Brüel & Kjær
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LEGISLATION, REGULATION AND BEST PRACTICE IN AIRPORT NOISE MANAGEMENT

WHITE PAPER

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1. OVERVIEW

The majority of the world's major commercial airports, and a significant number of airport bases, have adopted processes and systems to manage the impact of operational noise from the airport onto surrounding communities.

There have been two main ("carrot and stick") drivers behind the adoption; in many cases, airports have made the investment in recognition of the need to gain community support for ongoing operation and expansion plans (the "carrot"). This is particularly where airports are privatised and they need to secure long term profitability and growth to satisfy their shareholders and these issues, and techniques used by various airports, are documented in Brüel and Kjær's paper "Expanding Environmental Capacity", available from www.bksv.com.

In other cases, governments have mandated such measures as part of the social responsibility of government to its citizens (the "stick"). Such measures are particularly prevalent where airports are retained as national assets, are often a response to the increasing sensitivity of an increasingly wealthy population to increasingly busy airports.

Around 85% of the world's busiest 100 airports have installed systems to manage noise and to monitor noise mitigation procedures. A review of the table below, which shows airports with Brüel and Kjær systems, will reinforce the impression that noise management at airports is standard practice in much of the world.

Europe, Middle East and Africa		Americas		Asia Pacific
Amsterdam	Madeira	Anchorage	Opa-Locka	Adelaide
Athens	Madrid Barajas	Austin	Palm Beach	Anchorage
Barcelona	Malmö	Boca Raton	Phoenix	Archerfield
Birmingham	Manchester	Bogota	Port Columbus	Auckland
Bologna	Manston	Bolton Field	Portland	Bankstown
Bournemouth	Newcastle	Boston	Portland Hillsboro	Beijing
Bristol	Nice	Brasilia	Reno-Tahoe	Brisbane
Cagliari	Norrkoping	Calgary	Reid-Hillview	Cairns
Cannes	Örnsköldsvik	Chicago Midway	Rickenbacker	Canberra
Düsseldorf	Palermo	Chicago O'Hare	Sacramento Exec.	Coolangatta
East Midlands	Palma	Cincinnati	Sacramento Int.	Essendon
Eindhoven	Ponta Delgada	Dallas	Sacramento Mather	Guiren Base
Faro	Porto	Denver	San Diego	Hong Kong
Flores	Porto Santo	Edmonton	San Francisco	Jandakot
Frankfurt	Prague	Ft Lauderdale Exec.	San Jose	Jeju
Göteborg	Rome	Ft Lauderdale Int.	Santo Domingo	Longtan Base
Groningen	Rotterdam	Hayward Exec.	Santiago, Chile	Melbourne
Halmstad	Santa Maria	Hilo	Sao Paulo	Parafield
Helsinki	Skellefteå	Honolulu	Seattle	Perth
Horta	Southampton	Kendall-Tamiami	Torrance	Sydney
Humberside	Split	Lantana	Toronto City	Taiwan (8 airports)
Jönköping	Stockholm	Lehigh Valley	Toronto Pearson	Wellington
Kalmar	Sundsvall	Long Beach	Van Nuys	Williamtown
Karlstad	Swedish LFV	Los Angeles	Vancouver	Xingshe Base
Kiruna	Turin	Lunken	Washington Dulles	Zuoying Base
Leeds Bradford	Umeå	Miami Homestead	Washington Reagan	
Lisbon	Visby	Miami Int.	Waterloo	
London Gatwick	Warsaw	Montreal Dorval	Westchester	
London Heathrow	Warton	Montreal Mirabel		
London Stansted	Windsor	Oakland		
Luxembourg	Zurich	Ontario		

States with no current policy or regulatory frameworks in place around airport noise management, especially those with a vibrant and growing aviation sector, should be encouraged to established such frameworks before the issue becomes critical and using the best elements of established global practice.

