Presented To: REDAC E&E Subcommittee
By: Don Scata, Sean Doyle, Muni Majjigi
Date: 9 March 2021
Topics

• Neighborhood Environmental Survey (NES) - 45 minutes
• Noise Research - 45 minutes
  ▪ Aircraft Noise Impacts Research
  ▪ UAS / AAM
  ▪ Aircraft Source Noise Reduction Technology
Introduction

**Noise Research Federal Register Notice**
- FAA released a Federal Register Notice to provide an overview on the agency’s noise research programs alongside the results of the Neighborhood Environmental Survey (the “Survey”)
- We are seeking public comment on our research program and the survey results

**Aviation Noise**
- FAA recognizes that aircraft noise continues to be a challenge and we have a longstanding noise research program focused on the topic
- As a part of our research program, we decided to conduct a national survey to gather data to improve our understanding of the community response to aircraft noise
- Addressing aviation noise will require meaningful collaboration among all aviation stakeholders, and this includes the FAA

**Focus**
- This briefing will provide context for our research, present an overview of the Survey, and identify next steps as we review our noise policy and engage with stakeholders
The FAA recognizes that aircraft noise continues to be a challenge

- As part of our longstanding noise research program to better understand the impacts of aircraft noise on human health and welfare, we decided that a new national survey should be conducted to gather data to improve our collective understanding of how communities are currently responding to aircraft noise.

- The Survey is the first noise annoyance survey conducted by a US federal agency since the Federal Interagency Committee on Noise (FICON) performed an in-depth US Government agency review of human annoyance to noise in 1992.

- FAA’s goal for the Survey was to obtain updated information about the way people perceive aircraft noise.
Neighborhood Environmental Survey

• The agency conducted a nationwide survey of over 10,000 people living near 20 representative airports regarding annoyance related to aircraft noise

• FAA conducted follow-up phone interviews with 2,000 of the respondents to obtain qualitative information regarding individual responses

• The responses to the survey were used to develop a nationally-representative “dose-response curve,” which is a tool that establishes the relationship between annoyance and noise exposure

Results

– The survey results show a substantial increase in public annoyance to aircraft noise compared to the data that FAA and other agencies currently rely on to inform noise policy, which was acquired in the 1970s

– While the results of the survey bring forward new data, they are consistent with the observed trend of increasing noise concerns, and consistent with the results of more recent surveys conducted outside the United States
Methodology

Airport Selection:

- At the outset, the survey team assembled by the FAA determined to survey communities around a representative set of airports.
- 16 airports were statistically chosen to represent configurations found at nation’s airports as a whole.
- Four additional critical airports were also included.

To ensure sufficient sampling, the following criteria were applied to determine eligible airports:

- AIRPORT SELECTION THROUGH BALANCED SAMPLING FACTORS:
  - Average Daily Temperature:
    - Above 70°F
    - Between 70°F and 55°F
    - And Below 55°F
  - Percent of DNL Nighttime operations:
    - Above 20% and Below
  - Average Daily Flight Operations:
    - Above 300 and Below
  - Aircraft Fleet Mix Ratio:
    - More large jet aircraft than commuter jet aircraft
    - Or more commuter jet aircraft than large jet aircraft
  - Population within Five Miles:
    - Above 230,000 and Below
Selected Airports

At the outset, the survey team assembled by the FAA decided to survey communities around a set of airports that represents the nation’s airports as a whole.
Methodology

Survey Instruments:

- A mail survey was issued to participants around 20 airports experiencing a range of DNL noise exposure from aircraft.

<table>
<thead>
<tr>
<th>DNL dB Categories</th>
<th>Survey Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>50-55</td>
<td>3,592</td>
</tr>
<tr>
<td>55-60</td>
<td>3,481</td>
</tr>
<tr>
<td>60-65</td>
<td>2,016</td>
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<tr>
<td>65-70</td>
<td>914</td>
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<tr>
<td>70+</td>
<td>325</td>
</tr>
<tr>
<td>Total</td>
<td>10,328</td>
</tr>
</tbody>
</table>

- Questionnaire used a five point scale of annoyance and top two levels (4 or 5 on the scale from 1 to 5) were combined to come up with number of people who are “highly annoyed.”

- Since aircraft noise was one of 13 environmental concerns listed, the recipient did not know this was in fact an airport community noise survey.

