Evolution of Aviation Noise

- What is noise?
- Community annoyance with noise is not a modern issue
- Early aircraft noise issues
- Evolution of federal regulations addressing aircraft noise
- Technological improvements to reduce aircraft noise
- Recent trends in aircraft noise concerns
What is noise?

• Noise is unwanted sound
  – What is music to my ears, may be noise to you

• While noise is subjective on an individual basis, social surveys indicate a relationship between noise level and community annoyance

• Federal regulations set acceptable levels of aircraft noise for environmental assessment, land use planning, and noise mitigation purposes
Community Annoyance

- In 6000 BCE, the Sybarites banned blacksmiths and cabinets makers from working in residential areas due to the noise
  - First recorded zoning ordinance

- Julius Caesar banned chariots from the streets of Rome after dark to reduce nighttime noise
  - Oldest recorded noise ordinance
Community Annoyance

• In some medieval European cities, horse-drawn carriages were banned at night and straw was laid on the streets during the day to reduce noise levels

• Concerns regarding community noise levels and sleep disturbance have continued to modern times
Early Aircraft Noise Issues

• Barnstormers used the sound of their aircraft engines to attract a public eager to experience the wonders of flight

• Early commercial flights, first US mail and then passenger carriers, were few and far between

• The public perspective shifted in the early 1960s as commercial air carriers transitioned from propeller-driven aircraft to jets
Early Aircraft Noise Issues

• Boeing 707s and Douglas DC-8s became the workhorses of commercial aviation

• Airport neighbors noticed and objected to this change in aircraft noise exposure and demanded action

• Aircraft noise was becoming recognized as a legitimate problem on both a local and national level
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1958

DC-8

Photo Credit: Airliners.net

1957

B-707

Photo Credit: Air-Review.com

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Federal Aircraft Noise Regulations – 1950s

• Federal Aviation Act of 1958
  – Congress gave the Federal Aviation Administration (FAA) the authority to regulate the use of the navigable airspace
  – Congress recognized that the public has a basic right to air transit, which was declared “a right of national sovereignty”
Federal Aircraft Noise Regulations – 1960s

• Amendment of the Federal Aviation Act of 1968
  – Recognized aircraft noise as a problem and authorized FAA to establish standards of measuring noise as well as regulations to control and abate aircraft noise
  – Required the regulations be “consistent with the highest degree of safety” and be “economically reasonable, technologically practicable, and appropriate for the particular type of aircraft.”
  – Aimed at controlling noise at the source (i.e., aircraft) not airport proprietors
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1963

B727-200

Photo Credit: RuthAS

1967

B737-200

Photo Credit: Boeing

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Federal Aircraft Noise Regulations – 1960s

• FAA Promulgates Federal Aviation Regulation (FAR) Part 36 in 1969
  – Established uniform measurement system for aircraft noise certification
  – Established maximum allowable aircraft noise limits for newly manufactured aircraft
  – Permitted heavier aircraft to have higher noise levels
Federal Aircraft Noise Regulations – 1970s

• Noise Control Act of 1972
  – Prohibits FAA from issuing type certificates for aircraft not meeting the Part 36 noise limits
  – Added the Environmental Protection Agency (EPA) to the regulatory process, but did not require FAA to adopt EPA’s regulations
Federal Aircraft Noise Regulations – 1970s

- FAA Amends FAR Part 36 in 1976
  - Required *currently operating aircraft* to comply with Part 36 noise limits
  - Allowed for phased compliance with the requirements by January 1, 1985, which was extended to January 1, 1988
  - The 1988 amendment also added the requirement for foreign carriers to comply with the regulations

- Established the noise-related “Stages”
Federal Aircraft Noise Regulations – 1970s

• FAA’s Aviation Noise Abatement Policy of 1976
  – Identified the various roles and responsibilities for aircraft noise abatement
    • FAA, airport proprietors, airlines, state and local governments, and prospective residents
  • This policy remains in effect today
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MD-80

Photo Credit: Boeing

1979
Federal Aircraft Noise Regulations – 1970s

- Aviation Safety and Noise Abatement Act of 1979
  - Required FAA to establish a method of quantifying and assessing the impact of aircraft noise at airports
  - Provided for federal funding of voluntary airport noise and land use studies