2. LEGISLATIVE FRAMEWORKS

There are a number of key legislative and policy frameworks supporting noise management approaches around the world, including:

- ICAO resolution endorsing the “Balanced Approach” to airport noise management, its classification of aircraft depending on noise profiles, and its provision for exclusion or differential charges based on this classification.
- The Policy and Recommended Practices of Airports Council International (ACI) which describes ACI policy and the measures used by airports to implement the policy.
- European Commission directives 2002/30 and 2002/49 (Environmental Noise Directive or END) which, inter alia, describe the framework for airport noise management procedures and mandates that States must produce noise maps and noise action plans for airports with more than 50,000 movements per year.
- The Airport Noise and Capacity Act of 1990 in the USA, which established procedures for airports wishing to impose operating restrictions (Part 161) or seeking Government grants to invest in noise mitigation (Part 150).
- A variety of local regimes and regulations have also been adopted to try to ensure a balanced outcome between the national economic needs for a strong aviation sector and the environmental needs of the population.

2.1. ICAO Standards and Recommended Practices

There is a substantial body of ICAO material on noise management, ranging from the migration to quieter aircraft to the introduction of noise-related changes for aircraft using airports which are affected by noise issues.

In 2001, the 33rd ICAO Assembly adopted Resolution A33/7 which endorsed the concept of a "balanced approach" to aircraft noise management (see ICAO document 9829 updated 2007) by identifying the noise problem at an airport and then analysing the various measures available to reduce noise through the exploration of four principal elements, namely reduction at source (quieter aircraft), land-use planning and management, noise abatement operational procedures and operating restrictions. ICAO has developed policies on each of these elements, as well as on noise charges.

Annex 16, Volume 1 of the Chicago Convention on International Civil Aviation contains various noise standards for aircraft, usually referred to as “Chapters” or “Stages”, with Chapter 2 aircraft now barred from flying in to many airports and pressure being applied on the noisiest Chapter 3 aircraft. Annex 16 also provides guidance on land-use around airports and on the use of operational procedures to restrict aircraft noise.

ICAO's 1981 policy with regard to noise charges is contained in “Policies on Charges for Airports and Air Navigation Services” (Doc 9082/6). ICAO considers that the costs incurred may,

at the discretion of States, be attributed to airports and recovered from the users. In the event that noise-related charges are levied, the Council recommends that they should be levied only at airports experiencing noise problems and should be designed to recover no more than the costs applied to their alleviation or prevention; and that they should be non-discriminatory between users and not be established at such levels as to be prohibitively high for the operation of certain aircraft.

Practical advice on determining the cost basis for noise-related charges and their collection is provided in the ICAO Airport Economics Manual (Doc 9562), and information on noise-related charges actually levied is provided in the ICAO Manual of Airport and Air Navigation Facility Tariffs (Doc 7100).

2.2. ACI Policy and Recommended Practices

Section 6.1 of Airports Council International (ACI)'s Policy and Recommended Practices Handbook (Sixth Edition – December 2008) outlines a number of policies relating to airport noise and contains a discussion about global best practice with respect to the implementation of each policy.

The key relevant ACI policies relating to noise include:

- Minimise or mitigate the adverse effects of aircraft noise on people
- ACI supports the implementation of ICAO's Balanced Approach (BA).
- Reduction of noise at source is the most effective and lasting way to curtail aircraft noise on a permanent and global scale.
- Land use planning is an effective tool in minimising the impact of aircraft noise.
- Sound insulation is part of the solution for residences, classrooms and other noise sensitive buildings affected by aircraft noise.
- Noise abatement procedures can be used to help reduce aircraft noise levels.
- Restricting operations can reduce noise disturbance at sensitive times, usually at night.
- Noise monitoring at airports is an important process in understanding and dealing with aircraft noise impacts
- Interaction with communities affected by noise is an important tool in community / airport cohesion.
- Noise metrics provide a valuable tool for communicating with communities.
- Noise-related user charges can be a strong incentive for airlines to operate quieter fleet
- Ground-based noise sources must also be considered for mitigation measures

2.3. European Directives 2002/30 and 2002/49

Directive 2002/30 established rules and procedures with regard to the introduction of noise-related operating restrictions, specifically:

- to lay down rules for the Community to facilitate the introduction of operating restrictions in a consistent manner at airport level so as to limit or reduce the number of people significantly affected by the harmful effects of noise;
- to provide a framework which safeguards internal market requirements;
- to promote development of airport capacity in harmony with the environment;
- to facilitate the achievement of specific noise abatement objectives at the level of individual airports;
- to enable measures to be chosen from those available with the aim of achieving maximum environmental benefit in the most cost-effective manner.