- A follow up phone survey was also issued to mail survey participants to gain further understanding why they were annoyed.
Determining DNL

1. Detailed modeling with INM using 2012-2013 operational data
2. DNL contours generated from 50 dB to 70 dB, in 5-dB increments to determine potential respondents
3. Modeling updated with 2015 operational data
4. DNL computed at each respondent's address to associate with their responses
Aircraft Noise Annoyance Results

The NES results support an observed increase in Annoyance from Aircraft Noise:

• The results show a substantial increase in annoyance for the population living in the vicinity of airports
• The increase in annoyance is generally consistent across various levels of noise exposure

The new Survey was designed to use a consistent approach across each airport community surveyed. This has allowed for an enhanced ability to provide additional statistical information about the new results, such as the 95% Confidence Limits and range of results from each of the 20 airports, as shown on the plot above. This was not possible with the older Schultz Curve.
Phone Survey Analysis

Two thousand mail survey respondents participated in a follow-up phone survey which asked more detailed questions that were aimed at understanding the underlying reasons for annoyance to aircraft noise

- While informative, the findings do not have the same statistical robustness as the primary mail survey due to the voluntary nature of the sampling
- A detailed statistical analysis was conducted to identify why people are annoyed by aircraft noise

Phone survey respondents who have experienced being “Startled,” “Frightened,” or “Awakened” by aircraft at home were most likely to be annoyed by aircraft noise.

Those who were bothered, disturbed, or annoyed by “General Traffic Noise” and “Smells” were also more likely to be annoyed by aircraft noise.
What do the Results Mean?

The results of the Neighborhood Environmental Survey show a substantial increase in the level of annoyance to aircraft noise relative to past surveys

• Multiple factors may be driving these changes and public input is requested to inform next steps

• Public and stakeholder feedback on these and other factors will be critical to informing FAA’s understanding of the Survey results

• Taken together with the rest of the FAA’s noise research program, FAA is seeking to establish a national dialogue on aircraft noise issues
Looking Forward

How will the FAA use the Findings from the Survey?

• The Neighborhood Environmental Survey provides data that quantitatively shows that substantially more people are highly annoyed by aircraft noise exposure than in the past
• The FAA will look at the NES findings alongside outputs from other noise research programs and inputs from public and stakeholder comment to inform future actions
• The ongoing research to understand the potential impacts to sleep and cardiovascular health should be particularly insightful

The results of the survey are an important element of a broader portfolio of research and community engagement to investigate and mitigate the impacts of aircraft noise

• The FAA intends to continue reviewing these research findings in combination with public and stakeholder feedback to inform research and policy priorities
Next Steps

Publishing the Federal Register Notice (Notice) is a key first step towards engaging in a conversation with aviation stakeholders about FAA noise policy

- FAA is encouraging the public and other stakeholders to review the Notice and Survey report, and provide constructive comments
- Please note that the Notice and the Survey report provide data that will be used in the upcoming discussion about policy, but is not policy in itself

Timeline

- **60 90 day comment period on the Federal Register Notice (currently being extended)**
- Review public comments and identify general themes
- FAA will concurrently identify next steps beyond the Notice and engage with stakeholders as we move forward
- Keep the public and stakeholders up to date as we make progress
Next Steps

Public Comment Invited

• The Notice invites public comment on FAA’s noise research program, including the Survey
• Input on three questions is requested through a 60-day comment period
• To help provide additional information on aircraft noise, FAA’s existing noise policy, and a detailed overview of the methodology and results of the Neighborhood Environmental Survey, a website has also been made available at www.faa.gov/go/aviationnoise
Topics

• Neighborhood Environmental Survey (NES) - 45 minutes
• Noise Research - 45 minutes
  ▪ Aircraft Noise Impacts Research
  ▪ UAS / AAM
  ▪ Aircraft Source Noise Reduction Technology
Today’s Aircraft Noise Situation – Our Efforts

Effects of Aircraft Noise on Individuals and Communities
• Speech Interference and Children’s Learning
• Neighborhood Environmental Survey
• **Health and Human Impacts Research**
  – Impacts to Cardiovascular Health
  – Sleep Disturbance
  – Economic Impacts

Effects of Aircraft Noise on Individuals and Communities
• Aviation Environmental Design Tool
• Noise Screening
• Environmental Data Visualization
• Supplemental Noise Metrics

Reduction, Abatement, and Mitigation of Aviation Noise
• Aircraft Source Noise Reduction
• Noise Abatement
• Noise Mitigation Research

Public comment is critical to informing the FAA on setting research priorities for these programs.
How should economic impacts and any tradeoffs in aviation growth and efficiency be managed against potential for health and welfare impacts from noise?

