Integrated System-Wide Safety Tools and Methods

Objective of Breakout Sessions

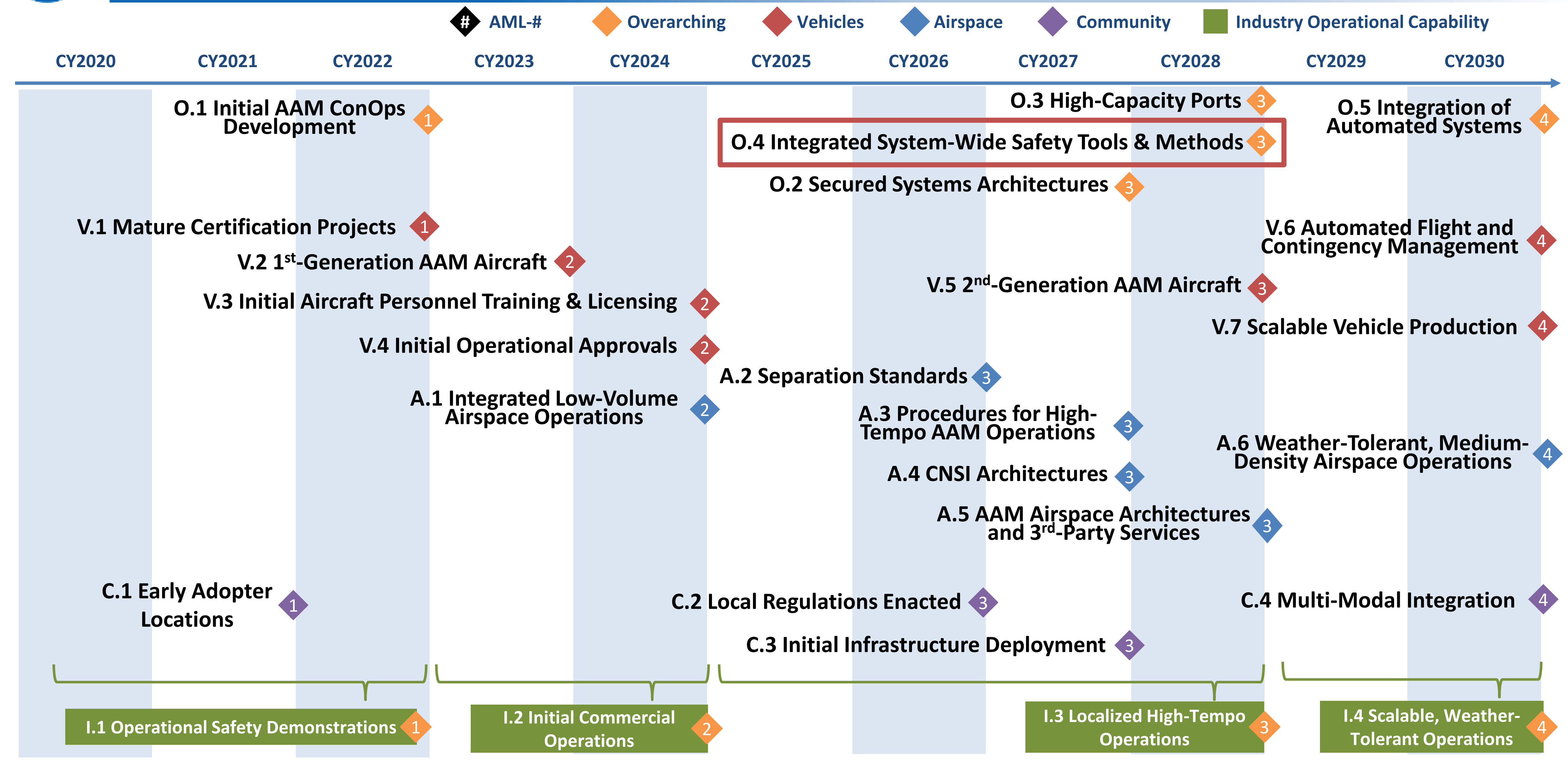
- **Review the Ecosystem Goal definition**