- Resulted in FAR Part 150 Airport Noise and Land Use Compatibility Planning in 1984
  - Approved Noise Compatibility Programs measures are eligible for federal funding (e.g., sound insulation, land acquisition, ground run-up enclosures, noise monitoring systems)
Federal Aircraft Noise Regulations – 1990s

• Airport Noise and Capacity Act of 1990
  – Established the phase-out of Stage 2 aircraft greater than 75,000 pounds by January 1, 2000
  – Grandfathered existing airport-specific noise limits

• Resulted in 14 CFR Part 161- Notice and Approval of Airport Noise and Access Restrictions
  – Study of last resort
  – Many have tried, but only one restriction was approved since 1991
Technological Improvements

• Aircraft have become significantly quieter since the 707s and DC-8s of the early 1960s

• More stringent noise requirements through FAR Part 36 and the International Civil Aviation Organization’s (ICAO) Committee on Aviation Environmental Protection (CAEP) have helped to drive aircraft noise research

• The airlines’ desire to reduce fuel consumption and air emissions have provided further incentives to reduce aircraft noise
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B727-22  B787-9

Photo Credit: Museum of Flight

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GE-9X Turbofan Engine for the 777X

10:1 Bypass Ratio
11-foot Blade Height
105,00 Lbs. of Thrust
GE’s Lowest Noise Level Engine in Terms of Decibels per Pounds of Thrust

Photo Credit: General Electric
Technological Improvements

- At many airports, the average aircraft size is increasing as airlines “upgauge” their fleets
  - More passengers are carried with fewer operations
- As a result, aircraft operations have increased modestly as passenger volume has gone up dramatically
- These technological improvements and airline practices have resulted in millions of people being removed from noise impact areas near airports
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The Historical Record:
Order of Magnitude Noise Exposure Reduction Despite Traffic Growth

Source: FAA
Technological Improvements

• On the aircraft
  – Low-bypass engines replaced by high bypass engines
  – Improved wing designs and winglets; improved climb performance
  – Vortex generators reduce tonal noise from wing vents
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A-320neo

Photo Credit: Airbus

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Airline Fleet Changes

• For improved fuel efficiency, airlines are replacing four-engine long-haul aircraft (e.g., A-380s and B-747s) with twin-engine widebody aircraft (e.g., B-787s and B-777s)

• These aircraft look very similar to their much smaller twin-engine narrowbody counterparts such as the A-320 and B-737

• As a result, these widebody twin-engine aircraft often appear to be lower at the same altitude
Comparison of a Boeing 787-900 to a Boeing 737-900 at an altitude of 2,500’ Above Ground Level

Source: Environmental Science Associates
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Last year, Airbus announced the cessation of the production of the A-380 aircraft because. . .
...it cannot compete with the fuel efficient, twin-engine widebody aircraft such as the 777 and 787.
While some future aircraft may become even quieter, others may require changes in current noise standards.
Technological Improvements

• In flight
  – Continuous Descent Approaches (CDAs) or Optimized Profile Descents (OPDs)
    • Uses flight-idle throttle settings and keeps the aircraft “clean” until several miles from touchdown
  – Performance Based Navigation (PBN), Required Navigation Performance (RNP), and Area Navigation (RNAV) departures and approaches
    • Incorporates OPDs into standard arrival procedures and, when possible, concentrates aircraft over compatible land uses

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Optimized Profile Descent

RNAV PBN

Source: FAA

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2014 SMF South Flow Departures

Image Source: SCAS

32,048 Departure Flight Tracks

Image Source: SCAS

[Map showing flight tracks over Westlake, Westshore, and Sundance Lake]
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2017 SMF South Flow Departures

33,871 Departure Flight Tracks

Image Source: SCAS
Recent Trends in Aircraft Noise Concerns

- Aircraft altitudes
- Frequency of overflights
- Increased nighttime flights
- Concentrated flight tracks over noise sensitive land uses
- New noise sensitive areas exposed to aircraft overflights and noise
- Impact of aircraft noise on human health
Recent Trends in Aircraft Noise Concerns

• Reaction
  – Increased community activism
  – Requests for the establishment of lower national aircraft noise standards (i.e., 55 DNL)
  – Formation of a congressional caucus on aircraft noise
  – Independent aircraft noise complaint websites and automated noise complaint filing apps
  – Threats of litigation
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Questions?