

ANIMA



Aviation Noise Impact Management
through Novel Approaches



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PLEASE NOTE

This document relies on input from consortium partners and their collaborating organisations to prepare overviews of the noise policy implementation and airport practice across EU Member States.

The material received has been of varying quality and detail, in part reflecting national expertise and experience; however, we are mindful that despite review by all partners there may still be areas of incomplete/inaccurate data. Thus, we will through the course of ANIMA seek opportunities to clarify and update data on Member States and, as this report is confidential to the consortium, reserve the right to amend this document should significant omissions/inaccuracies be identified in the future.

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¹ Use one of the following codes: R=Document, report (excluding the periodic and final reports)

DEM=Demonstrator, pilot, prototype, plan designs

DEC=Websites, patents filing, press & media actions, videos, etc.

OTHER=Software, technical diagram, etc.

²Use one of the following codes: PU=Public, fully open, e.g. web

CO=Confidential, restricted under conditions set out in Model Grant Agreement

CI=Classified, information as referred to in Commission Decision 2001/844/EC.

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1 Executive Summary

This report presents the work carried out, and the outputs produced for Deliverable 2.1 of ANIMA, in which EU regulations, legal obligations and practical interventions in relation to aircraft noise have been reviewed, focusing on the extent to which policy and practice have enabled effective implementation of ICAO's Balanced Approach to noise impact mitigation. As described in the methodology, the task was led by MMU and contributed to by all WP2 partners.

In so doing, the report was driven by 2 primary approaches:

- A Pan-European Review of Existing Regulations and Mitigation Strategies, as driven by the use of data capture templates completed by WP partners and their networks. This review identified different approaches to noise impact mitigation in EU Member States and different patterns of implementation.
- Elite interviews conducted by an MMU researcher with aviation stakeholders who are impacted by, or who have the ability to influence the impacts of aviation noise. These interviews helped to understand how and why the patterns identified through the template forms have developed.

As well as internal validation by ANIMA members, further validation of the findings of this review will also be provided by the Impacts and Balanced Approach Expert Committee who will have the opportunity, throughout ANIMA, to validate project findings, and feed in additional expertise. The first opportunity for IBAEC feedback on ANIMA will be on the key findings of this report and presented in Deliverable 2.2.

The research found that whilst the transposition of the Environmental Noise Directive and EU Directive 2002/30/EC have gone a long way to ensuring that the ICAO Balanced Approach underpins aviation noise management and mitigation in the European Union, several challenges and priorities for future research remain. The main findings were:

- There is no one size fits all solution to aviation noise: each airport requires its own solutions based on its specific characteristics. In other words, Balanced Approach implementation needs to be tailored to the requirements of individual airports.
- Although there is a comprehensive noise policy framework at European level and associated policy at the national level, there remain gaps in implementation of noise mitigation measures.
- There are significant issues regarding land-use planning around airports, rooted in competing priorities for local-authorities and airport operators, and a lack of clear and robust legislation to protect airports from encroachment by incompatible land uses.
- There are many stakeholders who have the potential to mitigate aviation noise. Collaboration amongst all stakeholders (including airport communities) seems essential in mitigating noise exposure and impact effectively.
- There are multiple areas requiring further research that can inform best practice, not least regarding issues such as: quality of life of airport communities; the efficacy of different balanced approach interventions in



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reducing noise exposure and annoyance; how communities can be effectively engaged with on aviation noise; and, more detailed understanding the factors influencing expressed noise annoyance.

2 Background

The growth of the air transport industry and disturbance caused by environmental noise have always had a close relationship - the first complaint regarding aircraft noise was published just 8 years after the Wright brothers maiden flight³. Today, it is widely accepted that the most significant local environmental impact associated with the operation of an airport arises from aircraft noise. This is despite aircraft being 75% less noisy today than 30 years ago⁴ due to improvements in airframe and engine technology. However, the benefits of such developments have been offset by the growth of the air transport industry in terms of aircraft movements, poor land-use planning, and the encroachment of urban conurbations around airports. Public attitudes have also changed, with the consequence that people are becoming more sensitive to noise exposure, at least as conventionally measured. The result is that complaints regarding airport noise are on the rise in many EU Member States^{5,6}, with noise exposure, or active opposition to aircraft noise representing one of the major constraints to airport growth. To address the noise challenge, international policy, guidance and tools to assist airports in noise monitoring and management have grown in recent years.

2.1 Noise Policy

2.1.1 ICAO Balanced Approach

At a global level, regulatory responses to aircraft noise are influenced by the UN International Civil Aviation Organisation (ICAO). The basis of ICAO noise certification system is that new types of aircraft are required to comply with agreed limits known as 'Chapters' (which are periodically tightened) and that older, noisier types of aircraft have to be phased out of service over time. An important extension to this focus came when ICAO called for the adoption of the 'Balanced Approach' to noise management at the ICAO 33rd Assembly on Aircraft noise in 2001⁷.

Part of the rationale for the Balanced Approach was that the specific conditions of each airport are unique in terms of levels of traffic, the amount of night flying, proximity of the airport to built up areas, and attitudes of local residents to noise. The Balanced Approach provides ICAO contracting states⁸ with an internationally agreed approach to address aircraft noise problems at individual airports in an environmentally responsive and economically responsible way⁹. In so doing, it provides a flexible way to identify and transparently address specific noise problems. It comprises four principal elements:

1. Reduction of noise at source – by encouraging the use of quieter aircraft;
2. Land-use planning and management – to prevent noise sensitive developments close to airports and flight paths, and to mitigate noise impacts (i.e. through sound insulation);

³ E. Murphy, E. A. King: Environmental Noise Pollution: Noise Mapping, Public Health, and Policy, Elsevier, Amsterdam, 2014.

⁴ [Towards a Comprehensive Noise Strategy](#)

⁵ [Babisch et al., 2009](#)

⁶ [Brooker, 2009.](#)

⁷ <https://www.icao.int/environmental-protection/Pages/noise.aspx>

⁸ A member of the ICAO as being party to the 1944 Chicago Convention.

⁹ https://www.icao.int/environmental-protection/Documents/Publications/Guidance_BalancedApproach_Noise.pdf

3. Noise abatement via alternative operational procedures that separate aircraft from noise sensitive areas or reduce thrust settings and therefore the noise generated by aircraft; and,
4. Operating restrictions on aircraft at sensitive times (e.g. at night) or in terms of absolute numbers of movements.

The Guidance on the Balanced Approach to Aircraft Noise Management¹⁰ states that operating restrictions should only be applied as a last resort, after the other elements have been considered and applied where appropriate. This acknowledges the key role played by aviation in the global socio-economic system, and that reductions in noise can be achieved at a lower economic cost when a stronger focus is placed on the other Balanced Approach elements.

The ICAO Balanced Approach is transposed into European Law through EU Directive 2002/30/EC, later replaced by Regulation (EU) No 598/2014. The exact implementation of the four Balanced Approach elements is at the behest of the contracting states, that can also choose to delegate their powers to a competent authority to conduct noise assessments, develop noise action plans, or to perform a cost benefit analysis.

2.1.2 The EU Environmental Noise Directive

The first attempt at creating an EU-wide noise policy was the Green Paper on Future Noise Policy, adopted by the European Commission in 1996¹¹. The paper set the framework for Directive 2002/49/EC also known as the Environmental Noise Directive (END)¹². The aim of the END was to “define a common approach intended to avoid, prevent or reduce on a prioritised basis, the harmful effects, including annoyance, due to exposure to environmental noise”. In so doing, the END provides a basis for developing measures to reduce noise emitted by the major sources of noise, including aircraft.

The END has two main aims. Firstly, to define a common approach to avoiding, preventing or reducing the harmful effects of noise exposure. To this end, Member States must:

- Carry out noise mapping to determine populations exposed to environmental noise.
- Make sure that information on environmental noise and its effects are made available to the public.
- Adopt action plans, based on the results of noise mapping, with a view to:
 - preventing and reducing environmental noise, particularly where noise levels can have harmful effects on human health; and
 - maintaining the level of environmental noise where it is good.

Secondly, END requires that Member States provide a basis for developing measures to reduce noise from major sources, particularly road and rail vehicles and networks, aircraft, outdoor equipment, industry, and mobile machinery. The

¹⁰ ICAO (2008) Guidance on the Balanced Approach to Aircraft Noise Management, Doc 9829. AN/451. <https://store.icao.int/index.php/guidance-on-the-balanced-approach-to-aircraft-noise-management-2nd-edition-2008-doc-9829-english-printed.html>

¹¹ E.A. King, E. Murphy, Environmental noise – ‘Forgotten’ or ‘Ignored’ pollutant?, Applied Acoustics, Volume 112, 2016, Pages 211-215.

¹² [The Environmental Noise Directive](#)

END requires that a series of actions are implemented by EU Member States every five years. These actions are⁴:

- Monitoring environmental noise – Member States must develop strategic noise maps in order to estimate the level of population and/or building exposure to environmental noise in priority areas in their jurisdictions;
- Managing environmental noise issues – on the basis of the developed strategic noise maps, Member States must adopt action plans containing measures designed to address noise issues, including noise prevention/reduction and preserving sound quality where it is deemed to be good;
- Public information and consultation – strategic noise maps, action plans and relevant information about noise exposure, its effects and measures considered to address environmental noise issues should be made available to the public and developed in consultation with the public.

The Directive reflects the need to limit the disturbance produced by noise (and its associated health impacts), but in a way that allows the aviation industry to grow. However, due to the diverse range of nations in the EU, and their distinct characteristics (i.e. population, GDP, dominant industries), the legislation empowers nations to determine the specific ways in which the END will be adhered to. The result is a significant variation in approaches to noise monitoring and mitigation across the EU.

2.2 Noise Modelling Tools and Methodologies

Sound level measurement and modelling is key to being able to define thresholds and criteria for decision-making and mitigating action. Because of the considerable variation in individual sensitivity and response, objectively quantifiable sound levels are the only reliable means of avoiding litigation based on allegations of unfair and/or inequitable treatment for residents of different areas around airports. However, the use of objectively quantifiable sound levels in criteria has also contributed to considerable technical debate over many years, as people disagree about the precise metrics to be used, and which specific variables should be taken into account. This is one of the main reasons for on-going research, to resolve outstanding technical issues with the use of different metrics for different purposes.

Actual measurement is the gold standard for determining objective sound levels on the ground, but there are two problems with this:

- there are many variables which affect the generation of sound at the aircraft source and the propagation of that sound from the aircraft source down to the receiver on or near the ground. This means that even exactly the same aircraft flying exactly the same procedures over exactly the same measurement point on or near the ground is likely to generate sound levels varying by plus or minus 5 dB or more;
- people do not remain in fixed points on the ground, such as could be suitable for defining standardised measurement positions. Not only do they move around both inside and outside their houses, but they also go out, to work, shopping, and for leisure purposes. Many residents are not even at home during peak periods for aircraft flyover noise but may nevertheless object strongly to the noise. For practical purposes, there

are essentially far too many places where measurements could be taken and far too much variation for measurements to be useful in setting criteria.

This means that computer modelling has effectively taken over from objective measurements for quantifying aircraft noise sound levels on the ground. Computer models are now available (see below) which have been developed to a high degree of sophistication, but they should nevertheless be recognised as one step removed from actual measurement, which would be the gold standard if it were otherwise feasible and practical. Computer models essentially calculate long time averaged sound levels according to defined procedures, and although various claims are made as to absolute accuracy in justification for the use of one model over another, since they calculate arbitrarily defined long time average sound levels which do not actually reflect airport resident's experience, absolute accuracy is actually less important than that the model can be shown to take into account all input variables considered relevant to the use to which the model outputs are actually put. This is a point which is not always particularly well understood.

Noise modelling is essential for airports to assess noise exposure, to understand the impact of their noise abatement interventions, and importantly to communicate with noise affected communities. Such dissemination typically takes the form of noise maps. The END defines such mapping as 'a map designed for the global assessment of noise exposure in a given area due to different noise sources for overall predictions for such an area'. Thus, strategic noise mapping is concerned with the practicalities of the noise mapping exercise as well as the assessment of exposure. Estimates of the population exposed to different noise levels may then be determined from the results of these strategic noise maps.

Computer noise modelling is used extensively to determine the level of noise exposure, design of mitigation measures, number of people exposed to noise, and those qualifying for noise insulation and/or compensation. Such software uses calculation methodologies set out in national, or international, standards or guidelines, such as the EC Directive 2015/996¹³. In essence these models combine data on aircraft sound generation (aircraft type, configuration and phase of flight), location in time and space (using flight track data), schedules (forecast air traffic movements by aircraft type and destination) and sound propagation. The latter is affected by many factors including the frequency of the sound (lower frequencies travel further), topography, the shape and size of barriers, the ground surface (concrete reflects sound while grassland absorbs it) and the weather. Quantification of aviation noise impact at ground-level therefore requires the analysis of thousands of potential scenarios, thus requiring tools and methodologies that are able to rapidly analyse noise exposure and the effects of noise-abatement procedures or different technology options¹⁴. Today, noise models are robust enough that noise calculations can be completed with minimal uncertainty; although outputs do vary depending on the levels of granularity in the model. However, such accuracy comes at the cost of significant

¹³ COMMISSION DIRECTIVE 2015/996 establishing common noise assessment methods according to Directive 2002/49/EC of the European Parliament and of the Council - Official Journal of the European Communities, (2015).

¹⁴ Antonio J. Torija, Rod H. Self, Aircraft classification for efficient modelling of environmental noise impact of aviation, *Journal of Air Transport Management*, Volume 67, 2018, Pages 157-168.

computational time and complexity and so are not always of practical use when it comes to airport decision-making - particularly for smaller airports with limited resources. As such, a number of simplified models for noise calculations have been developed that are able to quickly determine noise impacts, but with less accuracy than higher fidelity systems, or with other limitations, for instance only being able to consider certain variables. For instance, rather than considering specific aircraft types, simplified models may group aircraft into broadly similar categories. A common method for displaying the calculated aggregated output from noise models has been the use of 'average noise contours' to describe noise exposure at airports. The contours derive from the aggregation of the 'noise profiles' of individual aircraft types (the sound pressure at ground level and at a given distance from the airport) and the flight path of each aircraft, tracked using radar. Work has been on-going to ensure common modelling methods are used across the EU.

In the EU, the ANP database (v2.2) is maintained by EUROCONTROL and is publicly available¹⁵. This online database provides the necessary data (noise and performance characteristics of specific aircraft types) to compute noise contours around airports. Recommended best practices for aircraft noise modelling is also found in ICAO Doc 9911 Recommended Methods for Computing Noise Contours Around Airports¹⁶ and European Civil Aviation Conference (ECAC) Doc 29 Report on Standard Method of Computing Noise Contours Around Civil Airports, 3rd Edition¹⁷. Within the context of the SESAR Research and Innovation programme, EUROCONTROL has developed IMPACT, an integrated aircraft noise and emissions modelling platform that supports both aircraft noise and fuel burn/emissions assessments¹⁸.

In the United States the Aviation Environmental Design Tool (AEDT)¹⁹ is used to model aircraft performance in space and time to estimate fuel consumption, emissions, noise, and air quality consequences. Such computations can take place on a range of levels, from a single flight at an airport to scenarios at the regional, national, and global levels.

In Australia, The Department of Infrastructure, Regional Development and Cities developed the Aircraft Noise Disclosure and Carbon Footprinting Software²⁰ to enable aircraft noise exposure information to be rapidly produced for individual airports and for computing carbon emissions from aircraft operations.

