Sound Insulation Related Research

2 COE/Partner and 2 ACRP projects

Federal Aviation Administration

Presented to: Aviation Noise Research Roadmap workshop

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Background

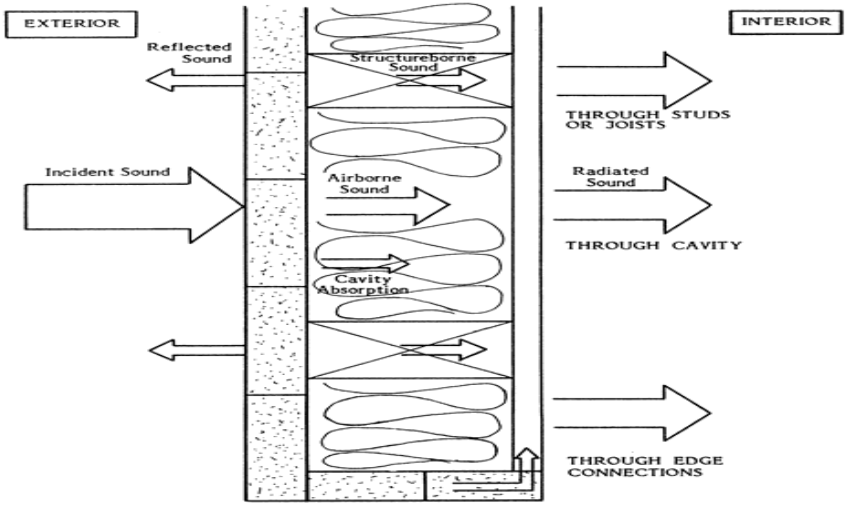
As part of land use planning and management, FAA funds* were established for Part 150 noise mitigation which includes sound insulation

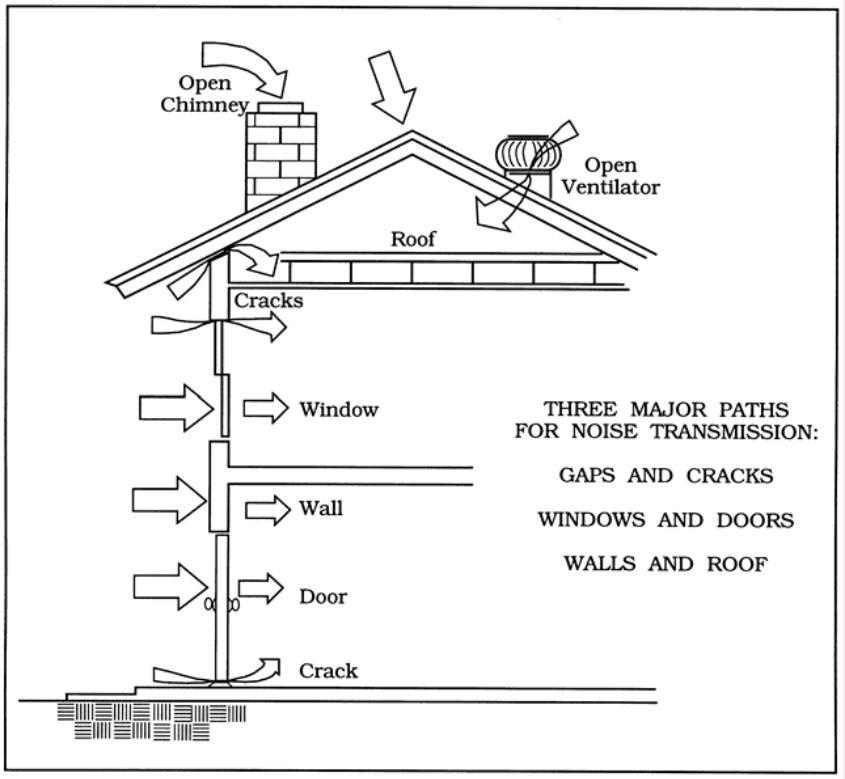
- Over $8.5 billion investments since 1982
- Dwellings inside 65 DNL are eligible for sound insulation
- Sound insulation guidelines**: interior noise exposure above 45 DNL; Noise reduction goal: minimum 5 dB
- Insulation often includes (among many other treatments) installing better sound insulated windows and doors
- Program management of sound insulation is complex

  (multiple stakeholders, diverse requirements, diverse resources)

