

# AIRPORT ENVIRONMENTAL MANAGEMENT

04-08 October 2015

Abu Dhabi, UAE

## Module 7: Aircraft Noise Airport Environmental Management

## Module Objectives

- Provide an introduction to aircraft noise.
- Explain noise capacity constraints at airports.
- Review the regulatory framework covering noise.
- Examine methods of assessment of noise exposure and nuisance.
- Describe methods of managing aircraft noise.
- Explain the process of airport stakeholder communications.

## Introduction



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## Aircraft noise challenge

- Airport benefits are significant and spread across the state.
- Aircraft noise impact is significant but borne locally.
- This impact can generate significant opposition leading to constraints upon airport capacity.
- Community disturbance can limit the ability of airports to contribute to regional development.

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## History of aircraft noise

- 1950s – The arrival of the jet aircraft
- Initially a Trans-Atlantic problem
- Shock responses from communities around airports
- Airlines excluded from national noise legislation
- Investment in noise technology
- ICAO noise certification

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## Aircraft noise today

- Despite massive investment in technology
- Significant impact upon quality of life for tens of millions of people.
- Is the major constraint to airport growth



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## The cause of the problem

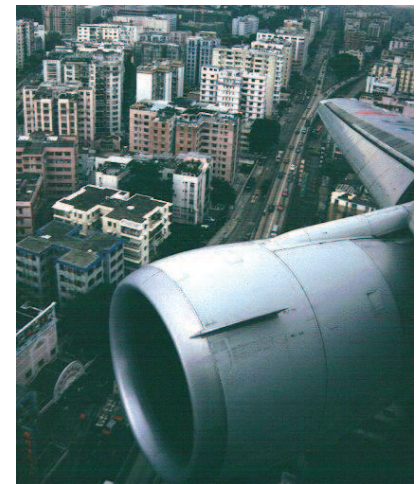
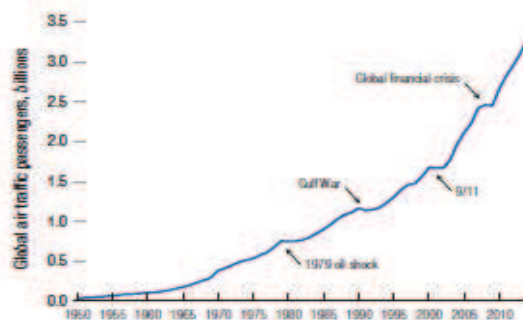


Figure 1: Global air passenger traffic trend, 1950-2014 (ATA Forecast for 2014)



Source: IATA.

### Airport Capacity:

- Is a function of:
  - Its infrastructure
  - The ATM system that serves the airport
  - Quality of management
- Aircraft noise can restrict operations to below infrastructure capacity and limit future growth.

### Capacity constraints arise:

- From public protest or court action
- As voluntary act to secure planning
- As a condition of planning

## Examples:

- Existing operations exceed:
  - Regulatory limits (Schiphol)
  - Planning requirements (Manchester)
  - Community tolerance (Sydney)
- Further development is prevented due to the anticipated noise disturbance (Japan, Strasbourg)

## Airport noise capacity constraints - EU

- 60% of airports surveyed already have noise capacity limits, 80% expect restriction in 5 years.
- Many believe planning approval for future growth will be limited by noise issues.
- Airport constraints have significantly reduced the capacity of the air transport system.



## How are noise capacity limits set?

- Noise contours
- Number of houses
- Aircraft movements
- Aircraft types
- Opening times
- Runway closure
- PLANNING REFUSAL



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## Manchester case study

- The 'noise climate' will not be worse than in the 'base' year
- Day time noise
  - Contour area limit
  - Limits on noisiest aircraft
- Night noise limits
  - Contour area
  - Limits on noisiest aircraft
  - Movement limit
  - Noise budget limit



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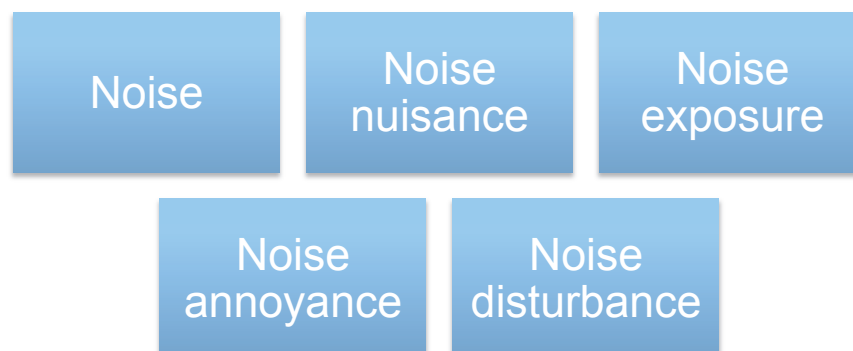
## Measuring noise



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## Exercise

- List the different ways you can measure the following issues:



- Work individually to begin with and when told to, compare your results with colleagues.
- As a group, discuss how an airport can assess whether it has a 'noise' problem.

