Manchester Metropolitan University

e-space

Manchester Metropolitan University's Research Repository

Please cite the Published Version

Ohlenforst, Barbara, Hooper, Paul, Heyes, Graeme, Aalmoes, Roalt, Burtea, Narcisa, Jeram, Sonja, Konovalova, Olena, Rajé, Fiona, Flindell, Ian, Radulescu, Dan, Rahne, Sara, Zaporozhets, Oleksandre, Dragasanu, Luminita, Kuhlmann, Julia, Schreckenberg, Dirk, Peerlings, Bram, Vesel, Claudia and Garcia Sainz-Pardo, Ana (2021) ANIMA D2.11: recommendations from exemplification case studies summary and implications for BP dissemination. Project Report. Aviation Noise Impact Management through novel Approaches (ANIMA).

DOI: https://doi.org/10.5281/zenodo.5604651

Publisher: Aviation Noise Impact Management through novel Approaches (ANIMA)

Version: Published Version

Downloaded from: https://e-space.mmu.ac.uk/629676/

Usage rights: CC BY Creative Commons: Attribution 4.0

Enquiries:
If you have questions about this document, contact openresearch@mmu.ac.uk. Please include the URL of the record in e-space. If you believe that your, or a third party's rights have been compromised through this document please see our Take Down policy (available from https://www.mmu.ac.uk/library/using-the-library/policies-and-guidelines)

ANIMA

Aviation Noise Impact Management through Novel Approaches

D2.11 Recommendations from exemplification case studies summary and implications for BP dissemination

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

ANIMA
Aviation Noise Impact Management through Novel Approaches

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 Nº AND TITLE	Deliverable D2.11 : Recommendations from exemplification case studies summary and implications for BP dissemination
TYPE OF DELIVERABLE[1]	R
DISSEMINATION LEVEL[2]	PU
BENEFICIARY NUMBER AND NAME	MMU
AUTHORS	Barbara Ohlenforst, Paul Hooper, Graeme Heyes, Roalt Aalmoes, Narcisa Burtea, Sonja Jeram, Olena Konovalova, Fiona Raje, Ian Flindell, Dan Radulescu, Sara Rahne, Sasha Zaporozhets, Luminita Dragasanu, Julia Kuhlmann, Dirk Schreckenberg, Bram Peerlings, Claudia Vesel, Ana Garcia Sainz-Pardo
CONTRIBUTORS	
WORK PACKAGE Nº	2
WORK PACKAGE LEADER	Delia Dimitriu
WP LEADER VALIDATION DATE	07 October 2021
COORDINATOR VALIDATION DATE	11/10/2021
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.

Version follow-up		
Update	**Name**	**Version**
04/08/2021	R. Aalmoes	Version for review/V1
30/08/2021	N. Burtea	V2

TABLE OF CONTENTS

1 Executive Summary

This study presents the analysis of seven airport exemplification case studies undertaken in the European project "Aviation Noise Impact Management through Novel Approaches – ANIMA". Best practices related to aircraft noise management at airports in individual airport contexts were implemented and evaluated. Case studies on communication and community engagement in airport noise management were investigated at Heathrow (United Kingdom), Ljubljana (Slovenia) and Rotterdam The Hague (The Netherlands) airports. For Zaporizhzhia (Ukraine) and Iasi (Romania) airports, the implementation of interventions related to land use planning was examined. The interdependencies between noise and emissions were studied for the airport at Cluj (Romania) along with an exploration of key Quality of Life issues. All case studies were performed under the scope of the corresponding national legislation and guidelines. Individual characteristics of airport operations were taken into account. The case studies were aligned with expectations and priorities of all involved stakeholders, such as representatives of airport operators, local communities, civil aviation authorities and policy makers. The efficacy of the noise management case studies was assessed in terms of the capacity to negotiate consensus outcomes, the extent to which noise impact reductions were achieved, and the participants' satisfaction with the process and outcomes. The case studies revealed the **vital importance of community engagement in noise management if decisions are to be accepted and outcomes valued**. In general, the **earlier this engagement starts in the process of decision-making and implementation the better**; although care needs to be taken in the selection of methods of engagement to ensure the tools used are appropriate to the engagement and communication task faced. In this way, overly long engagement should be avoided and with that the risk of increased uncertainty in outcomes. Such engagement should also ensure that decisions and subsequent interventions are tailored to local community concerns reflecting national, regional and cultural differences across Europe.

Key recommendations for communication and engagement are:

- Start early.
- Explain why this communication is taking place and the wider process into which the engagement is feeding, so as to manage resident and other stakeholder expectations.
- Accept that some issues are complex and will require the time and access to the expertise necessary to explain issues upon which opinions are being sought.
- Less extensive, but more intensive, qualitative tools can help foster quality dialogue.
- Communication with residents in forms that allow dialogue and mutual understanding are preferred over information sessions targeting larger audiences
- When principles are discussed, it is important that they are prioritised in order to inform later decision-making over proposed actions.
- Consensus on how best to articulate performance against any noise management principles is critical if the relative merits of specific change options is to be compared transparently.

- Trade-offs cannot be avoided in many circumstances; thus, both the quality of decision-making processes and input information will determine the acceptability of outcomes.