2.3 Noise Monitoring and Measurement

Noise monitoring and measurements are an important aspect of airport noise management as they can validate the output from noise models and also demonstrate the consequences of specific noise management interventions by measuring change at strategic locations, thus informing on management responses to noise. Noise monitoring can also be used to underpin 'noise penalty

¹⁵ The Aircraft Noise and Performance Database <https://www.aircraftnoisemodel.org/>

¹⁶ <https://atm.airport.ir/documents/799481/2248457/DOC+9911+Recommended+Method+for+Computing+Noise+Contours+Around+Airports.pdf/18c0efad-9695-4dd6-a7f9-dffc3bad24cd?version=1.0>

¹⁷ <https://www.ecac-ceac.org/ecac-doc-29>

¹⁸ <https://www.eurocontrol.int/sites/default/files/service/files/2014-IMPACT-factsheet.pdf>

¹⁹ <https://aedt.faa.gov/>

²⁰ https://infrastructure.gov.au/aviation/environmental/transparent_noise/tnip.aspx

schemes' that are used by some airports to encourage airlines to operate quieter aircraft and to encourage pilots to fly their aircraft more quietly.

Many airports implement both fixed and mobile monitoring systems. Fixed systems tend to be located at internationally agreed positions along flight paths (and are used for penalty enforcement) or at locally agreed sensitive sites (e.g. on the edge of a community or sensitive building such as a school or town hall). Mobile monitoring systems are sited either in response to local complaints (e.g. to assess the noise climate at a particular location), or to test out the effectiveness of new operational procedures.

2.4 Noise management, mitigation and compensation measures

Noise management is action taken to reduce noise at source or to maximise the horizontal or vertical distance between the noise source and the receiver. Noise mitigation is action taken (for example sound insulation) to minimise the transmission of noise from the source to the receiver. Noise compensation is action taken to compensate people in situations where noise management and mitigation have failed to alleviate the impact sufficiently.

Monitoring of noise is also important because Member States are required to develop noise action plans, defined by the END as 'plans designed to manage noise issues and effects, including noise reduction if necessary'. Moreover, the action plans developed by each Member State have ensured that each Member State is able to communicate how it intends to mitigate such exposure. As such, these action plans can be seen as helping to focus airports, competent authorities and Member States on the issue of noise and to make first steps towards noise management.

In terms of airport operations there are a wide variety of Noise Abatement Procedures that can be used, most of which require collaboration between the airport operator, airlines and air traffic management service providers (ATCs). According to 2009 data, 490 airports worldwide have adopted noise abatement procedures, but most of them are not optimized for local conditions²¹. In particular, they are often designed to deliver noise reduction objectives, rather than reducing the noise impact on the affected population²².

In essence comprehensive noise management requires the systematic application of BA options informed by effective noise monitoring and modelling. Modelling and monitoring establish current noise exposure, how this might be affected by a BA intervention and validate outcomes in terms of noise changes on the ground once a measure has been implemented. The range of such measure include²³:

- Sound source reduction – this is achieved through technology improvements by aircraft manufacturers but influenced by the demands of airports/airlines through for example the criteria for the application of operating restrictions, landing charges, mandatory phase-out, and noise

²¹ Netjasof, F., 2012. Contemporary measures of noise reduction in airport surroundings. *Appl. Acoust.* 73, 1076e1085.

²² Erkelens, L.J.J., 2000. In: *Research into New Noise Abatement Procedures for the 21st Century*. AIAA Guidance, Navigation and Control Conference. AIAA, Reston. VA

²³ R. Girvin, Aircraft noise-abatement and mitigation strategies, *Journal of Air Transport Management*, Volume 15, Issue 1, 2009, Pages 14-22.

quotas/budgets. Technological improvements and the application of infrastructure to screen noise also have a significant role to play here.

- Land-use planning – forecast changes in future noise exposure as a result of growth in air traffic can be used to zone areas to restrict the encroachment of airports by incompatible land-uses. Such noise exposure assessments can also form the basis of qualification for any sound insulation, noise compensation or relocations schemes.
- Operational improvements – reduce noise exposure via the implementation of different operating procedures, such as preferential runways, the use of performance-based navigation to ensure that populated areas are not overflowed, or continuous descent approaches.
- Operating Restrictions - achieved by actively restricting different types of aircraft with the aim of reducing noise exposure, for instance via the mandatory phase-out of noisier aircraft, curfews, and noise taxes or charges. Per-aircraft noise limits (through certification standards and movement limits) and cumulative noise limits (through noise quotas or budgets) can constrain airline activities in such a way that they may be encouraged to invest in quieter fleets.

In a 2015 review by Airport Regions Conference²⁴ it was found that the 'must have' mitigation procedures strongly implemented in almost every airport studied were:

- Noise monitoring – as considered in previous section.
- Flight operations, such as continuous descent operations.
- Passive protection, such as noise insulation.
- Ground noise related measures, such as auxiliary power units.
- Noise related fines – for noisy aircraft that exceed stated limits.

Mitigation and management tools such as land use planning and building restrictions, noise charges, stakeholder mediation, operating restrictions (air traffic restrictions) and caps were much less well represented in terms of airport implementation.

The report also found that developing trust amongst noise stakeholders was an essential characteristic of good noise management, with dissemination of noise data, and engagement through tools such as dialogue forums being important.

²⁴ Airport Regions Conference, Noise Policies in Airport Regions.

3 Methodology

This report summarises and analyses the way in which noise regulations, noise assessment and noise management systems have been implemented across European nations and airports. The assessment relies on qualitative research and a stratified critical analysis to identify current practice regarding airport noise policy and practical interventions in different parts of the European Union. By analysing data from across Member States, it is possible to identify patterns and trends to approaches of noise policy and management, and to understand why such categorizations have occurred. Data collection was driven through two approaches:

- **Data Capture Templates** were used to collect information on each EU Member State regarding the implementation of EU regulations and practical interventions in relation to aircraft noise. Captured data enabled a critical assessment of national implementation of EU noise policies, any associated national legislation, guidance and research initiatives designed to support implementation. The templates also provided an opportunity to capture data pertaining to best practice airports in each Member State. Templates were primarily completed collaboratively by Work Package partners and their networks, for instance by Member State aviation authorities. Where no template return was received and/or the return was incomplete, desk research drawing on published sources was used to supplement for data gaps wherever possible.
- **Structured Interviews** with 17 representatives of air transport stakeholders (target group of 20 representatives was reduced to 17 as a result of ability/willingness to contribute within fixed timeframes). These elite interviewees included end users (airport operators), airlines, air navigation service providers, local authorities, local communities and aviation industry bodies. Interviews were designed to provide insight into the different perspectives on noise impact mitigation and the effectiveness of current interventions as applied by industry stakeholders. The additional context provided through interviews helped in the interpretation of the range of policy implementation and practice identified from the data templates.

The aim of the review is to understand EU regulations, legal obligations and practical interventions in relation to aircraft noise. As such, the primary focus of the review is on European Member States, however efforts were made to collect information pertaining to other nations in the proximity to the European Union and reference to them is provided in Sections 4.6 and 6.1.8.

4 Review of Member State Approaches to Noise

This section summarises the data received through the described methodology in Section 3, highlighting the differences in policies and management approaches to noise between Member States. First, compliance with the EU Environmental Noise Directive is presented, followed by a review of policies and guidance to support Member State compliance with Regulation (EU) No 598/2014 – requiring adoption of the ICAO Balance Approach. Guidance documents produced by Member States to support effective noise management responses to legislative requirements by airports and other actors are also summarised, together with a review of any national research programmes. Finally, current practice at a sample of exemplar airports from each Member State are presented. A broader review of the research findings and their implication for effective noise mitigation and management is presented in more detail, and in parallel with the findings of the Elite Stakeholder Interviews, in Section 6.

4.1 The Environmental Noise Directive

Compliance with the END by each Member State was assessed by identifying how the Directive was transposed into national legislation, the organisation responsible for compliance, how many airports qualified for inclusion²⁵, and what national noise limits exist in each Member State. The findings are summarised in Table 1. The END has been successfully transposed into national legislation across all European Member States. This transposition can be considered largely successful in that only a small minority of airports that qualified for inclusion under the Directive in the last round had failed to produce noise maps or action plans. Indeed, several airports completed these requirements despite having fewer than 50,000 air traffic movements.

Whilst all Member States had effectively transposed END into national legislation, there are significant differences between implementation approaches - as might be expected considering that END is designed to be implemented to suit the specific needs of each Member State. The Competent Authorities responsible for the development of Strategic Noise Map(s), Noise Action Plans (or both), differs greatly, with no clear patterns identified in terms of, geographic region or national economic characteristics. Responsibility generally lies at the governmental agency level (i.e. Environmental Protection Agencies or Ministries for Transport/Travel).

The majority of Member States have set noise limit values, despite this not being a requirement of the END. Such values are used in applying fines, defining noise contours, and the selection of appropriate noise abatement interventions; such as sound insulation. It was impossible to establish from the template returns whether these noise limits had been effectively enforced. The approach to noise limits essentially sees Member States split into two categories. 11 Member States analysed set noise limits according to the period of the day typically L_{den} and L_{night} . 12 of the Member States analysed set noise limits according to types of land use around the airport, with different land use types having different noise limits, for instance for noise sensitive developments. For the remaining airports, no expressed noise limits could be identified. All countries use L_{den} and L_{night}

²⁵ Over 50,000 air traffic movements per year.

indicators in order to prepare noise maps under END, however not all Member States do so with the same reference period of time, each choosing their own preferences as to what constitutes morning, evening and night hours. Night hours typically range from 2200 or 2300 to 0600 or 0700 hours. For example, in Lithuania noise limit values of L_{day} 65dB(A), L_{eve} 60 dB(A), and L_{night} 55 dB(A) have been set for different times of the day at a national level. These are 0600-1800 (day), 1800-2200 (evening) and 2200-0600 (night). Heathrow and Gatwick have a night period from 2300-0700, within this period there is an operational ban on the noisiest aircraft types. There is also a night quota period from 2330-0600, within this period there are movement and night quota limits. Frankfurt Airport, has a total ban on scheduled aircraft movements between 2300 and 0500 hours, and during the morning and evening periods (2200-2300 and 0500-0600) a limited number of flights are allowed, providing they comply with ICAO Chapter 4 noise regulations.

The data presented in Table 1 was supplemented by an evaluation of END implementation by Member states completed by the European Commission²⁶. Further detailed analysis of the END (in the context of all noise sources) can be found in the latter Report.

²⁶http://ec.europa.eu/environment/noise/pdf/country_fiches_study_evaluation_directive_environmental_noise.pdf

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Table 1: Summary of END compliance in European Member States²⁷

	# Qualifying Airports (Round 1, Round2).	Competent Authority ²⁸	Airports with noise maps (Round 1, Round 2) ²⁹	Airports with Action Plans (Round 1, Round 2)	Defined Noise Limits and Noise Indicators Used ³⁰
Austria	1,6	BMVIT (Austrian Ministry for Transport, Innovation and Technology)	1,1	1,6	65 Lden 55 Lnight (Protection against air traffic noise is not regulated to date).
Belgium	1,1	Shared responsibilities between City Authorities, Roads and Traffic Agency, Environment, Nature and Energy Department for each region	2,2	2,2	3 zones for day and night. Lday (65,60,55) Lnight (55,50,45) Enforcement differs by region. Includes noise charges and land-use planning mitigation measures.
Bulgaria	0,0	Shared responsibility with different aspects shared between Minister of Transport Ministry Environment and Water, Ministry of Regional Development and Public Works, Ministry of Health.	0,0	0,0	Land-use dependent. Limits determine when noise mitigation measures are implemented.
Croatia	0,0	Croatian Civil Aviation Agency.	0,0	0,0	Land-use dependent. The purpose of setting noise limit values is to avoid noise nuisance and protect human health and well-being.
Czech Republic³¹	1,1	SNM prepared by Institute of Public Health Ostrava (ZUOVA). Action plans prepared by the Ministry of Transport.	2,2	1,1	Day dB(A) 60 Night dB (A) 50 Limit values for noise indicators (trigger limits) are set for the purpose of preparing NAPs for noise protection. Based on the limit values, problematic areas are identified along with proposed measures for reducing the noise load from individual sources.

²⁷ This table is heavily supplemented by a European Commission evaluation of 2002/49/EC found at http://ec.europa.eu/environment/noise/pdf/country_fiches_study_evaluation_directive_environmental_noise.pdf

²⁸ The organisation nominated as being responsible either for the development of Strategic Noise Map(s), Noise Action Plans or both.

²⁹ Countries must submit noise maps and action plans under END every five year. The first round took place in 2007, and the second in 2012.

³⁰ Although there are no common EU-wide Limit Values in the Directive itself, most but not all MS have put in place mandatory noise limits at national level, whose exceedance generally leads to sanctions, or whose potential exceedance blocks the operation of installations (such as new roads, railways, or industry).

³¹ Data obtained via desk research, no template received.

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	# Qualifying Airports (Round 1, Round2).	Competent Authority ²⁸	Airports with noise maps (Round 1, Round 2) ²⁹	Airports with Action Plans (Round 1, Round 2)	Defined Noise Limits and Noise Indicators Used ³⁰	
Cyprus	0,0	Ministry of Agriculture, Rural Development and Environment.	0,2	0,2	No limits set	
Denmark	3,3	Environmental Protection Agency (Copenhagen airport) and Municipalities.	3,3	3,3	Land-use dependent	
Estonia	0,0	No qualifying airports	0,0	0,0	Land-use dependent. The Health Protection Inspectorate also has the right to impose sanctions in case of violation of limit levels either on the grounds of violating the Ambient Air Protection Act or the Public Health Act.	
Finland	2,3	Data collected by The Centres for Economic Development, Transport and the Environment. SNMS completed by the Finish Transport Agency. NAPs prepared by Finnish Transport Safety Agency.	2,3	2,3	Residential areas, industrial areas; Lden 55 Lnight 50 Holiday settlements, campsites conservation areas; Lden 45 Lnight 40 Finland does not legally enforce noise limit values. Instead there is a Government Decision on General Guideline Values for Noise Levels (993/1992) which was enacted under the Noise Abatement Act (382/1987).	
France	9,8	'Infrastructure managers' i.e. airport authorities.	9,8	9,9	Day dB (A) 55 No specific enforcement system is foreseen if the above limit values are exceeded	
Germany	8,22* numbers include NAPs produced for districts bordering airports, EEA data for 11 airports in R2	Federal States	8,22	3,22	Lday (6am-10pm) Zone 1: 65dB(A) (60 dB(A) for new/extended airports) no (new) housing and facility (e.g. hospital) construction allowed (with exception), owners get compensation Zone 2:	Lnight (10pm-6am) 55 dB(A) (50 dB(A) for new/extended airports) 6 x 57dB (53dB) LAmax no (new) home construction allowed (with exception), owners get sound insulation refunded.