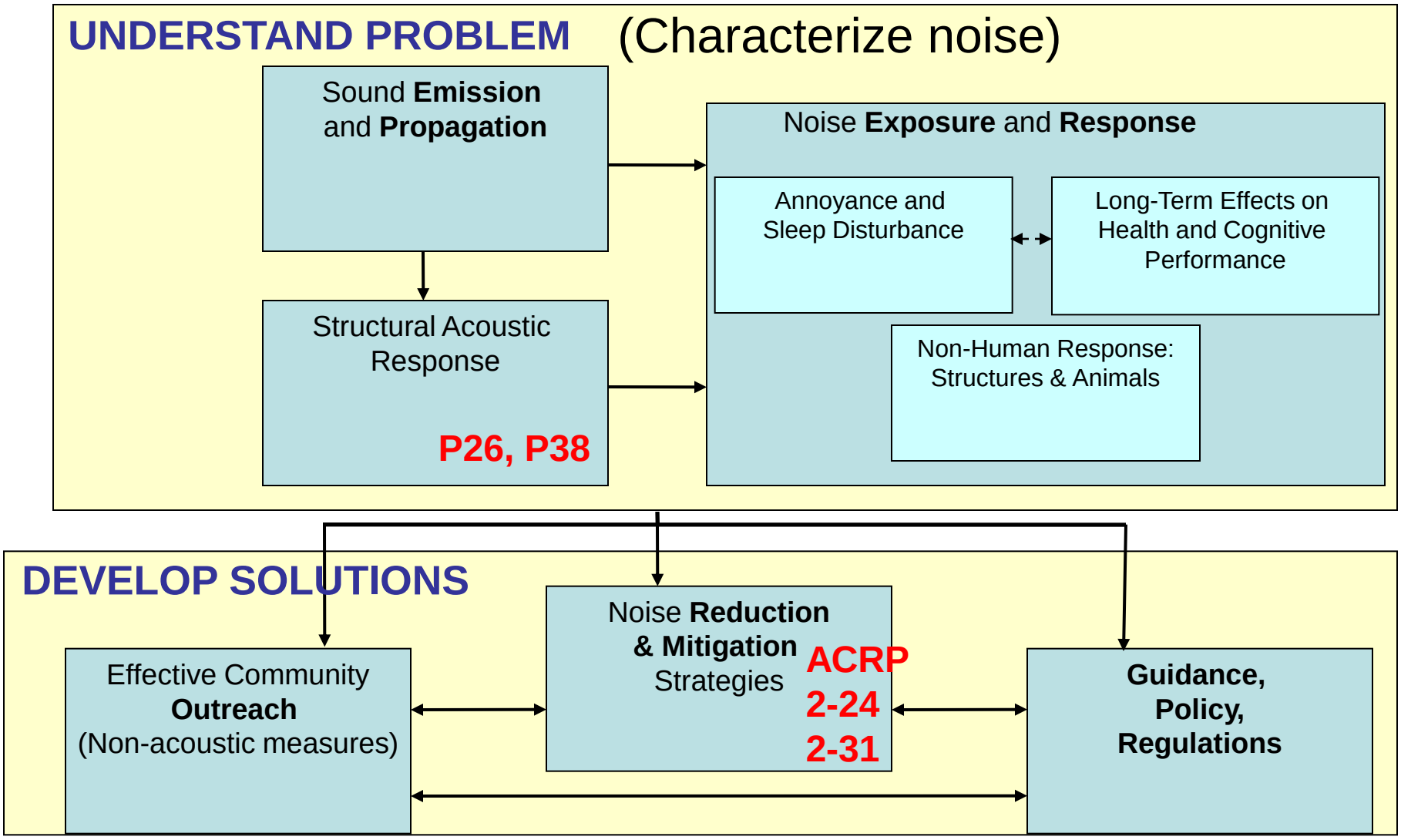
* Airport Improvement Program (AIP) and Passenger Facility Charge (PFC)

** "Guidelines for Sound Insulation of Residences Exposed to Aircraft Operations" - 2005


EXTERIOR
INTERIOR
Reflected Sound
Structureborne Sound
THROUGH STUDS OR JOISTS
Incident Sound
Airborne Sound
Radiated Sound
THROUGH CAVITY
Cavity Absorption
THROUGH EDGE CONNECTIONS


Open Chimney
Open Ventilator
Roof
Cracks
Window
Wall
Door
Crack
THREE MAJOR PATHS FOR NOISE TRANSMISSION:
GAPS AND CRACKS
WINDOWS AND DOORS
WALLS AND ROOF