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## Noise annoyance is a matter of perception

- Individuals respond differently to noise depending upon a variety of socio-economic, lifestyle and cultural issues.
- So what should we measure?
  - Noise exposure
  - Noise impacts on people's lives
  - Level of disturbance
  - Response to that disturbance

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## Noise exposure

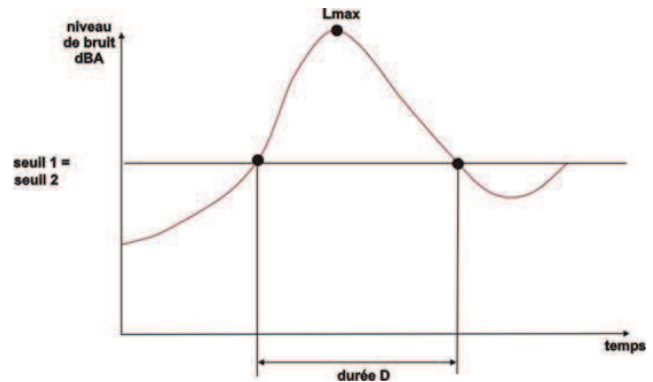


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## Combination of single events

- Number and frequency of events
- Peak noise in decibels and duration
- Timing of event



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## Noise exposure single events

- To implement penalties
- To validate contours
- To confirm noise levels to communities
- To test new low noise operations
- To confirm compliance



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## Noise exposure – noise monitoring

- Where to monitor?
  - Response to community concerns (EHO/ Airport)
  - Confirming boundaries of sigs/ compensation scheme
  - Support penalty schemes
- How to monitor?
  - Background noise
  - Weather effects
- 'A' weighting
  - Emphasize frequencies the ear is most sensitive to, attenuating high and low frequencies



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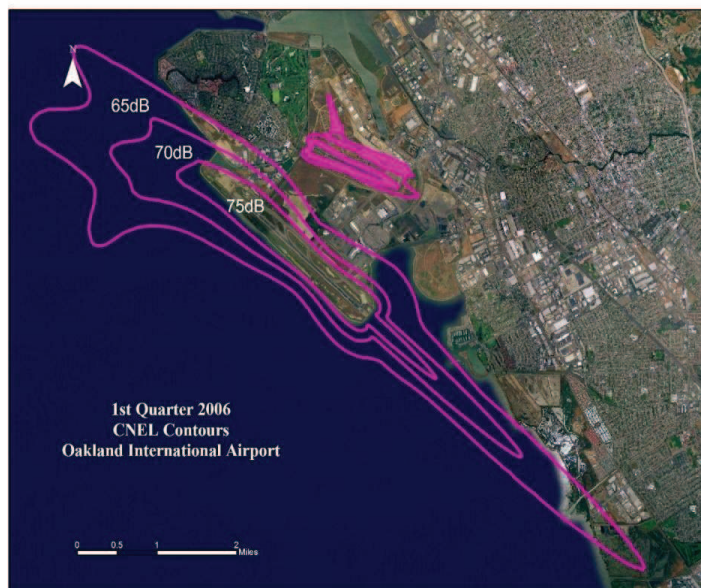
## Noise exposure contour modelling

- Provide a cumulative overview of noise exposure from multiple single events. Useful for:
  - Land use planning
  - Boundaries of:
    - Sound insulation schemes
    - Compensation
    - Mitigation schemes
- NOT understood/trusted by communities

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## Noise exposure contour modelling

- Average – 16/8 hours
- Often associated with:
  - Onset of disturbance
  - 57 LAeq (UK)
- Indicators:
  - Contour area
  - Population exposed



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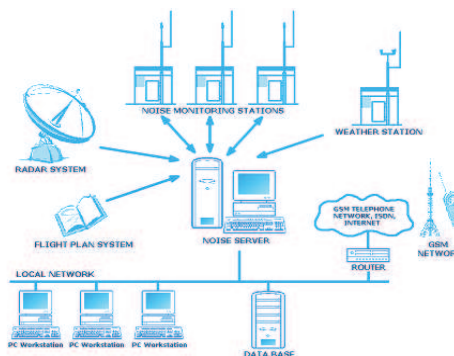
## Noise exposure contour modelling

- Shape determined by:
  - Noisiness of aircraft
  - Number of aircraft
  - Flight paths
  - Climb rates



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## Noise and track monitoring



## Community noise indicators

- Number of aircraft
- How noisy they are
- Time of day
- Height
- Will there be quiet periods? (Respite)





## What is disturbing?

# Noise impacts are not measured in decibels

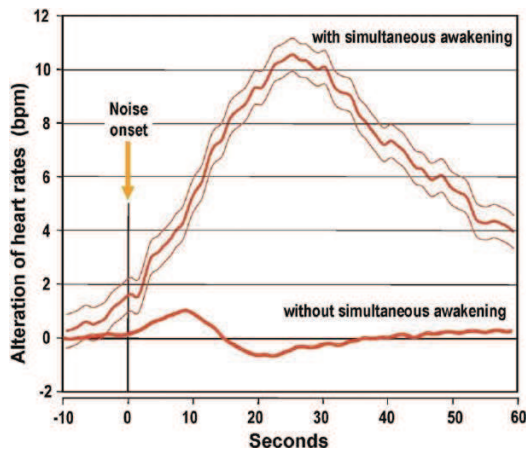
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## It depends on what you are doing?



