- The F44 executive subcommittee will use this to establish new work as it applies to General Aviation Aircraft on an as-needed basis.
- It will also share this with other ASTM aviation committees for their consideration.

*AC433 Tasking –*

# *Gap Analysis for the ASTM Means of Compliance for EVTOL/UAM aircraft*

## Collaboration Area AC433

- Based on Part 23 performance-based rules (PBR) to accommodate new technologies
- Covers eVTOL aircraft, simplified vehicle operations and complex systems
- 23 work items currently identified

## Co-Chairs: Tom Gunnarson, Anna Dietrich

- Coordinate and maintain list of action items, priority, time to ballot, leads and updated status
- Bi-monthly update calls and report outs to ASTM, GAMA, authorities

# AC433 Activity Update

- Items are revisions to existing standards and a few are new
- Activity supports cooperation between FAA, EASA and other CAA activity in this trade space
- New items are added as need is discovered
- Items cover wide spectrum from Distributed Electric Propulsion to Handling to Bird Strike
- Several items have been through at least one ballot cycle
- Some items cross to other committees, holistic approach
- Looking for more scoping and drafting support from eVTOL industry

| Subject/Title | Distance to Ballot | Industry Priority | Existing Std | Sub Comm | WK number | Lead |
|---|---|---|---|---|---|---|
| Electric Propulsion Unit Design (EPU) | 1 | 1 | F3338 | F39.05 | WK67455 | Peter Lyons |
| Electric Propulsion Energy Storage Systems (ESS) | 3 | 1 | NONE | F39.05 | WK56255 | Tom Gunnarson |
| Emergency Conditions | 5 | 2 | F3083 | F44.30 | WK68781 | Eric Nottorf |
| Bird Strike | 5 | 2 | F3114 | F44.30 | WK68805 | Eric Nottorf |
| Handling Characteristics | 4 | 2 | F3173 | F44.20 | ~~WK68839~~ WK63578 | Mike Feary |
| Performance | 4 | 2 | F3179 | F44.20 | ~~WK68838~~ WK63580 | Nick Borer |
| Energy Shedding (Crashworthiness) | 4 | 2 | F3239 | F44.40 | WK65629 | Tine Tomazic |
| Electric Propulsion Unit Design (EPU) | 1 | 2 | F3338 | F39.05 | WK66523 \| (new: WK68764) | William Fletcher |
| Integral Thrusters | 2 | 2 | F3338 | F39.05 | WK70381 | Srinivas Chunduru |
| Aircraft Powerplant Control and Indication | 1 | 3 | F3064 | F44.40 | WK68803 | Carlos Mourão & Herb S |
| Aircraft Propeller System Installation | 1 | 3 | F3065 | F44.40 | WK68801 | Herb Schlickenmaier |
| Powerplant Hazard Mitigation | 1 | 3 | F3066 | F44.40 | WK68795 | Herb Schlickenmaier |
| Safety Assessment of Systems and Equipment | 5 | 3 | F3230 | F44.50 | WK68765 | Ryan Naru |
| Distributed Electric Propulsion | 2 | 3 | F3239 | F44.40 | WK66028 | Herb Schlickenmaier |
| Inadvertent Icing | 3 | 3 | NONE | F44.10 | WK68757 | Garrett Holand |
| Simplified Vehicle Operations (SVO) | 3 | 3 | NONE | F44.50 | WK68767 | Carl (Anna) Dietrich |
| Weight and CG | 3 | 4 | F3082 | F44.20 | WK68849 | Larry Van Dyke |
| Crew Interface - SVO modifications/coordination | 5 | 4 | F3117 | F44.10 | WK68779 | Anna Dietrich |
| Specification for Low-Speed Flight Characteristics of Aircraft | 5 | 4 | F3180 | F44.20 | ~~WK68850~~ WK70924 | Nick Borer |
| Maintenance Standards | 5 | 4 | NONE | F44.10 - may move to F46 | WK68762 | Ryan Naru |
| Design Loads and Conditions | 5 | 4 | F3116 | F44.30 | Pending | Jose Martin |
| Acoustic Evaluation Practice | 5 | 5 | NONE | F44.10 | WK68763 | Ryan Naru |
| Sensor Fusion | 5 | 5 | NONE | F44.50 | WK68766 | David Rottblatt? |
| Aircraft Electric Propulsion System (EPS) Design & Installation | OBE | OBE | F3239 | F44.40 | WK65620 | Christoph Genster |

# AC433 and F38

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- Industry driving innovation and has need for clear certification and operational path
- F38 standards for design, infrastructure, autonomy and operations support eVTOL and AAM:
  - WK62670 - Large UAS Design and Construction
  - WK59317 - Vertiport Design
  - F3269 - Bounding Flight Behavior of Complex Functions Using Run-Time Assurance
  - F3442 – Detect & Avoid
- AC433 facilitation function helps keep efforts on track
- Coordination with other SDOs best for industry success
- Working together “raises all boats”

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# F38 UAS Standards Roadmap

5 Nov 2020

Ajay Sehgal
Vice Chair, F38 UAS Committee
(Chief Engineer, KBR, Lexington Park, MD)