In terms of less experienced airports:

- Clear legislative provision and collaboration between governance authorities is the bedrock of effective noise management.
- Targeted external support can provide the evidence base on which to develop current and future noise management interventions.
- Stakeholder and community engagement can help inform the development of governance systems and help build trust in control outcomes.
- Engagement with wider quality of life issues can complement efforts to minimise noise impacts and demonstrate good corporate citizenship by airports.
- Thinking holistically about noise and taking longer-term strategic approaches to noise management can help ensure that activity at the airport will be more likely to deliver successful outcomes.

The case studies also highlighted the need for future research to:

- Better understand of the role of different engagement tools for different purposes.
- Define key management concepts such as 'fairness', especially in relation to concepts such as sharing, dispersal, concentration and respite.
- Identify and apply a suite of metrics to articulate performance against agreed management priorities.
- Understand the nature of strategic frameworks and methodologies that can support noise policy and the creation of noise action plans.

2 Introduction

This report presented the approaches and outcomes of six exemplification case studies conducted at airports throughout Europe. The aims were to address challenges related to noise management at airports, guided by the ICAO Balanced Approach [1], the implementation of noise action plans as required by the Environmental Noise Directive and previously identified best practices.

The ICAO Balanced Approach to Aircraft Noise Management (BA) [1] is a framework for identifying noise problems at airports and to structure efforts to reduce aviation noise exposure. The BA distinguishes between four pillars: 1) reduction of noise at source, 2) land-use planning (LUP) and management, 3) noise abatement operational procedures, and 4) operating restrictions. In addition to these four pillars, communication, community engagement and stakeholder collaboration are increasingly recognized as relevant factors for effective noise management around airports [2-4].

The ANIMA project aims to address aviation noise impact through novel approaches and to develop and assess best practices on noise management at airports, across and beyond the four BA-pillars. Within ANIMA an assessment of the implementation of the BA by airports across European Member States was carried out [5]. The research was conducted via in-depth case studies across 12 airports and one community organisation, using publicly available documentation and stakeholder interviews at each organisation. The results suggested that communication and engagement play a large and significant role in the implementation of noise abatement interventions across different BA interventions, and throughout the entire process of implementation. Communication and engagement should therefore be made a more integral component of the BA. Furthermore, LUP was found to be of particular importance to rapidly growing airports. Pro-active engagement in the BA can lead to avoidance of operating restrictions as the airport grows. When considering interdependencies, it was found that noise was the primary driver behind the majority of the case studies.

The work presented here was based on these previous learnings, best practises and the understanding of how airports have been trying to deliver the BA [5]. Moving one step further, this study tries to support the process of affective noise management interventions. Ongoing work and early results from WP3 were used as input for the studies as well, both for the topic of Quality of Life [6-7], as well as the Community and Engagement study [8].

Based on their experience of management three broad categories of airports have been suggested within the ANIMA Deliverable 2.1 "Scoping the challenges – Pan-European overview of Existing Knowledge and Implementation of Noise Reduction Strategies" [9]. Those categories are "Starting the journey", "Experienced travellers" and "Pathfinder" airports. The different levels of experience of airports within different categories suggested that the requirements of different airports were different as well. The focus on the processes and motivations was driven by the fact that the specific circumstances of each airport can be radically different. This makes it difficult to advocate one intervention over another. However, the process and the motivations that underpin their implementation can offer

opportunities for shared learning and best practice approaches, as well as classify the case study under specific requirements that different airports may have in common.

The selection of case studies within the current study reflect the different challenges across airports. Case studies on communication and community engagement in airport noise management were investigated at Heathrow (United Kingdom), Ljubljana (Slovenia) and Rotterdam The Hague (The Netherlands) airports. At Zaporizhzhia (Ukraine) and Iasi (Romania) airport, the implementation of interventions related to land-use planning was examined. The interdependencies between noise and emissions were studied for Cluj (Romania) airport, where Quality of Life was also further explored.

The case studies detailed in this report include examples of how airports have engaged with communities, highlighting the tools and metrics used to describe the noise environment and changes to it arising from management interventions. The aim is to distil learning from these examples that can inform the development of best practice principles for communication and engagement to be incorporated into the ANIMA Noise Platform, developed in ANIMA WP5. The selection of airport case studies was based on ANIMA airport partners, to ensure access to rich data.

1. ICAO Doc. 9829, *Guidance on the balanced approach to aircraft noise management*. Second edition, 2008.
2. ICAO Working Paper A40-WP/260, *Management of noise*. 2019. https://www.icao.int/Meetings/A40/Documents/WP/wp_260_en.pdf
3. EUROCONTROL. *Specification for Collaborative Environmental Management (CEM)*. Edition 1.1, 2018.
4. Heyes, G., Raje, F., Hooper, P., Hudson, R. & Dimitriu, D. Critical Assessment of Aviation Noise Communication Strategies in the European Union. *Proceedings of INTER-NOISE and 2019*, pp. 4377-4388. Madrid, Spain, June 2019.
5. Heyes, G., Galatioto, F., Dimitri, D., Hooper, P., Garcia Sainz-Pardo A., Ohlenforst, B., Burtea, N., Radulescu, D., Müller, U. ANIMA-D2.5 – Critical review of Balanced Approach Implemented across EU Member States. 2019.
6. ANIMA Deliveable D3.1, 2019
7. Julia Kuhlmann, Fiona Rajé, Isabelle Richard, Barbara Ohlenforst, Evaluations of previous interventions in improving quality of life, ANIMA Deliverable D3.6, 2021.
8. Dominik Hauptvogel, Isabelle Richard, Julia Haubrich, Julia Kuhlmann, Graeme Heyes, Sarah Benz, Paul Hooper, Susanne Bartels, Dirk Schreckenberg, Engagement Guideline, ANIMA Deliverable D3.9, 2021.
9. ANIMA Deliverable 2.1 "Scoping the challenges – Pan-European overview of Existing Knowledge and Implementation of Noise Reduction Strategies"

