

# Emerging Technologies: Focusing on the Delta, Building an A&P Plus Program



ATEC Conference  
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## Presenters (alpha order):

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  - Co-Principal Investigator, National Center for Autonomous Technologies (NCAT), Northland Community & Technical College





# Advanced Air Mobility - Overview of Current Trends & Infrastructure Requirements





## What is Advanced Air Mobility (AAM)?

- ▶ The vision of AAM is that of a safe, accessible, automated, and affordable air transportation system for passengers and cargo capable of serving previously hard-to-reach urban and rural locations. (NASA/AAM)

# AAM includes various missions and aircraft designs

Air Cargo

Package Delivery

All autonomous UAS missions

Air Taxi

Air Metro

Air Ambulance

Personal Air Vehicles

Google search: "AAM aircraft images"





# Large Unmanned Cargo Aircraft - LUCA

- ▶ **Large unmanned cargo aircraft (LUCA)** will be defined as **unmanned aircraft** carrying 100-25,000 pounds and with a range of 200-10,000 miles. (Collin, 2020)



Sabrewing Rhaegal RG-1

Source:  
<https://www.sabrewingaircraft.com/cargo-uav/>



Nautilus Company



Source: <http://www.natilus.co/>

# AAM Aircraft in Flight & Development



## Italdesign-Airbus PopUp (concept/development)

- <https://www.youtube.com/watch?v=L0hXslrvdmw>

## Joby Aviation S4 (flying - certification testing)

- <https://www.youtube.com/watch?v=4wbFw165ar0>



## Vertical VX4 (Development)

- [https://www.youtube.com/watch?v=FmuTM\\_80\\_qI](https://www.youtube.com/watch?v=FmuTM_80_qI)



## Lilium (Flying)

- <https://www.youtube.com/watch?v=sQJkHDwNvkk>



## Archer MAKER (Flying); MIDNIGHT (Development)

- <https://www.youtube.com/watch?v=IN0MK2PHgEo>
- <https://www.youtube.com/watch?v=h95jtCArSyA>







# Workforce Requirements for Emerging Technologies

## Outlook:

- Market for Advanced Air Mobility
  - 110 billion dollars by 2035 (Allied Market Research)
  - Projected \$1.0 tn market by 2040; \$9.0 tn by 2050 (Morgan Stanley)
- Expanding technologies in aerospace already outpace existing technician standards
- Current CFR Part 147 technician standards are insufficient to sustain these new technologies in the field.
- New standards must be developed and integrated into training curricula to ensure a highly qualified technician workforce is ready for the challenge.

# March 23, 2023 | United Airlines And Archer Announce First Commercial Electric Air Taxi Route In Chicago



## Details

- 100 acft order
- 2025 EIS
- ORD to Vertiport Chicago
- 10 minute flight, Cost of an Uber (National)

Source: <https://www.archer.com/news/united-airlines-and-archer-announce-first-commercial-electric-air-taxi-route-in-chicago>  
<https://www.abc4.com/news/national/chicago-to-debut-first-commercial-electric-air-taxi-route/>



# NASA & FAA working together on AAM/UAM

 **NASA**  
Urban Air  
Mobility

November 2018

## URBAN AIR MOBILITY (UAM) MARKET STUDY

 **CCI**  
CROWN CONSULTING, INC.

 **ASCENSION**  
GLOBAL

 **Georgia Tech** Aerospace Systems  
Design Lab

 **McKinsey & Company**

# NASA research findings

- ▶ Near-market segments - “commercially viable market for last-mile parcel delivery and air metro could be in place by 2030” (NASA, 2018)
- ▶ Likely market constraints - “limited potential market for air taxis in concentrated areas of high net worth individuals and businesses in 2030” (NASA)
- ▶ Key challenges - “For UAM to be viable, it is necessary to address the technical, physical, operational, and integration challenges of a highly interdependent system-of-systems” (NASA)
- ▶ Market viability depends on the following:
  - Safety & security
  - Economics
  - Transportation demand
  - Regulation
  - Market substitutes (ex. Autonomous delivery and transportation)
  - Public acceptance (NASA)

CityAirbus - In flight tests

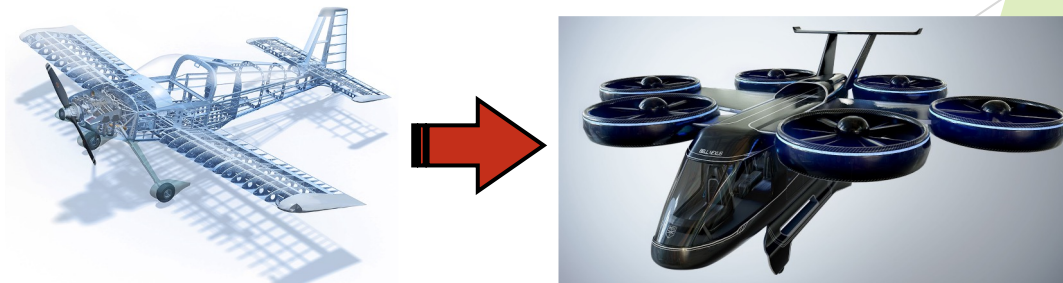


Source: <https://www.airbus.com/innovation/zero-emission/urban-air-mobility/cityairbus.html>