- **Discuss the major barriers associated with the Goal**

- **Define the different ecosystem stakeholder roles** (e.g., academia, industry, government, etc.) **associated with achieving the Goal**

- **Suggest the priorities and sequencing for achieving the Goal**

Advanced Air Mobility (AAM) Ecosystem Goals[1]

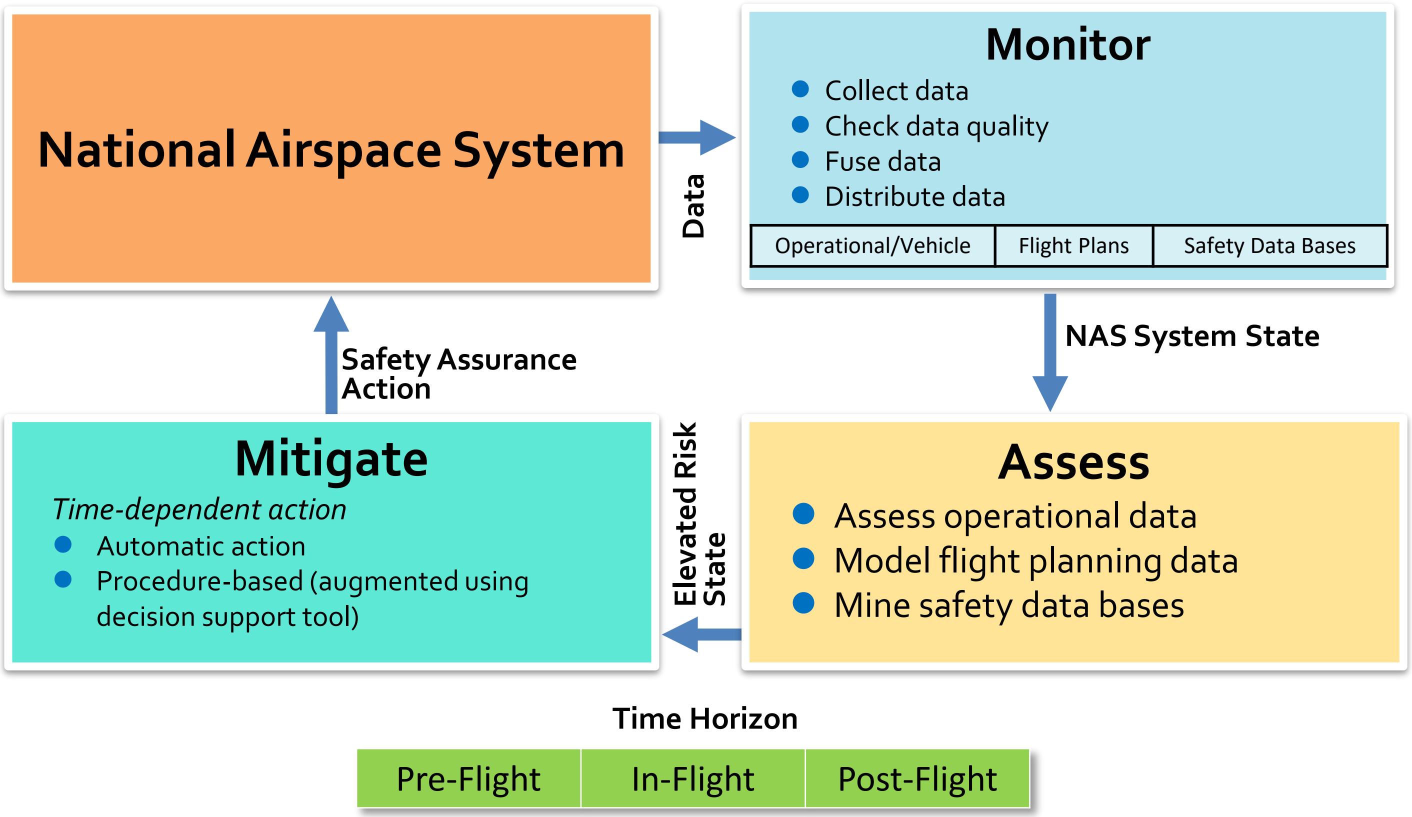


[1] Based on a range of publicly available industry projections; not a consensus view; aggressive