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	# Qualifying Airports (Round 1, Round2).	Competent Authority ²⁸	Airports with noise maps (Round 1, Round 2) ²⁹	Airports with Action Plans (Round 1, Round 2)	Defined Noise Limits and Noise Indicators Used ³⁰
					60dB(A) (55 dB(A) for new/extended airports) restricted construction and use of buildings (sound insulation required).
Greece	1,1	Noise, Vibration & Radiation Department at the Ministry of Environment & Energy.	1,1	1,1	Land-use dependent. When noise limit values are exceeded there are applied measures for noise reduction for a period of 10 years.
Hungary	1,1	Responsibility split between Airport Administration, the Ministry of Transport, the Ministry of Agriculture.	1,1	1,1	63 Lden 55 Lnight The Governmental Decree 280/2004 (X.20) specifies that when noise limit values are exceeded there are applied measures for noise reduction for a period of 10 years
Ireland	1,1	Mapping = Dublin Airport Authority and Fingal County Council. Noise Action plans = Dublin local authorities	1,1	1,1	Day; Preferred < 55 Lday Maximum 70 Lday Night; Preferred < 50 Lnight Maximum 55 Lnight
Italy	9,10	Airport Operators	9,10	9,18	Land-use dependent. Noise levels represent trigger values at which different mitigation measures are implemented.
Latvia	0,0	Ministry of Transport and State Joint Stock Company Riga International Airport of the Republic of Latvia	0,1	0,1	Land-use dependent
Lithuania	0,0	Civil Aviation Administration	0,0	00	65 Lden 65 Lday 60 Levening 55 Lnight Law on Noise Management states, that noise source holders must comply with the noise limit values and ensure that the emitted noise does not exceed the noise limit values set to certain areas.

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	# Qualifying Airports (Round 1, Round2).	Competent Authority ²⁸	Airports with noise maps (Round 1, Round 2) ²⁹	Airports with Action Plans (Round 1, Round 2)	Defined Noise Limits and Noise Indicators Used ³⁰
Malta	0,0	Various	0,0	0,0	No national noise limits.
Netherlands	1,1	Ministry of Infrastructure and Environment	1,1	1,1	No national noise limits.
Poland	1,1	State Enterprise "Airports" Warsaw	1,1	0,0	Land-use dependent
Portugal	1,2	ANA - Portuguese Airport Authority.	1,2	1,1	65 Lden 55 Lnight Values represent triggers at which noise-based charges are implemented.
Romania	1,1	Ministry of Environment	6 (The obligation is not limited to airports with > 50k movements. Airports are nominated in END implementing law.)	16 (The obligation is not limited to airports with > 50k movements. Airports are nominated in END implementing law.)	Day Limit = 65 Lden-dB(A) Target = 70 Lden-dB(A) Night Limit = 65 Lnight-dB(A) Target = 60 Lnight-dB(A)
Slovakia	0,0	Public Health Authority of the Slovak Republic.	0,0	0,0	Land-use dependent. The exceedance of limits set out in the table is not sanctioned.
Slovenia	0,0	Ministry of the Environment and Spatial Planning	0,0	0,0	Land-use dependent Limits for zone III and small airport. Lden = 58 dBA Lday = 58 dBA Levening = 53 dBA Lnight = 48 dBA Noise limits are the basis for the identification of noise abatement measures on a prioritised basis through NAPs
Spain	10,12	Ministry of Development	10,12	0,0	Land-use dependent
Sweden	2,3	The competent authority for the Regulation 598/2014 concerning Operating Restrictions is the Swedish Transport Agency.	2,3	3,3	Land-use dependent. Sweden does not set limit values for noise but applies indicative noise values that are set out in Government Bill 1996/97:53 Infrastructure Objectives for Future Transport. there is a specific environmental court (Miljödomstolen),

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	# Qualifying Airports (Round 1, Round2).	Competent Authority ²⁸	Airports with noise maps (Round 1, Round 2) ²⁹	Airports with Action Plans (Round 1, Round 2)	Defined Noise Limits and Noise Indicators Used ³⁰
					which sets out the conditions that airport owners must adhere to.
United Kingdom	19,14	Airport operators in general, however the Secretary of state is responsible for approving noise mapping and action plans at 3 designated London airports.	20,14	19,14	No formal limits.

4.2 ICAO Balanced Approach: Relevant Policy Instruments

This section summarises compliance with Regulation (EU) No 598/2014, requiring adoption of the ICAO Balanced Approach by each Member State in terms of the national policy instruments. The section is categorised according to each of the four Balanced Approach elements; Control of Noise at Source, Land Use Planning and Management Noise Abatement Operational Procedures, and Operating Restrictions. The findings are summarised in Table 2 and Table 3³². Data collected suggests that policy instruments to support Balanced Approach implementation is lacking in many nations, particularly compared to the Environmental Noise Directive. It should be noted that although national legislation may not exist, airports may impose local controls to manage noise, based on the specific characteristics of the challenges they face.

Table 2: Summary of Balanced Approach policy (At Source and Operating Procedures) in European Member States.

	At Source	Operating Procedures
Austria	No policy instruments listed.	No policy instruments listed.
Belgium	No policy instruments listed.	No policy instruments listed.
Bulgaria	No policy instruments listed.	No policy instruments listed.
Croatia	No policy instruments listed.	No policy instruments listed.
Czech Republic	Template not received.	Template not received.
Cyprus	Chapter restrictions.	No policy instruments listed.
Denmark	CAA has the ability to apply fines, for instance when flight tracks are not adhered to.	Considered in the environmental approval for airports.
Estonia	No policy instruments listed.	No policy instruments listed.
Finland	No policy instruments listed.	No policy instruments listed.
France	Noise based operational charges.	Fines for non-compliance with publish procedures.
Germany	Legal obligation to continuously measure the actual aircraft noise situation in the vicinity of commercial airports. Noise based charges.	No policy instruments listed.
Greece	No policy instruments listed.	No policy instruments listed.
Hungary	Chapter restrictions. Noise based charges.	No policy instruments listed.
Ireland	Chapter restrictions.	No policy instruments listed.
Italy	Regional tax on aviation noise for civil aircrafts.	No policy instruments listed.
Latvia	Chapter restrictions.	Some basic procedures listed at legislative level under AIP Latvia EVRA AD2.21.
Lithuania	Chapter restrictions. Regulation on aircraft noise abatement of the Republic of Lithuania.	Legislation on the noise abatement for the sub-sonic aircraft the Regulation on the noise abatement for the aircraft.
Malta	No policy instruments listed.	No policy instruments listed.

³² Data presented in two tables purely for formatting reasons.

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	At Source	Operating Procedures
Netherlands	No national policy instruments listed.	No national policy instruments listed.
Poland	Chapter restrictions. Noise limits. Noise charges.	No policy instruments listed.
Portugal	Chapter restrictions.	No policy instruments listed.
Romania	No policy instruments listed.	No policy instruments listed.
Slovakia	Chapter restrictions.	No policy instruments listed.
Slovenia	Rules on noise emission of aircraft.	Airport does not have direct influence on noise abatement procedures conducted by Air Traffic Control (ATC); by airport opinion noise abatement (flight) procedures should be implemented only when all stakeholders agree on it.
Spain	Chapter restrictions, Noise taxes and quota penalties.	Most Spanish airports have noise abatement procedures published in AIP. Most of these procedures was considered and assessed during Environmental Impact Assessment procedures of each airport. Only two of them have specific regulations about it, Madrid and Barcelona.
Sweden	Noise charges are implemented, where noisier aircraft at more noise sensitive airports have higher charges.	Noise Abatement Procedures and runway/route use are designed on an airport-per-airport basis. The main Swedish Air Navigation Service Provider often contribute.
United Kingdom	Noise certificate regulations. Powers to introduce noise control measures to limit or mitigate the effect of noise and vibration connected with take-off or landing aircraft. Financial penalties on aircraft operators who breach noise abatement requirements.	A range of noise controls relating directly to aircraft operations are set out in statutory notices and are published in the UK Aeronautical Information Package (UK AIP) and elsewhere as appropriate. These controls cover aspects such as Continuous Descent Approaches (CDAs), noise abatement procedures and night flight restrictions.

Table 3: Summary of Balanced Approach policy (Land-Use Planning and Restrictions) in European Member States.

	LUP	Restrictions
Austria	Some regulations in place.	No policy instruments listed.
Belgium	Flanders Spatial Structure Plan (RSV) also determines the demarcation of urban areas.	Chapter restrictions.
Bulgaria	No policy instruments listed.	Chapter restrictions.
Croatia	No policy instruments listed.	No policy instruments listed.
Czech Republic	Template not received.	Template not received.
Cyprus	Some restrictions of certain types of developments. Requirement for Environmental Impact Assessments.	No policy instruments listed.
Denmark	Most airports have a land use plan putting up restrictions for development of areas around the airports.	No policy instruments listed.

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LUP		Restrictions
Estonia	Hierarchical planning system. National Plan -> County Comprehensive Plans -> Detailed Local Plans. Environmental Impact Assessments required for developments. Airport master plans state noise should be taken into consideration by integrating noise contours into detailed plans adopted by local Government.	No policy instruments listed.
Finland	No policy instruments listed.	No policy instruments listed.
France	Noise Exposure Plan, revised every 5 years, to control urbanization around airports. Noise Annoyance Plan, which delineates the zones in which inhabitants may be eligible for home sound-proofing grants. Environmental code (articles R 571-85 to R 571-88) gives the possibility for households' owners to require the purchase of their real estate by airports.	Chapter restrictions.
Germany	No policy instruments listed.	No policy instruments listed.
Greece	For projects with high environmental annoyance factor, a physical planning licence and an Environmental Impact Assessment study are required.	No policy instruments listed.
Hungary	No standards regarding building licences, obligatory building examinations and sanctions for real estate owners when not complying with legal regulations.	Chapter restrictions.
Ireland	Fingal County Council County Development Plan includes Inner and outer noise zones for Dublin Airport designed to protect against inappropriate development within the zones. Home insulation policy.	No policy instruments listed.
Italy	Designation of noise protection areas around the airports based on noise zoning. Compulsory exterior acoustic insulation of residential buildings exposed to noise pollution exceeding strategic thresholds.	Technical Committee has the duty of defining and designing guidelines for the adoption of restrictions.
Latvia	Latvian Construction Standard LBN 016-11 "Building Acoustics" prescribes the main requirements for acoustic parameters of building premises and roofed-in open-air stages.	Regulation No. 1041 adopted 27 December 2005 "Regulations Regarding Restrictions on the Operation of Aircraft at Aerodromes in Conformity with the Requirements of Environmental Protection".
Lithuania	A specific Technical Committee exists to coordinate the planning and development policies for airports of Regional Interest. There are three noise threshold zones with associated noise limits. Sanitary Protection Zone (SPZ) around certain activities that can pollute the human environment is established by Part 1 of Article 24 of the Law on Public Health of the Republic of Lithuania. The Law on Aviation of the Republic of Lithuania also establishes that the SPZ should be established for airports.	No policy instruments listed.
Malta	No policy instruments listed	No policy instruments listed.

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	LUP	Restrictions
Netherlands	No national policy instruments listed.	No national policy instruments listed.
Poland	Noise zoning led insulation programme and restrictions of noise sensitive buildings.	Aviation Laws Art. 75.122 and 119.1. minister competent for transport in consultation with the minister responsible for the environment may, in the direction of the regulation, introduce restrictions or prohibitions on flights for aircraft failing to meet the environmental protection requirements
Portugal	There is a technical note on noise for developers.	Chapter restrictions. The Noise General Regulation prohibits, the arrival and the departure of civil aircraft between 0 and 6 am.
Romania	LUP regulation are general and do not address noise exposure. Ministry of Transport (CA) is responsible for LUP. Are some vague recommendation	RACR-PM (regarding environmental protection; methods for noise reduction, means of compliance, penalties - mainly, operational restrictions). Chapter restrictions.
Slovakia	No policy instruments listed	No policy instruments listed.
Slovenia	National legislation for spatial planning We take into consideration noise limits for different areas regarding the land use (industrial, residential/retail/manufacturing, mainly residential and nature/quiet areas)	No policy instruments listed.
Spain	Law 37/2003 introduced the possibility of establishing easements in the land sectors affected by the functioning or development of transport infrastructure. Noise Act defines the areas of acoustic easement and where restrictions can be established for certain use of land.	Resolutions introducing operating restrictions to Madrid and Barcelona.
Sweden	"Areas of National Interest" around major airports including noise zones. These areas form a basis for the municipalities land use planning	No policy instruments listed.
United Kingdom	National regulation through National Planning Policy Framework – but no policy to protect airports from encroachment or to constrain development. Planners and developers are alerted to the existence of the END, and NAPs. In line with the National Planning Policy Framework (2012), policies and decisions should aim to avoid a situation where noise gives rise to significant adverse impacts on health and quality of life as a result of new development.	Chapter restrictions.

4.3 Guidance

As shown in Table 4, the majority of templates received listed limited or no guidance documents to support implementation of the Balanced Approach at airports. The stand out Member state was the United Kingdom that has a range of guidance available through a variety of sources, from Governmental White Papers, to aviation noise road maps, and a total of 87 documents about noise published by the national Civil Aviation Authority. A number of guidance documents were also identified for France. Several respondents stated that guidance was available for the Environmental Noise Directive – particularly in the production of noise mapping.

Table 4: Summary of guidance documents identified in each Member State

Member State	Guidance Identified
Austria	Legal guidelines on public engagement.
Belgium	None identified.
Bulgaria	Participation in the ICAO Action Plan Buddy Programme.
Croatia	None identified.
Czech Republic	Template not received
Cyprus	Noise mapping guidance.
Denmark	None identified.
Estonia	Noise mapping and action planning guidance.
Finland	None identified.
France	Multiple guidance documents on Land-Use planning, operating procedures, and restrictions
Germany	Noise mapping guidance.
Greece	Noise mapping guidance.
Hungary	Noise mapping guidance.
Ireland	There are detailed guidelines for the noise mapping and planning process. No specific guidance on ICAO Balanced approach.
Italy	None identified.
Latvia	Noise mapping and action planning guidance.
Lithuania	None identified.
Malta	Noise mapping and action planning guidance.
Netherlands	No national guidance identified.
Poland	None identified.
Portugal	Multiple guidance documents - mostly related to noise mapping and action planning.
Romania	Guide for safety requirements when pursuing noise reductions. EPA provided with an Internal Guide on reporting data for noise action plans.
Slovakia	None identified.
Slovenia	None identified.
Spain	None identified.
Sweden	Guidance on the END compliance. Noise monitoring guidance and for small airports.
United Kingdom	Various guidance from a range of sources including Governmental White Papers, guidance for noise action planning and mapping, master planning guidance and guidance from the CAA.

4.4 National Research Programmes

As shown in Table 5, the majority of Member States do not have national research programmes focussed on aviation noise. The primary exceptions were France, Germany, Sweden and the United Kingdom, all of whom listed significant contributions to national research programmes in their template returns. Some Member States are taking part in international research programmes at an EU level, whilst some academic publications related to noise were also identified. Some of the more prominent research programmes or studies are described below:

CORAC (France)

CORAC³³ is the Council for Civil Aviation Research. Research focuses on climate, air quality and noise and brings together all key stakeholders in the French air transport sector and aims to bring together research and innovation efforts in the aeronautical field, particularly for the preservation of the environment and sustainable development, including the development of an aviation roadmap³⁴.

DEBATS (France)

DEBATS³⁵ took place between 2012 and 2013 around Paris Charles-de-Gaulle and Toulouse-Blagnac airports. The project aimed to characterise the health effects of aviation noise. It consisted in a series of three studies combining surveys, medical monitoring (blood pressure, cardiac frequency, cortisol measurement) and quality of sleep monitoring. Statistical analyses are to substantiate the health effect of aircraft noise.

Leiser Flugverkehr³⁶ (Germany)

A program of measures to reduce aircraft noise to halve noise pollution in the vicinity of commercial airports.

Maßnahmen und Instrumente des Aktiven Schallschutzes bei Fluglärm; methods and instruments of active sound protection for aircraft noise (Germany)³⁷

Innovative strategies and concepts in the area of aircraft noise protection developed and individual measures and instruments in the field of aircraft noise protection analysed and evaluated. This includes the systematic review of current flight operations (noise monitoring) for noise abatement options.