FAA noise research framework



Four research projects

COE/Project 26:

Sound transmission indoors – innovative windows

(Purdue University, from 2006)

COE/Project 38:

Sound transmission indoors – whole house sound insulation

(Georgia Tech and Penn State, from 2010)

ACRP 2-24:

Guidelines for Airport Sound Insulation Programs

(The Jones Payne Group, 2010-2011)

ACRP 2-31:

Assessment of Sound Insulation Treatments

(Contracting in progress., 2011-2012)

COE - Center of Excellence

PARTNER - Partnership for AiR Transportation Noise and Emission Reduction

ACRP - Airport Cooperative Research Program

COE/Project 26: Sound transmission indoors – innovative windows

Background:

Windows are often the weak link in sound transmission indoors. But current choice of windows is limited. There is a need for innovative windows to achieve better and balanced performance in terms of both acoustics and other factors such as indoor air quality and energy efficiency.

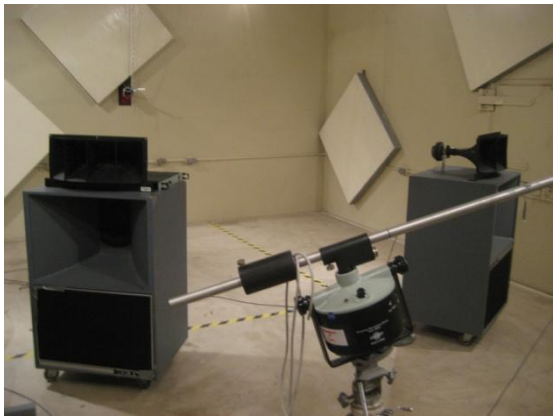
Objective:

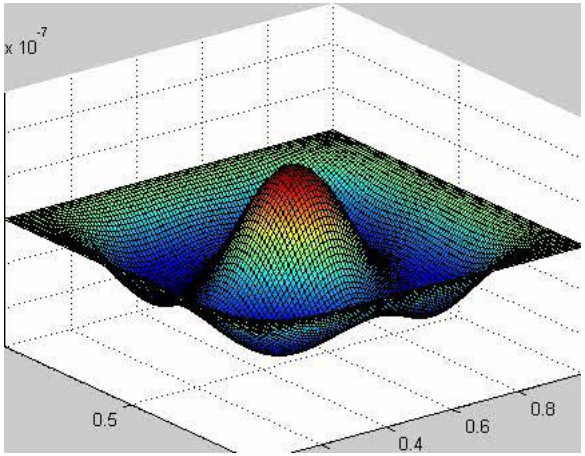
To investigate and develop innovate window designs to address both acoustic and other performance considerations.

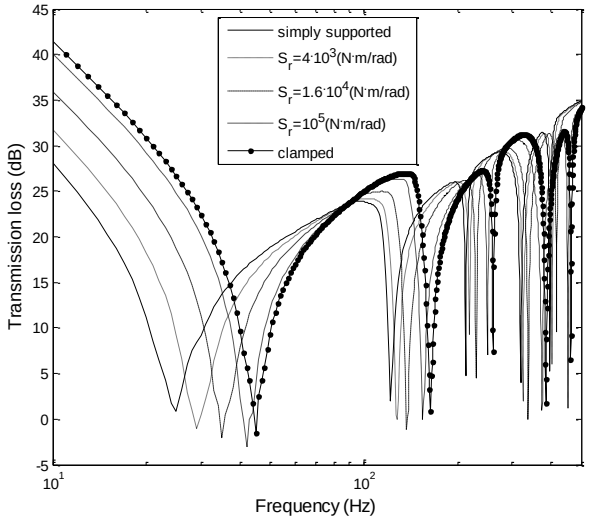
P26: windows – various research methods

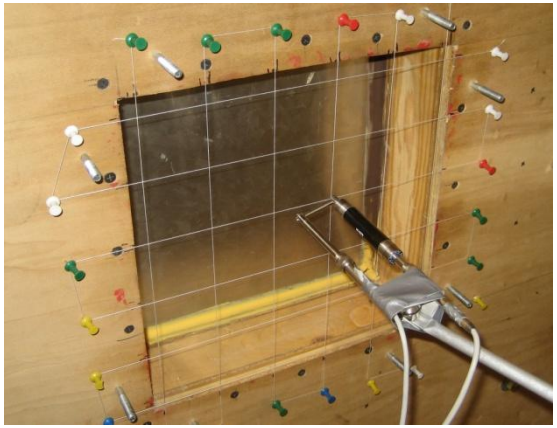
$$TL = 20\lg(f_{1,1}\rho Ah) + function1(\frac{f}{f_{1,1}})$$

