ANIMA

Aviation Noise Impact Management through Novel Approaches

D2.9 Recommendations for the implementation of the exemplification case studies

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 769627

European Commission

Horizon 2020
European Union funding
for Research & Innovation

Project Information	
PROJECT ID	769627
PROJECT FULL TITLE	Aviation Noise Impact Management through Novel Approaches
PROJECT ACRONYM	ANIMA
FUNDING SCHEME	RIA – Research and Innovation action
START DATE OF THE PROJECT	01.10.2017
DURATION	48 months
CALL IDENTIFIER	H2020-MG-2017-SingleStage-INEA
PROJECT WEBSITE	www.anima-project.eu
Deliverable Information	
DELIVERABLE N° AND TITLE	D2.9 Recommendations for the implementation of the exemplification case studies
TYPE OF DELIVERABLE[1]	R
DISSEMINATION LEVEL[2]	CO
BENEFICIARY NUMBER AND NAME	2 - Manchester Metropolitan University
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WORK PACKAGE N°	2
WORK PACKAGE LEADER	Delia Dimitriu, MMU
WP LEADER VALIDATION DATE	XXXXX
COORDINATOR VALIDATION DATE	
COORDINATOR SIGNATURE	

[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.
[2]Use 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 Introduction to ANIMA and the Roundtables

1.1 What is ANIMA?

ANIMA (Aviation Noise Impact Management through novel Approaches) is a comprehensive research project, which addresses a critical issue for Europe: Aviation noise. It is granted and supported by the Horizon 2020 Research and Innovation Programme of the European Union. The overall objective of this €7.5 million project is to develop new methodologies, approaches and tools to manage and mitigate the impact of aviation noise, enhancing the capability of the aviation system to respond to the growing traffic demands.

1.2 What are these roundtables?

This Deliverable presents the proceedings of roundtable discussions that took place in Work Package Two as part of Task 2.4. The report represents the findings that were presented to workshop attendees and provides key feedback provided by participants of both.

Two workshops took place as part of this milestone. The first took place in Brussels on the 3rd July with airport end-users invited via members of the ACI Europe Noise Taskforce – the intention being to obtain perspectives of airport end users actively dealing with noise management challenges. The second workshop took place on September 12th at the International Congress on Acoustics in Aachen, with the intention of gaining the insights of experts in noise, health and annoyance.

These roundtables were supplemented by a series of interviews with 'Starting the Journey' airports, defined in ANIMA Deliverable 2.1 as "Those who are beginning their journey into noise management and mitigation". This additional step was taken to ensure that the views of such airports played a strong role in the validation of WP2. The input from these interviews is provided in Section 4.

1.3 Format and rationale of this report

This report presents the information that was provided to participants in the Roundtable discussions for their feedback and discussion, and details the key outcomes of the discussions that took place. First, findings regarding noise and health are presented, followed by a detailed assessment of Balanced Approach noise mitigation initiatives are presented, followed by pertinent round. At the end of each section, key roundtable feedback is provided. The report closes with a summary of core messages and recommendations to ensure wider endorsement of proposed content of the BP Portal (WP5), priorities for future research (WP3), and emerging tools to inform model and scenario building (WP4).

2 Key Finding: Health Impacts and the role of Non-Acoustic Factors (Task 2.2)

This task was composed of two sub-tasks. The first focused on a review of evidence of long-term health impacts associated with aircraft noise exposure and the second explored the role of annoyance and its contributors in mediating these effects and the implications for noise management strategies.

The first sub-task provided an overview of the considerable evidence collected by researchers investigating the health implications arising from aircraft noise exposure. Specifically, it sought to review and update the meta-analyses conducted on behalf of the World Health Organization (WHO) to inform their latest Environmental Noise Guidelines for the European Region (WHO, 2018). The WHO evidence base has been supplemented with a review of research published since the cut off for the WHO meta-analyses (circa 2014). The substantive health impacts reviewed covered the following outcomes:

- Cardiovascular diseases
- Sleep disturbance
- Annoyance
- Cognitive impairment
- Mental health/quality of life (QoL)
- Hearing impairment
- Adverse birth outcomes
- Metabolic diseases

On the basis of these substantive literature reviews community health risks were summarised, acknowledging the inherent uncertainty in the evidence base.

2.1 Key finding: Health Impacts

Substantive health impact reviews demonstrated that a general stress-model is the theoretical background for the assumed link between acute psychological and physiological responses of individuals to aircraft noise exposure and long-term health impacts. The evidence highlighted that researchers have been able to measure short-term physiological (and psychological) responses to noise exposure with reasonable accuracy and confidence.

Meta-analyses of epidemiological studies undertaken on behalf of the WHO and our review of subsequent studies showed positive associations between aircraft noise exposure and ischaemic heart disease, annoyance, reading and oral comprehension and sleep disturbance during the night. For other health outcomes statistically, significant associations were not consistently observed. Whether this is due to the lack of association or due to the unresolved uncertainties in the research is still unknown, future studies should focus on addressing these limitations.

The position of the WHO appears to be that whilst the evidence supporting the associations between aircraft noise exposure and health impacts is of 'moderate quality', future research may improve this quality and result in firmer associations. As a result of this position the WHO 'strongly recommends' that noise levels produced by aircraft should be reduced to below 45dBA L_{den} and 40dBA L_{night} (2018b:6) based on the percentage of highly annoyed and highly sleep disturbed people, respectively. The WHO regards these as critical health outcomes in their own right as well as potential mediators of other long-term health impacts.

Our report acknowledges the WHO position when highlighting that health outcomes are only one important segment of more comprehensive assessments of the health impacts of policies, plans and projects in diverse economic sectors using quantitative, qualitative and participatory techniques. For example, it is important to consider the positive role played by the air transport industry in terms of socio-economic contributions.

2.2 Key finding: Implications for Noise Management

At the most basic level these WHO recommendations require political processes to be established that allow for the balancing of the costs of achieving reductions in risks to health (in terms of the economic and social cost of constraining airport/aviation development) against those borne in terms of risks to the health of populations exposed to noise. In the meantime, it is desirable that every effort is made to ensure effective and efficient use of any resources deployed to mitigate risks. With this in mind, the WHO reviews, and that conducted as part of this sub-task in ANIMA, highlight the importance of addressing annoyance and sleep disturbance as the most critical outcomes; given that on the one hand it represents direct disturbance and irritation of residents living near airports and on the other hand persistent annoyance has been linked to other adverse health effects through the stress mechanism. Consequently, it can be hypothesised that reducing annoyance and sleep disturbance will decrease adverse health effects of aircraft noise and improve well-being/quality of life.

Thus, the report concludes that in order to optimise efforts to mitigate these health risks airports and other aviation actors should focus on annoyance outcomes in addition to conventional attempts to reduce noise exposure.

The role of annoyance and how best to address this in management strategies was the focus of the second sub-task within the general review of noise impacts conducted in Task 2.2. The main aim of this sub-task was to systematically derive scientifically well-founded and substantiated recommendations on practicable and actionable measures to reducing aircraft noise annoyance. A thorough review covered the following areas:

- Scoping definitions of aircraft noise annoyance.
- An overview of the Balanced Approach guidance and implementation.
- Exploration of the word 'noise', and moreover, the meaning of 'annoyance' in general to establish a more comprehensive vision of the nature of the impact that aviation stakeholders are attempting to manage.

- Detailed exposition of the acoustic and non-acoustic factors contributing to noise annoyance accompanied by a discussion of the implications for noise communication and engagement.
- Development of multi-faceted approach to noise management considering both acoustical and non-acoustical factors in light of a critical review of the efficacy of existing noise management interventions. The latter revealing the need for further research and enhanced noise management.
- Summary of the constituent elements of what is described as a more comprehensive approach to noise impact mitigation encompassing more refined elements of communication and stakeholder engagement.

2.3 Key finding: Non-Acoustic Factors must be Addressed Directly

The detailed review of historic noise management interventions and the contributors to noise annoyance highlighted the significance of non-acoustic factors in determining the human response to noise exposure. Specifically, certain non-acoustic contributors were identified as potentially amenable to management interventions by the aviation sector – namely those relating to attitude to the source, capacity to influence ('voice'), perceived control and trust. The implication being that a comprehensive response to ameliorate the health impacts associated with noise exposure should address both acoustical and non-acoustical contributions to annoyance.

2.4 Key finding: A Substantive Role for Communication and Engagement

Potentially modifiable non-acoustic factors were identified as amenable to enhanced communication and engagement with affected communities. The review of approaches to communication and engagement provided indications as to how aviation actors should design communication and engagement processes that are likely to influence the non-acoustical factors contributing to noise annoyance. They implied that:

- Communication should be underpinned by a 'common language' that is comprehensible to all.
- Access to expertise should be available to all.
- Decision-making processes are inclusive, transparent and allow the validity of claims to be challenged.