Blue - current policy
Green - on-going research
Discussion & Input

FAA Noise Impacts Programs (bricks):
- Neighborhood Environmental Survey
- Impacts to Cardiovascular Health
- Sleep Disturbance
- Economic Impacts
- Noise Metrics
- Community Outreach

Gaps (mortar):
- How can the findings from these programs best be assembled to inform options to address aircraft noise?
- Is additional research needed to inform the development of options to address aircraft noise?
- How can noise research best be targeted to finding implementable, cost-effective solutions to aircraft noise concerns?

Actions:
- Short Term Actions (<1 year)
  - Collecting public comment and positions on factors related to aircraft noise concerns
  - Identifying research gaps that need to be filled to address aircraft noise issues
- Longer Term Actions (1-3 years)
  - Understanding tradeoffs to noise exposure, aviation growth and airspace system efficiencies
  - Establishing new noise policies informed by the entire portfolio of noise research, but adaptive enough to incorporate new findings and manage tradeoffs
Topics

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  ▪ UAS / AAM
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Background & Context

Rotorcraft Noise

All noise sources contribute to acoustic signature – both at takeoff and during landing.

Community Exposure

Community exposure set by aircraft types, operational tempo over day and night, and where people live.
## Background & Context

### EQUIVALENT OPERATIONS FOR DNL = 65

<table>
<thead>
<tr>
<th>EVENTS/DAY</th>
<th>SEL</th>
<th>DNL</th>
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</thead>
<tbody>
<tr>
<td>1 EVENT/DAY</td>
<td>114.4 dBA</td>
<td>65</td>
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<tr>
<td>10 EVENTS/DAY</td>
<td>104.4 dBA</td>
<td>65</td>
</tr>
<tr>
<td>100 EVENTS/DAY</td>
<td>94.4 dBA</td>
<td>65</td>
</tr>
<tr>
<td>1,000 EVENTS/DAY</td>
<td>84.4 dBA</td>
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</tr>
<tr>
<td>10,000 EVENTS/DAY</td>
<td>74.4 dBA</td>
<td>65</td>
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</tbody>
</table>
Background & Context
Background & Context

NATIONAL CURVE

- National Curve
- National Curve 95% Confidence Limits
- Range of Available Airports Curves

% of People Highly Annoyed

DNL (Decibels)

50 55 60 65 70 75

Federal Aviation Administration
Discussion & Input

FAA UAS/AAM Noise Research Programs (bricks):
• ASCENT Project 49
• ASCENT Project 61
• ASCENT Project 77
• Fly Neighborly
• Ongoing Noise Measurements

Gaps (mortar):
• How can the findings from these programs best be assembled to inform options to address UAS/AAM noise?
• Is additional research needed to accomplish this?
• What should we be doing to ensure that the FAA/public can consider possible impacts of operations that do not yet exist?
• How can noise research best be targeted to finding implementable solutions to UAS/AAM aircraft noise concerns?

Actions:
• Short Term Actions (<1 year)
  – Data collection
  – Include UAS/AAM in FAA Noise Policy Review discussion
• Longer Term Actions (1-3 years)
  – Additional research
  – Rulemaking / Policy
Topics

• Neighborhood Environmental Survey (NES) - 45 minutes
• Noise Research - 45 minutes
  ▪ Aircraft Noise Impacts Research
  ▪ UAS / UAM
  ▪ Aircraft Source Noise Reduction Technology
## Aircraft Source Noise Reduction Technology - CLEEN Summary