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## Sleep disturbance

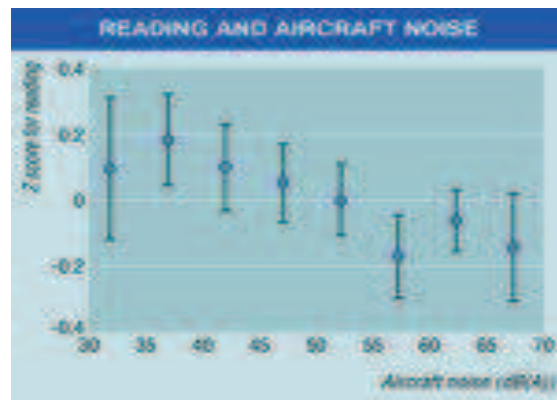


## Health impacts

- Blood pressure
- Stress
- Heart Attacks?
- WHO studies



# Education



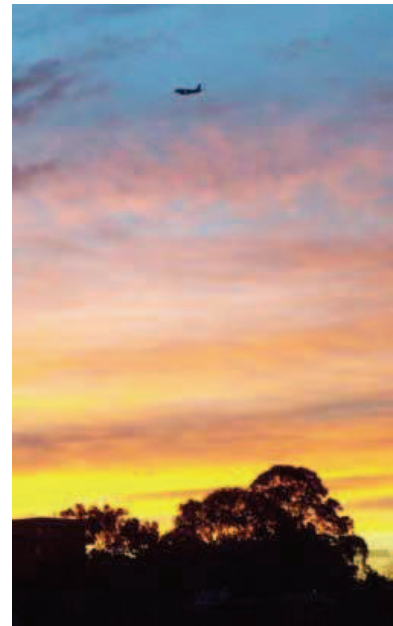
# Fear





## Perceived disturbance

- Attitude depends on a variety of issues:
  - Geography (weather)
  - Lifestyle, e.g. time of going to bed
  - Affluence
  - Expectation of quality of life



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## Response to disturbance

- Complaint
- Legal action (Heathrow)
- Direct action (Sydney)
- Tolerance
  - Sharing benefit
- Silence
  - No point in complaining
  - Fear of complaining
  - Propensity to take action



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## Monitoring community disturbance

- Noise monitoring
- Noise Modelling
- Complaints
- Consultative forums
- Social surveys
- Public consultation
- Analysis of the media

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## Complaints

- Aircraft off track, too low, too noisy
- Complaints increase as a result of newspaper articles-  
heightened awareness
- Complaints increase following accidents
- Sensitivity alters throughout the day/week
- Individuals can skew complaints analysis
- People expect airports to listen and act

## Social surveys

- Level of disturbance in each community
  
- Key issues:
  - Noise
  - Local air quality
  - Loss of green belt
  - Road traffic congestion
  
- It's not worth complaining, no action is taken
  
- In any conflict between community and commercial expediency, commerce always wins

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## Public consultation

- Project specific (What evidence is there that consultation leads to change?)
  
- Reveals similar priorities to complaints
  
- Reveals fear of future growth (change has been so rapid in the last decade)

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	<b>Affected by</b>	<b>Measures</b>	<b>Control</b>
<b>Noise Exposure</b>	Aircraft type Numbers Time	Monitoring Modelling	Technology Operations Restrictions
<b>Attitude</b>	Individuals Socio-economic lifestyle Trust Fear	Social Surveys Consultation Complaints	Stakeholder engagement Compensation Mitigation

# REGULATION OF AIRCRAFT NOISE

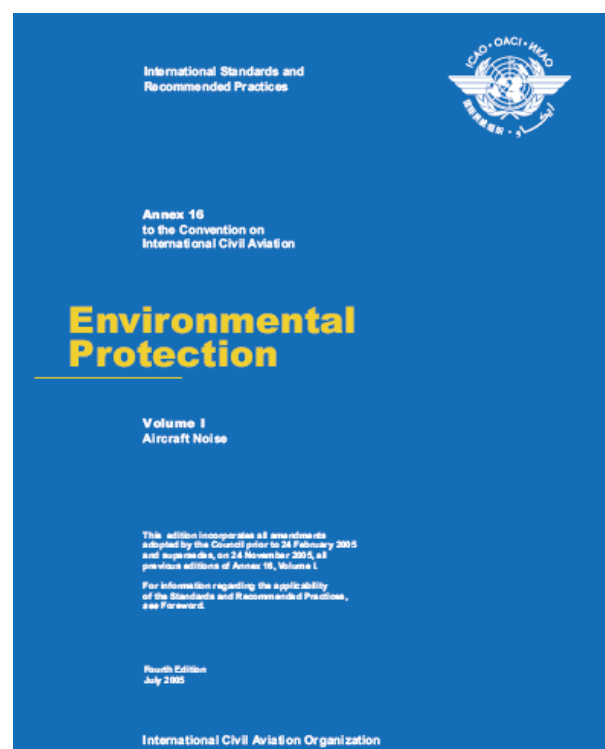
## Regulation

- Global regulation of local problem
- Needs to acknowledge:
  - Impact upon communities of noise and the industry of action to reduce noise
- Community responses differ across the World
- Requirement to tailor according to national and local needs

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## Regulation - global

- ICAO Annex 16
  - Certification of new aircraft
  - Phase out of noisier aircraft
- Transfer older aircraft to developing world