3 Methodology

Seven case studies were conducted between spring 2019 and summer 2021 at airports across Europe (among which two in the same airport), and were clustered in three groups. ANIMA partners developed each case study collaboratively with airports and other local stakeholders to address particular (local) challenges, taking individual airport operations into account. Case studies conducted at Heathrow (United Kingdom), Ljubljana (Slovenia) and Rotterdam The Hague (the Netherlands) airports focused on communication and community engagement; case studies at Zaporizhzhia (Ukraine) and Iasi (Romania) airports dealt with land-use planning; and one case study at Cluj (Romania) airport studied interdependencies between noise and emissions. Airports were selected to include a variety of types, sizes and experience levels with (noise) interventions. All case studies were performed under the scope of the corresponding national legislation and guidelines.

4 Case Studies

4.1 UK Airspace Modernisation Processes and Heathrow Airport (Community Engagement)

4.1.1 Overview and Objectives

The UK has embarked on a radical process of Airspace Modernisation to optimise the benefits from the adoption of performance-based navigation (PBN) that has been gradually introduced across most airline fleets as newer planes incorporating this technological capability have been purchased. In modernising airspace, the UK Civil Aviation Authority has acknowledged the potential negative environmental impact of changes and highlighted objectives supporting 'a strong and sustainable aviation sector'.

From a noise perspective, the CAA and airports responsible for coming forward with airspace change proposals were charged with balancing economic and social benefits from a growing air transport system and any associated emissions outcomes with the potential adverse noise impacts on communities near airports. The aim of this case study was to critically reflect on the efficacy of arrangements made by the CAA and airports for arriving at airspace changes which reflect community noise concerns whilst attempting to deliver the wider social and economic benefits derived from aviation.

In order to meet this overarching aims a series of objectives for the case study were established, which were to:

- Understand the consequences for aircraft noise distribution on the ground from the adoption of PBN technology
- Critically assess the UK's approach to the determination of airspace changes in order to:
    - Review stakeholder engagement processes and outcomes
    - Establish whether a dialogue on design principles usefully informs the determination, appraisal and consultation on specific airspace change proposals
    - Reflect on the likelihood that following this more open and transparent procedure will result in more acceptable outcomes for noise affected communities
- Distil core learning from the UK approach to airspace change to better understand the determinants of consensus outcomes and the core information required to illustrate performance against agreed priorities (design principles).

4.1.2 Approach and Results

In order to address these objectives a research intervention was undertaken in 4 distinct phases:

- Phase 1 – background policy review to establish the motivation for UK airspace modernisation
- Phase 2 – critical appraisal of the implementation of the CAA's approved airspace design protocol by UK airports. This focused on the processes and outcomes of discussions over design principles that 12 of the UK's largest

airports have conducted with a range of stakeholders including members of local communities.

- Phase 3 – focus groups with representatives of airport amenity groups were held to provide insight into community concerns over the introduction of PBN and management options that may by implemented as part of airspace modernisation.
- Phase 4 – a workshop with Heathrow Airport's airspace change team, who are responsible for ensuring compliance with the CAA's airspace change procedures and determining airport-specific design principles.

Phase 1 – The UK CAA in CAP 1616 Airspace Change (2018) outline procedures that must be followed by airports when introducing airspace. This 7-stage process makes specific requirements for stakeholder engagement and CAA approval at pre-determined gateway points in the decision-making process. To date as a result of COVID-19 most airports have paused the implementation of this airspace change process at Stage 1B, consultation on design principles. Thus, it is on this stage that this case study focuses.

Phase 2 – the review of 12 airports' engagement with the 'design principles' engagement step 1B of the CAA process, focused first on the processes of stakeholder engagement and then their outcomes.

The review of the engagement processes revealed that:

- Airports had made clear attempts to address the CAA's engagement priorities involving a wide range of stakeholders in different modes of engagement, with relevant communities identified as those within the geographic footprint of aircraft operating under 7000ft to and from the airport.
- The consultation described within the various airport reports tended to focus on questions around noise priorities and noise versus emissions, as well as technical and operational issues.
- The main methods adopted were focus groups, workshops and online questionnaires, supplemented with emails, dedicated websites and leaflets
- Differences in the responses of those attending focus groups and those using online feedback methods was identified in some cases

Review of the emergent draft Design Principles demonstrated the priorities addressed the following issues:

- Safety – targeting changes to reduce risks and ensure compliance with industry standards and regulations
- Airspace users – these address the impact of changes on other airspace users, seeking to minimise impacts
- Technology – emphasis is placed on the utilisation of the latest navigational technology to deliver operational and environmental benefits
- Policy – relating to delivering on existing UK aviation policy and associated guidance
- Capacity/continuity – development of airspace that provides continuity of services and maximises utilisation of existing and planned new infrastructure

- Emissions – relating to the control of climate change and local air quality emissions
- Noise – those DPs designed to address noise effects

The wording of all noise-related DPs implies that these are discretionary and should therefore be achieved where 'possible'/'practicable'. Most airports commit to minimise the overall impact/effects of noise exposure and/or minimise the number of people affected.