2.5 Key Finding: Community Empowerment

The findings demonstrate that airports must shift from information provision and limited consultation to participation and empowerment if community engagement is to be genuine and influence the non-acoustical factors known to exacerbate annoyance responses. Further, if participation is to be secured and meaningful (and thus likely to influence attributes like attitudes and perceptions of fairness and trust) then communication and engagement should relate to issues that affect the participants i.e. relate to noise management or wider QoL issues directly impacting on communities close to airports.

2.6 Key Finding: Need for Systematic Evaluation of Community Engagement

Enhanced communication and engagement provides an opportunity to address annoyance directly through affecting non-acoustical contributions to the annoyance response. However, whilst some airports at the lead-edge have been experimenting with such approaches there has been little/no systematic evaluation of these efforts, nor indeed the wider consequences for more traditional exposure-reduction interventions (e.g. for impact on QoL for example). Further, research into the efficacy of certain forms of communication and engagement is so limited as to be of little use to airports when designing noise management interventions or more general community outreach programmes. This may explain why in many cases airport community engagement efforts do not yield the intended benefits for airports and communities alike.

2.7 Key Finding: The 'Process' of Noise Management is Central to Determining Outcomes

To date much of the industry focus has been on noise reduction at source complemented by exposure reduction/management through application of the 4 Pillars of the Balanced Approach. Whilst this is entirely appropriate, if the societal benefit of these initiatives is to be optimised, these efforts should be underpinned by communication and engagement activities designed to involve exposed communities in decisions that affect them. In so doing airports can help address the perceived lack of control that can alienate communities and lead to poor attitudes to airports with consequent negative implications of annoyance responses. In other words, by focusing on the process by which change is designed, decisions are made on options, procedures are implemented and appropriate monitoring regimes determined, more socially acceptable outcomes should arise that may have beneficial impacts on tolerance/annoyance levels.

Such an approach requires evaluation of the outcomes of interventions that extends beyond the objective assessment of changes to noise exposure to embrace wider impacts such as that on annoyance, acceptability of management outcomes, attitudes to the source (airports) and QoL more generally. This in turn demands new approaches to research into the efficacy of Balanced Approach interventions.

Questions for reviewers [3]

- Do you agree with the idea to address annoyance directly in response to the WHO guidelines?

- How can impact studies be improved?

  - How can we capture 'noise dose' more effectively
  - Are there better noise exposure descriptors

- We argue that *Comprehensive* noise management must address impact directly (i.e. annoyance) and not just noise exposure

  - Are target non-acoustic factors amenable to influence?

- Community engagement/empowerment – do you agree with the importance of establishing a 'common language' to underpin engagement processes?

- Should intervention evaluation extend beyond acoustic outcomes – e.g. perceived value/impact on attitudes/QoL.

2.8 Feedback from Roundtable with ACI Europe Noise Taskforce members:

- It is good that the WHO report has been published as it has led to useful discussions but in the main it has been unhelpful. The timing and lack of context (as to the impact of 40dB) has led them to be used by a 'vocal minority' at certain airports when this is an unrealistic target.
- It would be impossible to make policy based on the WHO report without shutting down most airports (and road and rail networks).
- The levels cited in the report have actually increase annoyance as it has made people feel like they are getting an illness.
- There has not been an effective cost-benefit analysis on the report in terms of the significant benefits that the airport can bring to people.
- Agreement in the room that focusing on Non-Acoustic Factors is sensible – although this should not be at the cost of reducing noise exposure.
- For some people there is no turning back (in terms of their views). It would be better to focus on helping the silent majority of people who are affected and who it might be possible to help. Too much airport communications is about helping the vocal minority – there should be more focus on those who are not necessarily complaining.
- Forums are useful but spokespeople are usually democratically elected from those who shout the loudest – the result is an over representation of that group. Groups need to be more representative of their communities.
- How airports can help communities beyond socio-economic benefits is an important area for future attention – airports are in a position to make strong positive contributions to Quality of Life.

2.9 Feedback from Roundtable with experts at the International Congress on Acoustics Conference:

- Approaches need to be fully integrated – technical, acoustic, and non-acoustic. You have to remember that people's personal 'journey' in noise management has started before they are engaged with. You are generally 'playing catch up'.
- You can't target people based on their 'noise sensitivity'. Things become complicated very quickly – i.e. people will question why their neighbour gets a benefit when they do not.
- The problem with the WHO report is that it used noise metrics that are not most applicable to communities and their understanding of and experience of noise. This was disappointing.
- Interventions have to be at the population level – not the individual. Packages offered to whole communities not just people. But at the same time there is an awareness that "Thou shall not average" – there is no such thing as an average person. The problems with noise arise at the deviations from average. Addressing average may tackle the most people but it will not help those who are most annoyed. So it may be worth tailoring responses to reflect the most affected in any communities.
- Annoyance is an early warning system for health outcomes. Non-acoustic factors are therefore essential to be considered. If you are reducing annoyance you are going in the right direction.
- Awakenings are important to consider but this too is linked to non-acoustic factors as people's perception of the airport and of noise will impact their reported awakenings. We have to look at physiologic reactions to noise to really see what is going on inside people and what the true health impacts are.
- We should not ignore those non-acoustic factors that have been identified as 'not or not easily modifiable'.
- Messages about the airport and its noise should not originate from the airport – they should come from an independent source or from the government. This has been successful at Vienna and has been successful at Heathrow.
- Competence raising is extremely important – but it is important to do so using a common language.
- Engagement timing is important. It should come before any changes or people will feel manipulated and you will lose trust. People must be engaged with pro-actively.
- It is importantly to consider annoyance but to never actively talk about it – people do not understand it and you can't tell someone you are or are not annoyed.
- 'Perceived control' of noise is less about controlling the noise itself, but in controlling you reaction to the noise.
- Technology should be pursued – technology such as noise cancelling ear pieces to provide true silence to residents at night time – this may offer a new means of personal control over noise intrusion.

3 Detailed Assessment of Balanced Approach Noise Mitigation Initiatives (ANIMA Sub Task 2.3.1.)

Recently, ANIMA researchers have performed a detailed assessment of Balanced-Approach implementation by airports in the European Union to identify the range of operational improvements, land-use planning interventions and operational restrictions introduced to address specific noise management challenges. This assessment was based on a range of airport case studies[3], which explored examples of balanced approach interventions and established their contribution to noise impact reduction.

3.1 Key finding: Motivations for implementing a noise abatement intervention.

The assessment found that larger airports had more advanced portfolios of Balanced Approach interventions, and a more rigorous processes underpinning specific interventions; community engagement was in particular found to be more advanced. Smaller but rapidly growing airports were, however, found to be developing their own approaches to noise abatement, either due to regulatory and legislative requirements, or due to the desire to address emerging land-use planning issues.

Although the specific cases of Balanced Approach intervention selected in this Sub-Task may not be fully representative of the wider approach to noise management taken by the selected airports (or others), it is noticeable that case studies from airports regarded as being at the cutting edge of noise management demonstrated a high degree of learning with regard to community engagement. Both Vienna and Heathrow for example were responding to community suggestions and requests for new flight paths, rather than acting with the specific intention of reducing complaints, as per the case of Barcelona. This matches the findings of ANIMA which show that effective community engagement is one of the best ways to manage the human response to noise.

Smaller airports showed a strong commitment to noise management, with specific focus on land-use planning, suggesting that this is a pressing concern for rapidly growing airports. This is important as stopping encroachment of noise sensitive developments near airports is perhaps the best way to avoid noise impact in the future. The rapid growth at such airports (i.e. 43% increase in passengers at Iasi since 2016) suggests that citizens may be becoming newly aware of the impacts of airport noise on their quality of life, and that such concerns are only just beginning to reach airport managers and regional municipalities, local authorities and property developers. It is important to engage with such communities in an open and transparent fashion in order to establish trust and to take their concerns into account. Likewise, growth in aircraft movements will inevitably lead to requirements for land-use based changes, for example through new or extended runways. The case study conducted in Kiev is indicative of a forward-thinking airport that is looking to achieve compliance with

[3] 13 airport case studies were completed in total covering a wide range of experience and geographical locations. Case airports were: ACNUSA, Arlanda, Barcelona, Catania, Cluj, Frankfurt, Heathrow, Helsinki, Iasi, Kiev, Ljubljana, Schiphol, Vienna.

future anticipated regulations, and is an example of where European policy is acting to guide airports outside of the European Union in their move towards reducing noise impact and exposure.

In terms of the motivation for the interventions in each case study, six categories of motivation where identified, which may act as a useful structure for presenting information in the Best Practice Portal. These are summarised in Box 1.

Box 1: The motivations that drove the interventions studied in each airport case study.