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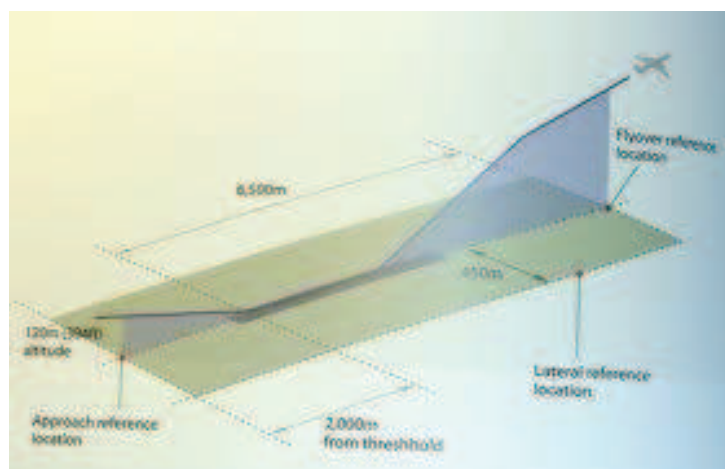


## ICAO – Noise certification

- Annex 16 Volume 1 of this document contains standards for the assessment and certification of noise levels from an aircraft during take-off and landing
- The standards “should reflect the current state of the art of technology” (Discussion, does this lead or follow technology?)
- All major aircraft/engine combinations are certified according to Annex 16 Vol.1 requirements and aircraft must carry a copy of the certificate

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## ICAO – Noise certification



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## ICAO – Early standards

- First generation of Jet powered aircraft not covered by Annex 16 – Non-noise Certificated (NNC) aircraft included the Boeing 707 and the Douglas DC-8
- Chapter 2 became applicable in 1973
- Example aircraft included the B727 and the DC-9
- Only applied to new production models of aircraft types certified after 1<sup>st</sup> January 1969
- In most developed countries, most Chapter 2 aircraft were banned after 2002

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## ICAO – Chapter 3

- Development of high bypass ratio jet engines improved fuel efficiency and engine noise
- Chapter 3 applies to aircraft certificated after 1977
- Examples: Boeing 737-300/300, 767 and Airbus 319
- Requirements expanded to helicopters, light and heavy propeller driven aircraft
- After 2002, some aircraft were re-certificated to Chapter 3 including some with Hush-Kits retrofitted to engines

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## ICAO – Chapter 4

- Chapter 4 limits were approved at the CAEP/5 in 2001 and came into force in 2006
- Chapter 4 limits require that the cumulative noise level is at least 10 decibels quieter
- Sum of reductions at any 2 points must be at least 2 dB
- There are no requirements for an improvement at all 3 of the measurement points
- These requirements only apply to newly certified aircraft/engine combinations and not to those already in production in 2002

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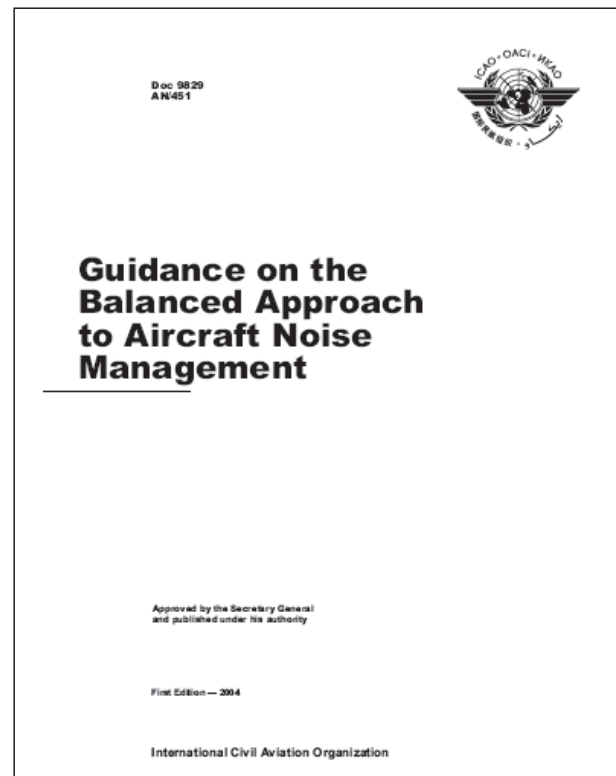
## Challenge for ACI – Inadequacies of Ch4

- Chapter 4 only 10 dB cumulative below Chapter 3
- No requirement to improve at each of the 3 measurement points
- Does not apply to aircraft/engine combinations certified before 2006
- Not a cutting edge goal, but a peg under the bar
- “Technological interdependencies – can’t improve noise without increasing fuel burn and NOx”
- A380 and B787 are 25 dB below Ch3 requirements (with substantial emissions improvements too)
- Chapter 14 requires at least 7 EPNdB reduction over Chapter 4 from 2017 (small aircraft <55 tonnes from 2020)

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## ICAO – Balanced approach

- Assembly Resolution A33-7
- Reduction in noise at source
- Land use planning
- Noise abatement operational procedures
- Operating restrictions



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## Regulation - EU

- Strategic Goal – no increase in numbers seriously affected by aircraft noise
- Longer term objective – reduce numbers
- Directive 2002/30(EC):
  - Does not prescribe actions but a process
  - Limits operating restrictions to marginally compliant aircraft
  - Classifies ‘City Airports’ which may be more stringent

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## Regulation - EU

- EU Directive 2002/49/EC (Assessment and Management of Environmental Noise)
  - EU-wide noise measuring units and noise assessment techniques
- Approach
  - EU-wide noise mapping exercise
  - Local action plans to prevent or reduce noise from major sources (Airports >50,000 movements)