CNSi: Communication, Navigation, Surveillance, Information
AML: AAM Maturity Level

AAM Risks and Integrated System-Wide Safety

In-Time System Wide Safety Assurance



Risks

- **Flight outside of approved airspace**
- **Unsafe proximity** to air traffic, people on the ground, terrain or property
- **Critical system failures** (including loss of link, loss or degraded positioning system performance, loss of power, flight control failure and engine failure
- **Loss-of-Control** (i.e., envelope excursions)
- **Physical/Environment Related Risks**
  - Weather encounters (including wind gusts)
  - Threat by person—malicious
- **Cyber-security** related risks
- Those we have **not yet identified…**

AAM Ecosystem Goal Definition

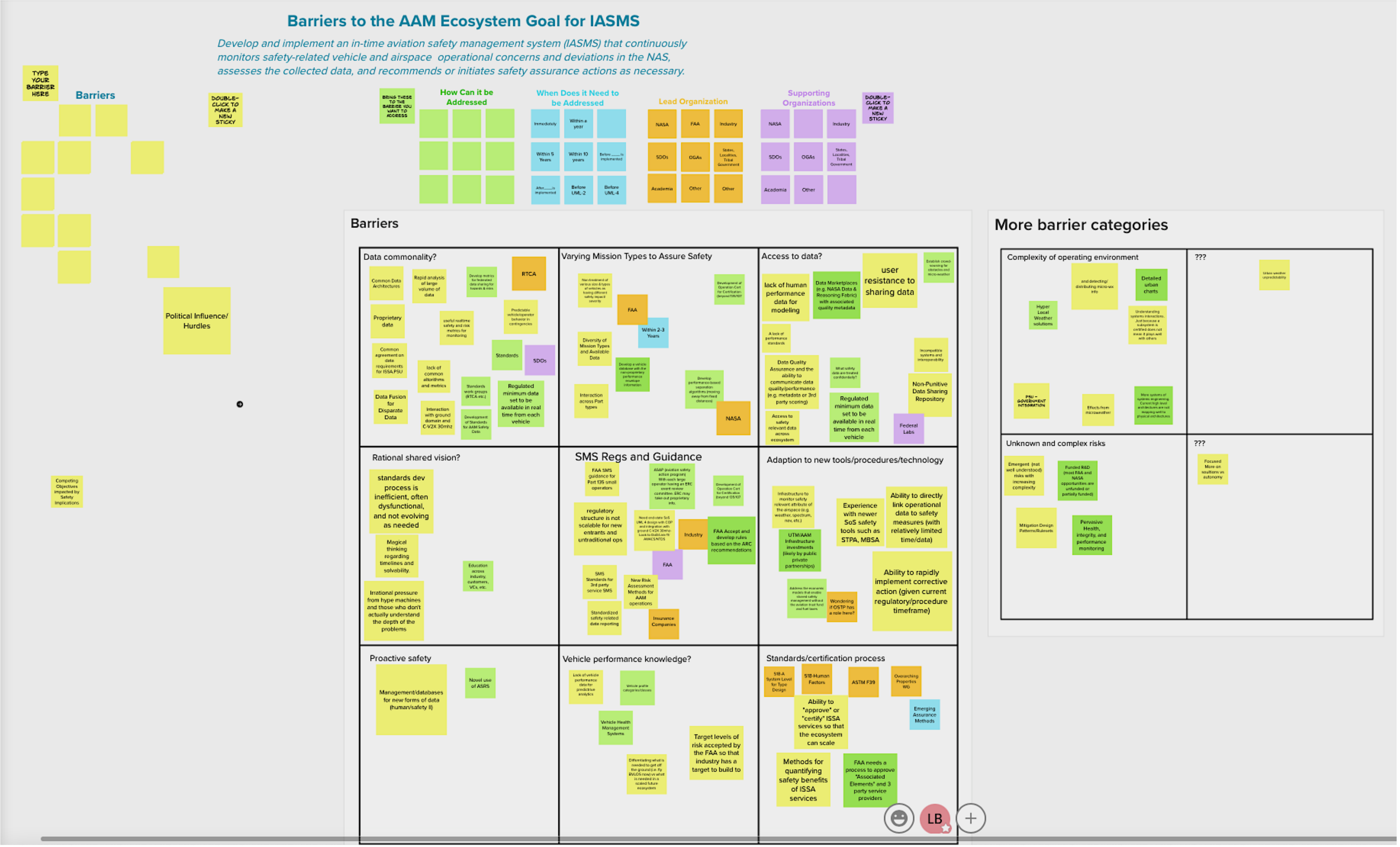
Ecosystem Goal	Ecosystem Goal Statement
Integrated System-Wide Safety Tools & Methods, 2028	Develop and implement an in-time aviation safety management system (IASMS) that continuously monitors safety-related vehicle and airspace operational concerns and deviations in the NAS, assesses the collected data, and recommends or initiates safety assurance actions as necessary.