- Two-way dialogue. Interventions implemented as a result of the airport listening to community suggestions for changes to operations. This is a pro-active approach, initiated by the communities, and acted upon by the airports.
- Communities complaining. Where interventions have been implemented due to local communities and groups complaining. This is an airport driven response to reduce complaints.
- Predicted growth, not land use driven. Changes made when the airport is not yet at capacity and the same number of runway/s can be used i.e. utilising existing infrastructure.
- Predicted growth, land use driven. Changes made when the airport needs to expand capacity through extension of the existing runway or expansion through an additional runway i.e. infrastructure expansion.
- Reducing impacts. The key driver for the intervention is a combination of the need to reduce noise, fuel, and emissions.
- Strengthening Community engagement. A situation where there is a need to strengthen the relationship with local communities, typically at new or fast-growing airports that want to avoid making mistakes or to simply to learn from experience of others.
- Regulatory. Airports that need to deal with new regulation implementation (e.g. EU Environmental Noise Directive, END) or how regulatory frameworks can help in making sure some element of BA such as land use be more effective in reducing noise exposure and complaints.

Research conducted in previous phases of ANIMA found that in the case of some airports with less than 50,000 movements per year (Iasi, Cluj Airports), an unclear legislative existed framework to reflect the designation of responsibilities among authorities to manage aviation noise led to difficulties in establishing the extent of involvement of all interested parties. This can hold back airports in understanding the best steps to be taken in beginning their noise management journey.

A case study at Cluj-Napoca Avram Iancu looked at the use of preferential runways and night restrictions at the airport to avoid over flying Cluj city centre, and therefore avoiding a highly populated area. This was a useful case study to inform both on the implementation of operating restriction and operational procedure noise abatement interventions. Prior to the production of strategic noise maps and noise action plans in 2012 noise was not a concern for the airport, however these documents helped to understand how important noise management is for the sustainable development of the airport. The adoption of preferential runways represents an example of an airport transitioning from the

beginning steps of noise management, towards the type of practices implemented by larger airports.

Iasi airport in Romania looked to understand the impact of noise from the airport on its surrounding communities with specific focus on the use of land use and zoning around airports. It found that legislative changes are required to include and efficiently support land-use planning and management around airports, despite some provisions being made within the National legislative framework. In addition, guidance for ensuring a proper understanding and application of land-use planning and management for all relevant stakeholders was an identified as a priority.

The case study at Ljubljana Airport, Slovenia, looked at the noise management strategies conducted and proposed by the airport. Here, an important issue was related to the necessity to establish a legislative framework for airports that cannot be classified as major airports. There is a lack of noise policies or unclear and ineffective provisions for aviation noise below the 50,000 annual movements as required by the European Noise Directive. This results in poor involvement of the relevant stakeholders in noise management. The concern is that there are many airports that may take 20 years to reach this threshold and so are without adequate guidance until this time.

3.2 Key finding: Underpinning intervention processes.

Successfully implementing a noise abatement intervention is underpinned by five broad steps from identification through to post-implementation evaluation. Although airports were found to be, in effect, taking considered approaches throughout the process of implementation - for example via the use of stakeholder engagement, trials, modelling and monitoring - there was no evidence of any clear prescribed and systematic processes being used by any of the case airports. The variable nature of different Balanced Approach elements, or even specific interventions, suggests that there may be some validity taking such a tailored approach, however identifying core principles that underpin each implementation phase could have value for airports. This could for example take the form of a series of questions that airports should answer at each stage of the process to ensure the level of transparency and procedural fairness advocated in ANIMA Deliverable D2.4. An example of such a staged process for the introduction of a new operational improvement is given in Annex 1. A key observation from the described processes is the importance of speaking to stakeholders early to identify what data is pertinent to them and where noise-monitoring terminals should be located. Such dialogue can also help to identify how this data should be reported back to stakeholder groups, and via what metrics.

3.3 Key Finding: The role of communication and engagement

It seems essential that airports have fully integrated communication and engagement in the delivery of a Balanced Approach intervention from the identification of the need for a change, through to Post-Implementation evaluation. Although none of the airports studied went as far as considering impacts on quality of life and annoyance in their evaluations, the literature studied in ANIMA health research suggests that this would also constitute best practice. For effective noise management, communication and engagement

appear to be integral and should therefore be more fully integrated into the ICAO Balanced Approach. Rather than being considered as an ancillary measure, or even a 5th pillar, communication and engagement should run across, and be fully integrated into all existing Balanced Approach interventions, and through all the processes that underpin the full delivery of a given intervention. In so doing airports will be able to optimise the how interventions are implemented, build trust, avoid mistakes (that can break trust), and to better ensure that there is integration across this different balanced approach elements, as illustrated in Figure 1 below.

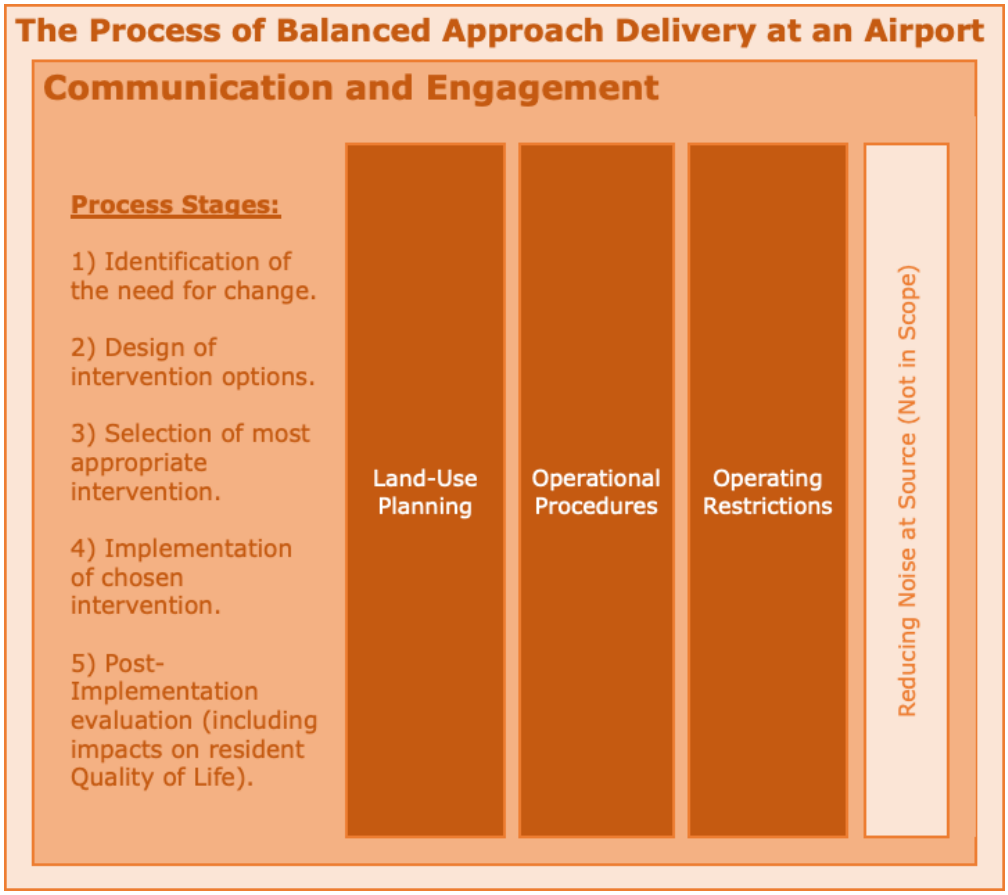

Figure 1: illustrating the role of communication and engagement in the effective delivery of Balanced Approach interventions.[4]

It is essential that communication efforts address the full range of stakeholders who have the potential to impact the production of, or to be impacted by, aviation noise. Engaging with communities ensures that their specific concerns can be responded to – and importantly be understood. By understanding these concerns, the requirements for dissemination can be determined. For instance, one community may be concerned with the number of over-flights per day, whilst another may only be interested in the number of departures of a given aircraft each day.

[4] Reduction of noise at source has been excluded from this diagram to reflect the fact that this is difficult for airports to influence other than indirect measures such as noise charges.

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3.4 Key finding: Land Use Planning

Land use planning across the different case studies was highlighted as being critically important, with significant implications for the community perception of noise, and for community engagement. For those airports where land use planning was the key implementation element, it was demonstrated that there is a lack of national legislation that can empower airports to have a role in the land use planning decision process. Two case studies, namely Kiev and Catania airports, provided very good examples of best practices of land use planning, in particular how the national legislation helps that process and ensures that zones surrounding the airports are subjected to as little as possible uncontrolled or commercially driven development of inappropriate land uses. Both case studies have drawn attention to the key role of collaboration and communication between airport and related local authorities. In so doing the needs of each party can be understood, and the long-term implications arising from development of noise sensitive buildings close to airports can be disseminated to regional decision makers. Thereby the long-term health and economic future of the region can be safeguarded – the airport is better able to grow, whilst the health impacts of living near an airport can be mitigated. How best to establish appropriate and novel land-use planning techniques around airports should be an area for increased attention by the research community. The link between the introduction of new operational procedures and LUP needs to be further explored. This is particularly the case for small but rapidly growing airports that have the opportunity to stop local developments near an airport before they occur. For airports suffering from encouragement by noise sensitive developments, such as Heathrow, the challenge is distinctly different and requires bespoke solutions.