At a broader level (because it applies not only to airports, but also to railways, roads and large cities), 2002/49 established agreed metrics for environmental noise (L_{den} to measure annoyance and L_{night} to measure sleep disturbance) and requires states to develop ***and publish*** strategic noise maps and action plans (including noise reduction plans where appropriate) for (inter alia) all major airports…ie. airports with over 50,000 jet movements per year.

The first round of strategic noise maps and action plans have now been produced and submitted to the European Community and the focus will now be on the extent to which airports carry out the proposed action plans.

2.4. USA Airport Noise and Capacity Act of 1990 and other legislation

Two important provisions of the Act (commonly referred to as the national noise policy) were the establishment of a national aviation noise policy (Sections 9308 and 9309) and the creation of a passenger facility charge (Sections 9110 and 9111), which enables airport sponsors to impose fees on the tickets issued to eligible enplaning passengers. An amendment to FAR Part 91, "Transition to an All Stage 3 Fleet Operating in the 48 Contiguous United States and the District of Columbia," and new FAR Part 161, "Notice and Approval of Airport Noise and Access Restrictions", implement the national noise policy. New FAR Part 158, "Passenger Facility Charges," implements that portion of the Act authorizing the imposition of such a charge.

There is a well established "65 dB DNL" threshold in the USA which establishes that people who live in areas subject to this level of noise or greater are entitled to some relief, usually in the form of compulsory property purchase or grants to cover building works and insulation. Airports access federal/FAA grant funds to carry out these works by undertaking often quite extensive "Part 150" studies, which analyse the impact of noise on the community and the potential impact of various measures.

2.5. Local Regimes and Regulations

Empowered by these global frameworks, there have been a number of local regimes introduced at specific airports, often to support specific expansion or development projects at the airport. For example:

- London Heathrow, one of the world's busiest airports and surrounded by dense population, has a night curfew and a complex night quota system which empowers airlines to manage their own use of curfew shoulder periods and occasional late departures, although subject to the ultimate sanction if they "run out" of quota.
- BAA, the operators of Heathrow, have long championed the use of "continuous descent approach" procedures, whereby aircraft adopt a straight-in, 3-degree glideslope which has been proven to reduce noise impact by 30% or more. BAA use analysis from their noise and operations management system to monitor compliance and to pursue violations, and they now have unmatched levels of compliance with the procedures. CDA is now being championed by a cross industry initiative (The CDA Action Plan) which aims to drive CDA procedures into 100's of European airports over the next 5 years.
- Amsterdam Schiphol airport, in association with the introduction of the fifth runway and other measures, have a strictly monitored requirement to adhere to specific "noise load" limits at points around the airport, to the extent that they need to carefully plan their operational modes on a day to day basis to ensure that they do not run out of "load" for specific modes prior to the end of the year.
- When Denver International Airport opened its new Greenfield airport in 1985, it committed not to exceed specific noise loads at 100 points around the airport and has, to date, paid tend of millions of dollars in penalties associated with exceeding those agreed limits.
- In Sydney, Australia, the opening of the third runway caused significant community outrage with demonstrations and even blockades of the airport. A complex settlement with the various communities around the airport resulted in an agreement to "share the noise" with quotas set for each operating mode and a reporting requirement established against that agreement.

3. BEST PRACTICE

Within these legislative and license fameworks, airports have adopted a range of measures to meet legal and license requirements, to adhere to applicable policies, and to secure a harmonious relationship with their communities. A recent study by Vancouver International Airport and Wylie Laboratories has identified the following as “best practice”:

Ground Operations	
Run-up operations	Designate specific locations where run-ups can be performed and monitor compliance.
Ground Run-up Enclosure	Build and maintain a Ground Run-up Enclosure.
Acoustic Barriers, Berms, Walls	Construct berm or wall when noise reduction is needed in only one direction.
APU Noise	• Provide sufficient ground power and preconditioned air to all gates. • Directives requiring APU shutdown after gating
Flight Operations	
Noise Abatement Flight Corridors	Establish flight corridors that minimize noise for exposed populations in all noise sensitive locations
De-rated Thrust Departure Procedures	Implement departure procedures that employ the minimum thrust necessary for safe take-off roll and climb-out
Area Navigation /Required Navigation Performance (RNAV)	Establish departure and arrival procedures that minimize noise for exposed populations in all noise sensitive locations
Continuous Descent Approach (CDA)	Implement arrival procedures that allow aircraft to perform a CDA at idle power
Reverse Thrust Reduction	- Design airfield to minimize the need for thrust reverse - Implement monitoring program to promote pilot awareness
Curfews and Access Restrictions	Apply voluntary and involuntary curfews and access restrictions as a last resort
Propeller Noise Abatement	Encourage operators to reduce take-off power and to increase # of propeller blades
Monitoring and Tracking	
Complaint Management System	Maintain a noise complaint system that provides a substantive and timely response to all noise complaints
Flight Tracking System	Maintain a flight tracking system that provides an accurate history of aircraft flight tracks
Noise Monitoring System	Maintain a noise monitoring system that provides accurate history of noise environment around the airport
Operator Compliance with Noise Abatement Procedures	Establish incentive-based techniques to encourage all operators to comply with all noise abatement measures
Community Relations	
Reporting of Noise Exposure	Provide noise exposure information to all stakeholders
Communication Media	• Identify and implement multimedia communication lines

	• Web Portals off airport main page
Define Noise Exposure With Alternative Noise Metrics	Select metrics and threshold levels that are the most effective in communicating noise exposure
Noise Committee / Roundtable	Establish a permanent noise advisory committee or roundtable that includes empowered, accountable stakeholders.
Stakeholder Outreach and Education	Establish outreach effort that provides all relevant noise information to all stakeholders.
Non Acoustic Measures to Mitigate Annoyance	Implement a set of non-acoustic measures that do not directly abate the noise, but rather mitigate the level of annoyance affected parties express toward the noise source.
Land Use Planning	
Static Airport Operating Area (AOA)	Establish static AOA with development limitations that are sufficient to permit unrestricted airport growth.
Noise Disclosure in Real Estate Transactions	Require disclosure of airport noise exposure for real estate transactions early in the sale process and continuing through closing.
Building Codes	Establish building code provisions that assure appropriate noise level reduction for all construction within high noise areas.

4. CONCLUSIONS

The most developed aviation markets in the world have extensive noise management and mitigation programs supported by global, regional and local legislation and regulations. It is inevitable that similar approaches will be required in other jurisdictions as the growing expectations of the population increasingly come into conflict with the continued growth in demand for aviation travel.

Managing the balance between these competing demands requires a complex set of approaches both to minimise and mitigate the effect of noise on the population and to manage the expectations and tolerance of the community to the issue. The role of government and national regulators is also important, because it establishes the metrics, reporting requirements, and the frameworks in which the airlines and airports operate to try to achieve the best outcome.

Without investment in managing this issue, governments and airports can become embroiled in long and costly legal and political battles with the community which can cause significant operational interruption in the short term and lead to a long term relationship of distrust and obstruction.

On the other hand, with appropriate systems in place, not only can the debate be undertaken on the basis of high-quality, consistent and credible information, but the advanced nature of today's systems support a vast array of operational procedure development and enforcement options such as noise corridors, continuous decent approach, curfews and quotas etc.

Countries with no formal and regular airport noise management systems in place, especially countries with rapidly developing aviation sectors, should consider the establishment of standard noise and operations monitoring systems (NOMS) as soon as possible, and well before significant issues emerge publicly.

Airports that wait for communities or governments to apply pressure and legislate noise management, rarely get back on the front foot with respect to environmental issues and often end up having to invest significantly more in noise management than would have otherwise been the case.

Whilst it is possible to legislate for each airport operator to make appropriate investments and deal with the issues at a local level, experience in countries with multiple airports and complex route systems suggest that there is benefit from a consolidated approach, where the core systems are deployed and managed by a central service on behalf of all of the stakeholders, potentially taking advantage of international service expertise to accelerate access to the right skills and to underline the impartiality of the information and procedures.