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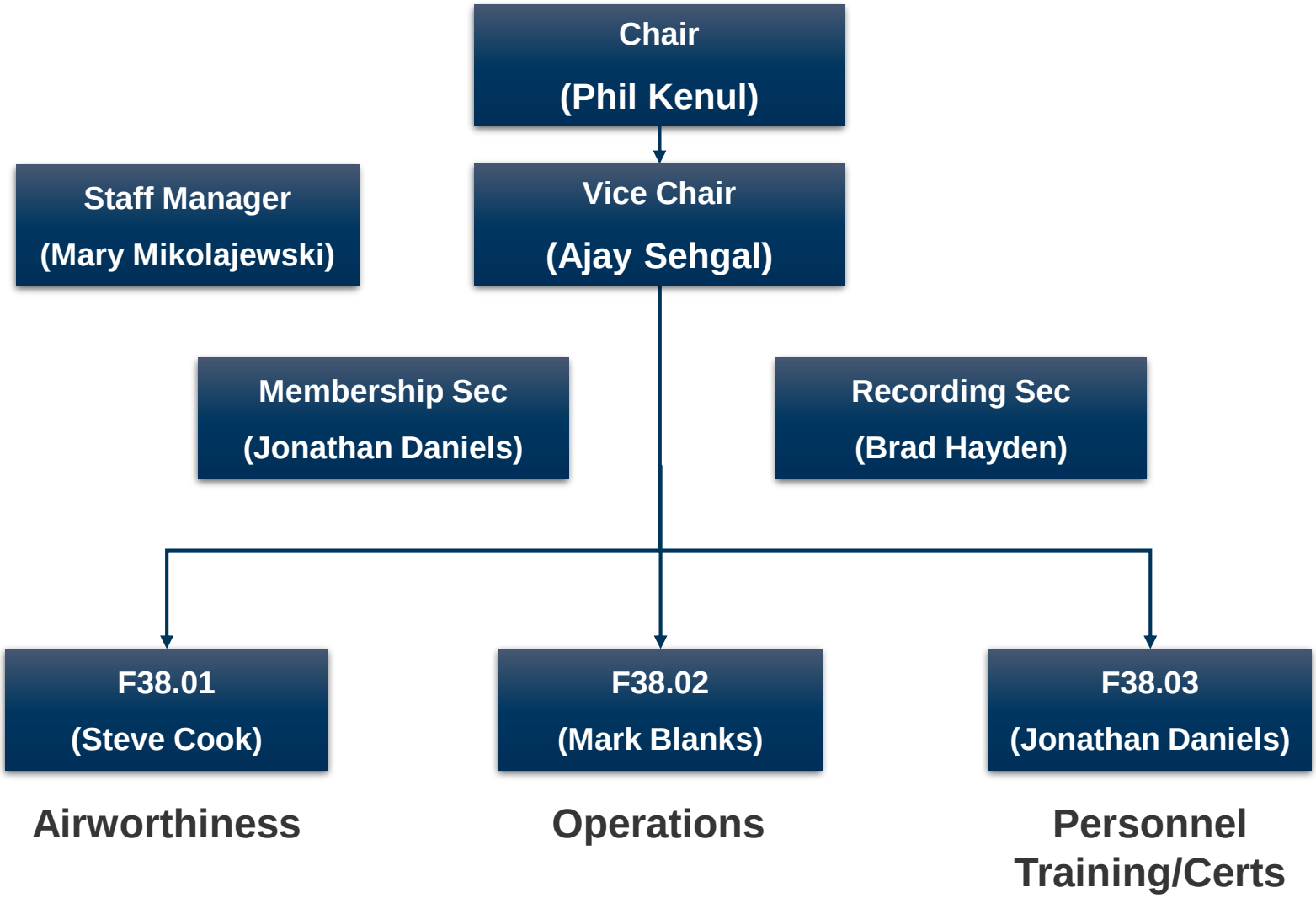
# F38 UAS Standards Roadmap
## AGENDA

- 2018 Roadmap Overview
  - Approach / Criteria
  - Current Status
- 2020 & Beyond Roadmap
  - ANSI (2020) Roadmap Gap Analysis
  - New Scope – Optionally Piloted Aircraft
  - ASTM Administrative Collaborations (AC377, AC433, AC478)
  - Other New Topics ?
  - Priorities ?
  - Common standards with other ASTM aviation committees ?

# F38 UAS Standards Roadmap

## Technical Committee Organization



# F38 UAS Standards Roadmap

## Approach / Criteria used for 2018 Roadmap

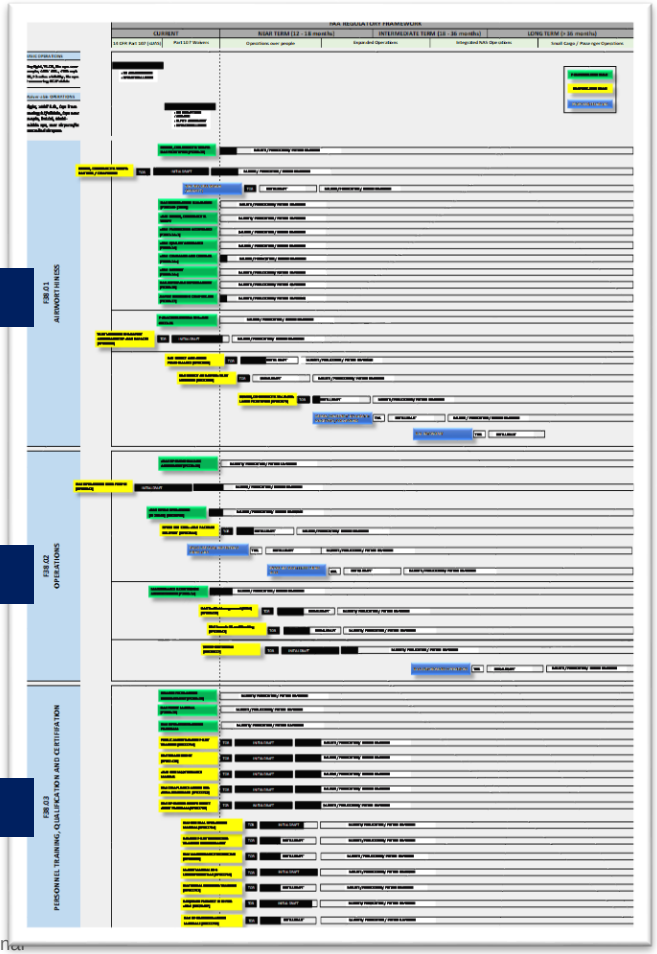
- UAS Standards Roadmap
  - Identify Requirements- WHAT?
  - Identify efforts already completed / in work- WHO?
  - Identify GAPS- WHAT / WHO?

**ANSI Roadmap Version 1 Dec 2018**

- Prioritized (ASTM F38) standards based on- √
  - FAA strategy/guidance
  - User demand signal(s)
- Developed timeline based on- √
  - Priority
  - Resource(s) availability
  - Level of complexity/maturity (TRL etc.)