$$\left(\frac{f_1}{C'}\right)^2 = C_1\left(r + \frac{1}{r}\right)^2 + C_2$$

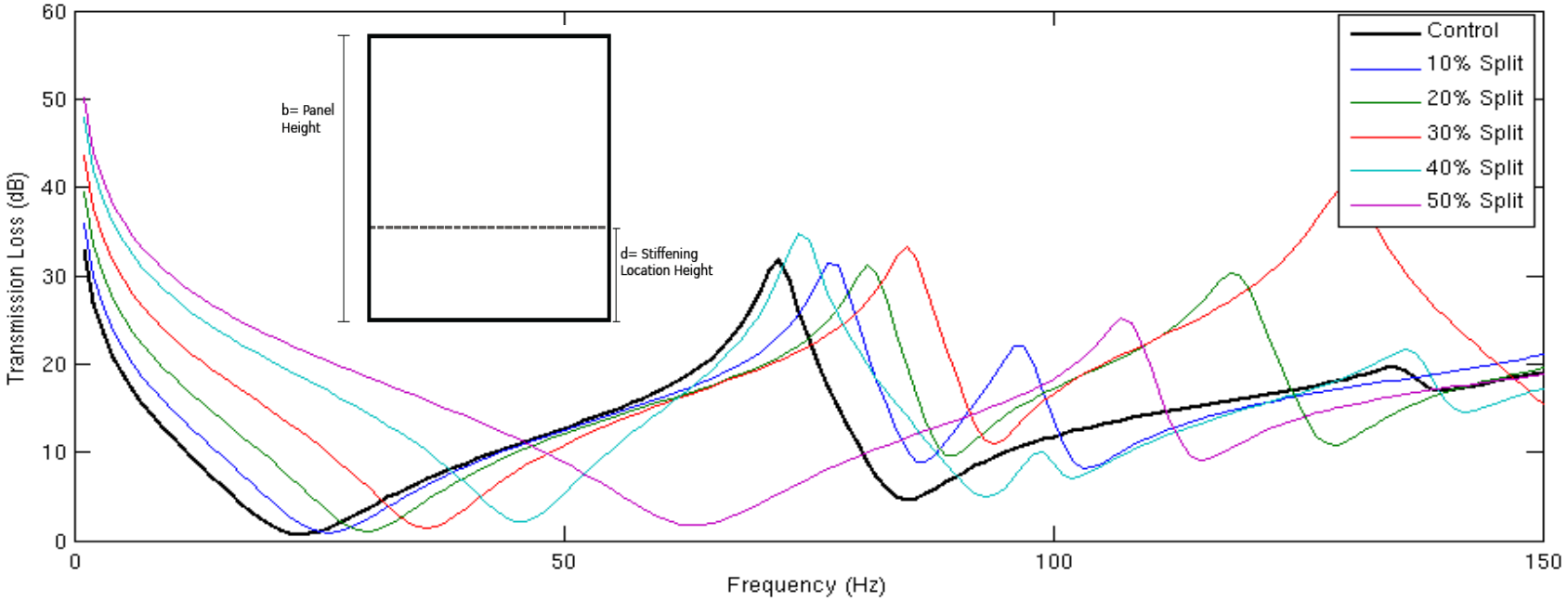








P26: Windows – Beam-stiffening concept

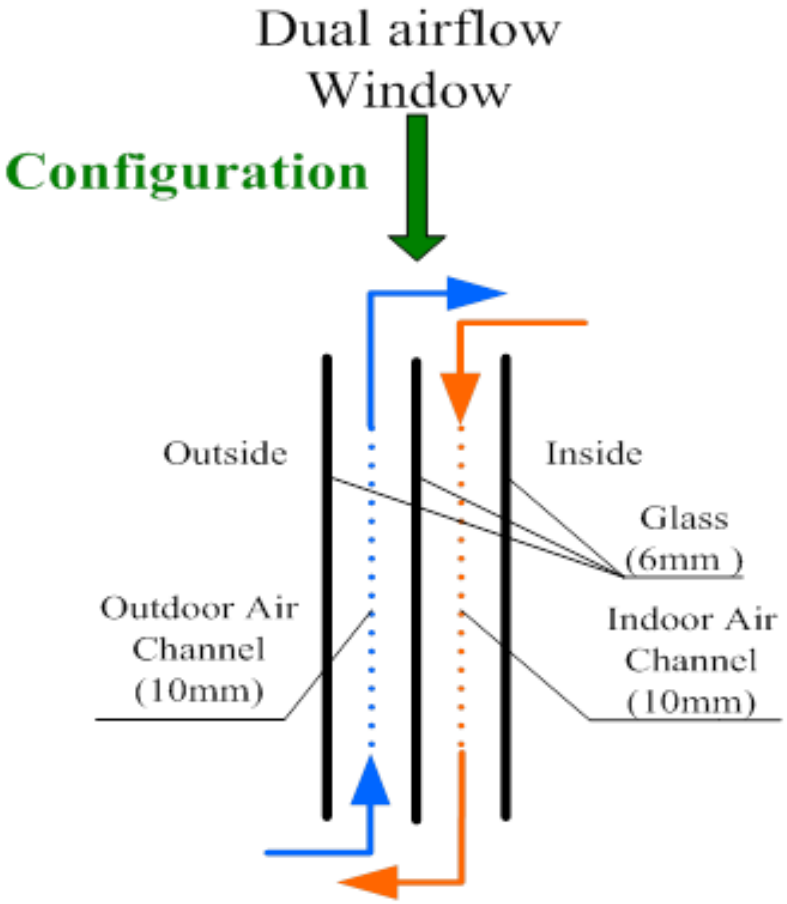


Effect of beam-stiffening has significant (4 dB for single panels, 7 dB for double panels) effect on noise below 150 Hz

Elastically-mounted panels can have effects of 1-3 dB

(Thus need for careful design of window mounting)

P26: Windows – Dual Airflow Window Concept



Energy saving analysis conducted

- Dual airflow window works better

  in cold Season

Acoustic performance analysis is ongoing

COE/Project 38: Sound transmission indoors – whole house sound insulation

Background/Motivation

In order to better link noise metric/threshold such as DNL65 (outdoors) to noise effects (indoors), we need to know in more detail about noise reduction performance of different building constructions. For each construction, noise reduction performance is often highly dependent on noise frequencies. Currently, detailed information about building noise reduction performance is either fragmented or lacking.

Objectives:

To quantify and predict noise reduction performance (in 1/3 octave bands as well in overall levels) for different building types and across different regions.

Project 38: Whole House Sound Insulation – Project approach

- Identify, evaluate and improve various prediction models
  - Identify prediction models → IBANA-Calc, INSUL
  - Preliminary evaluation
  - Acquire prediction models
  - Conduct detailed evaluation and compare with benchmarks
  - Identify, acquire and evaluate measured data for model validation
  - Validate models for selected measured data / improve modeling when needed
- Identify typical construction types near major U.S. airports