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## Regulation - EU

- Facilitates aviation growth
- Acknowledges needs of different regions, airports, communities
- Incorporated into national law and enforced by members states
  - Assess noise exposure risk
  - Evaluate most cost effective control
  - Public consultation, national oversight, dispute resolution
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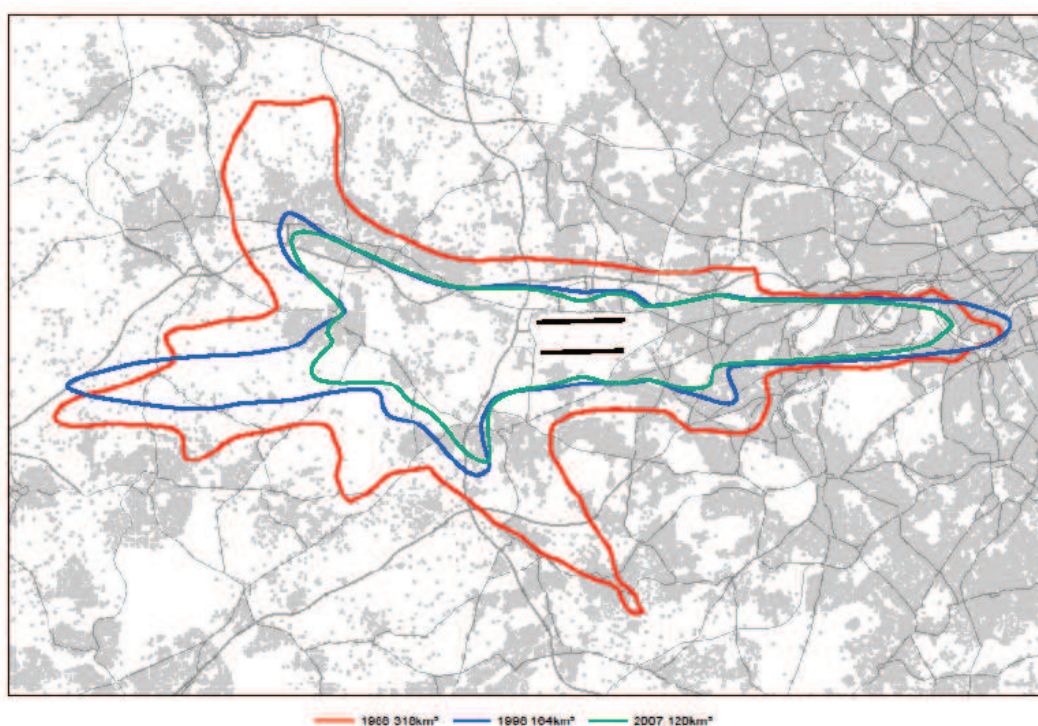
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## The Airport Sustainability Challenge

- How to achieve a sustainable (equitable) balance between:
  - The 'benefits' of further airport growth – enjoyed by millions
  - And
  - The 'costs' (noise disturbance) – borne by thousands?

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## Populations affected were declining



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## But this is changing

- Engine improvement is getting harder
- Rapid growth is outstripping fleet modernisation
- New runways/flightpaths (airspace changes)
- Newly exposed populations very sensitive



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## Public attitudes are also changing

- Levels of noise that were acceptable are no longer so
- Increasing:
  - Affluence
  - Democratisation
  - Home ownership



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## The noise problem is likely to get worse

- The single most significant environmental impact
- Growth > than technological/operational improvement
- Number of people exposed likely to increase
- Sensitivity will increase as people become more affluent
- Increasing democratisation will make them more vocal
- This will lead to increasingly active opposition.

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## Managing aircraft noise



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## Site-wide approach preferred

- Airport lead/co-ordinating role
- Legal responsibility – Civil Aviation Act
- Long term sustainable development of site
- Responsible infrastructure development
- Viewed as responsible by external groups

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- Airport:
  - Noise control strategy
  - Infrastructure design
  - Preferred noise routes
  - Operational practices
  - Monitoring/reporting
  - Mitigation and compensation
- Airlines:
  - Aircraft type
  - Flight procedures
  - Operational efficiencies
- ATM:
  - PNR design
  - Operational efficiencies
- Government
  - Land use planning
- Ground handling:
  - Operational efficiencies

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## Different partners direct control or influence

<b>Airport</b>	<ul style="list-style-type: none"> <li>• Noise control strategy</li> <li>• Infrastructure design</li> <li>• Preferred noise routes</li> </ul>	<ul style="list-style-type: none"> <li>Operational practices</li> <li>Monitoring/reporting</li> <li>Mitigation and compensation</li> </ul>
<b>Airlines</b>	<ul style="list-style-type: none"> <li>• Aircraft type</li> <li>• Flight procedures</li> <li>• Operational efficiencies</li> </ul>	
<b>ATM</b>	<ul style="list-style-type: none"> <li>• PNR Design</li> <li>• Operational efficiencies</li> </ul>	
<b>Government</b>	<ul style="list-style-type: none"> <li>• Land use planning</li> </ul>	
<b>Ground Handling</b>	<ul style="list-style-type: none"> <li>• Operational efficiencies</li> </ul>	