# Additional challenges related to support of UAM equipment in the field

- ▶ Current Federal Aviation Regulations (FARs) not ready for emerging technologies
  - Certification criteria for hybrid propulsion and transitional lift systems
    - FAA proposes SFAR to incorporate ‘Powered-Lift’ aircraft category for eVTOL Ops (NPRM); impacts aircraft certification 14 CFR Part 21.17(b) (Trock, 2022)
    - Impacts maintenance and inspection criteria - Technician standards, TBD
  - Advanced integrated technologies and systems within air vehicles is beyond the scope of current FAR Part 147 Aircraft Maintenance Technician standards
    - Industry, education & training and FAA collaboration essential
    - Need new standards and industry to provide information & training aids





BY TEXTRON AVIATION



## Additional challenges related to support of UAM equipment in the field, cont.

- Current aftermarket support services, and MRO facilities are strategically centralized within regional boundaries
  - customers fly aircraft to service centers
  - Demographics of operations dramatically changes the type and location of in-service support footprint.
    - Limited ranges of eVTOL will require decentralization of support placed close to the area of operations
    - Increased demand for technicians, logistics & supply chain, facilities, & zoning for air operations close metropolitan areas
- Current aircraft OEMs, operators, and 3<sup>rd</sup> party service providers are knowledgeable and experienced
- Most of the UAM designs under development are from start up companies that are NOT traditional OEMs
  - Best solution is for new start-ups to leverage service support agreements with established FAR Part 145 Repair Stations (short term)