3.5 Key finding: Rapidly growing airports should consider Balanced Approach to avoid future restrictions

As air traffic growth is expected to be higher for Starting the Journey Airports than for 'Experienced Travellers' and 'Pathfinders', noise exposure and impact are expected to become the most pressing environmental issue and constraint for aircraft operations.

Without effective planning and incorporation into strategic decision making, organisations are forced to become more reactive, rather than proactive - potentially leading to increased costs, trade-offs and being left out of longer-term decision making and planning by other authorities. Such authorities gain the potential to inform on the political and legislative landscape that emerges.

The ICAO Balanced Approach offers the potential to study and manage aviation noise, particularly in the absence where any other guidance is available. However, work carried out in ANIMA to understand the needs and perspectives of Starting the Journey airports has identified that although most parties involved in aircraft noise management are aware of the Balanced Approach, further guidance, training and awareness raising should take place to help guide such airports – for example through the proposed ANIMA Best Practice Portal. This is particularly the case for land-use planning, where airports face competing interests for regional economic growth desired by local authorities and residents, with the desire to reduce noise exposure and impact to those same citizens.

A key output of ANIMA is to aid the development of these rapidly growing airports. To this aim we conducted a series of interviews with such airports and present the findings separately in Chapter 4, including recommendations for the Best Practice Portal, Future Development, Challenges, airport responses to noise, and the pressures to act on noise.

3.6 Key finding: Interdependencies

Analysis of the case studies shows that interdependencies were only considered in a small number of cases, and usually only as an ancillary factor to noise. The primary exception is Amsterdam Schiphol where fuel reduction was the primary motivator for the studied intervention – with reductions in noise also achieved. Although this represents a win-win situation, one could argue that in this specific case, noise was the interdependency to fuel reductions. In general, larger airports considered interdependencies more often compared to smaller airports. Interviews supported those carried out in Task 2.1 of ANIMA where the general opinion of local communities is that noise is by some distance the most important issue. Air quality has some importance, and Greenhouse Gas Emissions associated with climate change are the least important factor. For those living further away from the airport, climate change rises in importance. Pressure for fuel savings typically comes from industry stakeholders such as airlines.

3.7 Key finding: Tools for Noise Management

From the review of existing literature and the case studies identified and studied in this task, a set of tools have been identified according to four main categories namely Noise Modelling/ Mapping, Noise Monitoring/Management, Noise Forums and Noise Publications. Starting from trajectory visualisation tools and continuing with online real time depictions of noise contours, there is a great variety of tools used by different airports that bring an important contribution to the application of ICAO Balanced Approach principles. Table 1 summarises the different tools encountered during state of art research and fieldwork for the development of case studies, followed by a description of some.

Table 1: Noise tools used by Airport and case studies

Category of Tools	Tool	Reference to Case Studies
Noise Modelling/ Mapping	BaseOPS software pack (including NoiseMap suite)	(Cluj Airport Case Study, Iasi Airport Case Study)
	INM-AEDT	-
	IMMI	-
	IsoBella Model	(Boryspil Airport Case Study)
	Predictor-LimA	-
	SoundPLAN	-

Noise Monitoring/Management	ANOMS	(Heathrow Airport Case Study)
	CadnaA	(Iasi Airport Case Study)
	NoiseDesk	-
	Virtual Community Noise Simulator (VCNS)	(Stockholm Arlanda Airport Case Study)
	WebTrak	(Barcelona Airport Case Study, Heathrow Airport Case Study)
	WebTrak MyNeighbourhood	(Heathrow Airport Case Study)
	xPlane	(Heathrow Airport Case Study)
Noise Forums	Airport and Region Forum (Forum Flughafel und Region, FFR)	(Frankfurt Airport Case Study)
	Heathrow Community Noise Forum (HCNF)	(Heathrow Airport Case Study)
	Vienna Dialogue Forum	(Vienna Airport Case Study)
	GTTR (Noise Technical Working Group), CSAAB (Commission for Environmental Monitoring of the Airport Expansion Works	(Barcelona Airport Case Study)
Noise Publications	A Quieter Heathrow	(Heathrow Airport Case Study)
	Heathrow 2.0	(Heathrow Airport Case Study)
	Noise Management Plan (NMP)	(Stockholm Arlanda Airport Case Study)
	Noise Exposure Plan (PEB)	(ACNUSA Case Study)
	Noise Disturbance Plan (PGS)	(ACNUSA Case Study)
	Sustainability Reports	(Ljubljana Airport Case Study)
	Teddington Community Noise Information Report	(Heathrow Airport Case Study)

3.8 Key finding: Modelling tools and metrics

The previous finding highlighted the role of modelling tools in generating a range of noise outcomes. Conventionally, these outcome metrics were restricted to long-term average aggregate measures based on L_{EQ} and its variants (e.g. L_{DEN}) with the primary aim of setting criteria and targets for regulation. More recently these outputs have been complemented by a wide range of supplementary metrics designed to facilitate communication with different stakeholder groups. In essence these fall into two broad categories; disaggregated single event acoustic metrics and the presentation of a range of operational metrics often used as the input for acoustic modelling tools. A key strength of these supplementary metrics is their capacity to provide illustration of alternative 'what-if' scenarios thereby allowing stakeholders to inform an opinion to their preferred scenario.

Considering the wide range of case studies investigated in this Deliverable, it is understandable that a breadth of acoustic and operational indicators where used to describe noise to different stakeholder groups.

Table 2 presents a summary of the types of noise data provided. In the case of Heathrow, the airport objective was to respond to concerns about lower and noisier aircraft on a particular departure route over a specific community. The use of flight track vertical profiles and gate analysis presented extensively in a public report demonstrated that all departures were compliant with the original 4 degree climb-out trajectory, however a very small number of aircraft (0.72%) failed to achieve a 5 degree trajectory. However, those that did fail were usually A380s, which being the largest aircraft operating at Heathrow, appear to have had a disproportionate impact on the perception of noise. Thus, the airport set a new minimum trajectory of 5 degrees and has been able to monitor performance against this using the same illustrative operational data. Interim results show an improvement in compliance with the new 5 degrees threshold with only 0.52% of aircraft departures failing to achieve the performance standard.

At Frankfurt noise metrics were used to inform a complex set of operating restrictions and compensation plans designed to manage the impact of airport expansion. Similarly, the Barcelona case study highlights the challenges of managing the impact of airport expansion, whilst the Catania case study used aggregate metrics generated by a mix of models and monitoring tools to justify zoning for land-use planning and compensation.

Comparing alternative what-if scenarios was a common purpose for noise data collection and dissemination. At Helsinki for example data was used to ascertain the impacts of different operating procedures (alternative departure procedures). At Arlanda data was used to investigate the impacts of implementing steeper arrival glide slopes). In Vienna and Schiphol, a curved approach and amendments to NADPs were investigated respectively.

The Heathrow and Vienna cases represent cases where data was not only used to investigate the potential impacts of different operating procedures, but also to drive significant community engagement with local community action groups, thus leading to better citizen engagement.

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Table 2: Noise information matrix – airport case study use of different noise indicators by type

Airport Case Study	Operational Indicators			Acoustic Metrics		
	Lists of operations	Cross-sectional charts	Flight tracks	Single Event (at defined receiver points)	Time Averaged (at defined receiver points)	Spatial Averaging and Aggregation
ACNUSA	On request	On request	On-line flight track visualisation tools	LAmax – Number above event profiles over time periods and by aircraft groups	Laeq, Lden, Lday, evening, night. For arrival, departures and total movements	Lden contours for noise exposure plan
Arlanda	None listed	None Listed	None listed	None listed	Lden/Lnight	Lden noise contour maps
Barcelona	Per use of each runway and overall number of movements	Only on request	Number of infringements per track under 6000 ft	Lmax events from noise monitoring stations in 5dB bands for town councils	Lday, evening, night. Plus averaged indicators for monitoring stations	Lday, evening, night noise contours
Catania	% movements by different aircraft on different flight tracks	None listed	Flight tracks	None listed	Lden /Lnight	Lden and Lnight contours
Cluj	Lists of operations	NADP1 and NADP2 published information (AIP)	Flight paths and online tools (e.g. flightradar24)	$L_{E,A}$ sound exposure level; $L_{p,AS,max}$ or $L_{p,A,eq,1s,max}$ maximum pressure levels	Lden / Lnight	Lden and Lnight contours
Frankfurt	On request	On request	On-line flight track visualisation tools Environmental/neighbourhood Agency: INAA, FRAPORT: FRANOM German Air Traffic Control: Stanley track	Continuous SPL, L_{Amax_events} from noise monitoring stations	Measured data for $Leq_{Aircraft}$, Leq_{total}, $L_{DEN\_Aircraft}$, L_{DEN_total}, L_{DEN}, Maximum level distribution, L_{night}	Contour maps calculation Leq_{Day}, Leq_{Day}, $Leq_{Night50}$+6x68
Heathrow	% movements by operational mode Proportion of departing aircraft by type	Deviation from centre of gate chart	For particular departure routes	Single event noise profile	Leq for specific location	LAeq dB noise contours
Helsinki	On request	None listed	Departure profile comparisons to show NADP1 and NADP2 altitudes on climb	LAmax used to identify changes to the routes	None listed	None listed
Iasi	Lists of operations	NADP1 and NADP2 published information (AIP)	Flight paths and online tools (e.g. flightradar24)	$L_{E,A}$ sound exposure level; $L_{p,AS,max}$ or $L_{p,A,eq,1s,max}$ maximum sound pressure levels	Lden / Lnight	Lden and Lnight contours
Kiev	None listed	None listed	None listed	LAmax	LAeq day, evening and night	LAeq day, evening and night contours
Ljubljana	None listed	None listed	None listed	EPNL for loudest aircraft	Lday, Levening, Lnight and Lden	Lden and Lnight contours
Schiphol	Lists of trial and reference flights	NAPD 1 and 2 profiles compared	Flight paths highlighting runway usage	Lmax used to record measurements from monitoring stations	Lden	Grid analysis of contours
Vienna	Flugspuren.at has specific data relating to all routes from all runways at any point in time.	Flight profiles	Full information of flight tracks provided on flugspuren.at	LAmax profiles	Leq	N65 contours (As per mediation contract).