# F38 UAS Standards Roadmap

## 2018 Standards Roadmap



# F38 UAS Standards Roadmap

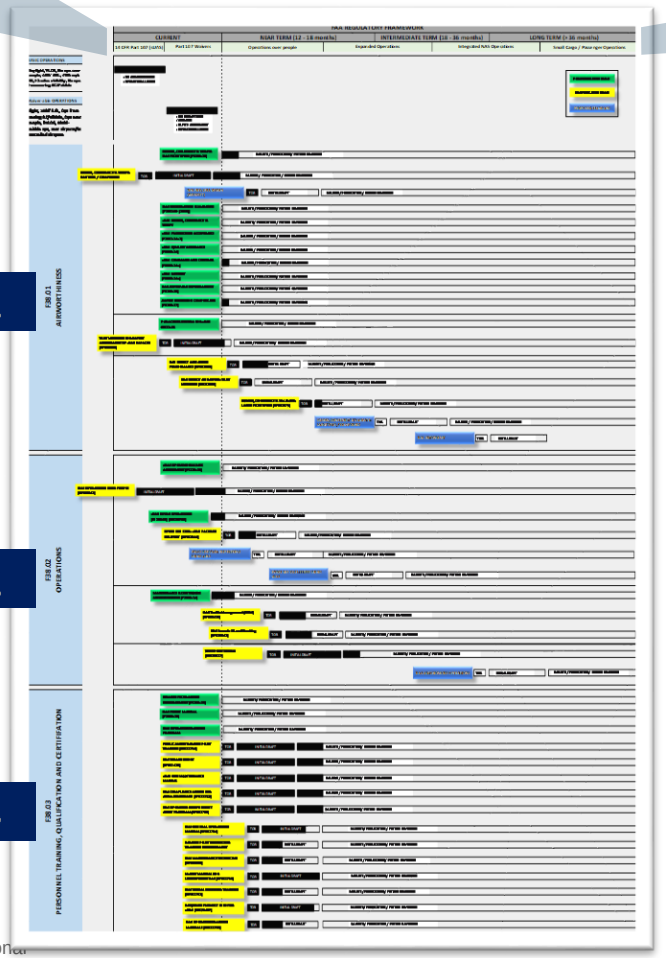
## 2018 Standards Roadmap

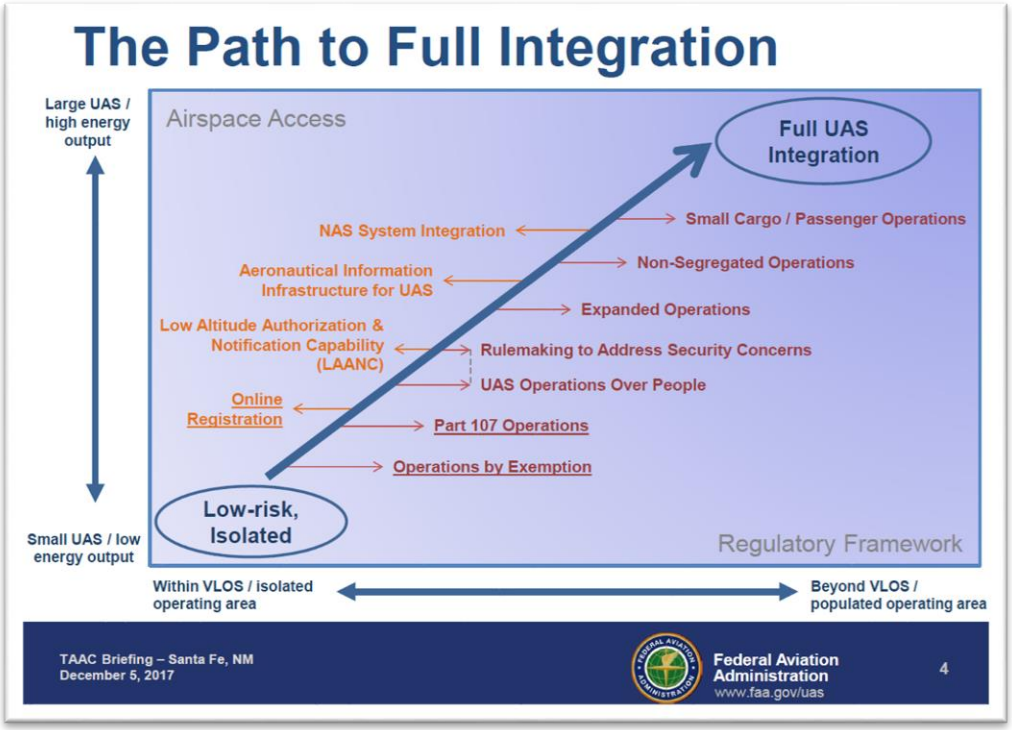
| FAA REGULATORY FRAMEWORK | | | | | |
|---|---|---|---|---|---|
| CURRENT | | NEAR TERM (12 - 18 months) | | INTERMEDIATE TERM (18 - 36 months) | LONG TERM (> 36 months) |
| 14 CFR Part 107 (sUAS) | Part 107 Waivers | Operations over people | Expanded Operations | Integrated NAS Operations | Small Cargo / Passenger Operations |