# The Roadmap to New Standards Development for Aerospace Technicians

# Emerging Technologies – Context is Important

Advanced  
Traditional Fixed &  
Rotary Wing Aircraft



Spacecraft



Hybrid-Electric/  
Hydrogen Fueled



Supersonic Aircraft



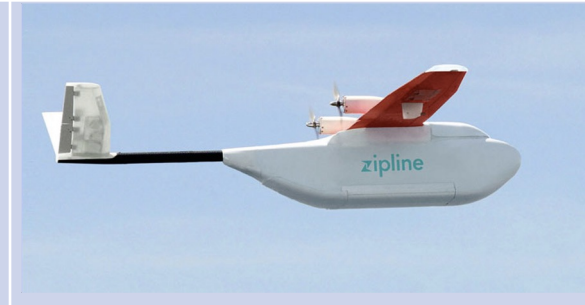
AAM  
UAM – eVTOL  
Air Taxi/Metro/PAV



AAM  
Thin Haul/GA- eCTOL



AAM  
UAS – Small/BVLOS



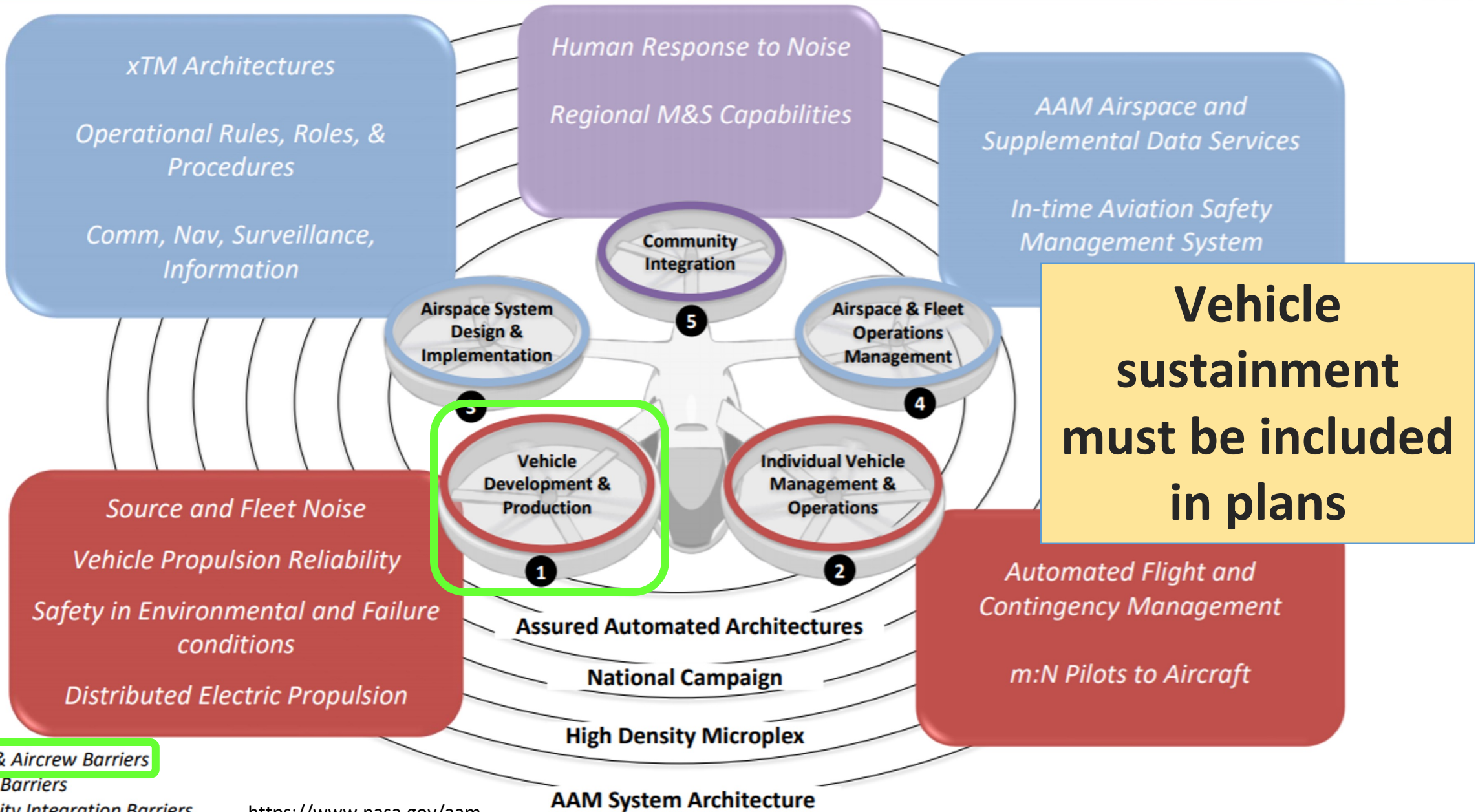
AAM  
UAS - LUCA







# NASA AAM Mission Priorities



- Aircraft & Aircrew Barriers
- Airspace Barriers
- Community Integration Barriers
- # Pillar number

<https://www.nasa.gov/aam>

# Successful Vehicle Operations

Vehicle  
Design &  
Certification  
Standards

Infrastructure  
Development  
- Operations

## Workforce Development

Qualifications

Standards

Certification/  
Credentials

Training

Industry,  
Education &  
Government  
Collaboration is  
Essential for  
Successful  
Operations

“Important to focus on  
technician requirements now”





NASA

- AAM Infrastructure



FAA

- Advanced Aircraft Advisory Committee



GAO

- Workforce Requirements



OEMs



GAMA

- EPIC



NBAA

- Emerging Technologies Committee



ATEC/AEA

- Part 147 & Avionics Technician School Advocacy



ASTM

- (F46/AC377/AC433)



CertTEC/SpaceTEC

- Credentialling



Vertical Flight Society

- Advocacy, Resources, Community



Utah Advanced Aircraft Maintenance Planning (UAAMP)



Advanced Air Mobility Working Groups

- State Infrastructure Initiatives

# Organizations engaged in emerging technologies

**“Many involved, few coordinated to create qualified technicians for new technology (Stove piped)”**

(SAMPLE – Not All Inclusive)



# Technology Evaluation for Technician Standards



“Broad based, unified  
solution to create  
qualified technicians is  
needed”



Identify & assess new technology



Research technical data on technology



Find instructions for continued airworthiness (if available)



Perform task analysis



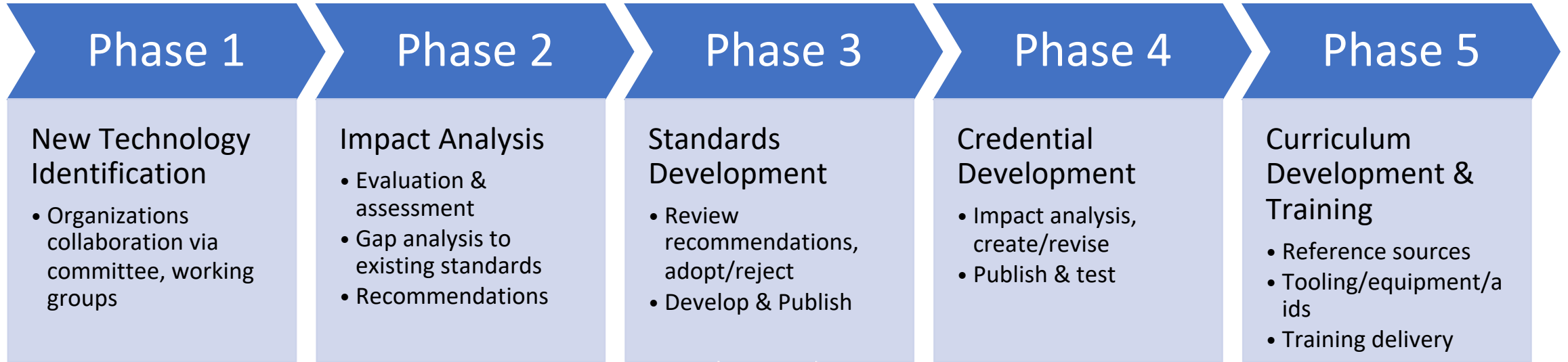
Identify competency requirements to sustain/repair technology