Transformed Airspace

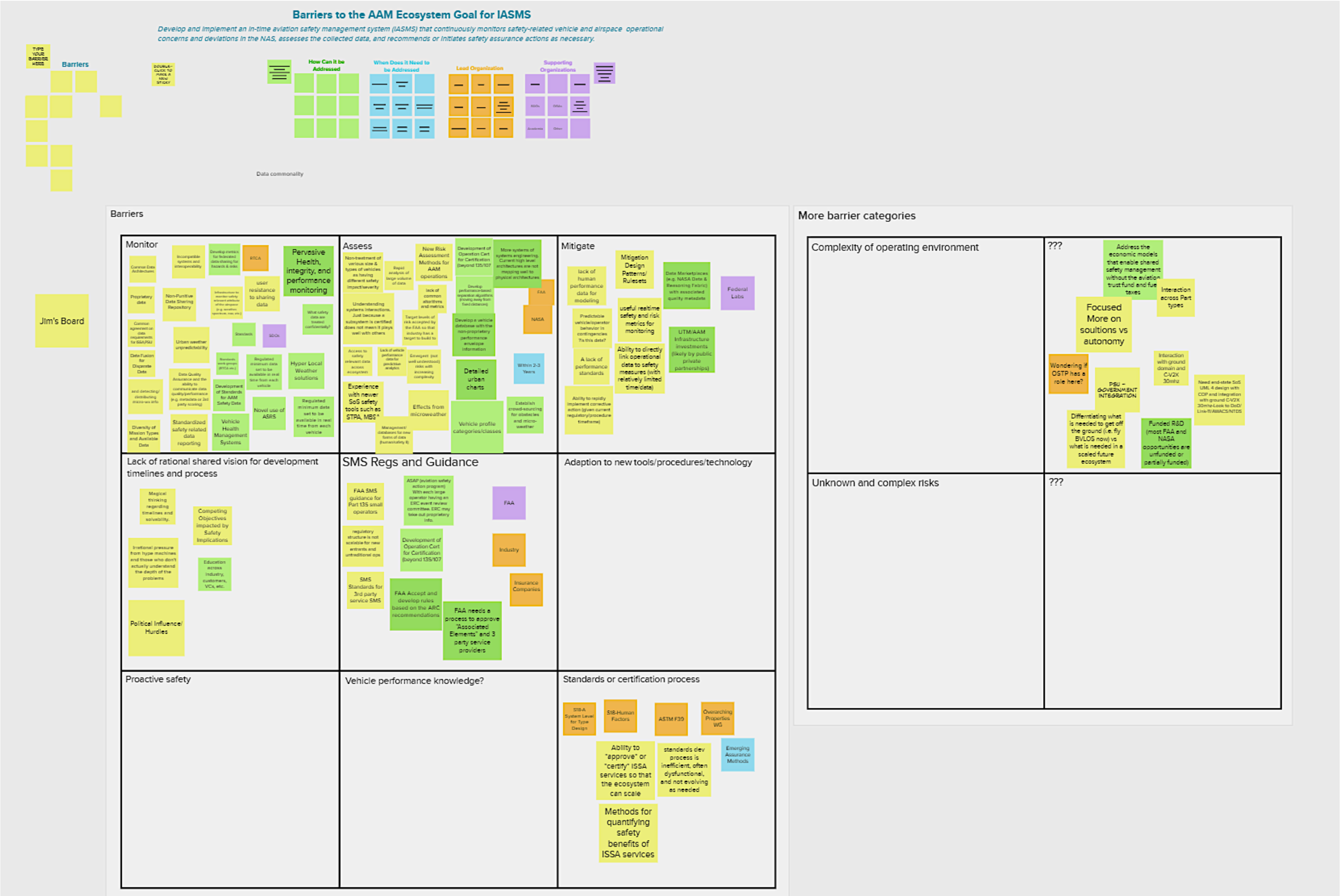
Integrated System-Wide Safety Tools and Methods