F38.01

F38.02

F38.03





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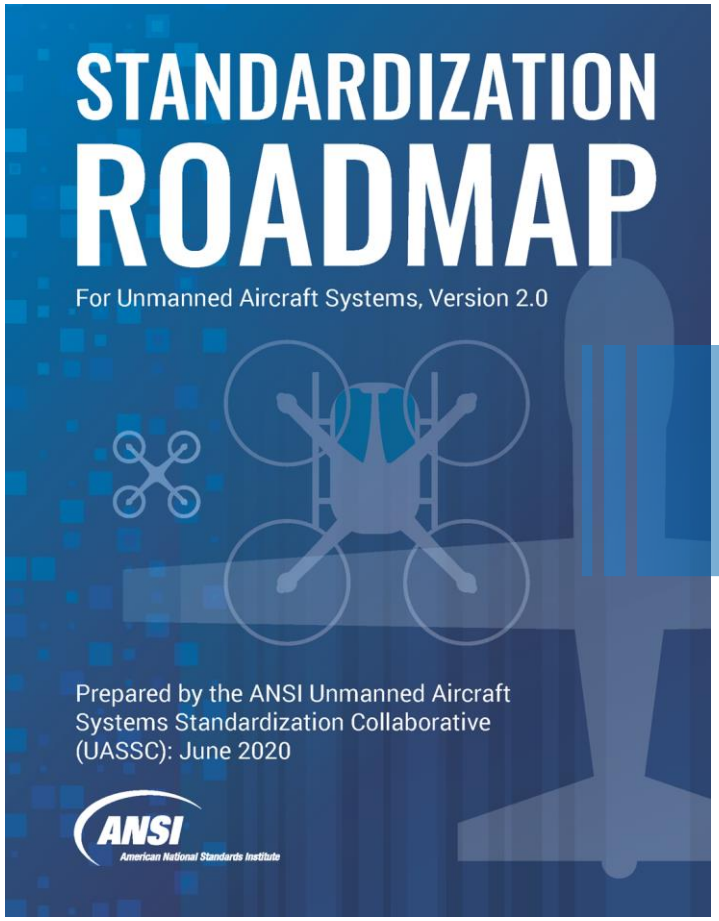
# F38 UAS Standards Roadmap

## ANSI (2020) Gap Analysis

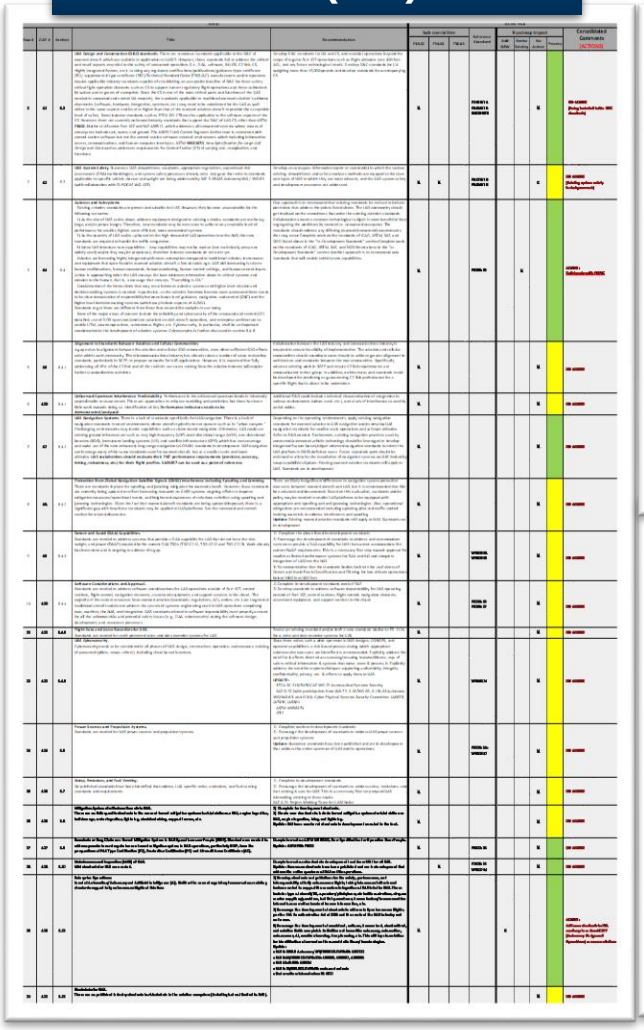



- Version 2.0 published in June 2020
- Identified *71* Total Gaps
  *(Gap means No Published Standard)*
- F38 identified, prioritized, and made recommendations for a total of *71* gaps, in the topical areas of:
  - Airworthiness (19) (section 6)
  - Flight operations (45) (sections 7-9)
  - Personnel training, qual. and cert. (7) (section 10)

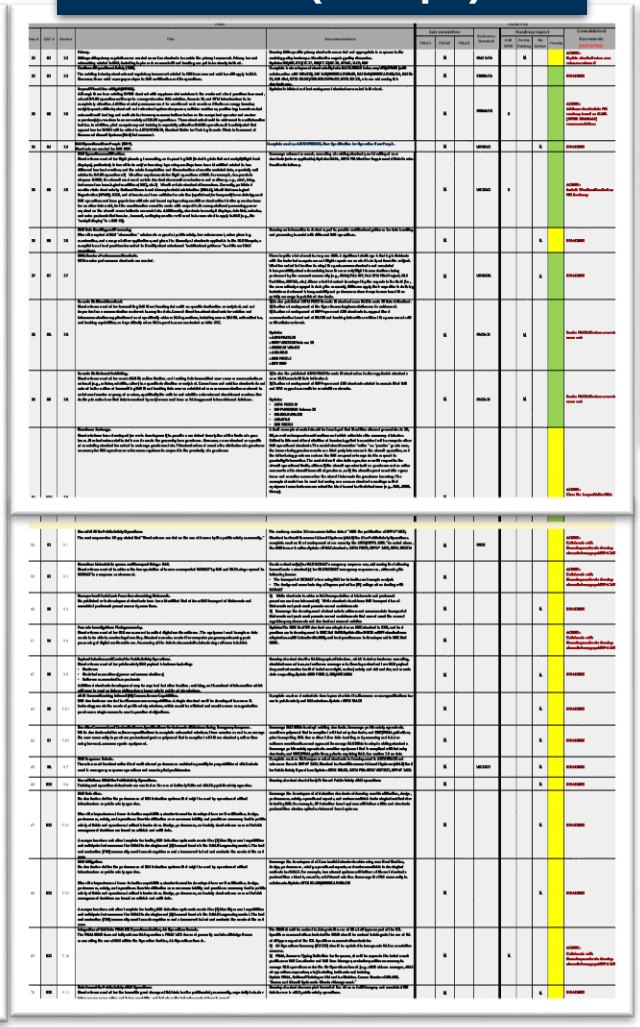
# F38 UAS Standards Roadmap

## ANSI (2020) Gap Analysis - Summary

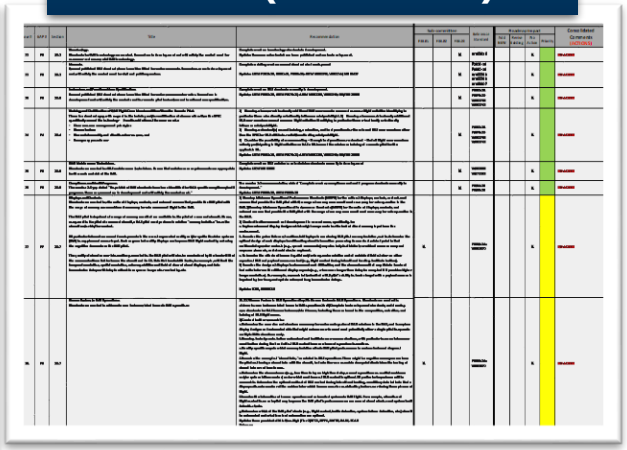
### CH 6 (AW)