Survey of Noise Attitudes 2014: Aircraft (United Kingdom)

The objective was to reassess attitudes to aircraft noise in England; their correlation with the Leq noise index; and to examine (hypothetical) willingness to pay in respect of nuisance from such noise, in relation to other elements, on the basis of stated preference (SP) survey evidence³⁸. This builds upon previous such surveys in 1982 (ANIS)³⁹ and 2005 (ANASE)⁴⁰.

³³ <http://www.aerorecherchecorac.com/>

³⁴ <http://aerorecherchecorac.com/programme/>

³⁵ <http://debats-avions.ifsttar.fr/>

³⁶ http://www.dlr.de/as/Portaldata/5/Resourcen/dokumente/abteilungen/abt_ts/Abschlussbericht_LFVK.pdf

³⁷ <https://wirtschaft.hessen.de/verkehr/luftverkehr/laermschutz/massnahmen-fuer-fluglaermschutz>

³⁸ <https://publicapps.caa.co.uk/docs/33/CAP%201506%20FEB17.pdf>

³⁹ Brooker et al 1985. Brooker P, Critchley J B, Monkman D J & Richmond C. DR Report 8402: United Kingdom Aircraft Noise Study: Main Report, January 1985.

⁴⁰ [ANASE Non-SP Peer Review](#), November 2007.

Table 5: Summary of national research programmes identified in each Member State

Member State	Level of National Research Programmes
Austria	None Listed.
Belgium	None Listed.
Bulgaria	International Collaborations only.
Croatia	None Listed.
Czech Republic	Template not received
Cyprus	None Listed.
Denmark	None Listed.
Estonia	None Listed.
Finland	None Listed.
France	Several large research programmes listed.
Germany	A large number of national and international research projects to address aviation noise and noise impact.
Greece	Small number of academic publications only.
Hungary	A statistical processing of noise measurement data around the busiest country routes, at peak hours. A review of strategic noise mapping in Hungary.
Ireland	Several large research programmes identified.
Italy	None Listed.
Latvia	A single national programme (SESAR co-sponsored) to reduce noise (and other environmental impacts).
Lithuania	A single national programme identified.
Malta	None Listed.
Netherlands	Several large research programmes listed.
Poland	One large project (noise reduction at source)
Portugal	A study to assess noise around Lisbon Airport only
Romania	Various international collaborations. National research programmes. Dose-effect study assessing annoyance levels produced by air traffic noise.
Slovakia	PhD research only.
Slovenia	None - but an aircraft manufacturer (Pipistel) is part of the ARTEM Horizon 2020 project.
Spain	None Listed.
Sweden	Various. A national centre for sustainable aviation. National health impact projects. Participation in International research projects.
United Kingdom	Several large research programmes listed.

4.5 State of the Art: Airport Noise Abatement Initiatives

This section of the data capture templates looked to understand what current practice is like at 'typical' airports in each Member State in terms of their application of the ICAO Balanced Approach and noise management in general. The text below contains examples of good practice by way of illustration only; please note these are not intended to be exhaustive. The findings are summarised in Table 6 (operational procedures and operating restrictions) and Table 7 (land-use planning and wider impact mitigation measures)^{41,42}.

4.5.1 Noise at Source

Reduction of noise at source was not specifically considered in the data capture template, however airports can have an impact in this regard via, for example, noise-related operational charges or operating restrictions, which may prompt airlines to utilise quieter aircraft. Evidence of this was found at a number of airports, for instance:

- Gatwick, Heathrow and Frankfurt incentivise A320 retrofit through either voluntary schemes or through additional charging.
- Noise based charging (or a noise factor in the charge) is the norm for large European airports – it is either based on certified or measured noise. Heathrow Airport charges loudest aircraft ten times as much as it charges the quietest aircraft.
- Heathrow has included aircraft chapter within its Fly Quiet program.
- Incentive schemes for quieter aircraft were found at Schiphol, with rewards applied per arrival or departure if marginally compliant chapter 3 aircraft are replaced.

4.5.2 Operational Procedures

Continuous decent approaches were commonly used at larger airports. Other best practice includes:

- London Heathrow having an arrivals and departures code of practice.
- Noise Abatement Departure Procedures (NADP1 or NADP2) used at most large airports).
- In the UK, aviation stakeholders developed an industry code of practice for noise from arriving and departing aircraft which includes options to reduce noise reduced use of landing flaps, delayed landing configurations, increased minimum altitudes and continuous descent approaches.
- Performance based navigation commonly used with the effect of concentrating flight tracks along specified pathways.
- Noise preferential routes commonly used. Practices such as 'early turns' not usually found.
- Low-power low-drag arrivals found common at larger airports such as London Heathrow and Madrid Barajas.
- Steeper approaches trialled at London Heathrow and Frankfurt airports.

⁴¹ Data capture templates were supplemented with data from external sources found via desk research, where appropriate, to account for any gaps in template returns.

⁴² Tables were split into two purely for formatting reasons.

- Frankfurt uses 'swing over' visual approaches to shift to a parallel runway up to 4 nautical miles from touchdown to avoid directly overflying specific areas.
- Some evidence of altitude restrictions at larger airports.

4.5.3 Land-Use Planning

Land-use planning and management measures can be categorized as mitigation instruments. Land use planning identifies areas for inclusion in sound insulation schemes or compulsory home purchasing and relocation programmes, planning instruments (such as noise zoning, restrictions and policy on new property developments), or financial instruments (such as noise related airport charges/fines that fund noise mitigation and compensation (e.g. community funds) schemes as described above. Land use policy varies between countries but is typically based upon zones based on noise contours. For example, Copenhagen airport has a clear land-use policy based upon contours and zones as defined below:

- Copenhagen note that no-one should be exposed to sound levels above 55 dB L_{den} at airports and 45dB L_{den} at airfields.

The majority of large airports have noise insulation schemes – typically based upon 60/65 dBA noise contours adapted for local or geographic boundaries, for instance London Heathrow ensure that a scheme applies to an entire street, even if the contour does not span the entire area. The scope and level of insulation varies depending on the contour and some airports apply different day/night contours to determine the scope of the noise insulation program. Some airports (London Heathrow, Paris Charles de Gaulle) offer multiple insulation schemes based on day-time and night-time levels. Funding for insulation is often provided by the airport, but it was identified that the State provides funding in Amsterdam, Brussels and Copenhagen. Compulsory purchasing of housing was also found at some larger airports, based on noise contours, and with strict conditions.

4.5.4 Operating Restrictions

The most commonly used restriction reported in Europe is the banning of Chapter 2 aircraft. Airports such as Charles de Gaulle and Frankfurt also limit the operation of marginally compliant Chapter 3 aircraft in the overnight period.

In terms of night flight restrictions, the night period generally ranges between 2200 or 2300 and 0400 and 0700 and has implications for curfews, charges and quotas. Night restrictions have noise at their core and are based on a number of criteria, for instance noise certification (marginally compliant chapter 3 aircraft banned at Amsterdam, quota system (for instance at Brussels, Gatwick, Heathrow, Madrid), and movement limits (Amsterdam, Gatwick, Heathrow). Restrictions on noisier aircraft during the night period, or periods before or after the night period were found at some airports, whilst Amsterdam, Charles de Gaulle, Madrid, Heathrow and Gatwick were amongst the airports found to apply higher charges in the night period or make use of a night noise surcharge. Noes quotas were found at a combination of larger airports such as at London Heathrow, Paris Charles De Gaulle, and Madrid, and smaller airports such as Vienna, Henri Coandă, and Budapest. Several restrictions referred to on-the-

ground noise sources, namely Auxiliary power units, engine testing and run-up restrictions.

4.5.5 Noise Impact Mitigation

Templates requested information regarding what measures exist to reduce the impact of a given noise exposure, and other attempts to address non-acoustic contributions to impact, for instance through community engagement initiatives. Returns indicate that this emerging area of airport noise mitigation strategies as examples detailed of intervention were rare, and typically evidence only by larger airports. Examples of note include the Dialogue Forum at Vienna Airport (which works with the airport, and other stakeholders, to determine effective noise abatement strategies including the provision of winter gardens), the Community Noise Forum and Community Trust Fund at London Heathrow, Expert Council Forums are various German airports, Commissions and Working Groups at Madrid.

Table 6: Airport implementation of operational procedures and operating restrictions.

Member State	Airport Name	Operational Procedures	Restrictions
Austria	Vienna	Various; including low power-low drag approach. Standard departure routes to minimise noise exposure.	APU restrictions, night flight restrictions, quotas, engine run up restrictions. Noise charges.
Belgium	Brussels	None identified.	Noise certificates. Limited night slots. Silent weekend nights
Bulgaria	Sofia Airport	Minimal	Chapter restrictions, Airport Curfews, Engine run-up restrictions. Landing charges for night flights.
Croatia	Zagreb Airport	CDA landings. Optimal curve approaches. Using less thrust at night.	No regular night flights.
Czech Republic	Template not received.	Template not received.	Template not received.
Cyprus	Larnaca International Airport / Paphos International Airport	Minimal	Restriction for A/C which are not compliant with ICAO Annex 16, Vol. 1, Chapter 3.
Denmark	Copenhagen Airport	Some, including; preferential runway systems,	Runway restrictions, chapter restrictions, engine run up restrictions, night restrictions.
Estonia	Tallinn Airport	None identified.	None identified.
Finland	Helsinki Airport	Some, including; preferred runways Preferred navigation routes and	Certain runways have usage restrictions in night time. Certain departure tracks are used only for quieter aircraft. Flight training is not allowed except on ATC permission. Run ups must be



Member State	Airport Name	Operational Procedures	Restrictions
		Continuous descent approaches.	avoided in nights.
France	Paris Charles de Gaulle	Some, including; Take-off and arrival procedures relating to altitude. Flight paths to avoid populated areas.	Chapter restrictions. No testing of engines between 2200 to 0600. Night flight quota restrictions between 0000-0459. Engine run-up restrictions. Noise surcharges.
Germany	Various	Various, including; minimum noise routings, preferred runways, continuous descent operations, minimum height operations.	National/regulatory response provided... At day, the restrictions apply to the noisiest aircrafts, the use of propulsion reversal, the use of APU and the conduct of engine tests. These restrictions are especially in place at night. Especially the exposure to aircraft noise during the night has decreased over the past few years. The growth over the past few years mainly took place during the day. The number of night flight movements has decreased on numerous locations. Therefore, the sound levels during the night have decreased as well.
Greece	Athens International Airport	Minimum, including; standard approaches, altitude restrictions, preferential runways.	Reverse thrust restrictions, night restrictions, engine run-up restrictions.
Hungary	Budapest Ferenc Liszt International Airport	Minimal, including; high altitude approaches. Continuous descent arrivals	Reverse thrust restrictions, engine run-up restrictions, practice and calibration flight restrictions, operating quotas, night time restrictions, APU restrictions, Chapter restrictions, night flight restrictions.
Ireland	Dublin Airport	Various, including; noise preferential runways, noise corridors, rules on departure climbs, continuous descent approaches.	None
Italy	Roma Fiumicino Airport	Minimal, including; initial climb procedures and preferential runways.	Curfew between 2300 and 0600. Chapter restrictions
Latvia	Riga International Airport	Minimal, including; climb procedures.	Chapter restrictions.
Lithuania	Vilnius international Airport	Minimal; preferential runways, standard departures to avoid communities, reduced noise glide paths.	Night flight restrictions
Malta	Malta International Airport	Minimal, including; preferential runways, high altitude approaches.	Chapter restrictions.
Netherlands	Amsterdam Schiphol	Various, including; minimum noise routings, reduced flaps, continuous descent approaches.	Night time restrictions. Movement cap of 510,000 until 2021. Runway restrictions.
Poland	Warsaw Chopin airport	Some, including; continuous descent approaches, standard departures and approaches.	Night flight restrictions, engine test restrictions, reverse thrust restrictions.



Member State	Airport Name	Operational Procedures	Restrictions
Portugal	Lisbon Airport	Minimal, including; preferential runways.	Night time restrictions.
Romania	Aurel Vlaicu & Henri Coandă International Airport	Various, including; continuous descent approaches, standard procedures to avoid communities, preferential runways.	Engine test restrictions, Chapter restrictions, APU restrictions, night quota limits.
Slovakia	Milan Rastislav Štefánik airport Bratislava	Some, including; preferential runways, continuous descent approaches, noise abatement departure procedures.	Night time restrictions.
Slovenia	Letališče Jožeta Pučnika Ljubljana	None identified.	Night time restrictions and movements from certain run way directions.
Spain	Adolfo Suarez Madrid Barajas	Various, including; noise reducing standard procedures, continuous descent approaches,	Chapter 2 restrictions, night time restrictions. restrictions for marginally compliant aircraft (chapter 3) all day from 2006 not only during the night. Noise quotas.
Sweden	Stockholm Arlanda Airport	Some, including; preferential runways, continuous descent approaches,	Night time and weather-based restrictions per runway. APU restrictions.
United Kingdom	London Heathrow	Various, including preferential routes, preferential runways, reduced reverse thrust.	Night quota limits only based on NCCs

Table 7: Airport implementation of land-use planning and noise impact mitigation initiatives.

Member State	Airport Name	Land Use Planning	Impact Mitigation ⁴³
Austria	Vienna	In the course of the mediation process, the Flughafen Wien AG (Airport Vienna AG) and the neighbouring communities agreed contractually on the abandonment of building land/ housing area in areas, based on the predicted aircraft noise zone of a three-runway system, with a Lden of 54 or 55, respectively.	Extensive, including 'Best Practice' Dialogue Forum

⁴³ There can be cross-over between noise impact mitigation and land-use planning strategies. For instance, sound insulation is traditionally considered a land-use planning activity, however it is implemented as means to reduce noise impact. For the purposes of this table noise impact mitigation refers explicitly to community engagement and dissemination schemes.



Member State	Airport Name	Land Use Planning	Impact Mitigation ⁴³
Belgium	Brussels	None identified.	None identified.
Bulgaria	SOFIA SOF/LBSF	Zone based noise insulation.	None identified.
Croatia	Zagreb Airport	Sound insulation in noise zones. Noise barriers and deflector installation.	Noise Action plans and mapping results published on airport website.
Czech Republic	Template not received.	Template not received.	Template not received.
Cyprus	Larnaca International Airport / Paphos International Airport	<ul style="list-style-type: none"> • Restrictions for recreational buildings, schools, hospitals, hotels, churches on exposed areas; • Residential buildings only with phonic insulation; (>40db); • Only small factories permitted; • Construction permitted only with airport administration prior approval; • Noise barriers. 	Functional noise committee of local stakeholders.
Denmark	Copenhagen Airport	Noise restriction on land use due to noise exposure from Airports.	Dissemination of noise impact via END
Estonia	Tallinn Airport	None identified.	None identified.
Finland	Helsinki Airport	No major new housing areas are allowed within the 55dB noise contour.	Continuous noise monitoring system. Annual and quarterly published noise briefings. Presence at neighbourhood parties to communicate what the airport does.
France	Paris Charles de Gaulle	Zoning laws defined by noise contours. Home sound insulation. Property disclosure laws. Land acquisition programme.	Noise monitoring system and "Commissions consultatives de l'environnement" (environmental consultative committees) which are intending, under the prefect aegis, to foster dialogue between airports, local authorities and neighbours or environmental associations.
Germany	Various	National/regulatory response provided... The aircraft noise protection law regulates building bans and other restrictions regarding land-use planning for single building projects. However, additional residential areas with more affected people are formed in the vicinity of airports. The law does not ensure that the legal sound protection requirements for housing or other facilities (e.g. hospitals) are complied with. No standards regarding building licences, obligatory building examinations by the building control authority and sanctions for real estate owners when not complying with legal regulations.	Several 'Best Practice' Examples from across the Member State, for example Expert Council Forums.