- **Tomorrow's airspace is foreseen as increasingly complex with dynamic changes in scale and variety of operations.**
- **Safety Management Systems must adapt and evolve to analyze larger and highly variable sets of data.**
- **Advanced data analytics identify risks and inform or execute safety assurance actions in-time to mitigate risks and prevent incidents and accidents.**
- **New safety technologies and concepts offer an opportunity to augment existing SMS processes and enable them to be increasingly predictive and timely, while also improving accessibility to more operators large and small.**

Barriers to the AAM Ecosystem Goal for IASMS



Monitor-Assess-Mitigate Framework



Barriers to the AAM Ecosystem Goal for IASMS

Monitor				
Barriers	**How Addressed**	**When Addressed**	**Lead Org**	**Supporting Orgs**
Architecture Design	Develop metrics for federated data sharing for hazards & risks		SDOs	NASA
Incompatible systems and interoperability	Standards		RTCA	Academia
Common Data Architectures	Standards work groups (RTCA etc.)		SAE	
Infrastructure to monitor safety relevant attribute of the airspace (e.g., weather, spectrum, nav, etc.)	Development of Standards for AAM Safety Data			
Data	What safety data are treated confidentially?			
User resistance to sharing data	Pervasive Health, integrity, and performance monitoring			
Proprietary data	Novel use of ASRS			
Non-Punitive Data Sharing Repository				
Common agreement on data requirements for ISSA,PSU				
Data Fusion for Disparate Data				
Diversity of Mission Types and Available Data				
Standardized safety related data reporting				
Weather data	Hyper Local Weather solutions			
Urban weather unpredictability				
Data Quality Assurance and the ability to communicate data quality/performance (e.g., metadata or 3rd party scoring) and detecting/distributing micro-wx info				
	Vehicle data			
	Regulated minimum data set to be available in real time from each vehicle			
	Vehicle Health Management Systems			

Barriers to the AAM Ecosystem Goal for IASMS

Assess				
Barriers	**How Addressed**	**When Addressed**	**Lead Org**	**Supporting Orgs**
Data analysis	More systems of systems engineering. Current high-level architectures are not mapping well to physical architectures	Within 2-3 Years	NASA	
Management/databases for new forms of data (human/safety II)	Develop performance-based separation algorithms (moving away from fixed distances)		FAA	
New Risk Assessment Methods for AAM operations	Detailed urban charts			
Non-treatment of various size & types of vehicles as having different safety impact/severity	Develop a vehicle database with the non-proprietary performance envelope information			
Rapid analysis of large volume of data	Vehicle profile categories/classes			
Lack of common algorithms and metrics				
Experience with newer SoS safety tools such as STPA, MBSA				
Lack of vehicle performance data for predictive analytics				
Experience with newer SoS safety tools such as STPA, MBSA				
Data fusion				
Access to safety relevant data across ecosystem	Establish crowd-sourcing for obstacles and micro-weather			
Effects from microweather				
Understanding systems interactions. Just because a subsystem is certified does not mean it plays well with others				
Determination of acceptable risk				
Target levels of risk accepted by the FAA so that industry has a target to build to	Development of Operation Cert for Certification (beyond 135/107			
Emergent (not well understood) risks with increasing complexity				