### CH 7-9 (Flt Ops)



### CH 10 (Personnel)



# F38 UAS Standards Roadmap

## ANSI (2020) Gap Analysis - Summary

| Chapter | Subject | Total Gaps Reviewed | F38 Sub-committee | | | F38 Recommended Action | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | F38.01 | F38.02 | F38.03 | In Work or on F38 Roadmap | Add to F38 Roadmap | | NO ACTION |
| | | | | | | | Collaborate with Other Committee(s) / Orgs. | New Standards | |
| 6 | Airworthiness | 19 | X | | | 5 | 1 | 1 | 12 |
| 7 | Flight Operations | 13 | | X | | 5 | - | 3 | 5 |
| 8 | Infrastructure Inspections / Commercial Services | 19 | | X | | - | - | 2 | 17 |
| 9 | Public Safety Operations | 13 | | X | | - | 4 | - | 9 |
| 10 | Personnel Qualifications | 7 | | | X | - | - | - | 7 |
| | | | | | | 10 | 5 | 6 | 50 |
| | | | | | | | 11 | | |

# F38 UAS Standards Roadmap

## ANSI (2020) Gap Analysis - Summary

### In Work / Already on F38 Roadmap

- D&C Standard(s) for Control Segment
- Detect and Avoid Capabilities
- Power Sources and Propulsion Systems
- Parachute or Drag Chute
- Maintenance & Inspection of UAS

- Privacy (Update upon rulemaking)
- UAS Operations and Weather
- Remote ID – Direct Broadcast
- Remote ID – Network Publishing
- Aerodrome Facilities for UAS

*Standards in Italicized Text → Collaboration with other committees / organizations*

### Add to F38 Roadmap

- *Avionics and Subsystems* – ***F39 TC***
- Autonomous Operations

- Beyond Visual Line of Sight (BVLOS)
- Geo-fence Exchange
- Geo-fence Provisioning and Handling

- Inspection of Building Facades
- Bridge Inspections

*Collaboration with DroneResponders*

- *sUAS for Public Safety Operations*
- *Hazardous Materials Response and Transport using UAS*
- *Forensic Investigations Photogrammetry*
- *Integration of UAS into FEMS Operations Section, Air Operations Branch*

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  - Other New Topics ?
  - Priorities ?
  - Common standards with other ASTM aviation committees ?

# F38 UAS Standards Roadmap

## New Scope – Optionally Piloted Aircraft (Definitions)

**FAA (8900.1 CHG 625, Volume 16, Chapter 1, Section 2) OPA Definition –**
An aircraft having UAS technology *that can be flown unmanned and retains the capability of being flown by a Pilot Onboard* (PO) using conventional control methods.

**Transport Canada definition for Optionally Piloted Aircraft (OPA) –**
An aircraft that is *integrated with UAV technology and still retains the capability of being flown by an onboard pilot* using conventional control methods. Transport Canada frequently defines RPAS as including a Remotely Piloted Aircraft (RPA) or Optionally Piloted Aircraft (OPA);

**JARUS defines OPA in JAR_DEL_Glossary_D –**
A *manned aircraft that can be flown by a remote pilot from a location not onboard* the aircraft.

**Common Theme**

Has the ability to be flown

with NO pilot on board
or
with a pilot onboard

# F38 UAS Standards Roadmap

## New Scope – Optionally Piloted Aircraft (Bylaws Update)

2.1 The objective of the F38 Committee is to establish the standards forming the basis for same-day File-and-Fly access to the civil airspace for unmanned aircraft systems (UAS) **and Optionally Piloted Aircraft (OPA).** The Committee will work with certification bodies and all stakeholders to develop standards and publications for use by end users as guidance to certify UAS and OPA for flight in relevant civil airspace. Ultimately, the desire is to reduce the regulatory burden on the industry and leverage standards to allow technology to be readily adopted in a streamlined certification process where appropriate.

4.1 The Scope of the Committee shall be the development of standards and guidance materials for UAS **and OPA**.

4.2 The focus of the committee shall be the development of standards and publications including (but not necessarily limited to):