Table 1. Summary of UK Airport Noise-Related Airspace Change Design Principles.

Noise DP Categories	LHR	LGW	STN	MAN	LTN	EDI	BRS	GLA	LPL	ABZ[1]	LCY	EMA
Minimise noise impact/effects	■	■	■	■		■	■	■	■		■	■
Minimise number people affected				■		■	■				■	
Minimise population newly overflown	■		■				■		■		■	
Multiple routes for Sharing/respite	■		■	■	■		■		■		■	■
Avoid noise sensitive areas	■		■	■		■		■	■			■
Avoid multiple routes over same community					■		■				■	

: Whilst not referring to minimising impacts nor people exposed to noise Aberdeen Airport's DPs do refer to 'investigating steeper approaches…to reduce noise footprint' and also 'minimise changes to tracks', with the latter by implication minimising populations newly overflown.

Significantly, commitments seeking to minimise the total number of people overflown/affected by noise and to minimise the population newly overflown may conflict with the design principles intended to share noise/routes to allow for more equity and/or respite. The challenge of trading-off between DPs at the airspace change proposal stage would appear to be all the more difficult given the absence of any prioritisation between DPs evident in many submissions. Further, addressing these challenges would seem to require some agreement on how to capture performance against specific noise-related DPs using metrics that describe operations and their noise consequences (to allow the relative merits of different options to be illustrated and informed decisions made); again engagement with stakeholders over DPs appears to have completely omitted to consider this issue.

Phase 3 – the amenity group member focus groups revealed a consistent view that PBN is undesirable for communities. This was expressed by all participants, with the perception being largely driven by a general agreement that concentration would be catastrophic for any communities below concentrated flight paths. Participants also expressed concern about PBN's potential application as a method to provide noise respite by flying different and alternating concentrated flight paths. It was suggested that multiple alternating and low-capacity flight paths would themselves fill up over time, resulting in multiple heavily concentrated flight paths rather than providing respite.

In short, there was a strong sense that the participants did not trust the aviation industry to implement PBN effectively, believing that environmental externalities are a secondary concern to growth, using the industry's importance to the economy and society as a means to justify such growth, whatever the local impacts. On several occasions participants across different focus groups raised the idea that impacts of noise had reached a threshold where it had become an intolerable problem, some going as far as suggesting that there may be a need for a 'limits to growth' of noise.

Regarding communication, participants demonstrated some empathy for the industry in its efforts to convey complex information in simple ways that were comprehensible to non-experts. However, there was also a sense of frustration as to the industry's inability to do so effectively.

Overall, noise sharing is preferred by those who are exposed to noise, although this runs counter to government policy to avoid newly overflying people. It appears then that there is an imperative for policy to be revisited as part of the processes of airspace modernisation.

Phase 4 – drawing on experiences at Heathrow from implementing the CAA's airspace change process to date revealed the following issues:

- Overly long consultation processes (exacerbated by COVID) – whilst early engagement is recognised as important there is a tension between the desire to engage early over key principles but a lack of specificity, and iterative approaches make the process arduous for all involved. Thus, there is a need for careful management of the whole process if stakeholders are to remain actively engaged in informing outcomes effectively and the uncertainty created by a long duration minimised.
- Design Principles conversations demand a 'context-free' examination of issues which can be a challenge when participants are often keen to understand what it means for them. However, as soon as lines are drawn on a map a 'not over my back yard' attitude can dominate, inhibiting discussions that can support consensus building and empathy.
- Prioritisation/ranking of design principles was regarded as essential if this stage in the CAA process is to facilitate future stages where the merits of specific airspace change options have to be illustrated, discussed and decided upon.
- Focus groups were seen as a particularly useful technique in facilitating the open-end discussion needed to explore principles as opposed to deciding

between specific proposals. They were associated with more nuanced understanding of issues of concern and the building of empathy.

- Noise sharing and respite are common design principles that may require further examination of what it is that the public views as important to help guide the determination of success factors. It would appear that there needs to be a better understanding of what people expect sharing and respite to bring

4.1.3 Key Findings and Recommendations

- If airspace modernisation is to optimise the impact of PBN then it needs to address the balance between flight track concentration and dispersal, recognising that local circumstances will dictate when one option is preferred over the other.
- Starting community engagement early can help reveal the principles by which airspace proposals should be developed; but the former should be prioritised and the means of articulating the latter agreed, if outcomes from early engagement are to inform and streamline later stages in the development process.
- There is a need to develop simple illustrative materials that highlight changes in noise exposure on the ground, associated with concentration or dispersal, incorporating the number and noisiness of events
- Community expressed preference for noise sharing (flight track dispersal) may run counter to UK/EU policy to 'limit and, where possible, reduce the number of people significantly affected by adverse impacts from aircraft noise'
- There is a lack of evidence on the potential impacts associated with dispersal/concentration (annoyance response, sleep disturbance, long-term health consequences); especially as the former may increase the number of newly exposed people. This should be a focus for future research.
- It cannot be assumed that all SHs buy into existing government policy and thus airspace change sponsors would do well to acknowledge feedback that challenges policy as this should allow for policy commitments to be scrutinised and amended, if appropriate, in the light of implementation experience