Member State	Airport Name	Land Use Planning	Impact Mitigation ⁴³
Greece	Athens International Airport	Sound insulation based on "acoustic comfort". New constructions must be compliant with noise specifications. "General Urban Plans" and "Specific Urban Studies", contain urban and local planning guidelines including maximum allowed noise levels. Existence of 'Annoyance zones'.	None identified.
Hungary	Budapest Ferenc Liszt International Airport	Sound Insulation, home purchase assurance, zoning laws, real Estate/ Property Disclosure Laws, land acquisition for Noise Compatibility, noise protection zones. Source of Noise Mitigation Program Funding for Aircraft Noise (starting from 2005): a noise protection fund is established, funded by the noise protection element of aircraft landing charges.	Public noise forums. Noise Protection Committee. Dissemination through airport website.
Ireland	Dublin Airport	Inner and outer noise zones that prohibit development and fund insulation. Noise insulation scheme in place.	Dublin Airport Stakeholders Forum set up an Environmental Working Group. Flight track monitoring system (but only summary data available to the public).
Italy	Roma Fiumicino	Acoustic zoning plan.	None identified.
Latvia	Riga International Airport	None identified.	Contour maps and noise monitoring system only.
Lithuania	Vilnius international airport	Sound insulation scheme.	None identified.
Malta	Malta International airport	None identified.	None identified.
Netherlands	Template not received.	Extensive and long established sound insulation scheme. Land Use Zoning that prohibits new developments. Land Use Compensation programme. Innovative noise barriers.	Schiphol Local Community Council. Local Community Contact Centre. Schiphol Quality of Life Foundation.
Poland	Warsaw Chopin airport	The airport engages with local authorities to ensure that aircraft operations are considered in planning applications for noise sensitive developments if they are exposed to levels of noise of 55dB LN or more.	None identified.
Portugal	Lisbon Airport	Creation of a zone of non-construction of buildings with noise sensitive uses (acoustic classification of mixed "throughout the urban network").	Noise monitoring system. Semi-annual noise reports.
Romania	Aurel Vlaicu & Henri Coandă International Airport	Action plans detail compliance with national regulations.	There are no clear processes regarding the analysis, monitoring, nor mitigation regarding non-acoustic factors. Communication is rarely established between persons and the airport. Even if the airports are trying to positively impact the community, the communication is not efficient enough.
Slovakia	Milan Rastislav Štefánik airport Bratislava	None identified.	Air traffic noise monitoring (publicly available).



Member State	Airport Name	Land Use Planning	Impact Mitigation ⁴³
Slovenia	Letališče Jožeta Pučnika Ljubljana	None identified.	Sustainability Reports 2015 and 2016 describes a commitment to good communication and a project of planting 13.000 trees for reducing vertical noise.
Spain	Adolfo Suarez Madrid Barajas	Noise zones around airports. CAA provides recommendations, such as: removal of noise sensitive buildings, compliance with building regulations.	Flight path tracking and compliance. Commissions and working groups: to discuss with the regions best solutions, i.e. to adjust tracks
Sweden	Stockholm Arlanda Airport	Zone based building restrictions. Building insulation.	None identified.
United Kingdom	London Heathrow	<p>The airport works with local authorities, government and local community groups to develop a plan to protect these areas in line with the Aviation Policy Framework (APF), Noise Policy Statement for England (NPSE) and National Planning Policy Framework (NPPF).</p> <p>The airport engages with local authorities to ensure that aircraft operations are considered in planning applications for noise sensitive developments.</p> <p>Insulation scheme, home relocation scheme.</p>	Heathrow Community Noise Forum – regularly occurring and well disseminated. Community Trust Fund.

4.6 Categories of Balanced Approach Implementation

Drawing on airport exemplars provided in Member State templates, and as summarised in Section 4.5, it is evident that there are three broad grouping of airports, in terms of the approach taken to aviation noise management⁴⁴, which can be classified by their progress on the ‘journey’ of implementation.

1. Pathfinders - The first group consists of internationally significant hub airports with high numbers of aircraft movements. These airports are at the forefront of extensive Balanced Approach implementation in terms of the breadth and depth of their approaches. Such airports typically apply a suite of operating procedures and restrictions and have a comprehensive range of community engagement initiatives. They go far in terms of land-use planning interventions such as home insulation, and relocation schemes. However due to their size their growth is constrained by their size and the number of people exposed to noise in their local communities, which in turn may explain why they have a long track-record and have gone furthest in their noise management approach. Member States with airport exemplars that fall into this category are:
 - France
 - Germany
 - The Netherlands
 - Spain

⁴⁴ The veracity of findings are subject to the quality of the data template returns. Whilst efforts have been taken to validate the data provided, it is possible that for some Member States data was missed from these templates.

- United Kingdom
2. Experienced Travellers - The second group of airports belong to countries that are engaged in noise management and mitigation and demonstrate several examples of best practice in terms of implementation of the balanced approach elements, but not as extensively as the first group of airports. These are:
- Austria
 - Belgium
 - Denmark
 - Finland
 - Hungary
 - Ireland
 - Italy
 - Poland
 - Portugal
 - Romania
 - Sweden
3. Starting the Journey - The third group of airports are defined as those who are beginning their journey into noise management and mitigation. Such airports demonstrate some, but limited, examples of implementation. It is noteworthy that the high levels of growth at some of these airports may mean that noise issues, which are currently regarded as relatively peripheral, could become significant in the near future. These airports are:
- Bulgaria
 - Croatia
 - Czech Republic
 - Cyprus
 - Estonia
 - Latvia
 - Lithuania
 - Malta
 - Slovakia
 - Slovenia

Although the report focused on the implementation of EU regulations, legal obligations and practical interventions in relation to aircraft noise European Member States, data on other nations in proximity to the EU was also collected. Of these nations⁴⁵, Norway and Switzerland were identified as falling into the 'Experienced Travellers' category. Airports in these nations demonstrated a clear commitment to reducing noise exposure through a range of approaches including continuous descent approaches, low-noise corridors, minimum altitudes before descent, noise abatement departure procedures, night restrictions, noise quotas and public engagement forums. Serbia and the Ukraine were found to be in the

⁴⁵Norway, Serbia, Switzerland, Ukraine.

'Starting the Journey' category of airports in that interventions to address noise (i.e. through Balanced Approach interventions) were lacking.

5 Interviews

Elite interviews took place with 17 individuals who are able to influence the impact of, or who are impacted by, aviation noise. An MMU researcher carried out interviews either over the telephone, or on a face-to-face basis. To reduce costs (and carbon emissions), face-to-face interviews were kept to a minimum and were focused, where possible, on community groups and individuals who had specifically requested a face-to-face interview take place. A list of interview stakeholder categories is provided in Table 8, with a description of the main themes arising from the interviews provided through the remainder of this chapter.

Table 8: List of interview participants stakeholder categories

Stakeholder Category
Community Groups
Community Groups
Community Groups
Local Authority
Aviation Research Centre
Aviation Research Centre
Freight / Cargo
Aviation Authority
ATM Organisation
Industry Body
Industry Body
Industry Body
ANIMA Airport Partners
ANIMA Airport Partners
ANIMA Airport Partners
Other Airports
Other Airports
Other Airports

5.1 Noise vs. other environmental impacts

Aircraft noise was identified as being the greatest negative environmental impact of air transport to local airport communities. Air quality was also cited as something that is of increasing importance to airport communities, but it remains somewhat behind noise as a priority. Climate change was generally seen as an important issue, but one for wider society and not of particular importance to those who live near airports, for whom noise has negative daily impacts.

- Community Group: "It can be almost brutal when noise is added where there wasn't any before."
- Community Group: "Climate change is far away in daily life. [...] It doesn't hit everyday life in the way that noise does. Air pollution can smell a bit but is away the next day. Noise is always there. It is the key issue that makes the lives of people around bad."

- European Aviation Body: "For me the big issue is noise that is the big constraint that can prevent sector growth i.e. through new runways, a major obstacle for growth."

5.2 Efficacy of the ICAO Balanced Approach

Community groups questioned the validity of the Balanced Approach and its appropriateness for reducing noise impact.

- Community Group: "Balanced Approach was drawn up less to deal with noise and more to preserve ICAO. It is pretty minimum advice."
- Community Group: "This should have been created by someone other than ICAO".

Different perspectives were expressed by industry, who expressed positive feelings about the Balanced Approach, but who were also able to identify some critiques.

- Freight Organisation "Properly administered Balanced Approach is great but we have experience of working with airports where no regard to Balanced Approach has been taken at all."
- Airport: "The Balanced Approach gives a structure and a common language to help translate noise to industry and local communities, but it misses non-acoustic factors and engagement. This gap needs filling."

All participants, except for community groups, stated that it is correct that operating restrictions are implemented as the 'last resort'

- Community Group: "No, it should be an equal part of the mix [...] Aviation is important but it strikes me as a document written by the industry for the interests of the industry to do as little as possible to inconvenience the operation of the industry."
- Freight Organisation: "If you can solve a demonstrative noise problem through the other elements of Balanced Approach, they have to be more preferable to the draconian restrictions of night bans etc. This was chosen to avoid a situation where airports simply went to restrictions before considering the other elements – which should be enough to solve the issue in a number of instances."

5.3 Land Use Planning and Encroachment

Land Use Planning (LUP) was consistently cited as the biggest failing of the four Balanced Approach elements, and of noise impact management in general. The reason for this was generally cited as a lack of legislation to protect airports from encroachment and guidance to support local authorities in better managing developments. It was however recognised that there is a difficult and delicate balance for local authorities to get right, due to the popularity and socio-economic benefits of living near an airport, placing pressure on local authorities to approve new developments. A particular challenge was the fact that successful noise impact mitigation interventions by airports often lead to noise contours shrinking size, only to lead to new developments being approved – resulting in no net reduction in the number of people exposed to aviation noise.

- Local Authority: "I really think that is not enough. I believe that actions are needed to zone the territory on the basis of exposure to noise and to introduce these criteria in the process of building authorization."



- Freight Organisation: “[Land Use Planning] is integral to the Balanced Approach, but it is outside our control and that of the airport. It either hasn’t been applied consistently or properly across Europe, and in many cases, it has been ineffective. So, more and more people are coming into contour areas.”
- Airport: “LUP is the most important thing – to protect the airport and the purpose of the airport – but also to protect the community from the undesirable impacts of the airport.”
- Airport: “We question the efficacy of LUP. It is generally woeful. It is local authority owned but often left to the airport to administer. Our data shows more households in all noise bands. Authorities can critique airports but authorities seldom report noise to people or stop people from moving to the area.”
- Aviation Body: “I would say it has not been effective. It needs to be better managed and used. There is lots of encroachments around airports. [...] One of the issues is local authorities are subject to political pressure. [For example] Brussels airport is located in a politically sensitive area – the airport is some sort of hostage to political conflicts. Local policy makers will try to avoid their constituencies being overflown – potentially impacting others.”
- Airport: “LUP and zoning doesn’t exist for us as we are not required to do noise maps. In general, I think that LUP can be effective, but in our case but due to the competent authorities being passive regarding this target there is no land use planning for our airport. Our legislation says inhabitants can expect compensation from noise exposure, but this legislation is not done because noise zoning needs to be prepared but it isn’t.”
- Aviation Body: “Encroachment is a major problem here. This part of the balanced approach is not well managed.”
- Aviation Body: “LUP policy needs to be in place early [...] It is important to make LUP policy before or during the creation of a new airport.”
- Community Group: “Legislation says flight paths can be put anywhere, but we need binding regulations to say ‘these are settlement areas’, and ‘these are fly over areas’”.

5.4 Limited Success of the Environmental Noise Directive

The success of the END in addressing airport noise varies by Member State. A trend has emerged that shows the Directive has had limited impact in ‘best practice’ Member States, but that the same is true also for countries “starting the journey” with limited noise impact interventions due to the fact that their size means that they do not need to comply with the Directive at all, so there is no drive for them to conduct noise mapping or action planning. Considering a previous comment regarding Land Use Planning being best implemented as early as possible, this can be considered a significant barrier to stopping encroachment.

- Airport: “The main problem in our state is that our airport is less than 50k movements so the CAA and others are not so keen in getting involved in noise and land use planning. The solution is, at least in our national legislation, is to lower the number.”

- Freight Organisation: "We are not so sure if it has actually achieved reductions as such, it has added value as it creates a common approach to noise across Member States."
- Airport: "[It is] Successful at one level as it is a wide policy piece that lets airports be compared against each other, but each airport has its own characteristics and requirements and END doesn't consider these."
- Aviation Body: "Limited impact here as airports already had action plans. Even without END there wouldn't be much change."
- Community Group: "It made accessible information to the public but the noise maps need expert knowledge for people to understand. Member states left to set limits – these are often set far from those recommended by the World Health Organisation."

5.5 Policy critiqued for vagueness

The END, ICAO Balanced Approach and Land Use Planning regulations in general were all cited as being too vague in their wording, leading to a lack of compliance.

- Local Authority: "Current legislation contains permissible and interpretable formulations, such as "avoiding" or "vicinity". It would be necessary to clarify legislation on aviation noise exposure issues, for example specifically prohibiting some types of construction and defining what means vicinity, for a more rigorous implementation of the requirements."
- Aviation Body: "The problem is that the END was too much subject to interpretation by Member States and not clear about which noise calculation method should be used."
- Aviation Body: "Legislation around insulation is often worded poorly so nothing happens."
- Airport: "[Land Use is considered at a national level] but only through a recommendation and it is not very specific. They say there should not be residential construction near the airport, but they do not define the vicinity or to avoid construction – they just advise to avoid – so economic factors win out and development happens."
- Aviation Body: "More precise guidance [is] needed. There is still too much interpretation on how to apply policy."

This reported vagueness corroborates the findings of a European Commission Review of the END⁴⁶, which stated that problems in transposition of the END can arise from poor transposition of definitions and key terms into Member State legislation. Such flexibility is however important in terms of the subsidiary principle underlining EU policy and the fact that all airports and nations are different. As such it appears that there is some conflict here between the requirement for such flexibility, and policy that is strict enough to ensure compliance and best practice.

5.6 Guidance

Regarding guidance on noise management the general consensus was that there was not enough guidance. However, it was also cited that guidance does not

⁴⁶ http://ec.europa.eu/environment/noise/pdf/study_evaluation_directive_environmental_noise.pdf

have to come through written documents, but rather can be done effectively through stakeholder committees who work together to tackle the noise issue holistically at the national level.

- Community Group: “[We have] an independent committee comprising aviation stakeholders who meet every few months to make sure everything is on the right track. If an agreement is not met they decide what they can do instead and how they can do it – they help to make things happen.”
- Airport: “There is no guidance on the effectiveness of the interventions to manage noise risk. We know noise impacts on learning, but should that mean that schools are insulated or students homes are insulated? There is no guidance on the value of different interventions.”
- Airport: “Guidance doesn’t exist in our country. I think that, for example, there is a lack of cooperation between the key stakeholders. For example, when new flight procedures are enforced only the air carrier and the ATC are communicated. The airports are not engaged with here.”
- Aviation Body “We have, on every airport, an aircraft commission. The airlines the airport the ATC and the affected communities sit together and talk about the situation at the airport and what they can do to get less noise. These also sit at a national level. The head of each commission sits on the committee and they talk about things together. Not all ideas a realistic, but it is a good way to find solutions.”