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Questions for reviewers

We are planning to create a website that aims to support airports in identifying and implementing best practice noise management interventions relevant to their own situation.

- What information do you think such a website should contain?
- In which areas of the Balanced Approach are you particularly looking for support in terms of noise management?
- What are the challenges you face in terms of noise management? Are there any that are particularly pressing?
- What might a 'Best Practice Portal' website look like to you? What would you like to see in it? What functionality would you find useful?
- Would you find it helpful to have access to a network through which you could communicate with other airports on regarding noise management?
- Do you have any thoughts on how smaller airports and those at earlier stages of noise management development can learn from the lessons of those at the cutting edge?

A central challenge emerging is the need to integrate communication and engagement into BA delivery:

- What have been your experiences – approaches, specific information exchange examples?
- How do we ensure good representation from across local communities? – how to tap into 'silent majority'
- What levels of empowerment can be reasonably achieved given potential technical, financial and safety constraints?
- How can BA implementation and outcomes be tracked effectively? – wider consequences (e.g. acceptability, attitudes , QoL). Have any attempts been made to understand these wider impacts? What challenges/opportunities were encountered
- Should noise management be regarded as part of a wider 'licence to operate' challenge

Land-use planning appears to be a particular challenge for fast growing airports currently under the movement threshold for BA implementation.

- Is there a role for consistent policy messages to support airport-local authority engagement designed to reconcile potentially competing agendas?
- Are you aware of examples where airports and local authorities are collaborating effectively on this issue?
- Do you have any thoughts on how best practice regarding land-use planning can be improved?
- Do you consider ***a Framework on LUP*** is useful, to explore a range of options, provide a pathway to Best Practice and work on compensation schemes?

Metrics and tools:

- Would general advice on the use and selection of tools and metrics be welcomed and help in tailoring information provision to user needs?

3.9 Feedback from Roundtable with ACI Europe Noise Taskforce members:

- Quality of Life is important but can be difficult to understand – what is important to people differs by age and location for example. Research is needed here and interventions may differ from airport to airport.
- Acknowledgement that noise only becomes an issue for people once they have satisfied other quality of life indicators. For young people owning a house is more important than living somewhere quiet – but they will care more about noise as they become wealthier.
- Young people also acknowledged as increasingly concerned about climate and health issues and so likely to become even more motivated in the future.
- A Best Practice Portal should stress the importance of quantifying and communicating socio-economic benefits. It should have guidance on how to do CBA as part of this.
- Any categorisations of airports would benefit from expanding to include the types of communities in the area – i.e. informed and engaged / high noise exposure but not complaining / Newly exposed and Angry. Each of these require their own approaches.
- Making people shareholders in the noise generating activity is a good way to get their buy in. This could be done through actual shares, or by communicating the benefits of living near the airport. This has been successful with wind turbines.

4 Additional feedback from organisations representing 'Starting the Journey' Airports

For the validation of ANIMA key findings, an additional approach was considered necessary. Therefore, as an integrated part of T2.4, several interviews were conducted with Starting the Journey Airports. The aim of this initiative was to raise awareness on the key findings of several ANIMA deliverables and to understand the utility of the information to airports that have begun to manage noise recently.

A closer approach on 'Starting the Journey' Airports was considered necessary, since airports falling under this category have the challenge of engaging in interventions with inefficient results, and implementing interventions which have already been approached by other airports ('Experienced Traveller' and 'Pathfinding') during their long-time experience in noise management. Additionally, these types of airports have the opportunity to rely upon a better understanding of noise management criteria and implications and to engage in a preventative strategy, rather than a mitigation-oriented approach on dealing with aircraft noise. For this, the experience of various European airports was documented and detailed in some of the ANIMA Deliverables (e.g. D2.5) in order to capture the key criteria to account for during an effective implementation of noise interventions. A part of such 'Best Practice' information was distilled as 'Key Findings' under this Deliverable and further validated with 'Starting the Journey' Airports for them to confirm that these findings are aligned with their needs.

This initiative was developed in two main phases. For both phases, the questions, together with the received feedback is described.

During the first phase, almost 100 airport representatives were contacted, from countries across Europe, having the focus on 'Starting the Journey' airports. Only four responses, representing four airports, were collected from the first phase. Based on the feedback received from the first round of interviews, the questions were structured into five major themes of discussion to facilitate discussions for a second round of interviews. In the second round of interviews, which has been launched only at a trial level, less than 10 organisations representative for airport administrations were contacted. Five responses were collected, representative for 49 airports.

The questions can be found in Annex 2, as well as the collective feedback from both rounds of interviews are presented in the following section, the latter being under the structure of the five themes of discussion.

4.1 Theme 1 – Pressures to act

4.1.1 Noise as a challenge

In the long-term, noise in relation to air traffic growth forecasts is considered to be an important challenge for the daily operations of airports. Air traffic growth is expected as an outcome of increasing requests for both commercial and cargo operations, some of which may be carried out during the night. Therefore, noise exposure is expected to increase as a result of air traffic growth. In this case, legislations, complaints and collaborations with authorities, especially the ones responsible for urban encroachment, will become increasingly relevant.

4.1.2 Noise as an environmental pressure

Most responses from airports stated that **the primary driver** towards noise management is the National legislative framework. In this case, noise requirements can originate from general National legislations on environmental issues or on noise alone and/ or aviation-related rules and regulations.

In the first case, the applicable piece of legislation is usually the transposition of the Environmental Noise Directive. Additional provisions are included, in some cases, under the requirements of Environmental Reports mandatory for infrastructure and/or significant operational changes. **These provisions are not applicable for aviation noise alone, but for various other types.**

In the second case, noise provisions are comprised as an integrated item of Aviation Rules and Regulations, designed for the general functioning of aircraft and/or airport operations (e.g. certification). These can, in some cases, be supplemented/complemented by policies applicable for all/many National airports or by individual corporate policies addressing this issue. Additional provisions are included, in some cases, as criteria of flight procedures. **These provisions are applicable particularly in the case of aviation noise.**

Apart from legislations, **another important driver** for noise management is represented by the pressure from communities. The most common expression of this pressure is under the form of complaints. In some cases, most complaints are filed from residents outside noise contours.

Further environmental pressures, aside from noise, include water quality, air quality, emissions and waste management. From the entirety of environmental issues, most airports consider noise as the main/one of the most important environmental pressures.

4.2 Theme 2 – Nature and extent of airport responses

4.2.1 Specific interventions

Some examples of interventions implemented by the respondents were provided during the interviews.

The main driver for action in most cases was the **legislative compliance**. Further drivers presented by respondents include **complaints** and **internal/ organisational policies**.

Interventions vary from one case to another, as only some airports are legally bound by the application of the Environmental Noise Directive. However, in almost all cases, **the development of noise maps**, together with **noise measurements and monitoring** have been deployed. At the same time, a form of **communication and engagement** with different stakeholders was employed, but during different phases of the implementation of the intervention, e.g. coordinating with stakeholders for the management of complaints (pre-implementation) or informing the local authorities and communities about the results from noise maps (post-implementation). In most cases, a **report** was developed to communicate results to different stakeholders.

Further examples include the use of **preferential runways**, **CDA** (Continuous Descent Approach) **procedures**, **limited use of APUs** (Auxiliary Power Units), **towing aircraft** from one location to another (e.g. from the stand to the taxiway), **restrictions on night-time engine-testing** activities, **noise insulation** and involvement in National programmes addressing aircraft noise.

4.2.2 Outcomes of interventions

Outcomes, according to the feedback collected from the interviews, are mainly reflected by **raising awareness on the relationship between the residential developments and noise exposure** for all interested parties.