4.2 Case Study Ljubljana (Community Engagement)

4.2.1 Overview and Objective

Ljubljana Airport is a small airport with around 35,000 aircraft movements per year. This means it is under the 50.000 movements per year threshold which would require a mandatory preparation of strategic noise maps and action plans according to implemented EU Directive 2002/49/EC. Based on monitoring data the average annual environmental noise pollution associated with the airport was considered to be problematic mainly in the summer evenings when the limit value of 53 dBA for indicator $L_{evening}$, was reached.

An important problem identified at the Ljubljana airport case study was a lack of transparent communication between all relevant stakeholders (including affected

communities) illustrated by the reaction of people to the unannounced change of take-off direction over Kranj in 2013. The change caused great agitation, dissatisfaction and distrust among local authorities and communities. The justification for such a decision was reduction in fuel consumption which was presented as an important saving for national airline company Adria Airways. A question remains as to why there was no open dialogue and consideration for Environmental Impact Assessment (EIA) in case of such a change of operations at the airport. The mayors of the nearest municipalities organized a meeting in 2019 and demanded explanations (Call of Mayors) from authorities / responsible stakeholders and the abolition of the new take-off route. They also questioned the performance and reliability of the noise measurements.

To respond to the Call of Mayors, in June 2019, Fraport (Ljubljana is part of Fraport group) initiated the Airport partnership group for environment LEPASO ("Letališka partnerska skupina za okolje") based on CEM specification and including the following stakeholders: Fraport Slovenija (coordinator of LEPASO), Slovenia Control (KZPS), Civil Aviation Agency (JACL), Domestic airline (Adria Airways), Institute of Occupational Safety (performing noise monitoring for the airport), Ministry for Infrastructure and an independent expert for noise monitoring and modelling. The main issues that the group planned to discuss were: legislation assessment (Decree on limit values for environmental noise indicators) and options to reduce noise at the airport like rapid taxiways, restriction of flights at night, changes in take-off and landing operations and directions.

Local community needs clear information on the responsibilities of authorities including management of complaints. Currently complaints are dispersed between different stakeholders, possibly causing loss of some complaints. A single focal point is needed for contacts with the public even in cases of responsibilities spread among stakeholders. Periodic reports should include all complaints and proposals from the public to show potential improvement.

The main outcome expected from this case study was to find a way to facilitate an open dialogue, increase trust, ensure transparent information policy and encourage a proactive involvement of all relevant stakeholders in the process of discussion and assessment of claims and other issues in order to assess realistic options for efficient solutions. All relevant stakeholders should be identified. It is essential to integrate community and local authorities into discussions that concern their quality of life and environmental policy including land use planning and aviation noise management but also the development of the airport and increase of traffic in the future. To achieve such communication, the establishment of an open dialogue forum was proposed as an intervention.

4.2.2 Approach and Results

To facilitate the dialogue among stakeholders (including local Authorities and communities), a workshop was organized on the 18th December 2019 as part of the ANIMA project. All identified stakeholders were invited to present their views and suggest possible solutions for the future. The workshop gave room for fruitful

discussions that are summarized in the workshop report "Transparent noise management and community engagement in the Ljubljana Airport area".

After the workshop the ANIMA-team proposed the setting up of a forum for an open dialogue, identifying all the stakeholders needed with duties and responsibilities including local communities to allow for an open dialogue relevant to airport-related environmental issues.

The key problem to be solved in the near future is to establish a transparent information policy that would allow constant access to information and explanations from the responsible authorities and furthermore to solve the existing problems in a constructive dialogue. ANIMA also proposes the introduction of additional noise indicators as part of noise measurements, which will enable a more accurate assessment of the impact on human health and well-being. These indicators would make it possible to estimate the short-term noise load for individual overflights, such as maximum noise level and number of flights or noise levels for a shorter period of the day. It is expected that a Dialogue Forum should consider the problems in the context of a broader picture including interdependencies (air pollution), land use planning and quality of life.

The programme for the next workshop should include outcomes from the first workshop and proposal/good practices from Vienna or Frankfurt Dialogue Forum and ANIMA partners. Consideration should be given to the question 'Which ways are possible to progress and search for efficient dialogue and for solutions for reduction of noise and annoyance, maintenance of health and quality of life in communities with a future vision for development of the airport together with improving overall quality of life in communities?'

The ANIMA Best practice portal includes a number of intervention examples from different airports and represents a possible source for ideas and guidance. In case of establishing the dialogue forum, we will follow the specifications from EUROCONTROL Collaborative Environmental Management - CEM.