5.7 Research Priorities

Several areas of desired future research have been identified. Firstly, there is a desire to better understand issues of annoyance and noise. For example, what factors determine annoyance, how annoyance translates into complaints, and how annoyance can be reduced.

Secondly, a number of participants stated that they would like to better understand the quality of life impacts of aviation noise, and importantly, how quality of life can be enhanced by airport interventions. Finally, the efficacy of interventions regarding noise was highlighted as an important future research direction, in terms of developing an evidence base on which noise impact and management interventions can be grounded. This was echoed by some statements that the health impacts of aviation noise are already known, research now needs to focus on solutions.

- Community Group “There is no need for any more [impact-based research] really, the thing is we need research on the impacts of interventions. For example, if you were to give people a half days break from noise by switching flight paths, what impact does that have? What impact, and how far away do planes have to be away for it to be classed as respite”.
- Aviation Body: “[We need to] move away from demonstrating health impacts. We know the impacts exist, we need to know how to stop them.”

Finally, better metrics to understand and communicate noise effectively to communities was identified as an important new research theme.

- Community Group: "There is enough knowledge on how noise works but we need urgent work on the interpretation of the data given. There is L_{den} for average sound level. Recent studies showed L_{den} is the same but annoyance has increased. They say we need more research – but we don't need more research. We know why [...] there are more planes. There is no silence anymore. And this is what stresses communities. L_{den} hides this problem. It is a calculation result it is not what people perceive."
- Aviation Body: "One of the central questions for us are the non-acoustic factors. It is really a major point of interest to airports. There has already been research to quantify the impact of non-acoustic factors, 20%-30% only is acoustic factors the rest is non-acoustic. We see noise contours are shrinking but complaints are going up. People who complain are often not significantly exposed."
- Aviation Body: " L_{den} and L_{night} are both average noise exposure based, it doesn't reflect the number of operations. [...] They don't reflect that more operations equals a huge effect on the population."

5.8 Noise Impact Mitigation

In terms of noise impact mitigation, it was cited by a number of stakeholder groups that communication is key. Doing so can help communities to understand the positive aspects of living near and airport, and efforts made by airports to reduce noise, and the challenges they face in doing so.

- Airport: "They are quite effective. People see that we are dealing with the issue. We take their concerns seriously. We invest money and they get improvements in their quality of life."
- Aviation Body: "Engaging with people about what an airport does (i.e. tours and detailed education sessions) can help people to understand the challenges airports face and the efforts gone to in order to minimise noise - this can reduce annoyance."

Again, a strong evidence base for interventions in noise impact mitigation was cited as important, for example with regard to insulation.

- Community Group: "We have 30 years of insulation [...] but has this made the situation any better? Maybe we shouldn't overestimate the impact of [these things]?"
- Airport: "We have an insulation scheme but only 15% of eligible people apply and we don't know if the insulation has actually helped."

6 Summary

The results of the review presented in this report lead us to a number of key findings and recommendations. These are discussed below in turn.

6.1 Key Findings

6.1.1 No one size fits all solution

There is no simple answer to aviation noise, and no one-size fits all solution that can be applied to all airports and across all Member States. The circumstances of each airport vary significantly so an effective operational procedure at one airport may not be appropriate (or even feasible) at another. The location of an airport may require entirely different land-use planning management. The economic importance of airports to their regions can differ significantly. It is therefore essential that guidance and toolkits to assist in noise impact management take into account a range of variables and are flexible enough to be applied as required by individual airports. This conclusion was expressed by a number of interview respondents and is borne out by the range of different approaches identified through data capture templates.

6.1.2 There is a comprehensive policy framework but there are gaps in implementation

The Environmental Noise Directive and the ICAO Balanced Approach set out a framework to help Member States manage aviation noise, for airports to develop effective action plans and noise maps, and for these to be communicated to the public. It is clear however that neither policy has been successfully implemented across all Member States, as illustrated through the evidence collected in the data capture templates, and also from key statements from the stakeholder interviews. There are many potential reasons for this, including the economic importance of aviation, a lack of knowledge and expertise in general and across some Member States, and a perceived vagueness in the wording of noise policy which many interview participants cited as leading to a lack of compliance. Lead airports (in terms of noise management) are generally large and have the resources with which to implement wide ranging and cutting-edge noise management approaches. They often develop their own approaches, being responsive to their own local circumstances and political pressures. They can be often seen as being at the forefront of knowledge generation and new data collection as they go about developing new approaches and interventions. Such airports need better support from the research community to help them develop effective strategies based on empirical data.

Airports with emerging noise management systems appear to be smaller in size and resource and are only just taking their first steps into effective noise management, they may however be growing rapidly and thus face problems in the near future. Such airports require established and proven guidance based on the lessons learned by airports that have gone before them. Importantly this should be done through a toolbox approach to ensure their own specific circumstances can be accounted for. The requirement for, and benefits of effective noise management should also be made clear to such airports so that effective solutions and decision-making can take place early. This is particularly important when considering land-use planning, to stop encroachment from occurring before an airport grows. One airport went as far as suggesting that the

criteria for compliance with END should be reduced from 50,000 to 30,000 movements per year, to ensure that effective noise action plans are developed at an early stage.

Although at the start of their noise management journey, such airports are in a privileged position whereby they can learn from the mistakes and successes of other airports and go straight into best practice, rather than slowly working towards it.

6.1.3 Land-use planning challenges

Templates highlighted a mixed pattern of land-use planning policy and implementation. This was corroborated in interviews, where encroachment of inappropriate development around airports was highlighted. At the heart of this problem appears to be competing planning priorities between local authorities and airports. Local authorities benefit from development in their regions, whereas airports desire to limit the development of incompatible land-uses near their sites. Encroachment appears to result from a lack of effective forum in which these potentially competing agendas can be discussed and consensus built. Interviews suggested that clearer policy specifically to protect airports from encroachment would help to solve this issue – such policy would appear to be best set at the Member State level to account for regional circumstances.

6.1.4 Efficacy of engagement programmes

Airports are undertaking a range of engagement activities with local communities and this type of engagement is on the rise, particularly at larger airports or airports that are constrained by noise. Engagement programmes can range from simply making noise data and management information available on airport websites, to deeply embedded Dialogue Forums that actively work with the airport and can have influence on airport decision-making. Despite this trend, and the fact that interviews suggest that there is great value in these activities, there is little empirical evidence of their efficacy, or where and when which forms of communication work best.

6.1.5 Impact of Balanced Approach Interventions

Many interviewees questioned the overall benefit of some Balanced Approach interventions. There was a feeling that despite a range of interventions across the full spectrum - from reduction to mitigation - the outcomes in terms of community benefit were not always evident. For example, several interviewees responded that they feel airports are often making noise management decisions for political reasons rather than based on the voices of community members who actively engage with them on noise issues. The concern is that there is often no evidence that interventions being made are making a difference to the quality of life of communities, and that airports could be having greater impact by focusing in other areas. For instance, community group and airport stakeholders both stated that further research was required to determine the impact and benefits of sound insulation schemes. This raises a broader question about the systematic assessment of the outcomes of Balanced Approach implementation.

6.1.6 Collaboration is important

Several interview participants highlighted that a constraint to effective noise management is the significant number of stakeholders involved and the devolved responsibilities. For instance, flight paths require collaboration between ANSPs, airlines and airports. Land-Use Planning requires collaboration between local authorities, developers and the airport. Pilots must be engaged with to follow flight paths and implement new operational procedures correctly. It was also highlighted that collaboration with aircraft manufacturers and research institutes is important to ensure that identified operational procedure improvements are feasible. A collaborative decision management system focused around noise could be helpful here, perhaps led by the airport operator, but bringing together all stakeholders how are impacted by, or who can influence the impact of aviation noise.

6.1.7 Future Research

Interviews identified that there is a requirement for future research in the following areas:

- Understanding the relationship between aviation noise and quality of life, and the wider role airports can play in enhancing quality of life.
- The efficacy of interventions across all aspects of the balanced approach, including non-acoustic factors. Which interventions are most helpful in terms of optimising community benefits?
- Development of effective communication strategies for different typographies of community groups, including the development of better metrics for disseminating noise to affected communities.
- A better understanding of noise annoyance. What factors influence noise? What is the relationship between noise, annoyance and the health impacts associated with noise? How can noise annoyance be abated? What non-acoustic factors are key?

6.1.8 Overview of Balanced Approach Implementation

The research identified three groups of airports in terms of the stage of on the journey of noise management and mitigation.

The 'Pathfinder' airports are at the cutting edge of noise management and implement a suite of best practice interventions. They are often generating their own data and developing their own unique mitigation measures beyond acceptable good practice. These airports could be assisted in these efforts by the research community. For instance, many interviews highlighted that whilst such airports are developing their own initiatives to tackle noise, they often do so without knowledge as to the efficacy of such interventions. The benefit of sound insulation schemes for households was often raised one as such area. Pathfinder airports need to be engaged with, so that their research needs can be identified, and collaboratively addressed. A number of areas requiring future research were identified in this review and are listed in Section 6.1.7. As these airports are at the cutting edge of noise management, and are trialling new and innovative new approaches, a platform to help disseminate latest findings and approaches would be of benefit to the wider airport community.

A clear trend here is that larger airports that are noise constrained appear to have gone the furthest in terms of noise management. This indicates that well developed noise abatement processes can reduce the numbers of those exposed to noise can have significant benefit in terms of airport development. There are particular implications here for the second two airport groupings, 'Experienced Travellers' and those 'Starting the Journey'. For these airports, the pathways taken by larger airports towards best practice can act as a roadmap along which such airports can travel by jumping straight to Best Practice and learning from the successes (and failures) of their larger contemporaries, for instance by effectively engaging in land-use planning to stop encroachment of noise-sensitive developments before it occurs.

For these airports there is a requirement for the provision of best practice toolkits that can empower airport management with knowledge of a suite of best practice approaches and what sort of interventions might be suitable for their own specific circumstances. Such a toolkit needs to be driven by underlying principles of best practice (i.e. how best to design, implement and assess balanced approach interventions) which should help airports identify the type of interventions they should be doing at each stage of their development. Doing so can help to ensure that a toolkit does not just act as a list of noise abatement interventions, but that it also helps guide users as to when they should be implemented.

It is essential that flexibility be designed into any toolkits or pathways towards best practice so that airports are able to choose interventions that are best suited to their circumstances. That said, for a pathway and toolkit to be effective it is essential that they are designed in such a way that there is no vagueness in their wording that may allow airports to stall in their implementation – as has been a barrier to effective noise management in the past.

7 Annex A; Data Capture Template Form

Data Capture Template – WP2 / T2.1 - ANIMA

Pan-European Review of Existing Regulations and Mitigation Strategies

Member State	
Completed by	

SECTION A: NATIONAL APPROACHES TO AIRPORT NOISE

1. Noise Policies

National response to the Environmental Noise Directive (END)

How has the Member State made provision in national legislation for the requirements of the Environmental Noise Directive? This may also include economic measures for a failure of compliance.

Other national policy instruments

What other national policy instruments are used to control airport noise? For example, planning procedures, environmental impact assessment, etc. Please use the subheadings provided below as a guide.

Control of Noise at Source

Operational Procedures

Operational Restrictions

Noise Impact mitigation and communication

Land Use Planning (i.e. planning for future developments).



2. Guidance

What guidance documents are produced to for airports to support ICAO Balanced Approach implementation?

Member States and their environmental or civil aviation departments often produce guidance on meeting legislative requirements such as END or the ICAO Balanced Approach. Does any such guidance exist in this Member State? How comprehensive is it? What methods do they describe in terms of monitoring, measuring and forecasting changes to airport noise that result from air traffic growth?

3. National Research Programmes and Projects

Please provide examples of research has been taking place in the Member State.

What research projects related to noise are taking place? Who is conducting this research? What is the funding source, e.g. government, local authority, private? How much money is being spent on such research? What are the key outcomes? Examples may include work conducted by independent commissions, Knowledge Exchange projects or specific projects on certain aspects of aviation noise.

4. Evaluation

Extent of END implementation.

To what extent has END (through implementation of legal instruments) been enforced by government, airports, and local authorities?

Other national policy instruments?

How have other policy instruments delivered on END outcomes? For instance, Airport Master Planning requirements? How has the ICAO Balanced Approach been implemented?



SECTION B: BEST PRACTICE IMPLEMENTATION AT AIRPORTS

Please select one or two airports that you believe represent best practice regarding noise in the Member State.

Airport Name(s)	
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1. Noise abatement through operational procedures

What procedures are the airport using to reduce airport noise impacts?

What procedures do each airport use to reduce noise exposure? This may be listed on airport websites or in their noise action plans, or elsewhere.

--

2. Land-Use Planning, management and strategic planning

How is the airport using land-use to reduce airport noise impact?

How does each airport describe the use of land-use management to mitigate the impacts of airport noise? This may be listed on airport websites or in their noise action plans, or elsewhere Interventions could include preventative planning procedures (e.g. zoning as well as specific mitigation actions such as insulation schemes).

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3. Operational restrictions

Does the airport impose any operational restrictions to reduce the impacts of noise?

How does each airport use operational restrictions to reduce noise exposure on the ground? This may be listed on airport websites or in their noise action plans, or elsewhere and may include, for example night flight restrictions.

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4. Noise Impact Mitigation

What measures exist to reduce the impact of a given noise exposure, and other attempts to address non-acoustic contributions to impact. E.g. Community engagement.

For example, what is the airports policy on insulation, compulsory purchasing of housing, or relocation assistance? How does the airport communicate and engage with its local communities?

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5. Complaints

What is the airport's approach to dealing with noise complaints?

How are complaints recorded? What is the airport's approach to dealing with complaints?

6. Comments

Are there any areas where you think the airport has exemplified good practice, or areas where they may need to improve practice?

When you have the example of the template have a footnote that says that further templates can be provided upon request.

8 Annex B: Example of Completed Data Capture Template

Data Capture Template – WP2 / T2.1 - ANIMA

Pan-European Review of Existing Regulations and Mitigation Strategies

Member State	SPAIN
Completed by	ARC

SECTION A: NATIONAL APPROACHES TO AIRPORT NOISE

Noise Policies

National responses to EU Directives relating to Environmental Noise (END 2002/49) and Noise Related Operating Restrictions (2003/30 and Regulation No. 598/2014), the latter reflecting the ICAO Balanced Approach to Noise management.

How has the Member State made provision in national legislation for the requirements of the Environmental Noise Directive and the Balanced Approach? This may include economic measures for a failure of compliance.

General Competences:

All the major airports in Spain (around 50) that are set out by law as “of general interest to the state”, are covered by national legislation. In the other cases, local airports and aerodromes, must comply with the regional legislation as well. Military airports are excluded but sometimes are a source of complaints.

Background:

There was no law of general regulation for noise until Act 37/2003, of 17 November, of noise (after the END). Certain rules for noise existed in civil law as far as relations of vicinity and cause of damages, as well as a regulation on noise in the work environment, technical provisions for the compliance certification of products and municipal instructions for rules on residents’ wellbeing and urban planning.

Prior to the transposition of the END, the main airports in Spain were engaged in a substantial process of revamping and modernisation, and in these cases they were undertaking some noise mapping included in the Environmental Impact Assessment (Directive 85/377/CEE transposed by Royal-Law Decree 1302/1986 and the decrees that develop it) <https://www.boe.es/buscar/doc.php?id=BOE-A-1986-17240> (Spanish link). After this regulation, the Environmental Impact Statement **always contained noise mapping with Acoustic Insulation Plan** statutorily approved. 65dB LAeq_{day} 16h / 55dB LAeq_{night} 8h contour was the limit to implement effective insulation measures by the promoter of projects.