Barriers to the AAM Ecosystem Goal for IASMS

Mitigate				
Barriers	**How Addressed**	**When Addressed**	**Lead Org**	**Supporting Orgs**
System risk mitigation	Data Marketplaces (e.g., NASA Data & Reasoning Fabric) with associated quality metadata			Federal Labs
Mitigation Design Patterns/Rulesets	UTM/AAM Infrastructure investments (likely by public private partnerships)			
Useful real-time safety and risk metrics for monitoring				
Ability to directly link operational data to safety measures (with relatively limited time/data)				
A lack of performance standards				
Ability to rapidly implement corrective action (given current regulatory/procedure timeframe)				
Human performance				
lack of human performance data for modeling				
Predictable vehicle/operator behavior in contingencies? is this data?				

Barriers to the AAM Ecosystem Goal for IASMS

Lack of rational shared vision for development timelines and process				
Barriers	**How Addressed**	**When Addressed**	**Lead Org**	**Supporting Orgs**
Magical thinking regarding timelines and solvability.	Education across industry, customers, VCs, etc.			
Competing Objectives impacted by Safety Implications				
Irrational pressure from hype machines and those who don't understand the depth of the problems				
Political Influence/Hurdles				

Barriers to the AAM Ecosystem Goal for IASMS

SMS Regs and Guidance				
Barriers	**How Addressed**	**When Addressed**	**Lead Org**	**Supporting Orgs**
FAA SMS guidance for Part 135 small operators	ASAP (aviation safety action program) With each large operator having an ERC event review committee. ERC may take out proprietary info.		Industry	FAA
Regulatory structure is not scalable for new entrants and untraditional ops	Development of Operation Cert for Certification (beyond 135/107		Insurance Companies	
SMS Standards for 3rd party service SMS	FAA Accept and develop rules based on the ARC recommendations			
	FAA needs a process to approve "Associated Elements" and 3 party service providers			

Barriers to the AAM Ecosystem Goal for IASMS

Standards/certification process				
Barriers	**How Addressed**	**When Addressed**	**Lead Org**	**Supporting Orgs**
Ability to "approve" or "certify" ISSA services so that the ecosystem can scale		Emerging Assurance Methods	S18-Human Factors	
Standards dev process is inefficient, often dysfunctional, and not evolving as needed			Overarching Properties WG	
Methods for quantifying safety benefits of ISSA services			S18-A	
			System Level for Type Design	
			ASTM F39	

Barriers to the AAM Ecosystem Goal for IASMS

Misc.				
Barriers	**How Addressed**	**When Addressed**	**Lead Org**	**Supporting Orgs**
Near-term solutions	Address the economic models that enable shared safety management without the aviation trust fund and fuel taxes		Wondering if OSTP has a role here?	
Differentiating what is needed to get off the ground (i.e., fly BVLOS now) vs what is needed in a scaled future ecosystem	Funded R&D (most FAA and NASA opportunities are unfunded or partially funded)			
Focused More on solutions vs autonomy				
Other considerations				
Interaction across Part types				
Interaction with ground domain and C-V2X 30mhz				
PSU - Government integration				
Need end-state SoS UML 4 design with COP and integration with ground C-V2X 30mhz-Look to DoD/Link-11/AWACS/NTDS				

KEY TAKEAWAYS

Many viewpoints and lots of information to digest -> Large variation in baseline education/knowledge within new entrant community regarding certification processes (airworthiness and operation) and how safety plays a role. -> Assumption and feasibility issues when approaching CAAs.

More time with specific application context (Vehicle type and Ops as Envisioned) is necessary to build out prototypical safety cases that can then be analyzed for common themes and general guidance for AAM SMS.

Large need for standards and guidance on how to implement *Safety Assurance* and *Risk Management* for new entrant operations. In particular, data exchange and requisite safety considerations based on type of operation/mission (piloted vs remotely piloted, environment, airspace, level of automation/autonomy).

NEXT STEPS

This is an iterative data gathering process…

1. **Combine what we already have captured as barriers with information from this workshop**
2. **Can host additional workshops to continue filling in gaps in the assessment**
3. **Cross reference existing barriers analysis with this data gathering exercise for commonality and begin to establish some level of baseline validation of the barriers and related information**

Back Up