<table>
<thead>
<tr>
<th>Programs</th>
<th>Period</th>
<th>Technologies</th>
<th>Benefits</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLEEN I</td>
<td>2010-15</td>
<td>Boeing: Ceramic Metal Composite Exhaust Nozzle</td>
<td>2.3 dB reduction re: hardwall</td>
<td>Tested on B787; TRL7</td>
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<tr>
<td></td>
<td></td>
<td>Boeing: Adaptive Trailing Edge</td>
<td>1.7 dB reduction re: fixed Trailing Edge</td>
<td>Tested on B737; TRL7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>GE: Open Rotor Noise Tech</td>
<td>15 dB to Stage 4 in Wind Tunnel test and</td>
<td>TRL6</td>
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<td></td>
<td></td>
<td></td>
<td>1980’s UnDuctedFan flight test experience</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>PW: Geared Turbo Fan Noise Tech</td>
<td>20 dB reduction in Wind Tunnel test and</td>
<td>TRL 8</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Certified product</td>
<td></td>
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<tr>
<td>CLEEN II</td>
<td>2016-20</td>
<td>Boeing: Compact nacelle</td>
<td>~0.8 dB aft fan duct compact nacelle</td>
<td>TRL7 Q3CY21</td>
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<tr>
<td></td>
<td></td>
<td>Collins: Nacelle Tech</td>
<td>2 dB reduction estimated</td>
<td>Continue outside of CLEEN II, TRL 6 QCY24</td>
</tr>
<tr>
<td></td>
<td></td>
<td>GE: Low Pressure Ratio Adv Tech</td>
<td>2dB novel liners; 1dB fan noise source</td>
<td>TRL6 Q4CY22</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>reduction (Total: 3 dB reduction) est.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Honeywell: Advanced Acoustics Fan and Liner Tech</td>
<td>2.5 dB reduction est.</td>
<td>TRL 6 Q4CY22 (CLEEN II Option exercised)</td>
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<tr>
<td>CLEEN III</td>
<td>2021-25</td>
<td>To Be Announced</td>
<td>Start date delayed due to COVID-19.</td>
<td>Details to be provided 2nd day of REDAC meeting</td>
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<td></td>
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<td></td>
<td>Negotiations on-going.</td>
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</tbody>
</table>

## CLEEN and ASCENT have enabled significant progress in aircraft noise reduction thus providing a solid foundation for needed reductions of future environmental footprint

### Subsonic Aircraft

<table>
<thead>
<tr>
<th>Project #</th>
<th>Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>Over-Wing Engine Placement Evaluation</td>
</tr>
<tr>
<td>55</td>
<td>Noise Generation and Propagation from Advanced Combustors</td>
</tr>
<tr>
<td>63</td>
<td>Parametric Noise Modeling For Boundary Layer Ingesting Propellers</td>
</tr>
<tr>
<td>75</td>
<td>Improved Engine Fan Bandwidth Noise Prediction Capabilities</td>
</tr>
<tr>
<td>76</td>
<td>Improved Open Rotor Noise Prediction Capabilities</td>
</tr>
<tr>
<td>77</td>
<td>Measurements to Support Noise Certification for UAS/UAM Vehicles and Identify Noise Reduction Opportunities</td>
</tr>
</tbody>
</table>

### Supersonic Aircraft

<table>
<thead>
<tr>
<th>Project #</th>
<th>Technology</th>
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</thead>
<tbody>
<tr>
<td>42</td>
<td>Acoustic Model of Mach Cutoff</td>
</tr>
<tr>
<td>47</td>
<td>Clean Sheet Supersonic Aircraft Engine Design and Performance</td>
</tr>
<tr>
<td>59</td>
<td>Jet Noise Modeling to Support Low Noise Supersonic Aircraft Technology Development</td>
</tr>
</tbody>
</table>
## Subsonic Priorities and Research Focus