Some examples: (Spanish links)

<https://www.boe.es/buscar/doc.php?id=BOE-A-1996-8242> Madrid Barajas 1996

https://www.boe.es/diario_boe/txt.php?id=BOE-A-2001-23622 Madrid Barajas 2001

<https://www.boe.es/buscar/doc.php?id=BOE-A-2002-1087> Barcelona El Prat 2002

Most of the Environmental Impact Statements of airports included the obligation to



establish Environment Monitoring Commissions ([Spanish link examples](#)) with all the stakeholders. Most of these commissions are still functioning to the present day, and some technical working groups with stakeholders (airlines, noise technicians of local authorities, air traffic controllers, and so on) depend on them. There is no webpage but information is available through the environmental offices of the airports.

https://www.boe.es/diario_boe/txt.php?id=BOE-A-1999-1918 Madrid Barajas 1999
https://www.boe.es/diario_boe/txt.php?id=BOE-A-2003-2794 Madrid Barajas 2003
https://www.boe.es/diario_boe/txt.php?id=BOE-A-2003-2795 Barcelona El Prat 2003
https://www.fomento.gob.es/MFOM/LANG_CASTELLANO/DIRECCIONES_GENERALES/AVIACION_CIVIL/INFORMACION/NORMATIVA/NORMATIVA_BASICA/INFRAESTRUCTURAS/RUIDO_AEROPORTUARIO/CSA.htm Private airports

In 1998, after the inauguration of the third runway of Madrid-Barajas (with noise mapping and an acoustic insulation plan approved with the project), the Spanish Parliament adopted one amendment of the Air Navigation Law (article 63 of Law 55/1999, of 30 December, which introduces the Single Additional Clause of Law 48/1960, of 21 July, on Air Navigation), introduced a new concept to protect the land planning around the main airports: "Servidumbres aeronáuticas acústicas" = "Aeronautical acoustic easements". This was a new kind of aeronautical space limitation with a right of way. In order to comply with this law, the DGAC (Spanish Directorate General for Civil Aviation) must issue a favourable report about each land planning plan under a noise contour: 55dB LAeq_{day} 16h / 45dB LAeq_{night} 8h contour around the civil airports. Generally, they do not allow new housing, schools and hospitals inside this contour.

After END 2002/49

With the approval of EU Directive 2002/49/CE in 2002, as regards assessment and management of environmental noise, and its subsequent transposition to Spanish legislation, in the form of the Noise Law 37/2003 <https://www.boe.es/buscar/act.php?id=BOE-A-2003-20976> ([Spanish link](#)) and its partial implementing regulations set forth in Royal Decree 1513/2005, https://www.boe.es/diario_boe/txt.php?id=BOE-A-2005-20794 ([Spanish link](#)) a process was introduced which will culminate in the production of strategic noise maps and the subsequent elaboration of action plans for urban agglomerations, heavy-traffic road junctions, large railway junctions and major airports.

These regulations establish that strategic noise maps must be created and reviewed every 5 years for major airports, understood to be civil airports exceeding 50.000 commercial movements a year, counting both take-offs and landings, and excluding training flights in light aircraft.

Twelve airports with noise strategic maps and action plans ([English link, but *.pdf files only Spanish](#))
<http://www.aena.es/en/corporate/strategic-noise-maps.html>

The Law 37/2003 transposed the European Directive into Spanish law, in order to prevent, monitor and reduce noise pollution. Its article 7 delegates to the autonomous communities (regional authorities) the classification of acoustic areas, although they must plan at least the following:

- a) Residential areas
- b) Industrial areas
- c) Recreational and entertainment areas



- d) Tertiary areas
- e) Health, educational and cultural areas requiring special protection against noise
- f) Sectors of the territory for general systems of transport infrastructures
- g) Natural areas requiring special protection against noise pollution.

The Royal Decree 1367/2007 <https://www.boe.es/buscar/doc.php?id=BOE-A-2007-18397> (Spanish link) developed the Law 37/2003. In this Royal Decree criteria are adopted for the delimitation of the different types of acoustic areas. However, the most important aspects of RD 1367/2007 are those relating to the determination of the acoustic quality objectives applicable to acoustic areas (both for outdoor and indoor places) as well as the methods and processes for the evaluation of acoustic indices. It also contains a chapter about mandatory prevention and correction plans, and an important chapter about inspection and penalties.

Noise Related Operating Restrictions and Balanced Approach

All rules about airport noise regulation is in this link (only Spanish):

https://www.fomento.gob.es/MFOM/LANG_CASTELLANO/DIRECCIONES_GENERALES/AVIACION_CIVIL/INFORMACION/NORMATIVA/NORMATIVA_BASICA/INFRAESTRUCTURAS/RUIDO_AEROPORTUARIO/

Royal Decree 1257/2003 of 3 October, adapted Directive 2002/30/EC of 26 March 2002 of the European Parliament and of the Council to the Spanish legal code. https://www.fomento.gob.es/NR/rdonlyres/65989BC7-CF9C-4876-9774-F8B16C1EC8E3/96583/RD1257_2004.pdf (Spanish link)

Following this RD, there are two important resolutions one for Madrid and one for Barcelona:

- Resolution of 30 August 2006 of Spanish Civil Aviation Authority introducing operating restrictions in Adolfo Suárez Madrid-Barajas Airport, following the *Balanced approach* procedure of. https://www.boe.es/diario_boe/txt.php?id=BOE-A-2006-15622 (Spanish link) the content can be found in item 20 and 21 of AIP ESPAÑA AD2-LEMD https://ais.enaire.es/AIP/AIPS/AMDT_297_2018_AIRAC_14_15_2017/AIP/aip/ad/ad2/LEMD_MADRID_A_S_Madrid_Barajas/LE_AD_2_LEMD_en.pdf
- Resolution of 31 May 2011 of the Spanish Air Safety Agency (AESA) introducing operating restrictions in El Prat Barcelona Airport, following the Balanced approach procedure https://www.fomento.gob.es/NR/rdonlyres/016FB705-7939-4A0A-9BDC-0E41A6DED8B5/104566/RES_31052011_AESA.pdf (Spanish link) the content can be found in item 21 of AIP ESPAÑA AD2-LEBL https://ais.enaire.es/AIP/AIPS/AMDT_297_2018_AIRAC_14_15_2017/AIP/aip/ad/ad2/LEBL_BARCELONA_El_Pratt/LE_AD_2_LEBL_en.pdf

These resolutions are controlled by AESA. After Regulation No. 598/2014, the responsibility of the different aspects have not yet been established.

Other national policy instruments

What other national policy instruments are used to implement the ICAO Balanced Approach for the control of noise at airports? For example, planning procedures, environmental impact assessment, etc. Please use the subheadings provided below as a guide.

Control of Noise at Source

Directive 92/14/EEC on the limitation of the operation of aeroplanes covered by Part II, Chapter 2, Volume 1 of Annex 16 was incorporated into Spanish regulation by Royal Decree 1422/1992, of 27 November.



Noise Taxes and quota penalties are applied to the landing airport tax for those aircrafts that exceed the acoustic certification limits in place, which are based on International Civil Aviation Organization Annex 16 included in Art 76 of Air Safety Law 21/2003, of 7 July <https://www.boe.es/buscar/act.php?id=BOE-A-2003-13616> (Spanish link) for Alicante, Barcelona, Madrid-Barajas, Málaga, Palma de Mallorca, Gran Canaria, Tenerife Sur, Valencia, Bilbao, Ibiza, Sevilla and Tenerife Norte airports.

Noise Impact mitigation and communication

As a result of the Environmental Impact Statements of airports, there are 15 airports with insulation plans <http://www.aena.es/en/corporate/noise-insulation-schemes.html> and 19 Environment Monitoring Commissions in 19 airports.

Noise control system and procedures are established in 6 airports (Madrid, Barcelona, Málaga, Valencia, Bilbao y Alicante). The article 47 of Air Safety Law 21/2003, of 7 July include penalties relating to the discipline of air traffic in noise to punish these offences.

There are 6 airports (Madrid, Barcelona, Málaga, Valencia, Bilbao y Alicante) with webtrak <http://www.aena.es/en/corporate/interactive-noise-maps.html>

WebTrak provides replay of aircraft operations around the immediate area of the airport for the general public. WebTrak can show both recent and past aircraft operations around the airport. It shows the path taken by aircraft and as much information about them as is permissible.

In addition to showing the aircraft operations, WebTrak can show measurements of noise taken at specific monitoring locations. These measurements allow you to compare the noise made by aircraft operations in an area and whether operations have made unusual amounts of noise.

The most important framework about the citizens' rights and the governments bonds was established by an amendment of the Air Navigation Law in 2010.

https://www.fomento.gob.es/NR/rdonlyres/01E1AC25-666F-4C4B-BBFF-BB0C7DF2F6AB/136989/Ley5_2010.pdf (Spanish link)

Operational Procedures

Most Spanish airports have noise abatement procedures published in AIP. Most of these procedures was considered and assessed during Environmental Impact Assessment procedures of each airport. Only two of them have specific regulations about it, Madrid and Barcelona.

https://www.fomento.gob.es/NR/rdonlyres/9D3827D1-D67E-4581-8C74-5F78D40B12BD/76083/CA_2_2006.pdf (Spanish link)

https://www.fomento.gob.es/MFOM/LANG_CASTELLANO/DIRECCIONES_GENERALES/AVIACION_CIVIL/INFORMACION/NORMATIVA/NORMATIVA_BASICA/INFRAESTRUCTURAS/RUIDO_AEROPORTUARIO/CA_1_2006_PAG.htm (Spanish link)

Operational Restrictions

As mentioned before:

- Resolution of 30 August 2006 of Spanish Civil Aviation Authority introducing operating restrictions in Adolfo Suárez Madrid-Barajas Airport, following the *Balanced*



approach procedure of.

- Restrictions on marginally compliant aircraft. Operations involving aircraft that exceed the limit certification values in Vol. 1, Part 2, Chapter 3, Annex 16 of the International Civil Aviation Organization by an aggregate margin of 5 EPNdB (effective perceived noise in decibels) are prohibited.
- Restriction of aircraft movements during night-time period in parking stands on R-5, R-6 and the South Dock. Movements on R-5, R-6 and the South Dock are prohibited from 11 pm to 7 am LT.
- Resolution of 31 May 2011 of The Spanish Air Safety Agency (AESA) introducing operating restrictions in El Prat Barcelona Airport, following the Balanced approach procedure.
 - Restrictions on marginally compliant aircraft. Operations involving aircraft that exceed the limit certification values in Vol. 1, Part 2, Chapter 3, Annex 16 of the International Civil Aviation Organization by an aggregate margin of 5 EPNdB (effective perceived noise in decibels) are prohibited.

Land Use Planning (i.e. planning for future developments)

As mentioned before, aeronautical acoustic easements were legally introduced by article 63 of Law 55/1999, of 30 December, which introduces the Single Additional Clause of Law 48/1960, of 21 July, on Air Navigation, by which the acoustic easements are recognised as “legal easements imposed due to air navigation”.

By Law 5/2010, of 17 March, which modifies Law 48/1960, of 21 July, on Air Navigation, both the approval procedure of acoustic easements of airports is established as well as the period to approve those corresponding to airports with more than 50.000 operations per year.

Moreover, Law 37/2003, of 17 November, on Noise, also introduced the possibility of establishing easements in the land sectors affected by the functioning or development of transport infrastructure, and Royal Decree 1367/2007 develops the Noise Act in terms of acoustic zoning, objectives of quality and noise pollution, where the technical criteria are established to limit them.

The Noise Act defines the areas of acoustic easement as land sectors in which noise can exceed the acoustic quality objectives applicable to the corresponding acoustic areas and where restrictions can be established for certain use of land, activities, facilities or buildings, with the purpose of, at least, complying with the limit noise values established for them.

Acoustic easements are aimed at achieving the compatibility of the functioning or development of transport infrastructure, with the use of land, activities, facilities or buildings established in the area affected by the noise coming from said infrastructure.

Here is the link with the content of these documents ([English link, but *.pdf files only Spanish](#))

<http://www.aena.es/en/corporate/acoustic-easements.html>

There is a Commission with stakeholders created per each aeronautical acoustic easement of an airport which main objective is to follow up the action plan measures. ([Spanish link to the order of creation of each one](#))

https://www.fomento.gob.es/MFOM/LANG_CASTELLANO/DIRECCIONES_GENERALES/AVIACION_CIVIL/INFORMACION/NORMATIVA/NORMATIVA_BASICA/INFRAESTRUCTURAS/RUIDO_AEROPORTUARIO/CMSAPA.htm

There is no webpage available with the information of these organisations. If you need it,



you would have to write or call to the DGAC or AENA.

List of measures set in the action plans:

1. Control of Noise at Source
 - a. Promotion at international forums (OACI and EASA) of strictest requirements for noise aircraft certification.
2. Noise Impact mitigation and communication
 - a. Noise Tax
 - b. Noise Quota
 - c. Noise control system and procedures
 - d. Improvement noise calculation procedures
 - e. Webtrak and web noise reports
 - f. Environmental Office for citizens
 - g. Commissions and working groups
 - h. Control and Punish
 - i. Compensatory measures
 - j. Insulation Plans
3. Operational Procedures
 - a. Preferred runways and routes
 - b. Threshold displacement
 - c. Redesign and paths optimization (new technologies available)
 - d. Landing (CDA, CDO and reverse)
 - e. Take-off
 - f. Ground (APU, engine tested)
4. Operational Restrictions
 - a. Restrictions on marginally compliant aircraft operations
5. Land Use Planning (i.e. planning for future developments).
 - a. DGAC reports for urbanistic plans
 - b. Aeronautical acoustic easements

Guidance

What guidance documents are produced for airports to support ICAO Balanced Approach implementation?

Member States and their environmental or civil aviation departments often produce guidance on meeting legislative requirements such as END or the ICAO Balanced Approach. Does any such guidance exist in this Member State? How comprehensive is it? What methods do they describe in terms of monitoring, measuring and forecasting changes to airport noise that result from air traffic growth?

No public guidance found. Several organizations (AENA, ENAIRE) have their own guides and procedures (not published).

National Research Programmes and Projects

Please provide examples of research has been taking place in the Member State.

What research projects related to aviation noise are taking place? Who is conducting this research? What is the funding source, e.g. government, local authority, private? How much money is being spent on such research? What are the key outcomes? Examples may include work conducted by independent commissions, Knowledge Exchange projects or specific projects on certain aspects of aviation noise.

-
- No information available.