- Predict noise reduction for typical constructions and analyze results
- Enhance low-frequency prediction capability in parallel
- Synthesize findings & identify future steps

ACRP 02-24 Guidelines for Airport Sound Insulation Programs

Background:

- Existing guidelines - published in 1992 and updated by the U.S. Navy in 2005*.
- Need to update or revise *to reflect current costs, codes, "Best Practices" and to address new topics.*

- basic concepts of noise & acoustics
- noise *reduction* requirements
- sound Insulating new and existing homes
- costs and code Issues.

Objective:

"…to develop updated guidelines for sound insulation of residential and other noise sensitive buildings for potential use by airport and non-airport sponsors to develop and effectively manage their aircraft noise insulation projects"

- Energy performance and sustainability
- Community outreach
- Improvements in products
- Current code and other regulatory requirements
- Bidding methodologies and project costs

* Guidelines for Sound Insulation of Residences Exposed to Aircraft Operations - 2005

ACRP 02-24 Guidelines for Airport Sound Insulation Programs - Milestones

Project Kickoff Meeting:	September 17, 2010
1st Survey – ANMS	October 4, 2010
Complete 2nd Survey – “Best Practices”	February 4, 2011
Complete 2nd Survey Data Analysis	April 4, 2011
Submit Interim Report to Panel	May 2, 2011
Submit Draft Guidelines	July 27, 2011
Submit Final Guidelines	December 31, 2011

ACRP 02-31 Assessment of Sound Insulation Treatments

Background:

Significant improvements in sound insulation materials, treatments, methods, techniques, and lessons learned over the last 2-3 decades

Evident that early insulation and treatment may not be performing as they once did.