<table>
<thead>
<tr>
<th>Priority</th>
<th>Areas of Research Focus - Potential</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Engine</strong></td>
<td></td>
</tr>
<tr>
<td>Fan Exhaust Noise</td>
<td>3D Fan / OGV design</td>
</tr>
<tr>
<td></td>
<td>Novel liners (high noise suppression per unit area and volume)</td>
</tr>
<tr>
<td></td>
<td>Broad band noise reduction</td>
</tr>
<tr>
<td>Fan Inlet Noise</td>
<td>3D Fan design (low self-noise)</td>
</tr>
<tr>
<td></td>
<td>Novel liners (high noise suppression per unit area and volume)</td>
</tr>
<tr>
<td>Jet Noise</td>
<td>Optimize for installed nozzle performance &amp; noise</td>
</tr>
<tr>
<td></td>
<td>Provision for deep liner for combuster noise</td>
</tr>
<tr>
<td>Combustor noise</td>
<td>Low noise combustor design</td>
</tr>
<tr>
<td></td>
<td>Combustor liner design</td>
</tr>
<tr>
<td>LPT Noise</td>
<td>Cut-off LPT design</td>
</tr>
<tr>
<td></td>
<td>Higher solidity</td>
</tr>
<tr>
<td></td>
<td>LPT liner provision</td>
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<tr>
<td><strong>Nacelle (Inlet, Exhaust) &amp; Installation</strong></td>
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<tr>
<td>Inlet</td>
<td>Lip liners (incl. de-icing)</td>
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<tr>
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<td>Novel liners (high noise suppression per unit area and volume)</td>
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<tr>
<td>Exhaust system</td>
<td>Novel thrust reverser design</td>
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<td>Novel liners (high noise suppression per unit area and volume)</td>
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<tr>
<td>Jet/Flap interaction</td>
<td>High lift device integration</td>
</tr>
<tr>
<td><strong>Airframe</strong></td>
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</tr>
<tr>
<td>Wing design</td>
<td>High A/R wing design</td>
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<tr>
<td></td>
<td>Optimized wing tip</td>
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<tr>
<td>Landing gear noise</td>
<td>Streamline design</td>
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<tr>
<td></td>
<td>Minimize cavities</td>
</tr>
<tr>
<td>High Lift devices</td>
<td>Simpler designs</td>
</tr>
<tr>
<td></td>
<td>Minimize cavities/ openings</td>
</tr>
<tr>
<td>Airframe</td>
<td>?</td>
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</table>

Discussion encouraged
## Aircraft Source Noise Reduction Technology
### Research Priorities and Gaps – Supersonic LTO Noise

### Discussion encouraged

<table>
<thead>
<tr>
<th>Priority</th>
<th>Areas of Research Focus - Potential</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Jet / Shock Cell Noise</strong></td>
<td>Mixer nozzle; Performance optimized variable area nozzle</td>
</tr>
<tr>
<td><strong>Fan Inlet Noise</strong></td>
<td>Multi-stage fan w. or w.o. IGV design</td>
</tr>
<tr>
<td><strong>Fan Exhaust Noise</strong></td>
<td>Novel liners (high noise suppression per unit area and volume)</td>
</tr>
<tr>
<td><strong>LPT Noise</strong></td>
<td>Cut-off LPT design</td>
</tr>
<tr>
<td><strong>Combustor Noise</strong></td>
<td>Combustor liner</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Nacelle (Inlet, Exhaust) &amp; Installation</strong></th>
<th></th>
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<tbody>
<tr>
<td><strong>Inlet</strong></td>
<td>Auxiliary inlet optimization (performance, operability and noise)</td>
</tr>
<tr>
<td><strong>Exhaust system</strong></td>
<td>Novel liners (high suppression per unit area and volume)</td>
</tr>
<tr>
<td><strong>Jet/Flap interaction</strong></td>
<td>High lift device integration</td>
</tr>
<tr>
<td><strong>Shielding</strong></td>
<td></td>
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</tbody>
</table>

| **Airframe**                                |                                                                 |
| **Landing gear noise**                      | Less complex designs                                                                 |
| **Minimize cavities**                       |                                                                     |
| **High Lift devices**                       | Less complex designs                                                                 |
| **Minimize cavities**                       |                                                                     |
| **Airplane L/D**                            | Reduced landing speed                                                |
## Supersonic Priorities and Research Focus - En-route Noise

<table>
<thead>
<tr>
<th>Priority</th>
<th>Areas of Research Focus - Potential</th>
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<tbody>
<tr>
<td><strong>Aircraft Design</strong></td>
<td></td>
</tr>
<tr>
<td>Low Boom Design M1.4 (X-59 - LBFD)</td>
<td>Nose design</td>
</tr>
<tr>
<td>Low Boom Design M1.8</td>
<td>Nose design</td>
</tr>
<tr>
<td>Low Boom Design M2 and 2+</td>
<td>Nose design</td>
</tr>
<tr>
<td>Mach cut-off</td>
<td>Atmospheric modeling</td>
</tr>
</tbody>
</table>
Backup Charts
Health Impacts Research Timeline

- Pilot Study on Aircraft Noise & Sleep Disturbance
- Cardiovascular Health Roadmap