Another approach, for example in the case of complaint management, led to different outcomes of this intervention, depending on its nature, i.e. **a fine was imposed**, **another intervention was launched** to investigate the complaint, **a supplementary commission for investigation** was formed, **a change in** general **flight procedures** was implemented or **the investigation conclusions were forwarded** to the responsible authority.

4.2.3 Potential responses/ interventions

If possible, the **active involvement of airports in land-use planning activities** is wanted to be included under law, together with **an increase in awareness for potential residents** within the areas surrounding the airport regarding the risks to noise exposure, provisions in order to be able to contribute to the prevention of encroachment situations.

4.2.4 Opinion on the cost of noise interventions

All noise control measures are perceived as being high-cost actions. **Relocations**, the implementation of **NADPs** (Noise Abatement Departure Procedures) and the implementation and operation of **continuous noise monitoring systems** are considered to have the highest costs within noise management.

4.2.5 ICAO Balanced Approach – implications

The aforementioned interventions were not driven, but influenced by ICAO BA (Balanced Approach) priorities. For example, one approach was to consider Land-use Planning (LUP) and Management as support for the development of Strategic Noise Maps and Action Plans (as required by the Environmental Noise Directive). Based on these LUP provisions, **different solutions** were formulated and integrated within the Action Plan, together with the conclusions from public consultations. Additionally, an **open dialogue with relevant stakeholders** and the **cooperation with local administrations** were initiated.

Most airports are familiar to a certain degree with ICAO Balanced Approach, especially with **'Land-use Planning and Management'**. However, additional support on **all ICAO BA** pillars would be preferred. As a result, some important barriers for the implementation of Balanced Approach actions are considered to be an **incomplete/ absent legislation**, **financial investments**, the **lack of support**, **insufficient knowledge** and the **political will**. For the evaluation of interventions, it is recommended to establish a certification for noise similar to the 'Airport Carbon Accreditation', used for emissions.

4.3 Theme 3 – Challenges

Different categories of challenges were formulated by respondents, mainly around four major categories of gaps and barriers, i.e. **knowledge, guidance, training** and **tools**.

Support in understanding the noise problem is highly needed to address **gaps and/ or the absence of knowledge, guidance and training** in the following areas:

- To understand the costs of measures (implementation and maintenance);
- To understand the efficiency of measures;
- To understand and address the needs of communities;
- To understand and address the needs of different stakeholders;
- To learn how to raise awareness on noise exposure and impact (especially for potential residents that have the intention to live near the airport).

The necessity of **tools** was formulated around the following areas:

- Assessing the feasibility of interventions on the short-term and on the long-term;
- Understanding how to best prioritise noise interventions;
- Understanding how to best prioritise measures for the overall management of environmental issues;
- Understanding how to best prioritise all airport requirements (e.g. noise in relation to increasing air traffic while ensuring flight safety);
- Simulating different noise scenarios to include in future airport development strategies.

Additional gaps have been formulated around the installation of noise monitoring systems, the implementation of noise alleviation procedures, as well as around the applicable legislative frameworks - addressing aircraft noise, noise

complaints, noise insulation, and Land-use Planning approval, which are insufficient, absent or not harmonised at the National level and more short-term oriented rather than on the long-term. One example, according to the responses, highlighted the impact of absent legislations resulting in complaints having no contribution for Land-use Planning.

Further challenges may be considered the absence of an effective communication method (e.g. a Noise Forum), the absence of a noise infringement system for the detection of events, together with a fining procedure, the absence of a database for the storage of all relevant flight data, as well as the political will.

4.4 Theme 4 – Future Plans

4.4.1 Expected challenges

Most responses stated that an increase in encroachment is expected to be the biggest challenge for the next period of time, especially in relation to expected increases in air traffic and airport expansions, therefore leading to an increase in noise exposure.

4.4.2 Expected requirements

According to the feedback from respondents, there are expected requirements with regards to the implementation of operational restrictions, noise insulation and noise monitoring.

4.4.3 Future Plans

The installation of noise monitoring systems is the primary intervention taken into consideration by most airports. Next, the collaboration with all relevant stakeholders to establish the responsible authorities for the management of noise (land-use planning, operating quieter aircraft, trajectory infringement) is considered to be the second important aspect of noise management. Additionally, through the collaboration with all relevant stakeholders, it is also expected to be able to contribute to the improvement of the legislation on environmental protection, as well as to establish effective communication with potential buyers of residencies within the neighbourhood of airports.

4.4.4 Additional Support

Guidance is needed on various topics, from overall noise management to specific noise issues. Specifically, guidance is needed on the development of Noise Action Plans, the implementation of interventions and communication with relevant stakeholders (e.g. collaboration protocols), local communities included. Additional support is required in regulating constructions to include noise insulation and clarifying legislative requirements, as well as on the provision of examples of practices from the experience of European countries and simulations.

From the perspective of a 'Starting the Journey' Airport, it is considered that, in order to be able to learn from the experience of airports that have implemented various interventions for preventing and/ or mitigating noise exposure and/ or impact, it is of interest to have guidance for 'Starting the Journey' Airports developed by 'Experienced Travellers' and 'Pathfinders'.

4.5 Theme 5 – Recommendations for the Best Practice Portal

When asked if they would use such a portal provided that it would be made freely available to them, the respondents had a positive answer.

With respect to the **particularities of the portal**, the respondents declared that they would like to have reviews and 'Best Practice' and 'Lesson Learning' examples of implemented interventions (e.g. organised based on the type of the airport – small, medium, large – according to different data – no. passengers, no. operations, cargo), as well as multiple simulation tools (e.g. noise change from an intervention, noise change with respect to air traffic change/ flight procedures). Additionally, different characteristics of interventions were requested, such as the types of interventions available and implemented so far (e.g. the number of airports that have implemented this measure), costs of interventions (e.g. the average cost of the intervention), efficiency of interventions (e.g. the evaluated efficiency of the intervention, expressed in [%]) and the cost of efficiency.

The most important lesson, according to the responses, is to be aware that any intervention is short-term limited in the absence of adequate land-use planning.

More practical and applicable information is needed, rather than theoretical. For that to be possible, the guidance and support material is recommended to be as summarised as possible and as clear as possible, in order to support its applicability. In addition, it is preferred to have the ability to access personalised information, i.e. to understand how to adapt to interventions given as an example on the portal. This expected output information is to be automatically developed on the basis of several input data (e.g. available budget, air traffic data). Other recommendations include the provision of:

- Information regarding the EU Regulations applicable for any type of airport, i.e. both categories having over and under 50,000 movements per year.
- Additional guidance on the use of noise metrics.
- If possible, it would be preferred to be able to feed the portal with relevant data and feedback from its use.
- An online forum for all relevant stakeholders within Noise Management, divided in discussion topics such as the Balanced Approach pillars, is considered to be useful.

Further needs from the Best Practice Portal are presented in **Error! Reference source not found.**.

Table 3 : Assorted Recommendations from STJ airports regarding the ANIMA Best Practice Portal	
Stakeholder: Policy Maker (Aviation, Noise, Land-use Planning)	
Level	**Information**
International Level	International research outcomes: *-noise at source* (engine data, aerodynamics, new prototypes, supersonic airplanes, helicopters, electric aircraft); *-new materials* (aircraft) *and fuels*; *-interdependencies*; *-new indicators* (noise and annoyance) *and test*; *-new navigation systems and tolerances;* *-global encroachment issues;* *-main events;* *-community engagement information* (forums, interventions, activities).
EU Level	International research outcomes: *-noise at source* (dB noise aircraft); *-airport noise health effects;* *-interdependencies;* *-new indicators* (noise and annoyance) *and test;* *-new navigation systems and tolerances;* *-new noise footprint calculation methods* (CNOSSOS/ Doc. 29)*;* *-new essays about new prototypes, helicopters, supersonic aircraft, UAVs etc.;* *-WHO outcomes;* *-aviation measures to minimise airport noise;* *-effectiveness and quantification of interventions;* *-health effects* (EU data); *-main events.*
National Level	International research outcomes: *-interdependencies;* *-aircraft certification requirements;* *-new indicators* (noise and annoyance); *-new noise footprint calculation methods* (CNOSSOS/ Doc. 29); *-new standards for ultralight aircraft and UAVs, helicopters, supersonic aircraft etc.;* *-WHO Guidelines (implementation examples);* Reviews of experiences: *-limits and indicators* (noise, annoyance, LUP); *-aviation/ aircraft and airport taxes and/ or incentives;* *-LUP control measures;* *-EIA mandatory provisions* (new tracks, new runways, % capacity increase); *-noise restrictions and curfew* (periods of time and aircraft type);