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## Responsibilities

	Airport	Airline	ATM	Ground Handlers	Government
Policy/strategy	X	I	I		
Targets	X		I		
Assessment/monitoring	X				
Flight paths	X	I	I		
Mitigation/compensation	X				
Land-use planning	I				I
Aircraft type	I	X			
Infrastructure	X				
Operations	I	X	I	I	

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## Engaging airlines: The challenge

- Many airlines
- Large / small
- National / international
- Local station office?
- Pilot education / engagement

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## Conflicting priorities

- Noise impact
- Capacity
- On time operations
- Operating costs
- Permission to grow

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## Minimising noise 'disturbance'

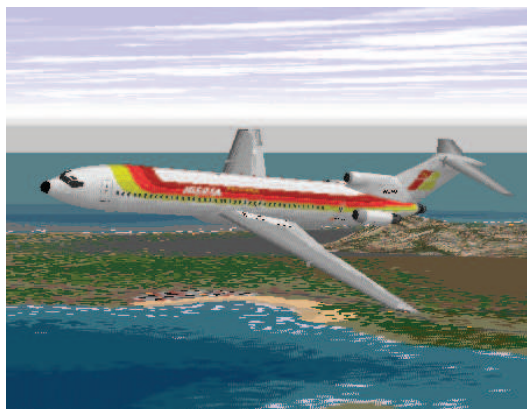
- Reduce noise exposure
- Increase community tolerance
- Public engagement is key to both

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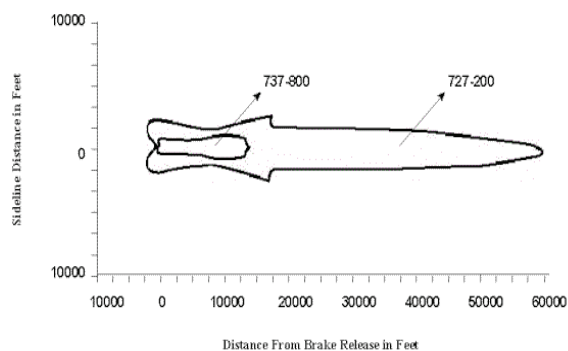
## Potential solutions

- Aircraft type
- Infrastructure alignment and design
- Land use planning
- Operational practices
- Operational limits
- Mitigation
- Compensation
- Relocation

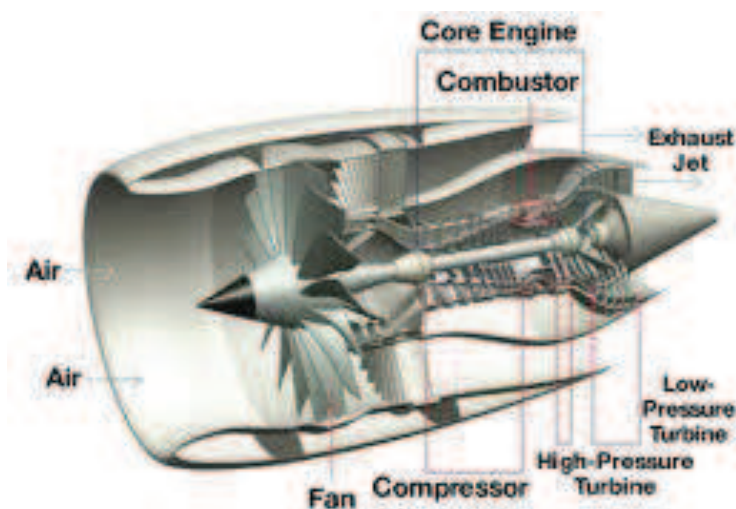
## Noise reduction at source



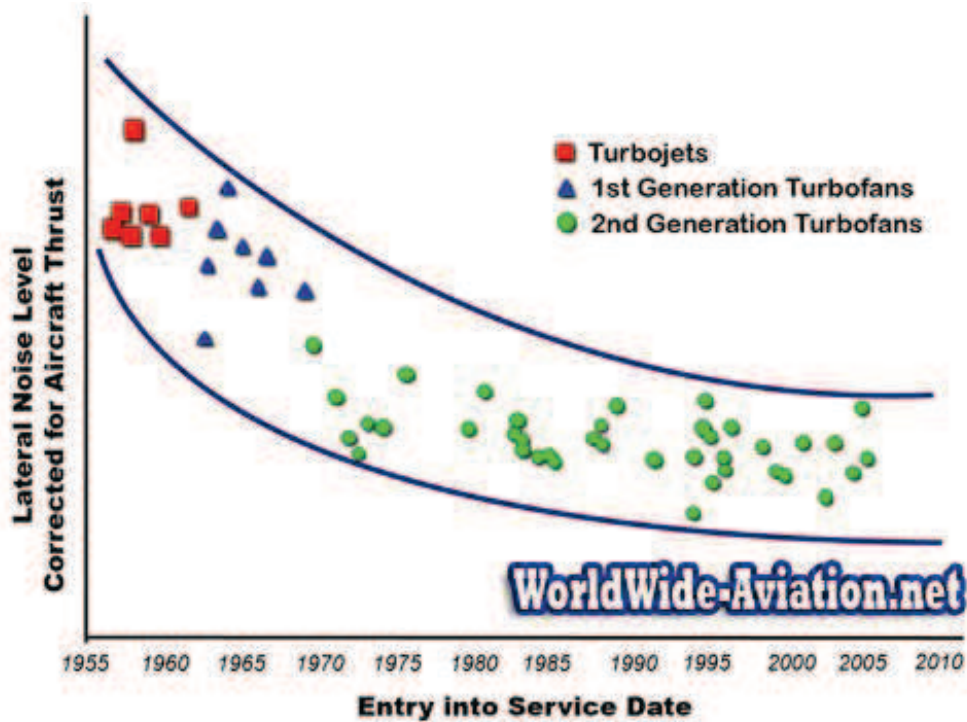
- Peak noise
- Area of impact



## Aerospace technology design



## It is getting harder to make improvements



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## Noise and emissions trade-off