4.2.1 Minimum safety, performance, and flight proficiency requirements for UAS.

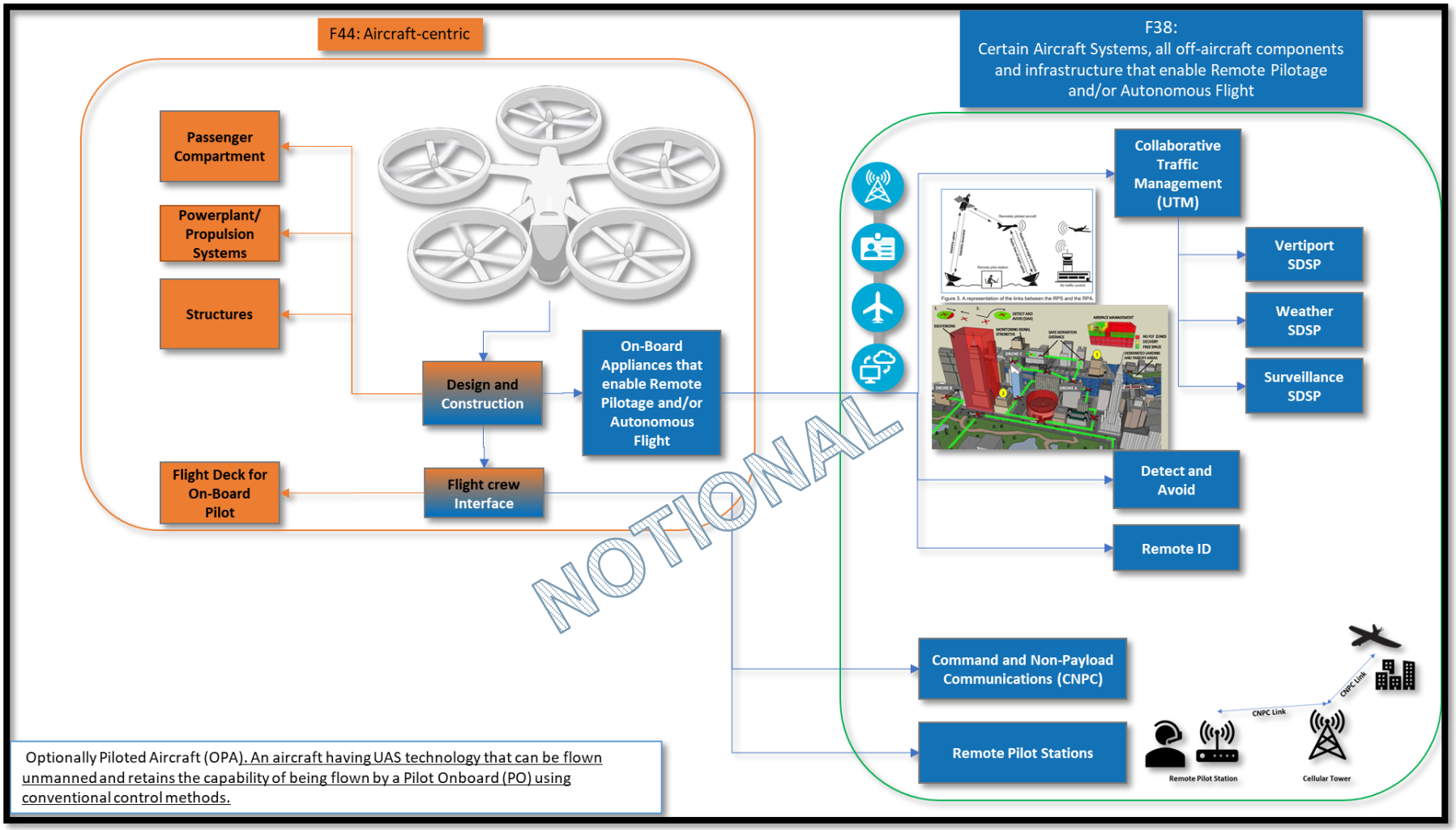
**4.2.2 Minimum safety, performance, and flight proficiency requirements for OPA, when acting as part of an unmanned and/or remotely piloted aircraft system.**

**4.3 The work of this Committee will be coordinated with other ASTM Aviation Committees having mutual interest, including but not limited to F37 Light Sport Aircraft, F39 Aircraft Systems, F44 General Aviation Aircraft, and F46 Aerospace Personnel.**

**4.3.1 A framework to define clear roles and responsibilities for applications with human onboard the aircraft shall be maintained to prevent duplication of effort between F37, F38, F39, F44, and F46.**

# F38 UAS Standards Roadmap

## New Scope – Optionally Piloted Aircraft (R&R Example)



# F38 UAS Standards Roadmap

## New Scope – Optionally Piloted Aircraft (R&R Framework)

| Area / System | | Technical Committee | | | | |
|---|---|---|---|---|---|---|
| | | F37 | F38 | F39 | F44 | F46 |
| Airworthiness | Air Vehicle Structures | | | | | |
| | Cockpit Design | | | | | |
| | Pasenger Compartment | | | | | |
| | Powerplant / Propulsion | | | | | |
| | Systems & Equipment | | | | | |
| | | | | | | |
| | | | | | | |
| Operations | Communications | | | | | |
| | Networking | | | | | |
| | Airspace Integration | | | | | |
| | Airspace Procedures | | | | | |
| | Infrastructure | | | | | |
| | | | | | | |
| | | | | | | |
| Personnel Training, Certification | Technicians | | | | | |
| | Maintainers | | | | | |
| | Remote Pilot / Operator | | | | | |
| | Observers | | | | | |
| | | | | | | |
| | | | | | | |

NOTIONAL

A - Accountable R - Responsible C - Consult I - Inform

**R**esponsible –
The committee(s) which are part of the working task group and contribute(s) towards standard development through shared responsibility (as determined by the *Accountable* committee) in accomplishing tasks/activities related to –

- TOR (Terms of Reference) development,
- Specific section(s) write-up,
- Technical discussions,
- Admin ballots to gather formal feedback, etc.

**A**ccountable –
The committee that has ultimate accountability and authority (***belly button***) over the standard. The committee -

- Has formal jurisdiction over the standard,
- Assigns and registers Work item,
- Finalizes TOR, and
- Conducts ballots and manages the standard

**C**onsult –
The committee(s) which are invited to participate to provide –

- Feedback regarding the standard TOR,
- Technical content, and
- Comments outside formal balloting process

**I**nform –
The committee(s) that are not expected to be a part of the standard development but are kept in the loop for situational awareness of the related activities.

# F38 UAS Standards Roadmap

## New Scope – Optionally Piloted Aircraft (R&R Examples)

| Area / System (OPA) | Technical Committee | | | | |
|---|---|---|---|---|---|
| | F37 | F38 | F39 | F44 | F46 |
| Design and Testing of LSA Propellers | A | C | R | I | I |
| UTM (UAS Traffic Management) | I | A | R | I | I |
| Electric Propulsion Units | C | C | A | C | I |
| Flight Data and Voice Recorders | R | I | C | A | I |
| Autonomous Nav System Technicians | I | C | C | I | A |

EXAMPLES

A - Accountable R - Responsible C - Consult I - Inform

# F38 UAS Standards Roadmap
## AGENDA

- 2018 Roadmap Overview
  - Approach / Criteria
  - Current Status
- 2020 & Beyond Roadmap
  - ANSI (2020) Roadmap Gap Analysis
  - New Scope – Optionally Piloted Aircraft
  - ASTM Administrative Collaborations (AC377, AC433, AC478)
  - Other New Topics ?
  - Priorities ?
  - Common standards with other ASTM aviation committees ?