Do gap analysis b/w required competency and existing technician standards



# Qualified Technician - Integrated and collaborative process workflows (Desired state)



“Partnership effort is needed – Reduce stove pipes”

**“Unify all groups through a common process for creating a qualified technician”**

*“The FAA is relying more and more on industry to help guide the regulatory environment, and that includes standards that are developed by ASTM.”*  
Jonathan Daniels, CEO of Praxis Aerospace.

*“The standards that exist provide about an 80 percent solution as-is, but some of them need to be revised or expanded while some new standards need to be created”* Anna Dietrich, AC 377 Committee Chair

**Stakeholder Partners**

- ATEC
- Industry
- Associations
- Schools (AMTS)



- **Inclusive, holistic approach, broad base support**
- **Additional expertise and expanded network & influencers**
- **Enables broader acceptance, credentialing and training deployment**





# Technician Standards & Certification Organizations



**Many organizations producing standards & certifications for aviation**

# Technician Standards and Certification Organizations

Mechanic Airmen Certification Standards

- 147 ACS (new 147)

National Center for Aerospace & Transportation Technologies (NCATT)  
- UAS Mx

ASTM F46.06 - Autonomous and Electric Aircraft Maintenance Personnel

Aircraft Electronics Technician (AET)

SAE ITC

AeroIT – IT Certification for Aviation

CertTech/SpaceTech



# Mechanic Airmen Certification Standards (ACS)

- New, replaces Part 147 subjects outlined in Appendix B, C, D
- More agile than old 147 to accommodate new technologies (every 3 yrs?)
- Does not address new technology adequately
  - High voltage electric/hybrid propulsion
  - Space vehicles, rocket propulsion
  - eVTOL / eCTOL Aircraft Systems
  - Satcoms and onboard IT systems
- Long lead time, burdensome process for changes







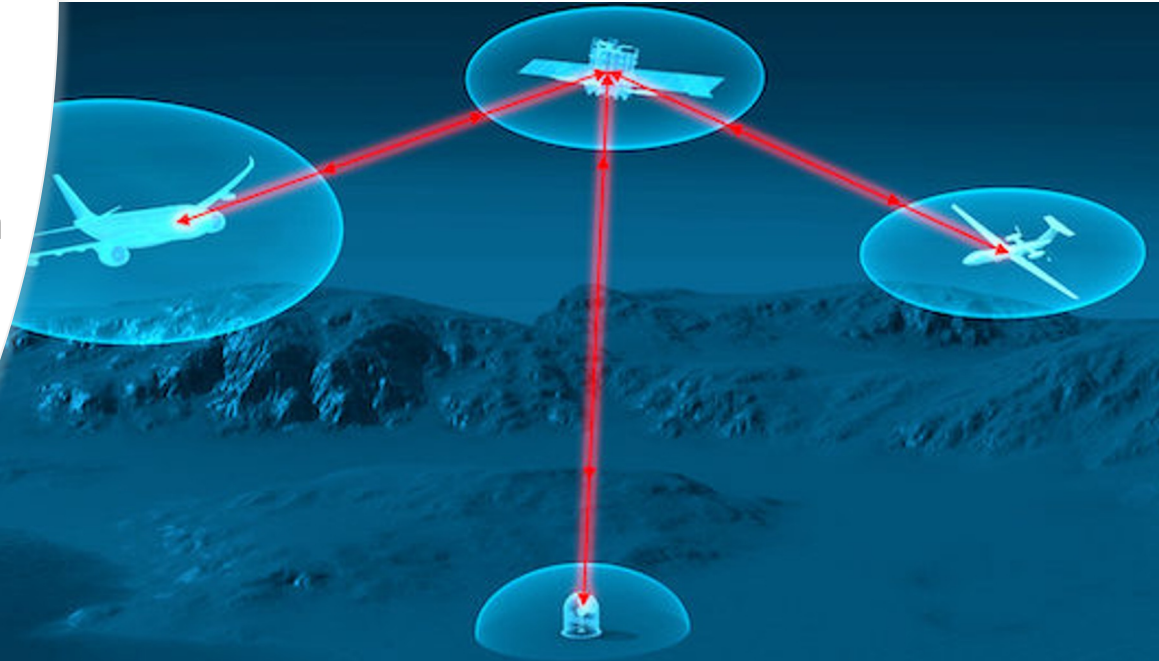
## NCATT/ASTM Aircraft Electronics Technician (AET)