An evaluation is planned after the first workshop is undertaken with an on-line questionnaire to assess the outcomes and satisfaction of participants and also suggestions for further discussions

In addition, evaluation after the second workshop is planned with an on-line questionnaire to find out how different stakeholders perceived new information and options to organise an open dialogue forum and transparent information policy.

4.2.3 Key Findings and Recommendations

The two workshops organised by the ANIMA project were well accepted and attended by all relevant stakeholders and professionals in the field of aviation environmental issues. The Dialogue forum of the airport was agreed to be the best option to function as an enlarged LEPASO group. Exchange of basic scientific and technical information among stakeholders was seen to be very important and

should continue in the future. Information from the Frankfurt Dialog Forum represented by Fraport and Umwelthous was considered useful although the difference between Ljubljana and Frankfurt airport is substantial. Strategies about how to involve citizens and how to work together can be implemented.

The recommendations for the future work include regular meetings and discussions. Work should be well coordinated with much understanding of mediation. Issues should be considered one by one regarding the priority of urgency but also feasibility. The process may be slow but in the long-term improved results are expected.

4.3 Case Study Rotterdam The Hague Airport (Community Engagement)

4.3.1 Overview and Objective

Rotterdam The Hague Airport (RTHA) is a minor international airport serving the South-Holland cities of Rotterdam and The Hague. It is located 5 kilometers northwest of the city centre of Rotterdam and is the third busiest airport in the Netherlands. The airport is part of the Royal Schiphol Group, has one runway of 2200 meters, handling the two runway directions 06 and 24. The airport has a Regional Consultation Committee (CRO: Commissie Regionaal Overleg Luchthaven Rotterdam). Project teams can be formed to address specific activities, and one was formed for the topic of this case study.

Figure 1. Location of the RTHA airport and the 06 departing route (grey) and the alternative route (blue).

This case study investigates the evaluation of an alternative departure procedure aimed to reduce noise annoyance for as many residents as possible. The goal of the project team is to involve communities around RTHA in the decision-making process to decide whether this alternative departure route is preferred or not. The study would evaluate whether the changes in the calculated noise levels would be

perceived by representatives of the community, and discuss their findings between each other and the project team.

4.3.2 Approach and Results

The technical analysis included a quick scan of changes in noise exposure for the departure route for runway 06, towards Lansingerland. The aim of the quick scan was to investigate the effect of the current and an alternative departure procedure on noise exposure, limiting noise exposure for the Bergschenhoek area (part of community of Lansingerland) and preferably reducing the total number of people annoyed. The results of the investigation, calculated by an external party Adecs Airinfra suggested that the calculated number of highly annoyed people within the Lden contours of 48 and 56 dB (A) would decrease, while the calculated number of people within the Lden = 40 dB (A) would be expected to increase. Therefore, the technical analysis suggested a shift in noise exposure with an overall benefit for the majority of people for the alternative procedure.

The community engagement study was prepared and carried out in close collaboration with stakeholders and residents. Different types of meetings were carried out during this case study to ensure equal engagement of all stakeholders. There were so called "Working group meetings" and "Information sharing meetings". The working group meetings consisted of a variety of stakeholders including representatives from the Regional Consultation Committee from the airport (Commissie Regionaal Overleg Luchthaven Rotterdam: CRO), local residents, the municipality Landsingerland and Rotterdam, Rotterdam The Hague airport, Air Traffic Management (LVNL), experts on noise exposure and a designer of flight procedures. The working group met frequently for half a year to prepare the perceptual study and the listening test for the information sharing meetings.

The participants were asked to do an online listening test before the information meetings took place. The results of the listening test were presented and discussed during the information meetings. The online listening test presented participants with simulated audio samples of aircraft noise for the current and alternative departure procedure at five locations, each affected differently by the changed procedure. These five locations are shown in Figure 2 and indicated by the numbers 1 to 5. The current (grey line) and alternative (blue line) departure procedures are also shown in Figure 2. The locations were unknown to the participants before doing the listening test. Neither did the participants know which of the two sounds that were compared was the current or the alternatively departure procedure. The listening test of the acoustic simulations was carried out online.

Figure 2. Current (grey) and alternative (blue) departure procedure and the five examined locations for the listening test.

The participants adjusted the noise level of the acoustic sounds on their own computer systems in their private homes. A calibration test was provided before the evaluation to help the participants to adjust the volume of the noise levels. The participants were asked to rub their hands against each other and to adjust the volume to a comparable value. Next, the participants listened to the noise samples and rated them for each of the five locations on a scale from -3 to +3. The current and the alternative departure routes were directly compared with each other during the listening test. When both routes were perceived as equally annoying in noise level the rating would be zero. If the alternative route was perceived as more annoying than the current route, the score would be between -3 for much more annoying and -1 for a little bit more annoying. If the current route was perceived as a little less annoying the score would be 1, and 3 for much less annoying. It was possible for the participants to repeat the sound comparison for each location before they made their decision.

After the listening test and the rating of both procedures was carried out by the participants, information sharing meetings took place. The information sharing meetings consisted of a variety of residents who had carried out the listening test and in that way evaluated the current and the alternative departure procedures. In total, 25 participants provided their subjective evaluation. Twelve participants were residents from different areas around the airport and 13 participants were members of the CRO.