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## Step change in technology is years away



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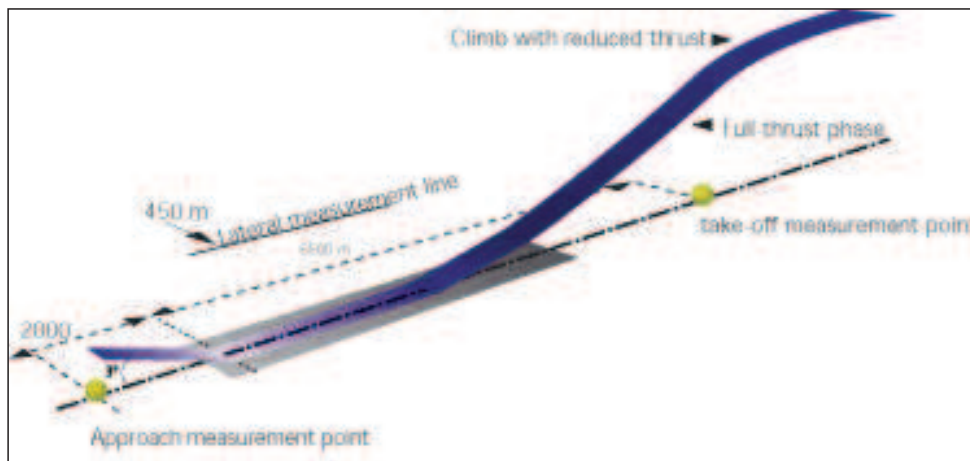
## Fleet modernisation

- Operational restrictions
- Noise charges
- Noise penalties
- Marketing incentives
- Second hand value of aircraft
- Aircraft fuel consumption

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## Quiet take-off procedures



## Continuous descent approach





## Preferred noise routes

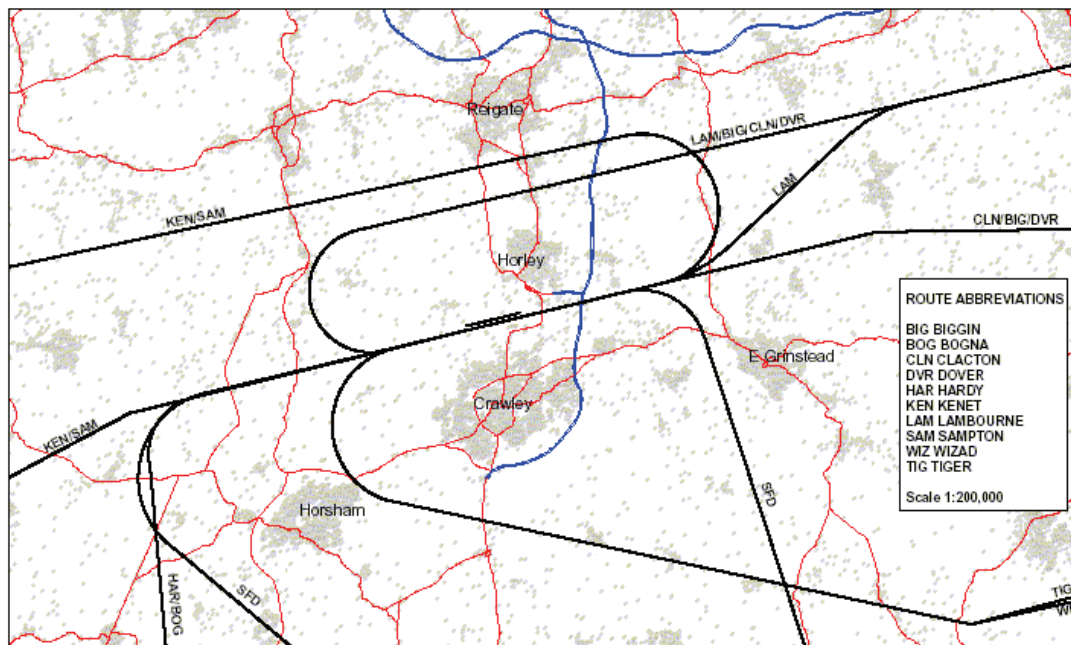


FIGURE 1: London Gatwick Airport Standard Instrument Departure Routes

## Track keeping



## Ground noise



- Holding locations, queuing
- Engine testing
- FEP, Ground Power

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## Preferential runway use

- Wind direction
- Cross wind
- Climate change

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## Night noise

- Sleep disturbance
- Night closure
- Movement limits
- Only quietest aircraft
- Slippage



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## Infrastructure



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## Land Use Planning

- Prevents noise sensitive developments
- Requires removal of some properties
- Lacking in many countries
- Not enforced in others.