- NCATT AET certification along with a minimum of one additional endorsement meets the intent of the regulation stated in 14 CFR section 65.101 (a)(5)(ii) for the issuance of a repairman's certificate.
- Four endorsements available:
  - Autonomous Navigation Systems (ANS)
  - Dependent Navigation Systems (DNS)
  - Radio Communication Systems (RCS)
  - Onboard Communications and Safety Systems (OCS)
- Can prepare technician for UAS/AAM technologies + modern avionics today

# AeroIT

- CompTIA and Satcom Direct collaboration
- Introduces 'off-aircraft' control stations (CS)
  - Monitor and control UAS and AAM aircraft
- Certification exam
  - Valid 3 years, renewal required
- Upskill avionics professional or A&P technician
- Introduces
  - Satcom
  - Network Managements
  - IP Theory
  - Troubleshooting aircraft networks

# aeroIT





# ASTM F46.06 Autonomous and Electric Aircraft Maintenance Personnel



- Workgroup finalized and published a UAS Mx standard (F3600-22)
  - UAS classified into 3 classes
  - Identified KSAs for each
- Classifies systems by equipage of entire system (not just size)
- Advanced Air Mobility (eVTOL) standards beginning development
- F46 similar scope as 147
  - Inclusive of new technologies
  - More adaptive and responsive
  - Committee members selected for inclusion based on SME





# CertTEC/SpaceTEC

- Works closely with ASTM
- Industry driven exam content
- Creates exams based on standards
  - Wide ranging skill topics
  - Can incorporate practical skills into exams
  - New UAS Mx standard planned
- Certifies institutions training to ASTM F46 standards