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# F38 UAS Standards Roadmap

## **AC377** Autonomy Design and Operations in Aviation

5 Nov 2020

Andy Lacher
Aerospace and Autonomous Systems Research
Noblis - Federal Civilian Solutions

www.astm.org

# F38 UAS Standards Roadmap

## Administrative Collaborations (AC377)

**Roadmapping Effort –**

Identify standards gaps associated with operations crew training and qualifications; systems design and testing; safety case development; and continued safety assurance.

**Possible new standards –**

Symposium identified desire for test method for measuring how well humans interact with autonomy; inquire if F37, F38, F39, or F44 want to pursue this

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# F38 UAS Standards Roadmap

## **AC433** Gap Analysis for the ASTM MOC for eVTOL/UAM A/C

5 Nov 2020

Tom Gunnarson
Wisk

www.astm.org

# F38 UAS Standards Roadmap
## Administrative Collaborations (AC433)

- **Industry driving innovation and has need for clear certification and operational path**
- **F38 standards for design, infrastructure, autonomy and operations support eVTOL and AAM:**
  - **WK62670 - Large UAS Design and Construction**
  - **WK59317 - Vertiport Design**
  - **F3269 - Bounding Flight Behavior of Complex Functions Using Run-Time Assurance**
  - **F3442 – Detect & Avoid**
- **AC433 facilitation function helps keep efforts on track**
- **Coordination with other SDOs best for industry success**
- **Working together “raises all boats”**

# F38 UAS Standards Roadmap
## Administrative Collaborations (AC433)

- **AC433 covers eVTOL aircraft, simplified vehicle operations, and complex systems**

- **AC433, F37, F38 and F44 common elements:**
  - **Vertiports, Large UAS**
  - **DAA, BVLOS**
  - **Electric energy storage and propulsion**
  - **Safety Assessment of Systems, Acoustic Evaluation**

- **Ideas for discussion**
  - **Expand WK 62670 Large UAS for passengers (after CAA acceptance)**
  - **Work with F46 (personnel training for maintenance, Vertiport ops) on respective F38 standards**
  - **Apply F38 autonomy standards to F37 proposal for LSA autonomy trials**

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# F38 UAS Standards Roadmap

## **AC478** BLOS Strategy & Roadmapping for UAS

5 Nov 2020

Adam Morrison
Streamline Designs

www.astm.org

# F38 UAS Standards Roadmap

## Administrative Collaborations (AC478)

- Handoff from one pilot to another
- Link handoff
- Command system/aircraft
- RPIC system status notification
- Aircraft & airborne hazard avoidance
- Terrain & obstacle avoidance
- Alerting other airspace users to contingency situations
- Geo-awareness
- Maintain operations within limitations
- Provide cybersecurity
- Positioning assurance
- Navigation
- Time synchronization
- Remote ID
- Autonomy & automation
- Risk evaluation
- Ability to land safely
- Weather
- Path-planning within the rules (4D trajectory)
- Contingency planning

# F38 UAS Standards Roadmap

## Administrative Collaborations (AC478)

**Spirent**

Navigation for UAS

### Develop a Standard Specification for Positioning Assurance of UAS

The following topics could be considered:

- Definition of Positioning Assurance
- Performance measure(s) for positioning assurance (including error and units of measurement)
- Level of service measures to provide a means to compare actual performance to the required performance for the operation
- Define how a manufacturer or operator establishes and makes information available, especially for safe BLOS operations
- Define any requirements for general airworthiness and instructions for continued airworthiness


Adobe Acrobat Document

# F38 UAS Standards Roadmap
## AGENDA

- 2018 Roadmap Overview
  - Approach / Criteria
  - Current Status

- 2020 & Beyond Roadmap
  - ANSI (2020) Roadmap Gap Analysis
  - New Scope – Optionally Piloted Aircraft
  - ASTM Administrative Collaborations (AC377, AC433, AC478)
  - Other New Topics ?
  - Priorities ?
  - Common standards with other ASTM aviation committees ?

# F38 UAS Standards Roadmap
## 2020 & Beyond- SUMMARY

- Continue with existing standards work
- Complete Mapping out ANSI roadmap against current F38 work
- EXCOM to review and finalize
  - New TOPICS
    - OPA, Derived from AC377, AC433, AC498, etc.
  - Priorities
    - Regulator strategy / guidance, Resource(s) availability
- Update F38 Roadmap