Evaluation
<p>Extent of END implementation.</p> <p><i>To what extent has END, and other aviation noise regulations associated with the ICAO Balanced Approach been enforced by government, airports, and local authorities?</i></p> <p>Aena's Integrated Quality, Environmental and Energy Efficiency Management Policy: http://www.aena.es/csee/ccurl/1018/801/2017_Politica_gestion_integrada_medioambiente_EN.pdf</p>
<p>Other national policy instruments?</p> <p><i>How have other policy instruments delivered on END outcomes? For instance Airport Master Planning requirements? How has the ICAO Balanced Approach been implemented?</i></p> <p>The Environmental Impact Assessment of projects (EIA) is an instrument enabling the preservation of natural resources and the defence of the environment by introducing the environmental variable into decision-making on projects which are predicted to have a significant impact on the environment.</p> <p>Strategic Environmental Assessment (SEA) is a preventive instrument permitting the integration of environmental aspects in decision-making on plans and public programmes, which is implemented by Airport operators and Air Navigation management for the environmental evaluation of its airports' master plans and Air navigation programmes or plans.</p> <p>In this regard, the legislation on strategic environmental assessment (SEA) on a national level is represented by Law 21/2013, of 9 December, for environmental assessment. This law, unifies, for the first time, the strategic environmental assessment of plans and programmes and the evaluation of projects' environmental impact in a single regulation. Thereby establishing a similar scheme for both procedures and unifying its terminology.</p> <p>On this basis, during the drafting process of the airports master plans or air navigation plans, the strategic environmental assessment procedure (SEA) is included as an additional measure, which concludes with the publication of the corresponding strategic environmental Statement in the Official State Gazette.</p> <p>The environmental assessment of projects provides greater reliability and trust in the decisions taken; a choice is permitted from different viable alternatives, in order to choose the one which, while safeguarding public interest, takes into account all the effects arising from the projected activity, from an overall, holistic viewpoint, ensuring adequate channels of information and public participation.</p> <p>https://www.enaire.es/about_enaire/sustainability_and_the_environment/environmental_assessment</p> <p>http://www.aena.es/en/corporate/strategic-environmental-assessment-sea-plans.html</p>



<http://www.aena.es/en/corporate/environmental-impact-assessment-eia-projects.html>

Royal Decree 1371/2007, of October 19, which approves the basic document "DB-HR Protection against noise" of the Technical Building Code and modifies Royal Decree 314/2006, of 17 March, by which the Technical Building Code is approved. <http://boe.es/boe/dias/2007/10/23/pdfs/A42992-43045.pdf> After this date, the insulation quality of the buildings must comply with this code, which contains specific instructions for aircraft noise.



SECTION B: BEST PRACTICE IMPLEMENTATION AT AIRPORTS

Please select one or two airports that you believe represent best practice regarding noise in the Member State.

Airport Name(s)	<i>Adolfo Suarez Madrid Barajas</i>
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Noise abatement through operational procedures

What procedures are the airport using to reduce airport noise impacts?

What procedures do each airport use to reduce noise exposure? This may be listed on airport websites or in their noise action plans, or elsewhere.

1. Preferred runways and routes: Preferred runways and routes are used for noise abatement so as to separate the initial and final flight paths. This includes the use of turns to move airplanes away from noise sensitive areas. In the South configuration, the night-time period is in effect from 11 pm to 9 am LT on Friday and Saturday nights, whenever allowed by operating circumstances. Standard instrument departures (SID) for the daytime period must be used for their assigned times.
2. Threshold displacement: the modification to the runway threshold is maintained, thus increasing the flyover altitude over towns near the airport and reducing the noise levels in said towns, as required by the Aeronautical Information Publication (AIP) and the Action Plan. Airport noise easements.
3. Noise abatement procedures during take-off: Aircraft cannot leave a standard instrument departure before reaching a flight level of 10.000 ft. The use of flight paths is limited to certain aircraft whose noise levels are higher than the rest. Moreover, noise abatement departure procedures (NADP) are also applied.
4. Noise abatement procedures during landing: in normal weather conditions, approach and landing operations are carried out at an angle equal to or greater than that defined by the GP of the ILS or PAPI for each runway. Landings on 18R must intercept the ILS in a minimum flaps and gear-up configuration until 5 DMEILS, as long as operational safety can be maintained at all times.
5. Implementation of continuous descent approaches (CDA): Continuous descent approaches (CDA) have been in use since 2010, replacing the stairstep approaches, which have a higher acoustic impact due to the change in engine thrust.
6. APU usage restrictions: the prohibition on using the airplane's Auxiliary Power Unit (APU) in certain parking stands is maintained, requiring instead the use of 400-Hz electricity supplied through mobile units or permanent connections on the jet bridge.
7. Restrictions on engine testing: Engines cannot be tested above idle thrust outside designated times and/or areas.
8. Prohibition to use reverse thrust: Reverse thrust cannot be used above idle thrust on certain runways at certain times, except for safety reasons.
9. Prohibition on training and test flights: No training or testing flights may be conducted in any configuration. No aircraft that is not in radio contact may enter the aerodrome.
10. General taxi, movement and parking procedure: Engines cannot be started up above idle thrust until the aircraft is lined up in the taxiway. Also, reverse thrust cannot be used to leave a parking stand that normally requires pushback with a tractor.

Land-Use Planning, management and strategic planning

How is the airport using land-use to reduce airport noise impact?



How does each airport describe the use of land-use management to mitigate the impacts of airport noise? This may be listed on airport websites or in their noise action plans, or elsewhere Interventions could include preventative planning procedures (e.g. zoning as well as specific mitigation actions).

Following the policies explained, the major airports must delimit the aeronautical acoustic easements areas. DGAC (Civil Aviation Authority) has to inform all the local and autonomous authorities for urban planning inside those areas. Final version of urban plans must include the recommendations of the DGAC. Among those recommendations are:

- The compatibility of noisier uses such as industries and leisure areas with the areas most affected by airport noise.
- Removal of sanitary, educational and residential uses from the noisiest areas.
- Strict compliance with the basic building regulations and the protection established there against airborne noise so that the acoustic quality objectives inside all kind of buildings are always guaranteed.

Operational restrictions

Does the airport impose any operational restrictions to reduce the impacts of noise?

How does each airport use operational restrictions to reduce noise exposure on the ground? This may be listed on airport websites or in their noise action plans, or elsewhere and may include, for example night flight restrictions.

1. Reduced operations of ICAO Chapter II: Aircraft since 2002, all operations involving aircraft certified under Chapter 2 of Annex 16, Vol. 1, Part 2, of the International Civil Aviation Organization have been prohibited.
2. Restrictions on marginally compliant: Aircraft Operations involving aircraft that exceed the limit certification values in Vol. 1, Part 2, Chapter 3, Annex 16 of the International Civil Aviation Organization by an aggregate margin of 5 EPNdB (effective perceived noise in decibels) are prohibited.
3. Restriction of aircraft movements during night-time period in parking stands on R-5, R-6 and the South Dock. Movements on R-5, R-6 and the South Dock are prohibited from 11 pm to 7 am LT.

Noise Impact Mitigation

What measures exist to reduce the impact of a given noise exposure, and other attempts to address non-acoustic contributions to impact. E.g. Community engagement.

For example, what is the airports policy on insulation, compulsory purchasing of housing, or relocation assistance? How does the airport communicate and engage with its local communities?

1. Flight path tracking and compliance: The noise monitoring system (SIRMA) at the Madrid-Barajas Airport is used to check for compliance with the noise abatement routes and procedures in place at the airport and to identify potential violations.
2. Noise fees and penalty quotas: are applied to the landing fee for those aircraft that exceed the acoustic certification limits in place, which are based on International Civil Aviation Organization Annex 16. Moreover, each airline has a total noise quota assigned for carrying out its operations that is based on the effective perceived and certified noise level.
3. Commissions and working groups: to discuss with the Regions the best solutions, to



adjust tracks to the paths and so on.

4. Insulation Plans: Noise Insulation Plans (PAA) in areas surrounding the airport as a result of the environmental impact assessment of its expansion projects, this plan is also carried out to comply with law 5/2010, of 17 March, regarding the execution of soundproofing actions included in the Action Plan associated with acoustic easement. The execution of Noise Insulation Plans is intended to minimise nuisance around airports due to the noise of aircraft during take-off, landing, taxiing, testing engines, etc. These Noise Insulation Plans are executed in housing and sensitive use buildings (education, healthcare and cultural uses requiring special protection from noise pollution), which are included in the isophone area of the corresponding airport, and which have a building permit dated before the publication in the Official Gazette of the Spanish State of the applicable resolution, with the intention of ensuring that the interior of these buildings meet the acoustic quality standards applicable to habitable interior spaces covered by table B of annex II of Royal Decree 1367/2007, of 19 October, implementing Law 37/2003, of 17 November, on noise, referring to acoustic zoning, quality standards and noise pollution.
5. Compensatory measures exist as a result of the environmental impact assessment of its expansion projects, and it is also carried out to comply with law 5/2010, of 17 March. Forest reforestation, wildlife centres and so on.

Complaints

What is the airport's approach to dealing with noise complaints?

How are complaints recorded? What is the airport's approach to dealing with complaints?

Madrid Barajas Airport has an Environmental Office for handling environmental, OFIMA, intended exclusively to process, record, handle and reply to queries of an environmental nature. In 2016, a total of 1.837 complaints and information requests were received from 205 individuals through the various channels in place. This was far lower than the number of complaints received the previous year.

You can contact OFIMA online <http://www.aena.es/en/madrid-barajas-airport/environment-office.html> , by mail OFIMA@aena.es, by telephone +34 913 936 710, Fax +34 917 466 704 and by letter Avda Hispanidad s/n / T-2, Control C; 28042 Madrid.

But the most useful way to send a complaint is through the webtrak <http://webtrak5.bksv.com/mad5>

WebTrak provides replay of aircraft operations around the immediate area of the airport for the general public. WebTrak can show both recent and past aircraft operations around the airport. It shows the path taken by aircraft and as much information about them as is permissible.

In addition to showing the aircraft operations, WebTrak can show measurements of noise taken at specific monitoring locations. These measurements can allow you to compare the noise made by aircraft operations in an area and whether operations have made unusual amounts of noise.

**Comments**

Are there any areas where you think the airport has exemplified good practice, or areas where they may need to improve practice?

The airport participates in several workings groups with numerous stakeholders, but we could not find online information about it (meeting minutes, working group activities, significant works and so on).

9 Annex C: Example of Interview Protocol

ANIMA WP2.1 Interview Protocol

Introductory statement.

Thank you for taking the time to participate in this interview survey regarding airport noise. You have been chosen to participate in the survey because you are an important and valued stakeholder in the air transport industry, and have the ability to influence the impact of, or are impacted by, aircraft noise.

This research is part of an EU funded research study called [ANIMA](#). Over 20 European partners are conducting ANIMIA, the ambition being to develop new methodologies, approaches and tools to manage and mitigate the impact of aviation noise on airport communities, leading to an increase in the quality of life for such communities.

This part of the research is about understanding the different perspectives on noise impact mitigation and the effectiveness of current interventions, for instance through land-use planning and management, or changes to operational procedures.

The findings of the research will be written up in the academic literature and in public-facing reports. Dissemination will also take place through workshops, conferences and committee meetings. It is hence your opportunity to help shape the future of airport noise management and policy across the European Union.

Completing the interview should take approximately 1 hour. You do not need to respond to all questions if you do not wish to. Your responses will be recorded but can be made anonymous in any public dissemination if you so wish. Audio from the interview will be recorded to help with transcription and later data analysis. This audio will only be accessed by the interviewer and will be responsibly disposed of after use.

The questions do not ask you to disclose any personal information. You should have received an information sheet in the invitation email to this survey that includes more information about ANIMA, however, if you have any further questions please do not hesitate to get in touch.

Noise Impacts

This section is about understanding your perspectives on the impacts of airport noise to local communities.

- How would you describe the impact of an airport on its locality?
- How much of an issue do you believe noise is to the communities around airports?
- Overall, do you believe that airports provide a benefit or a dis-benefit to the areas in which they are located?
- Where would you rank noise against other environmental impacts associated with airport activity, for instance local air pollution or climate change?

Noise Policy and Guidance

This section looks to understand your opinions on existing noise policy and guidance regarding noise. Policy can come from a range of sources, for instance at the EU or the national level, whilst guidance for different aviation sectors can come from governments, NGOs or industry bodies. Policy typically sets out legislative requirements and practices regarding noise, for instance noise level limits and rules around night flights, whilst guidance can provide guidelines on best practice and practical recommendations on how policy can be adhered.

- Are you familiar with aviation noise policy and legislation? If so, how successful has policy been at addressing issues of noise, for example END, BA implementation? Does policy go far enough? Too far?
- Do you feel that that air transport stakeholders have been given enough guidance to effectively monitor, mitigate and manage noise?
- If you are familiar with the Environmental Noise Directive END, do you think that noise action plans have proved effective? Do you believe that the industry is given enough guidance when completing such action plans?
- Are there any legislative interventions that you would like to see implemented regarding airport noise mitigation and management?
- Are there any areas in which you believe research may be required to provide additional knowledge and expertise on noise impacts and management?

Reducing noise impacts

The next few sections regard interventions by air transport industry stakeholders to reduce the impacts of noise. Here we are looking to understand the effectiveness of interventions at the airport level, by highlighting the strengths and weaknesses of current practice, and areas where noise impact management can be improved.

Noise abatement through operational procedures

Aircraft operations have direct impacts in terms of noise impact. It is possible for aircraft operations to be subject to different procedures that may reduce noise exposure on the ground, for instance use of noise preferential routes and low-noise procedures for take-off and landing.

- In terms of operational procedures, what interventions do you think have been effective?
- What future operational procedures/developments hold potential to abate noise impacts?
- Do you believe that changes to operational procedures have a negative impact on the air transport industry?
- Do you think that operational procedures go far enough in terms of protecting local communities? Do they go too far?

Land-use planning (LUP)

Land-use planning and management can help minimize the population affected by aircraft noise, for example by introducing land-use zoning around airports.

- How effective do you believe land use planning has been in reducing the impacts of noise, for example for preventing the encroachment of noise sensitive building developments around airports?
- Do you think current land use planning management goes far enough, could airports do more?

- What improvements can be done regarding Land Use Planning, for instance in terms of legislation or practical interventions?

Operational restrictions

Noise restrictions can result in the banning of certain types of aircraft, or involved curfews, night time restrictions, noise quotas/budgets, cap rules, and restrictions related to the nature of flight and restrictions relating to operational procedures.

- Are you aware of examples of operational restrictions used to control noise (in your nation)?
- Which operational restrictions do you regard as being most effective? Least effective?
- Do you agree that operational restrictions should be the “last resort” of the ICAO Balanced Approach as is currently the case?
- Are there any further operational restrictions you would like to see imposed?
- With respect to night flights, do you think that restrictions go far enough? Not far enough?

Noise Impact Mitigation

Noise impact mitigation refers to measures that aim to reduce the impact of a given noise exposure, for example, airports may have a policy on insulation compulsory purchasing of housing, or relocation assistance. Mitigation may extend to addressing non-acoustic factors known to exacerbate the human response to noise, e.g. negative attitudes towards airports can result in heightened levels of expressed annoyance. Increasingly airports are seeking to address such non-acoustic factors in their noise management strategies.

- In your experience, do airports use measures such as insulation, relocation, compensation etc., to mitigate noise impact?
- How effective do you believe such measures are?
- Noise complaints represent an important for of communication between airports and airport communities. Do you think that airports that you have engaged with have an effective complaints management process? For instance, recording, communicating and taking action on complaints?
- Are you aware of any efforts by airports to address non-acoustic factors directly, e.g. improved communication and public participation in decision making designed to facilitate acceptance of airport operations/development.
- Are you aware of a wider debate over both positive and negative contributions of airports to quality of life? If so, what attributes are being discussed in your networks?
- Are there any other communication engagement activity in which airports should be engaged?

General thoughts and perceptions

This final section looks to understand your thoughts and perceptions regarding airport noise in general.

- Who do you think should be responsible for reducing airport noise impacts?
- How seriously do you believe the government (European and national) takes the issue of and airport noise?



- How effective do you believe the efforts of the aviation industry to control noise impacts have been?
- Do you have any other comments regarding airport noise that you would like to make?

Thank you for taking part in this interview. Should you have any questions or concerns please get in touch at g.heyas@mmu.ac.uk or +44 (0) 161 247 6799.