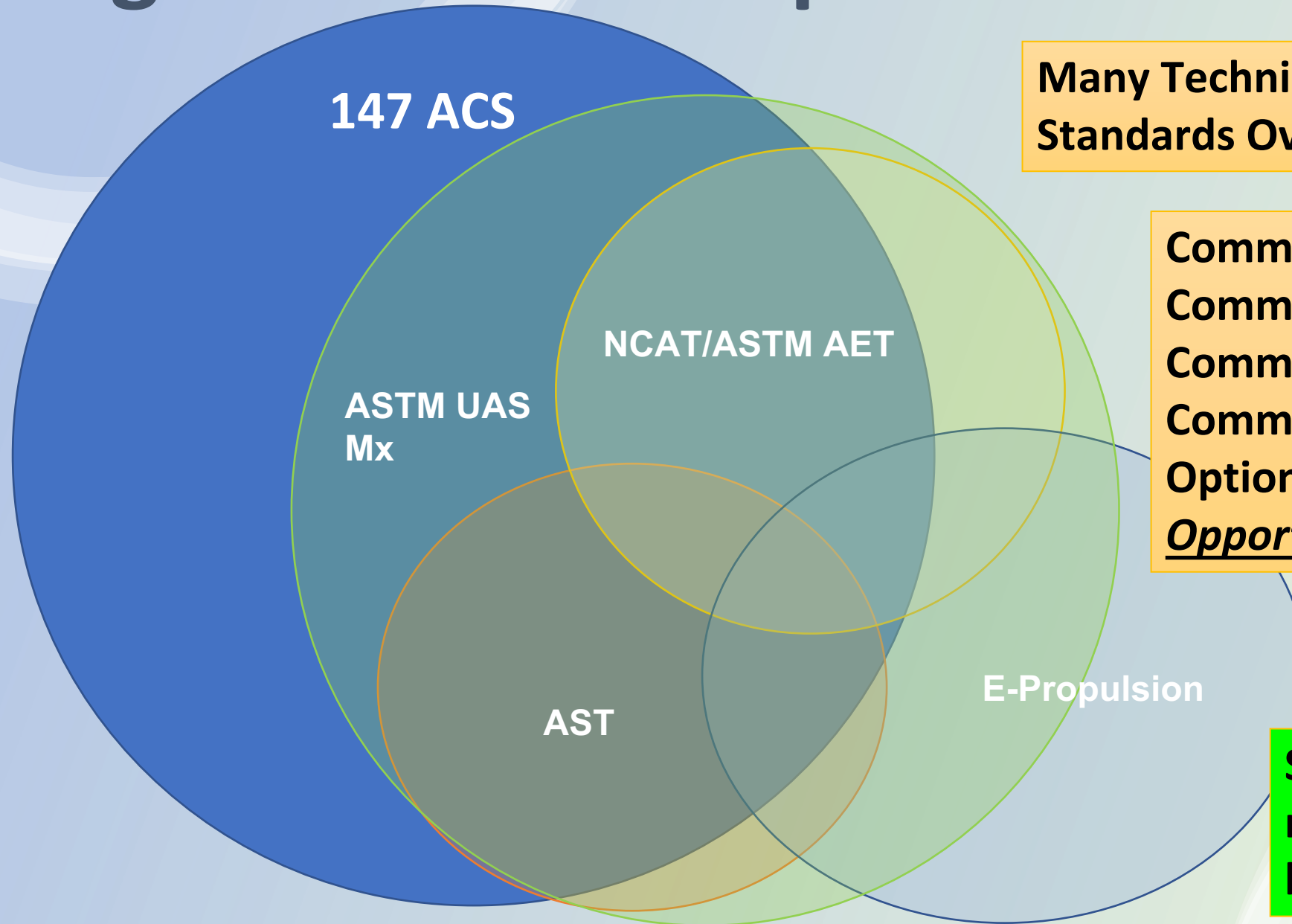


# SAE Industry Technologies Consortia (SAE ITC)

- Can support standards development, repository and certification testing
- PROBITAS Authentication
  - Proven processes for personnel and training authentication
  - Standards
    - Probitas Authentication authenticates AQMS auditors and reviews and approves AQMS training course content for the following IAQG standards:
    - IAQG 9100: Quality Management Systems – Requirements for Aviation, Space and Defense Organizations
    - IAQG 9110: Quality Management Systems for Aviation Maintenance Organizations
    - IAQG 9120: Quality Management Systems – Requirements for Aviation, Space and Defense Distributors



# Significant Overlap in Standards



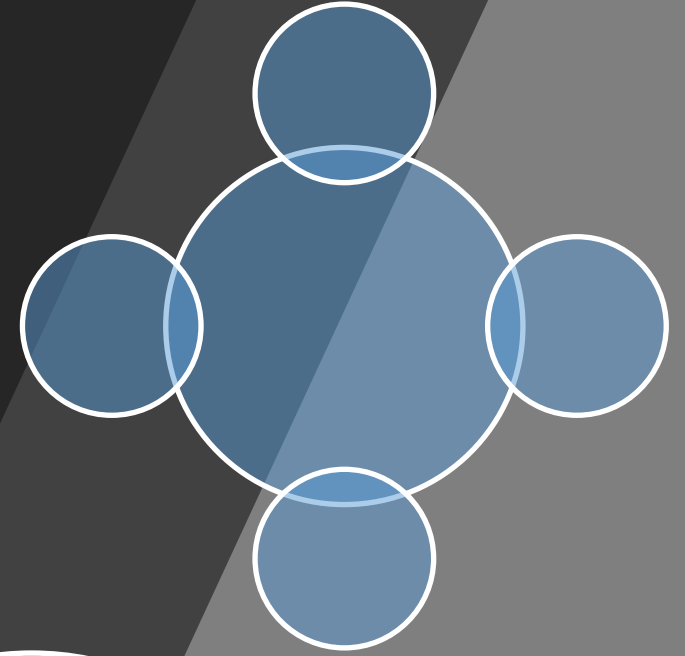
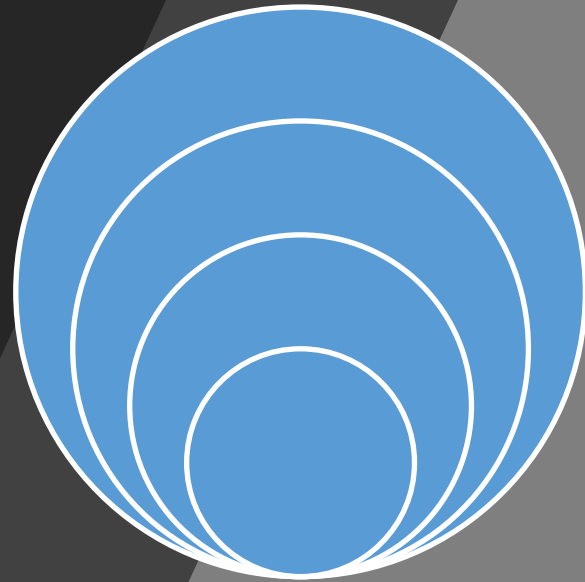
**Many Technician Certification Standards Overlap**

**Common Standards =  
Common Training =  
Common Lessons =  
Common Equipment =  
Options for Schools =  
Opportunity for Students**