	-types of trade-offs (funding systems and management of noise levels); *-insulation types* (noise levels and funding systems); <u>EU overview:</u> *-new navigation technologies to minimise noise;* *-implementation vs. outcomes for noise and safety;* *-challenges regarding ICAO BA recommendations;* *-industry noise recommendations* (e.g. glide path, thresholds, aircraft configuration etc.); *-guidelines on how to monitor interventions;* *-guidelines on how to establish the relevant stakeholders;* *-community engagement information* (forums, interventions, activities); *-noise contours* (types and use); *-EU noise policy events.*
Local Level	<u>International research outcomes:</u> *-influence of architectural and urban design on noise perception;* *-urban design guidelines to reduce noise stress;* *-aircraft noise guidelines for urban development* (rules for zoning); <u>Noise contours:</u> *-types of noise contours and their use;* *-understanding the footprint of airport noise* (what happens with the noisiest aircraft during high traffic levels; what happens during severe weather conditions)*;* *-airport operations* (configurations, % of use per track, flight procedures during the night); *-other types of airport noise* (e.g. helicopter noise, ground noise, Military aircraft noise); *-insulation 'Best Practices' specific to aircraft noise* (e.g. for windows and facades); *-'Best Practices' for reducing noise impact* (e.g. natural barriers, type of trees); *-encroachment issues;* *-awareness on the role of WHO;* *-awareness on the relevant stakeholders and their responsibilities.*

Stakeholder: Aviation-related (Airport, Airline, ANSP, CAA)	
Level	**Information**
Management	*-awareness on the role of WHO;* *-awareness on the relevant stakeholders and their responsibilities.* Summary 'Best Practice' information: *-community engagement;* *-noise abatement procedures;* *-airport taxes and/ or incentives;* *-LUP control measures;* *-noise restrictions and curfew* (periods of time and aircraft types); *-types of trade-offs* (funding systems and management of noise levels)*;* *-insulation types* (noise levels and funding systems)*;* *-noise contours* (types and use); EU noise policy events Encroachment challenges and solutions
Experienced Airports	*-community engagement information (forums, interventions, activities);* Support in reducing annoyance: *-insulation 'Best Practice'* (e.g. windows, decorations, gardening, house orientation); *-natural distractions* (e.g. water, trees, gardening); *-natural barriers or covering streets;* *-architectural and urban design;* *-commercial and leisure centres around the airport* (e.g. for meditation, spa, yoga); *-school campaigns around the airport* (e.g. noise, animals, nature); *-best soundscape as a distraction during overflying periods;* *-quality of life indicators around airports;* Encroachment challenges and solutions
Pathfinders	*-community engagement information (forums, interventions, activities);* Noise contours tools (scenarios): *-a number of days in a non-preferred configuration;* *-split tracks;* *-use of different tracks during the night;* *-an increase in air traffic;* Punitive measures for airports, aircraft operators or air navigation service providers Clarifications regarding the applicable rules, regulations and recommendations (e.g. ICAO BA, END, EIA, WHO Guidelines) Alerting Indicators – highlighting the necessity of Noise Management
Starting the Journey	*-awareness on the role of WHO;* *-awareness on the relevant stakeholders and their responsibilities;* Noise contours tools (scenarios):

	-a number of days in a non-preferred configuration; *-split tracks;* *-use of different tracks during the night;* *-an increase in air traffic;* Punitive measures for airports, aircraft operators or air navigation service providers Clarifications regarding the applicable rules, regulations and recommendations (e.g. ICAO BA, END, EIA, WHO Guidelines) Alerting Indicators – highlighting the necessity of Noise Management Noise indicators – How to choose the appropriate one? (e.g. Lmax, SEL, EPNdB, Laeq etc.) Community engagement information (forums, interventions, activities etc.)

Stakeholder: Communities	
Level	**Information**
International Level	Main organisations and events related to aircraft noise; Summary 'Best Practice' information: *-community engagement;* *-noise abatement procedures;* *-airport taxes and/ or incentives;* *-LUP control measures;* *-noise restrictions and curfew* (periods of time and aircraft types); *-types of trade-offs* (funding systems and management of noise levels); *-insulation types* (noise levels and funding systems); Support in reducing annoyance - information: *-insulation 'Best Practice'* (e.g. windows, decorations, gardening, house orientation); *-natural distractions* (e.g. water, trees, gardening); *-natural barriers or covering streets;* *-architectural and urban design;* *-commercial and leisure centres around the airport* (e.g. for meditation, spa, yoga); *-school campaigns around the airport* (e.g. noise, animals, nature); *-best soundscape as a distraction during overflying periods;* Clarifications regarding the applicable rules, regulations and recommendations (e.g. ICAO BA, END, EIA, WHO Guidelines)
Local Level	*-how to file a noise complaint;* *-conditions to obtain noise insulation and details about the process;* *-awareness on the role of WHO;* *-awareness on the relevant stakeholders and their responsibilities;* *-awareness on the importance of the airport and the importance of airport expansions;* *-information about the strategy of the airport for the next years* (expansion, noise burden, others); *-understanding noise indicators - How to choose the appropriate one? (e.g. Lmax, SEL, EPNdB, Laeq etc.);* *-understanding the airport noise footprint* (e.g. display annoyance levels and insulation limits to highlight LUP implementation limits); *-tools for understanding the variety of factors influencing noise contours;* *-understanding the selection and use of different flight procedures;* *-information about community engagement and available forums;* *-clarifications regarding the applicable rules, regulations and recommendations* (e.g. ICAO BA, END, EIA, WHO Guidelines); *-information about punitive systems and procedures for noisy aircraft.*

5 ANNEX 1: Example questions to be asked in the staged process of the delivery of Balanced Approach interventions

Identification of the need for an intervention:

- Do you have multi-stakeholder, and independently led stakeholder engagement forums (including community representatives) through which the requirement for an operational change could be communicated and discussed?
- Are all communities represented in such engagement activity, so that any re-distributive effectives on noise exposure can be systematically addressed and consensus built as to the most socially optimal outcome(s)?
- Are such stakeholders and community groups engaged with openly and transparently to establish trust? Is noise data made available on-line for those not able to attend such forums?
- Do stakeholders have the ability (via independent sources) to challenge noise and interdependency data at the request of members, i.e. to respond to a particular concern potentially through the generation of their own data?
- Is the stakeholder group driven by an agreed singular vision of what it is trying to achieve?
- Are there other avenues through which communities or other stakeholders can raise concerns with noise managers and/or make complaints?
- Are the concerns of those contacting an airport acknowledged? Are individuals provided with tailored responses relevant to their specific concern, rather than via template responses?

Design of options:

- Are all stakeholders given the possibility of designing their own solutions to the required change?
- Do stakeholders have the opportunity to work in collaboration with each other in identifying potential noise mitigation solutions?
- Are designs pre-informed by a set of criteria and objectives, for example by framing them within what is logistically feasible, safe, and regulatory compliant?

Selection of intervention option:

- Has modelling been carried out (ideally by an independent entity) to assess the impacts of the potential design options? Does this modelling include interdependencies?
- Are these results communicated to stakeholder forums for discussion?
- Have all stakeholders been included in the discussion, even if they appear to be removed from the designed option (to help identify unintended consequences and trade-offs between communities).?

- Have the reasons why some options may not be feasible been communicated effectively?
- Have the results of any modelling, analysis and discussions been effectively disseminated to the public so that there is a clear and transparent pathway that shows how the requirement for change was first raised, which options where considered, and why one in particular has been advocated.
- Have other complementary interventions been considered? For example, could an operational change be couple with a change in land-use planning to enhance the predicted benefits?
- Have trial been carried out to verify modelling outcomes, and to perform analysis on the impacts on communities and other stakeholders?
- Do communities understand and value the metrics and dissemination tools used? Do you need to consider a different approach to communication?

Implementation:

- Have all stakeholders been made aware of the intervention in advance?
- In order to demonstrate outcomes have you considered if you need to move noise monitoring terminals, purchase new terminals, or make use of mobile terminals?
- Is regular feedback of the progress of the implementation made available to stakeholders?
- Have contingency plans been designed should the new procedure change and you need to fall back to the previous procedure?
- Do you have plans for on-going evaluation of the procedure, and plans for regular dissemination?

Post-Evaluation:

- Have you committed to long term monitoring and evaluation and reporting to stakeholders?
- Do you communicate the procedure at engagement events?
- Do you have a long-term plan for the evaluation of the outcome of the intervention on non-acoustic factors, general acceptability of the decision and quality of life implications for local residents?