Three information sharing meetings took place to present the technical analysis and the community engagement study to the participants. During those meetings, technical details related to the two departure procedures were explained, such as the noise level calculations, technical aspects of the procedures and the listening test setup. In these meetings, the actual locations and the corresponding noise samples for the current and the alternative departure procedure were revealed. The expected number of households exposed to LAmax levels of 65, 70 and 80 dB SPL for the different regions that are represented by the five test locations were calculated and presented during the information sharing meetings (see Figure 3).

The bar graphs in Figure 3 illustrate the redistribution of the noise exposure when applying the alternative departure procedure. Not much change in noise exposure was expected for Krimpenerwaard. Within the municipality of Rotterdam, an increase of 2580 households is expected to be exposed to 65 dB SPL and 320 households to 70 dB SPL. For the municipality Lansingerland 2780 less households are expected to be exposed to 65 dB SPL, and 1650 households less to 70 dB SPL. For Zuidplas, 1530 less households are expected to be exposed to 65 dB SPL and 80 households more to 70 dB SPL. Overall, 1670 households less are expected to be exposed to 65 dB SPL, 1250 households less to 70 dB SPL and 30 households less to 80 dB SPL when applying the alternative departure procedure (see Figure 3).

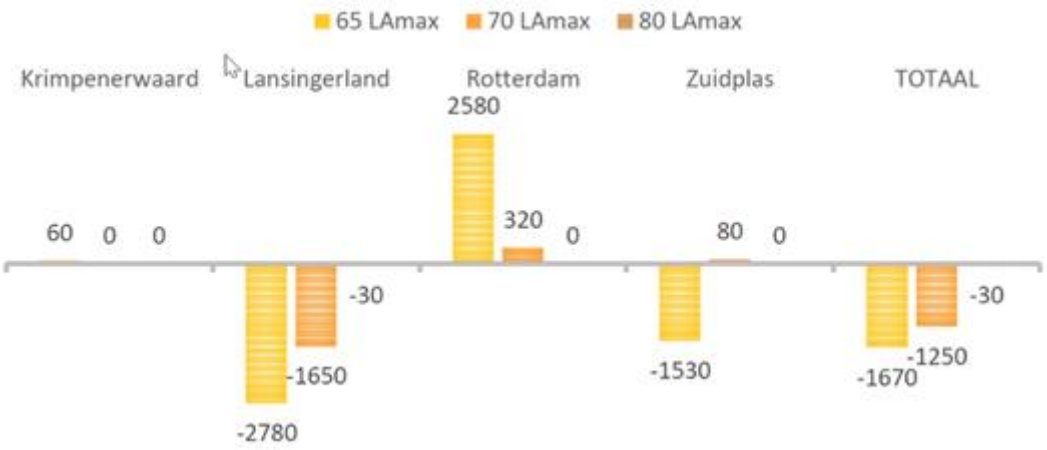


Figure 3. Number of the noise exposed households for the five test locations.

The participants were split up in groups from two to five people per meeting. The first two meetings were carried out for people who participated in the listening test and submitted their results from the listening test. The third meeting took place for two participants who had chosen not to submit their results from the listening test. During the meetings, participants were asked whether they would personally benefit from one of the procedures, whether they thought that the overall community would benefit and whether the community engagement strategy was helpful and valued.

The listening test scores were averaged over all 25 participants. For each of the five locations illustrated in Figure 2, the calculated LAmax noise levels, the calculated change in noise level, the mean listening test score and the standard deviation are listed in Table 2. For location 1, the current route was perceived as fairly more annoying than the alternative route (score 1.8). For location 2, the current location is little to fairly more annoying than the alternative route (score 1.4). For location 3, a score of -1.8 indicates that the alternative route is fairly more annoying than the current route. For location 4, the alternative route is a bit more annoying than the current one (score -1.2). And for location 5, the difference between both routes was not noticeable, as the quieter route was rated just a bit more annoying, but within the margin of uncertainty. The results from the listening test were in line with the expected noise level from the calculations with a relatively small standard deviation and with positive scores generally corresponding to

situations with reduced noise levels. The calculated changes in noise levels for location 3 (4.3 dB) and location 4 (4.4 dB) were almost identical. However, the score from the listening test suggests that the higher noise level for location 3 was perceived as more annoying compared to the increase in noise level for location 4. It seems that for higher noise levels, a reduction is more appreciated compared to the reduction of a lower noise level.

Table 2. Results from the listening test including the comparison of the current and the alternative departure procedure.

Location	Calculated LAmax, current route	Calculated LAmax, alternative route	Change in noise level	Mean Listening test score (-3 to +3)	Standard Deviation
1	76.2 dB SPL	72.7 dB SPL	-3.5 dB	1.8	1.2
2	69.2 dB SPL	66.5 dB SPL	-2.7 dB	1.4	1.2
3	65.4 dB SPL	69.7 dB SPL	+4.3 dB	-1.8	0.7
4	60.7 dB SPL	65.1 dB SPL	+4.4 dB	-1.2	1.0
5	73.2 dB SPL	73.6 dB SPL	+0.4 dB	0.1	0.4

Mixed results were received for questions about the personal benefit and the overall benefit for the community. Most participants put the overall benefit of the community first. Most participants reported that the process, the explanations, the listening test and the meetings were helpful and valued. However, some participants were unhappy about the approach as they felt the noise exposure and the annoyance is only shifted and not reduced. The discussion about sharing noise exposure revealed some interesting insights and opinions on what might be a fair approach. As of yet, no decision has been made for the current or the alternative procedure. The working group will propose advice, based on the calculated results, the listening test scores and the feedback from the information meetings.