Objective:

To evaluate the long-term effectiveness of sound insulation programs including design criteria, materials, and installation standards

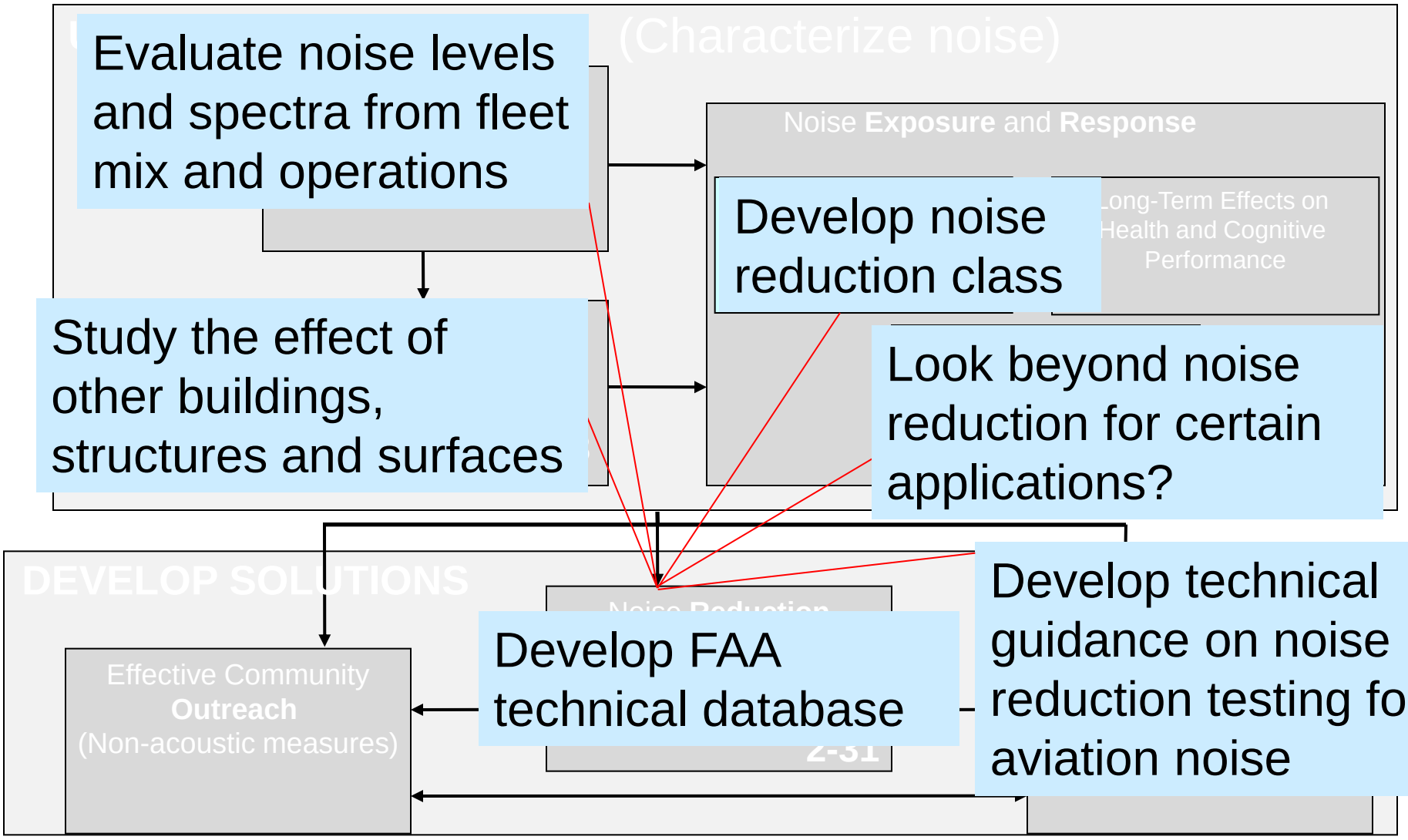
Summary

Sound insulation program is a significant part of land use planning and management near airports.

2 PARTNER research projects address sound transmission indoors. Innovative window concepts (Project 26) were evaluated; Predicting noise reduction levels (and spectra) of various dwelling constructions (Project 38) is expected to support the development of future guidelines.

2 ACRP projects develop useful guidance for the practioners in the fields as well as for many other stakeholders. Lessons learned, best practices and best knowledge would be important for managing an efficient and effective sound insulation program.

Likely future research



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