## Sound Insulation in Properties

- Noise contour
- Target internal performance
- Size of grant
- Provisions
- Lifestyles

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## Noise compensation schemes

- Payments where a step change in noise climate
- Compensatory payment
- Complex science determines amount paid

## House Purchase

- Payments for people to enable them to move to lower noise areas
- Apply when there is a step change in the noise climate

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## Minimising noise 'disturbance'

- Is a function of:
  - Reduce noise exposure
  - Increase community tolerance

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# CONSULTING WITH LOCAL COMMUNITIES



## Why consult with local residents?

- They understand the reality of impacts and can help:
  - Clarify the problem
  - Find solutions
- Build trust
- Good communication is necessary if communities are to tolerate disturbance caused by aviation
- Consultation can be a legal requirement
  - National legislation
  - Aarhus Convention
  - UNEP

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## The process of consultation

- Identify key stakeholders
- Provide accurate, understandable, pertinent and timely information
- Dialogue between those responsible for the decisions and those affected by them
- Assimilate what the public say in the decision
- Feedback action taken and how they influenced the decision
  - (UNEP)

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## Who to consult with?

- 1. External
- Local residents
- Elected representatives
- To clarify problem
- To build tolerance
- 2. Internal
- Airport
- Airlines
- Air Traffic Control
- Ground Handlers
- To deliver solutions

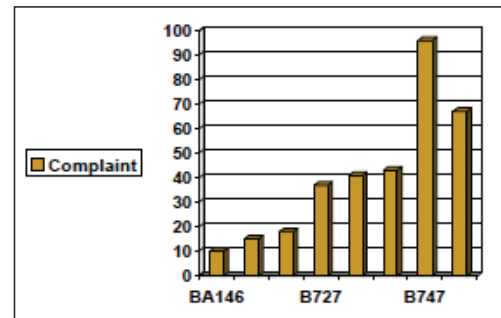
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## Factors affecting community attitudes

- Specific local issues/history
- Plans for growth
- Affluence
- Home ownership
- Relationship with aviation industry (trust)
- Media articles
- Cultural issues – willingness to complain

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## Public perception of aircraft



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## The process of consultation



WWW.DOUBT.IT

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## The value of stakeholder engagement

- Engagement with external stakeholders is essential to identify the nature and extent of impacts requiring attention
- Engagement with internal stakeholders is required to develop the most appropriate strategic and operational responses
- The process should ensure the correct balance is achieved between the interests of all stakeholders

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## Communication and consultation

- Documentation
- E-Newsletters
- Local media articles
- Telephone hotlines
- Exhibitions
- Website
- Twitter/Facebook
- Meetings
- Focus Groups
- Consultation committees
- Workshops
- Public meetings
- Field visits

## Enable community participation

- Concerns only partially informed and are influenced by opposition groups
- Expectations can be worse than expected reality
- Emotions can be strong and this requires managing
- They need help to most effectively contribute
- Use of the appropriate language is critical



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## Engage community in problem solving

- Actively seek involvement in problem solving
- Identify what is feasible and limit of influence
- Investigate practical options and seek views
- Investigate feasibility and cost/benefit of each
- Agree approach, targets, monitoring/reporting
- Feed into collaborative environmental management
- Report back performance/progress

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## Communications with external stakeholders



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## Use the right language

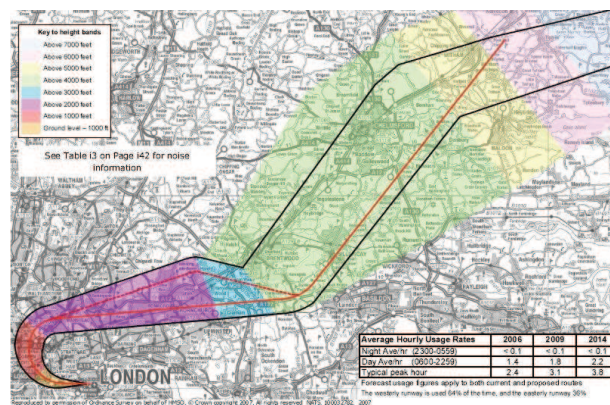
- **Technical Indicators**
  - Single events
    - Peak noise (PNdB)
    - Frequency
    - Duration
    - Monitoring
  - Contours
    - Modelling
    - TNIP
- **Community Indicators**
  - Number flights
  - Number engine tests
  - Adherence to PNRs
  - Number of NSDs
  - Monitoring results
  - Social survey
  - Complaints

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## Let community select indicators



- How many aircraft will I get?
- How noisy will they be?
- How high will they be?
- When will I get them?
- Will I still be able to use my garden?



## Maximising community tolerance

- Direct benefits / improvements locally
- Invest in communities worst affected
  - Jobs, trainings, support for businesses
  - Mentoring in schools
  - Creates workforce for the future
- Be a good neighbour
  - Invest in community projects (noise fines)
  - Community competitions, open days
- Inform of direct benefits
- Inform of indirect benefits

## Dangers of inadequate consultation

- External intervention
- Public protest, legal challenge
- Delays to process
- Constraints to growth
- On-going community conflict



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## Take home messages

- Noise is managed to minimise disturbance of local communities
- Local residents are best placed to explain the problem
- Engaging with local residents can be a frightening task involving politics and strong personal emotions
- You can minimise opposition by:
  - Acknowledging noise impacts
  - Engaging the community in defining solutions
  - Delivering those solutions through CDM and CEM
  - Reporting performance using language people understand
- Through such action airports achieve 'permission to grow'

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**Any questions?**