# F38 UAS Committee
## Contact Info

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# BACK-UP

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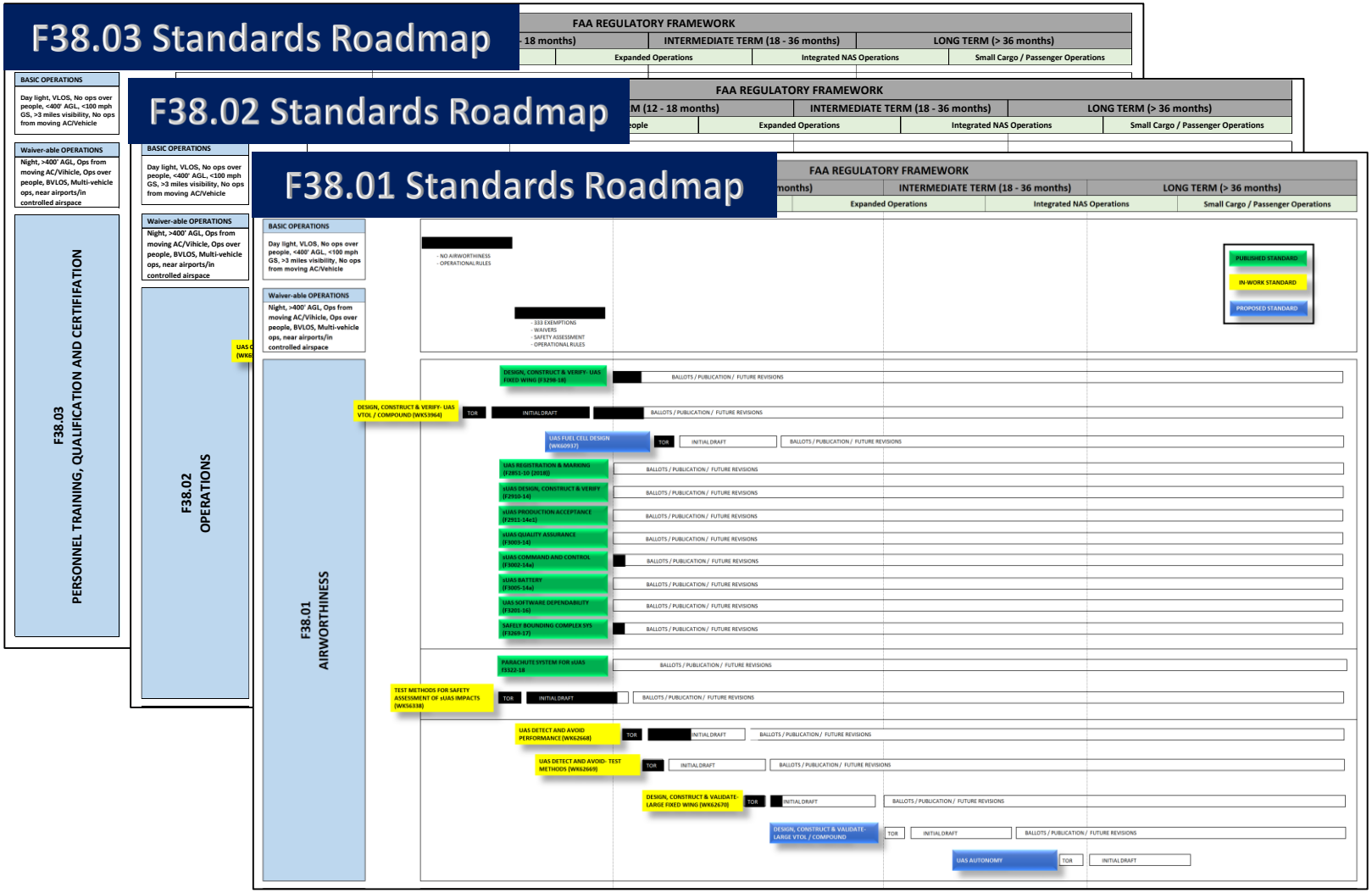
# F38 UAS Standards Roadmap

## 2018 Standards Roadmap



# F38.01 (Airworthiness) Standards Summary

**PUBLISHED**

- **F2851-10** — **UAS Registration and Marking**
- **F2910-14** — **Design, Construct and Test of sUAS**
- **F2911-14e1** — **Production Acceptance of sUAS**
- **F3002-14a** — **Design of Command and Control System for sUAS**
- **F3003-14** — **Quality Assurance of sUAS**
- **F3005-14a** — **Use of Batteries in sUAS**
- **F3201-16** — **Ensuring Dependability of Software for UAS**
- **F3269-17** — **Methods of Safely Bound Flight Behavior of UAS containing Complex Systems**
- **F3298-19** — **Design, Construction, and Verification of Lightweight UAS**
- **F3322-18** — **Parachutes for sUAS**
- **F3389/F3389M-20** — **Test Method for Assessing Safety of sUAS Impacts**
- **F3442/F3442M-20** — **Detect and Avoid Performance Requirements**

**IN-WORK**

- **WK56338** — **Safety of UAS for Flying Over People**
- **WK60937** — **Design of Fuel Cells for UAS**
- **WK62668** — **Detect and Avoid Performance Requirements**
- **WK62669** — **Detect and Avoid Test Methods**
- **WK62670** — **Design, Construction and Verification for Large UAS**
- **WK69690** — **Surveillance UTM Supplemental Data Service Provider (SDSP) Performance**
- **WK70877** — **Showing Durability and Reliability Means of Compliance for UAS**
- **WK72960** — **Verification of Light Weight UAS**

# F38.02 (Flight Operations) Standards Summary

**PUBLISHED**

- **F2849-10** **Handling of UAS at Divert Airfields**
- **F2909-19** **Continued Airworthiness of Lightweight UAS**
- **F3178-16** **Operational Risk Assessment of sUAS**
- **F3196-18** **Beyond Visual Line of Sight (BVLOS) Operations for sUAS**
- **F3411-19** **Remote ID and Tracking**

**IN-WORK**

- **WK59317** **Vertiport Design**
- **WK63418** **Service provided under UAS Traffic Management (UTM)**
- **WK65042** **UAS Operations over People**
- **WK69335** **Framework for Using ASTM Standards International for UAS**
- **WK73142** **Weather Supplemental Data Service Provider (SDSP) Performance**

# F38.03 (Personnel Qual/Training) Standards Summary

**PUBLISHED**

- **F2908-18** **Aircraft Flight Manual for UAS**
- **F3266-18** **Training for Remote Pilot in Command of UAS Endorsement**
- **F3330-18** **Training and Development of Training Manuals for the UAS Operator**
- **F3341/F3341M-20** **Standard Terminology for UAS**
- **F3364-19** **UAS Operator Independent Audit Programs**
- **F3365-19** **Compliance Audits to ASTM Standards on UAS**
- **F3366-19** **General Maintenance Manual (GMM) for sUAS**
- **F3379-20** **Training for Public Safety Remote Pilot of UAS**

**IN-WORK**

- **WK61763** **Training for Remote Pilot Instructor (RPI) of UAS**
- **WK62734** **Development of Maintenance Manual for Lightweight UAS**
- **WK62741** **Training UAS Visual Observers**
- **WK62744** **General Operations Manual for Professional Operator of Light UAS**
- **WK63407** **Required Product Information to be Provided with a sUAS**
- **WK67357** **Light UAS Manufacturers Quality Assurance System**