Health Overview:
- 2018: Noise Measurements in Louisville KY - NIH
- 2019: Pilot Study on Aircraft Noise & Sleep Disturbance
- 2020: CVD and Aircraft Noise Exposure
- 2021: National Sleep Disturbance
- Beyond 2025: Cardiovascular Health Roadmap

NIH – Louisville KY
Cardiovascular Disease & Aircraft Noise

**Objective:** Evaluate associations between aircraft noise and cardiovascular outcome

**Methods:** Use existing health cohorts to evaluate link between health outcomes and noise exposure while accounting for wide range of factors

**National longitudinal health cohorts:**
- Medicare database
- Women’s Health Initiative
- Nurses’ Health Study /Health Professional Follow-up Study

**Team:** Research being conducted by Boston University

**Reauthorization Connection:** HR 302 § 189 – Study on Potential Health and Economic Impacts of Overflight Noise

**Future work:**
- Utilize existing cohorts to determine if an association exists. The current cohort work will take 3 years.
- Seek additional cohorts that could be used to further examine association.
- Depending on the results, develop improved noise exposure metrics and policies
Sleep-Disturbance Research & Implication

**Objective:** Inform future considerations regarding aviation noise in the U.S. by obtaining dose-response relationships between aircraft noise exposure and sleep disturbance

**Goal:** National field study: acquire current objective sleep disturbance data relative to varying degrees of exposure at many airports; 4-5 year effort

**Team:** Research being conducted by UPenn with support of FAA Office of Airports’ Airport Technology Research (ATR) Program

**Next Steps:** Address comments received during Federal Register notice period and Complete U.S. Government data collection requirements (e.g. OMB and PRA)

**NOTE:** This project will be reviewed at the REDAC Airport Subcommittee

**Future work:**
- Partner with other organizations and experts who have expertise on the subject matter
- Depending on the results, develop improved noise exposure metrics and policies
- Exploring information exchange and partnerships with the FAA Civil Aerospace Medical Institute (CAMI)
ASCENT Project 49: Modeling of UAM Noise (Penn State)

Goals:
- Develop initial capability to predict UAM acoustics
- Improve understanding of UAM noise characteristics
- Identify noise reduction opportunities

Approach:
- Build on success of helicopter noise prediction system developed under ASCENT Projects 6 & 38
- Tailor approach to the unique characteristics of UAM
  - PSU DEPSim for flight state of multirotor vehicles
  - Unsteady loading with CDI’s CHARM
  - Increase efficiency of PSU-WOPWOP for many rotors
  - Generalize broadband noise models for UAM

Status:
- PSU-WOPWOP implementation allows for analysis of time-varying broadband noise, which may be especially important for UAM due to the complex interactional aerodynamics
- A new UAM noise prediction capability is being developed
- Potential noise reduction designs will be investigated

For more information on Project 49
ASCENT Project 61: Noise Certification Streamlining (Georgia Tech)

Goals:
- Evaluate and improve the business process of noise certification
- Increase efficiency and flexibility in noise certification of both existing and future aircraft type

Approach:
- Quantitative assessment of noise certification process via System Engineering tools and methods
- Leverage knowledge of technical experts and specialists

Status:
- Through workshops, Georgia Tech continues to seek information from OEMs about improvements possible for noise cert
- Georgia Tech preparing noise cert framework within process flow models to simulate baseline and develop optional scenarios of improvement.
- Research in-progress.

For more information on Project 49
https://ascent.aero/project/noise-certification-streamlining/
ASCENT Project 77 MEASUREMENTS TO SUPPORT NOISE CERTIFICATION FOR UAS/UAM VEHICLES (Penn State)

Goals:
• Develop noise measurement and data analysis techniques for repeatable characterization of UAS and UAM noise
• Establish a database of UAS and UAM noise measurements across a wide range configurations and operating conditions
• Inform the development of noise certification standards and identify effective noise reduction opportunities through design and operation

Approach:
• Develop noise source separation for multirotor vehicles
• Leverage Project 49 predictions to determine effective experimental procedures before flight
• Investigate microphone types and installations
• Develop reconfigurable multirotor UAS
• Collect noise data on UAS and UAM vehicles

Status:
• Understand noise source components and flight dynamics
• Evaluate testing techniques and procedures
• Measure variety of designs to inform noise certification
• Identify quiet designs and quiet flight procedures

For more information on Project 77