**Schools can offer many credentials beyond A&P**

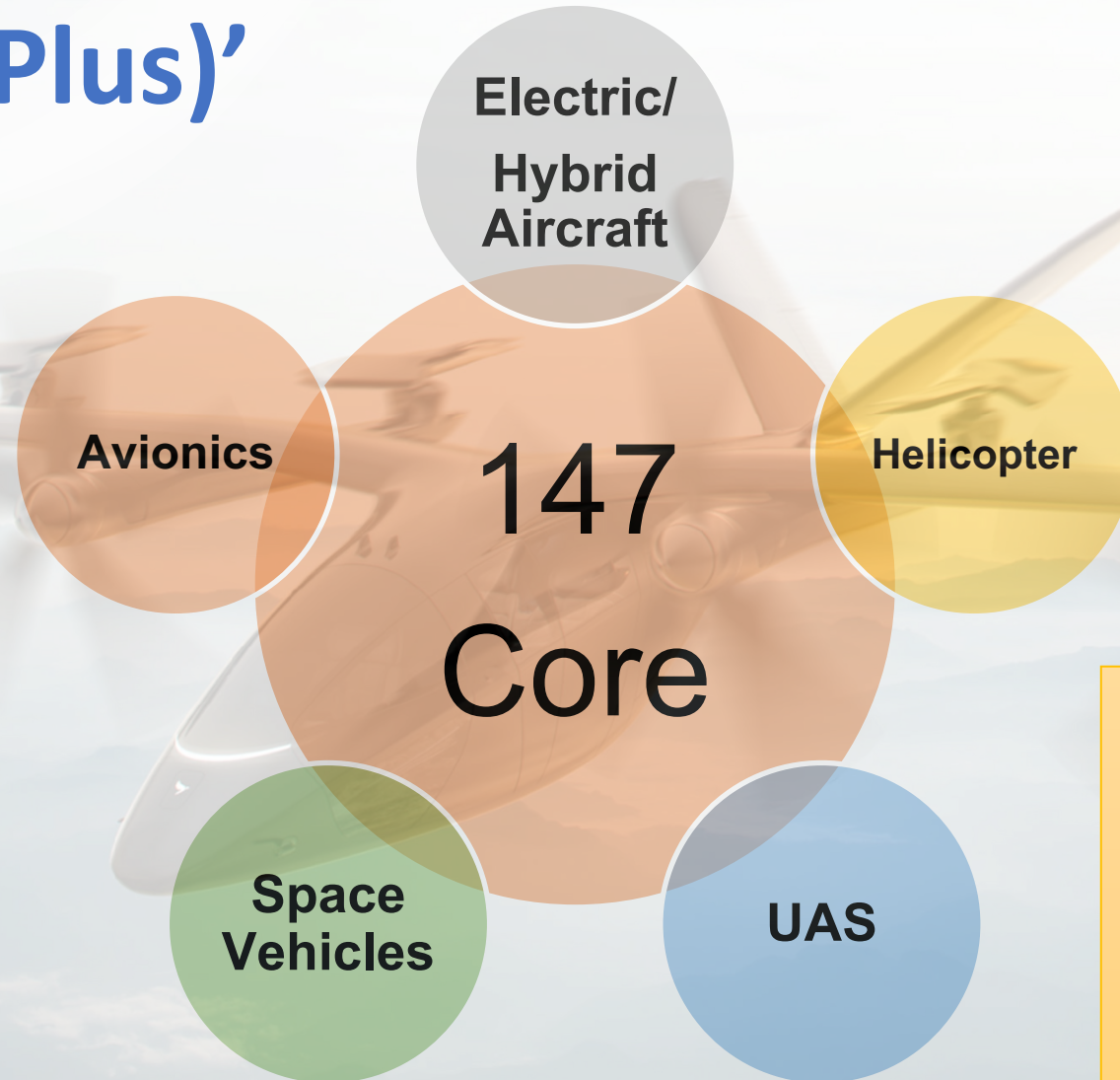


# Curriculum – Deployment Choices



# Technician Curriculum Deployment Model – Option 1

**‘147+ (Plus)’**



Additive programs bolted to established cores

- Flexible
- Localized workforce development based on employer demographics

# Technician Curriculum Deployment Model – Option 2

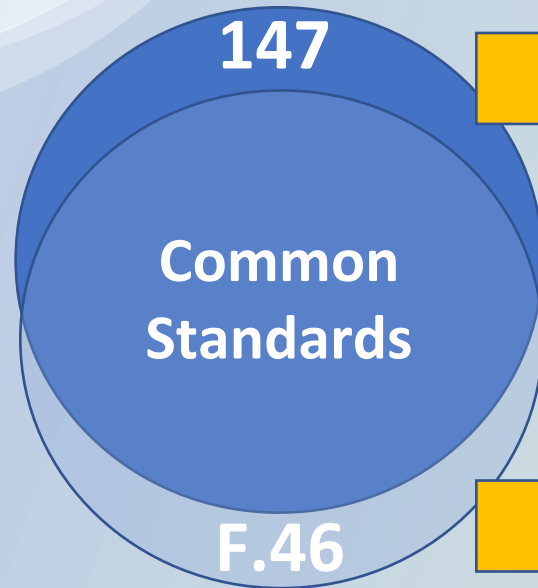
2 Unique Standards

Shared Standards

147 Subject Integration

147 Engine Electrical Systems

ASTM F.46 Electric Propulsion Systems



Core

Embedded

147 Engine Electrical Systems

F.46 Electric Propulsion Systems

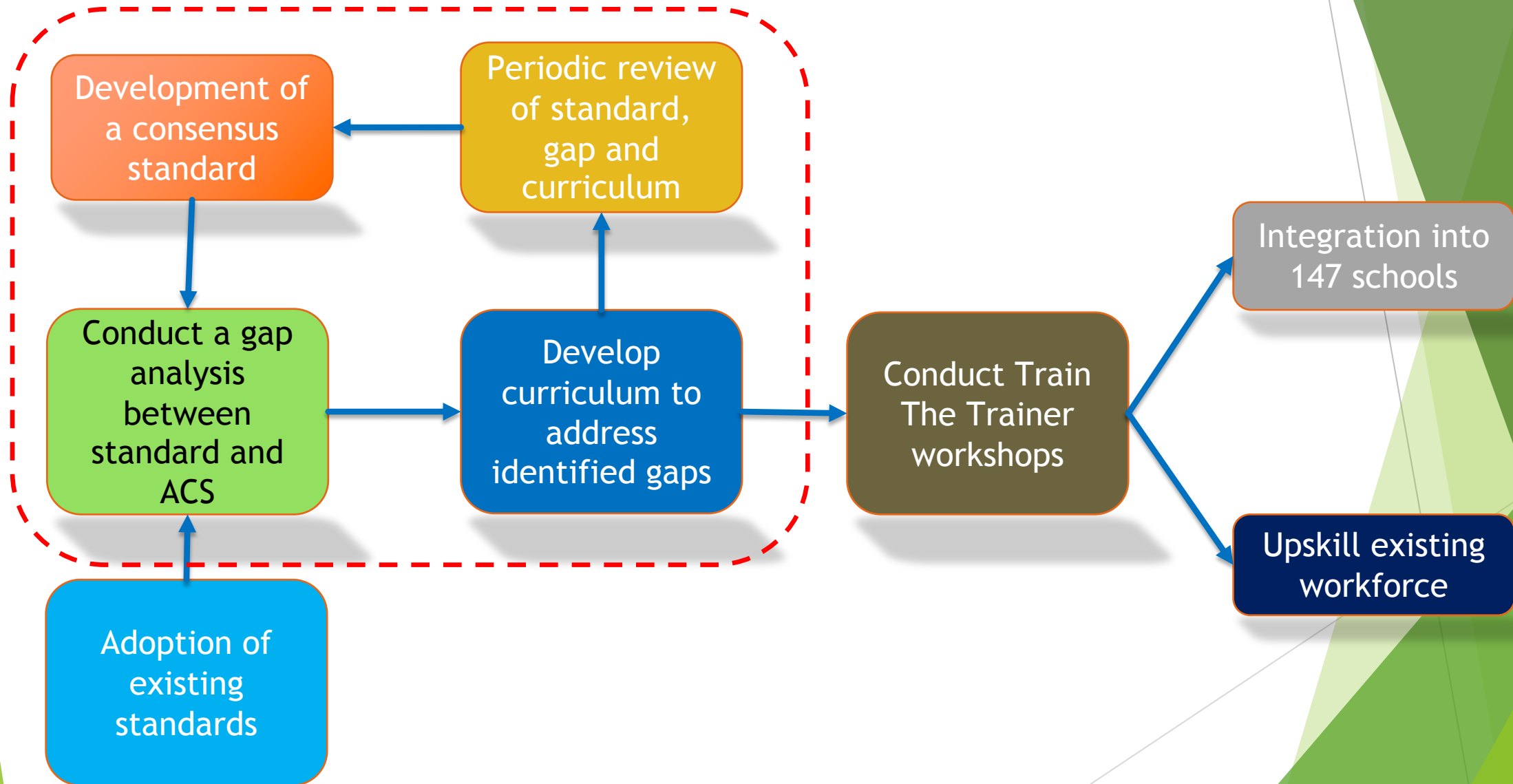
Integrated standards into course

- Overlap of standards
- Minimal investment and curriculum changes
- Ease of scheduling + value added skills

**'147 Integration'**



# Creating the Technical Workforce



# Online Resources

- National Center for Autonomous Technologies
  - <https://ncatech.org/>
- FAA UAS Collegiate Training Initiative
  - [https://www.faa.gov/uas/educational\\_users/collegiate\\_training\\_initiative](https://www.faa.gov/uas/educational_users/collegiate_training_initiative)
- FAA Center of Excellence for UAS Research, Education, and Training
  - Alliance for System Safety of UAS through Research Excellence (ASSURE) <https://assureuas.org/>
    - UAS Maintenance, Modification, Repair, Inspection, Training, And Certification (2017) <https://assureuas.org/projects/uas-maintenance-modification-repair-inspection-training-and-certification/>

## *Electric Propulsion in Part 147 Curriculum 2:30 to 3:30 Classroom 137*

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*"Aviation is proof that given the will,  
we have the capacity to achieve the  
impossible."*

Eddie Rickenbacker - WW I Ace



Q & A