6 ANNEX 2: Interview Questions

6.1 1st Round of Interviews

Table 1 – "Questions for reviewers"	
Topic	**Question(s)**
We are planning to create a website that aims to support airports in identifying and implementing best practice noise management interventions relevant to their own situation.	What information do you think such a website should contain?
	In which areas of the Balanced Approach are you particularly looking for support in terms of noise management?
	What are the challenges you face in terms of noise management? Are there any that are particularly pressing?
	What might a 'Best Practice Portal' website look like to you? What would you like to see in it? What functionality would you find useful?
	Would you find it helpful to have access to a network through which you could communicate with other airports on regarding noise management?
	Do you have any thoughts on how smaller airports and those at earlier stages of noise management development can learn from the lessons of those at the cutting edge?
A central challenge emerging is the need to integrate communication and engagement into BA delivery:	What have been your experiences – approaches, specific information exchange examples?
	How do we ensure good representation from across local communities? – how to tap into 'silent majority'
	What levels of empowerment can be reasonably achieved given potential technical, financial and safety constraints?
	How can BA implementation and outcomes be tracked effectively? – wider consequences (e.g. acceptability, attitudes, QoL). Have any attempts been made to understand these wider impacts? What challenges/opportunities were encountered?
	Should noise management be regarded as part of a wider 'licence to operate' challenge?
Land-use planning appears to be a particular challenge for fast growing airports currently under the movement threshold for BA implementation.	Is there a role for consistent policy messages to support airport-local authority engagement designed to reconcile potentially competing agendas?
	Are you aware of examples where airports and local authorities are collaborating effectively on this issue?
	Do you have any thoughts on how best practice regarding land-use planning can be improved?
	Do you consider ***a Framework on LUP*** is useful, to explore a range of options, provide a pathway to Best Practice and work on compensation schemes?
Metrics and tools	Would general advice on the use and selection of tools and metrics be welcomed and help in tailoring information provision to user needs?

Table 2 - "ANNEX 1: Example questions to be asked in the staged process of the delivery of Balanced Approach interventions"	
Topic	**Question(s)**
Identification of the need for an intervention	Do you have multi-stakeholder, and independently led stakeholder engagement forums (including community representatives) through which the requirement for an operational change could be communicated and discussed?
	Are all communities represented in such engagement activity, so that any re-distributive effectives on noise exposure can be systematically addressed and consensus built as to the most socially optimal outcome(s)?
	Are such stakeholders and community groups engaged with openly and transparently to establish trust? Is noise data made available on-line for those not able to attend such forums?
	Do stakeholders have the ability (via independent sources) to challenge noise and interdependency data at the request of members, i.e. to respond to a particular concern potentially through the generation of their own data?
	Is the stakeholder group driven by an agreed singular vision of what it is trying to achieve?
	Are there other avenues through which communities or other stakeholders can raise concerns with noise managers and/or make complaints?
	Are the concerns of those contacting an airport acknowledged? Are individuals provided with tailored responses relevant to their specific concern, rather than via template responses?
Design of options	Are all stakeholders given the possibility of designing their own solutions to the required change?
	Do stakeholders have the opportunity to work in collaboration with each other in identifying potential noise mitigation solutions?
	Are designs pre-informed by a set of criteria and objectives, for example by framing them within what is logistically feasible, safe, and regulatory compliant?
Selection of intervention option	Has modelling been carried out (ideally by an independent entity) to assess the impacts of the potential design options? Does this modelling include interdependencies?
	Are these results communicated to stakeholder forums for discussion?
	Have all stakeholders been included in the discussion, even if they appear to be removed from the designed option (to help identify unintended consequences and trade-offs between communities).?
	Have the reasons why some options may not be feasible been communicated effectively?
	Have the results of any modelling, analysis and discussions been effectively disseminated to the public so that there is a clear and transparent pathway that shows how the

	requirement for change was first raised, which options where considered, and why one in particular has been advocated.
	Have other complementary interventions been considered? For example, could an operational change be couple with a change in land-use planning to enhance the predicted benefits?
	Have trial been carried out to verify modelling outcomes, and to perform analysis on the impacts on communities and other stakeholders?
	Do communities understand and value the metrics and dissemination tools used? Do you need to consider a different approach to communication?
Implementation	Have all stakeholders been made aware of the intervention in advance?
	In order to demonstrate outcomes have you considered if you need to move noise monitoring terminals, purchase new terminals, or make use of mobile terminals?
	Is regular feedback of the progress of the implementation made available to stakeholders?
	Have contingency plans been designed should the new procedure change and you need to fall back to the previous procedure?
	Do you have plans for on-going evaluation of the procedure, and plans for regular dissemination?
Post-Evaluation	Have you committed to long term monitoring and evaluation and reporting to stakeholders?
	Do you communicate the procedure at engagement events?
	Do you have a long-term plan for the evaluation of the outcome of the intervention on non-acoustic factors, general acceptability of the decision and quality of life implications for local residents?

6.2 2nd Round of Interviews

Theme 1 – Noise concerns/pressures to act

The aim here is to understand the extent to which noise concerns/regulations etc. are demanding action from the airport. This should include an appreciation of:

- Sources of demand for action to reduce noise exposure/impact (e.g. regulations, community concerns/complaints, development proposals and associated environmental requirements, etc.).
- Prioritisation (i.e. which sources are most influential in determining the airport response).
- Other environmental pressures (i.e. are other environmental impacts resulting in pressure on the airport to make a response?).

Example questions, or additional questions should there be extensive information on the above topics could be:

- Does noise cause you any challenges in going about your business as an airport? If so, how?
  - Prompt: complaints/legislation/local authorities/urban encroachment?
- How do you rank noise as a challenge to your business compared to other environmental issues such as climate change or air quality?
- Is there any one aspect of noise management that is particularly challenging to your organisation?
- If your communities were made noise managers for the day, what would they chose to do?

Note: it may be that an airport representative feels there is little need to act and thus that nothing has been done to date. In these cases, it would be useful to establish whether they think this will change in the future and how prepared they feel for this.

Theme 2 – Nature and extent of airport responses

What specific actions/interventions has the airport made to reduce noise exposure/impact? Have these been influenced by the priorities embedded in the Balanced Approach hierarchy? The outcomes from this part of the interview should shed light on:

- Specific interventions
- Reflection on the outcomes of any interventions – what benefits results from investment in specific noise management interventions?
- Limitations on action – knowledge/expertise, financial constraints, access to appropriate technology, political support (internal and external to the airport company) and so on.

Example questions, or additional questions should there be extensive information on the above topics could be:

- What specific actions has the airport made to reduce noise exposure/noise impact?
  - What was the driver behind these actions?

  - If there was one noise management action that you could take but currently can't due to some barrier, what would it be?
  - Which action(s) related to noise management have the highest costs?
    - Was there any return on investment?
    - Which investment you consider to be more relevant, on noise exposure or on noise impact?
  - If you could only do one thing to reduce noise impact, what would it be?
  - Looking at your tasks as a noise manager, which measure, if done correctly, makes the rest easier? (For instance, was it responding to community complaints about a certain issue/an initiative to comply with legislation?)
- Have you heard of the ICAO Balanced Approach? If yes, have you used it?
  - Which of the Balanced Approach elements do you feel most comfortable with in terms of application?
  - With which do you feel you are least familiar and require additional support?
  - What barriers do you face in terms of implementing balanced approach actions? (Prompt: lack of knowledge, lack of support, lack of legislation, political will, technology, financial investment?)

Theme 3 – Challenges Encountered

Note: this may naturally be covered as part of Theme 2 conversations. However, for completeness please bear in mind that we are keen to understand obstacles to effective actions.

Here the aim is to understand barriers to action generally (lack of motivation, investment demands elsewhere, absence of pressure, etc.) and also challenges associated with specific interventions. The latter may relate to:

- How best to prioritise
- How to tap into what communities really want
- Gaps in knowledge/expertise required to implement specific measures
- Little evidence of the effectiveness of interventions at the case airport or elsewhere
- Difficulties associated with addressing the needs of diverse stakeholders

Theme 4 – Future Plans

This theme is relevant even if the airport has yet to make specific noise management interventions. We want to understand if the airport representative expects that noise management will be an issue in the future (and why) and what actions they may be contemplating. Where actions have already been implemented how has that experience influenced future plans for further noise mitigation efforts.

Example questions could include:

- Do you expect to have to take further action on noise in the coming years?
  - If so, what future challenges do you expect that might cause you to act? (Prompt: more flights, more exposure, encroachment?)
- Are there any specific noise management interventions that you think you may be required to implement in the coming years?
  - Do you feel like you have enough support to implement this intervention?
  - What sort of help would you like/need?

Theme 5 – Recommendations of the Best Practice Portal

In the light of the airport experiences, what support and guidance would they find most useful?

After introducing the idea of a Best Practice Portal to the interviewee, questions might cover topics such as:

- Would you use such a portal if it was made freely available to airport managers?
- Is there anything in particular you would like to see in such a portal?
- What would such a portal look like? What functionality should it have?
- If this portal could help you do any one thing what would that be?
- If you had to design a course/curriculum on noise management, what would be the most important lessons that you would like people to take home with them?
- If you attended such a course, what information would you like to take home with you?
- Navigating the huge amount of guidance and support material available
- Signposting to specific technical support
- Understanding what 'similar' airports have/are doing
- How best to work with stakeholders (especially communities) to help in defining problems/concerns and thus how best to address these
- Mechanisms of community communication and engagement
- Use of tools and metrics: answer may cover topics such as:
    - Demonstrating noise consequences from current airport operations
    - Illustrating impact of different noise management scenarios on patterns of noise exposure
    - Using a range of metrics to improve the communication of noise information to specific stakeholder groups.