4.3.3 Key Findings and Recommendations

Overall, the participants valued the community engagement procedure and the explanations of the effects of a possible change in departure procedure. The listening tests had additional value to the typically applied calculations of noise levels. The participants reported that being able to perform the listening test, including the acoustical comparison, provided better understanding of the differences of both procedures. In that way, the consequences and the impact were more easily understood. Sharing information, as well as discussing the dilemma that improving the situation for some may be at the cost of others, or striving for an overall benefit, helped to create understanding and empathy for some residents. These kinds of meetings are typically performed for larger audiences to reach as many people as possible at once. Interestingly, it seemed that during the information meetings in small groups more understanding and empathy were possible. People spoke openly about their concerns and listened to each other. The atmosphere was friendlier than during meetings with larger audiences and perhaps meetings in smaller groups create some sort of privacy. However, as the aircraft noise is not reduced but rather shifted to a different location, the difficulties of sharing exposure and annoyance were present. Especially for this kind of complex case, transparency and the clear communication

of expectations is very important and essential to create trust and the feeling of fairness.

4.4 Case Study Zaporizhzhia International Airport (Land-use Planning)

4.4.1 Overview and Objective

Zaporizhzhia International Airport is the fifth major airport in Ukraine and one of the key transport infrastructure enterprises providing services to the eastern and south-eastern regions of Ukraine. It is located 12 km north-east of the regional city of Zaporizhzhia. Its infrastructure includes one concrete runway of 2,500 m, which operates in both directions for take-off and from the north for landing.

This case study focuses on the implementation of noise protection zones (NPZ) with recommendations on compatible land-use planning while protecting people from noise exposure. The case study uses efficient dialogue between the airport, Civil Aviation Authority (CAA) and local authorities on this issue. The case study also involves the procedure of Environmental Impact Assessment (EIA) and communication procedures with the public, who are exposed to aircraft noise and other airport matters. This case study concerns the following aspects:

- Implementation of new legislation. According to the Air Code of Ukraine (2011) and Aviation Rules of Ukraine AR-381-2019, civil airports are obliged to establish noise protection zones (NPZ). NPZ boundaries must be calculated for current and future traffic scenarios and validated by measurements at predefined points at least once every five years.;
- Airport development plans. Prior to COVID-19, the airport expected a 25% growth in passenger traffic.

4.4.2 Approach and Results

The principal document related to noise management is Air Code of Ukraine with the Section X "Protection of Environment" which declares protection of environment and residents from noise generated during aircraft operations.

The normative criteria of noise contamination are equivalent noise levels L_{Aeq} (dBA) and maximum noise levels L_{AMax} (dBA) during daytime (from 7:00 till 23:00) and night-time (from 23:00 till 7:00) as it is set in the State Sanitary Norms N173. Annex N 19 to the Sanitary rules N173 defines opportunity and conditions for construction of new buildings inside the noise protection zones.

Noise levels are regulated by restrictions to construction around civil airports in areas designated as "Unsuitable for Construction", "Protection against noise impact" and "Limitations for residential Construction". Annex 18 to the Sanitary rules N173 defines 4 noise protection zones around the airports as presented in Table 3:

Table 3. Normative values for noise maps with respect to restriction of construction around airports.

Time	Zone A	Zone B	Zone C	Zone D

Day	L_{Aeq}≤60 L_{Amax}≤80	61≤L_{Aeq}≤65 81≤L_{Amax}≤85	61≤L_{Aeq}≤65 81≤L_{Amax}≤85	L_{Aeq}>65 L_{Amax}>85
Night	L_{Aeq}≤50 L_{Amax}≤70	51≤L_{Aeq}≤55 71≤L_{Amax}≤75	56≤L_{Aeq}≤60 76≤L_{Amax}≤80	L_{Aeq}>60 L_{Amax}>80

Under requirements of actual legislation noise maps are developed through the use of computer modelling techniques with obligatory validation using noise measurements. The methodology contained in ICAO Doc 9911 and ECAC Doc 29 is used for calculation of noise contours.

The development process accounts for various factors, such as the number of aircraft movements, the fleet mix, the expected fleet changes, potential infrastructure changes and others. Through the use of aforementioned factors, prediction noise maps are developed for the next 5 years.

According to the national sanitary and hygienic regulations for planning and construction of residential areas, two criteria are used as normative for aircraft noise zones – equivalent and maximum noise levels. Noise levels are regulated with respect to restrictions for constructions around civil airports designated the areas as 'unsuitable for construction', 'protection against noise impact' and 'limitations for residential construction'.

Where noise exposure is principally composed of a small number of discrete fly-by events, as in regional airports with low flight intensity, equivalent noise level is not representative, especially when thinking about the airport's possible growth in the future and the additional use of recommended L_{Amax} or *SEL* criteria. L_{Amax} can also be used for improving the measures of noise control inside NPZ, e.g. for more efficient sound insulation of the buildings.

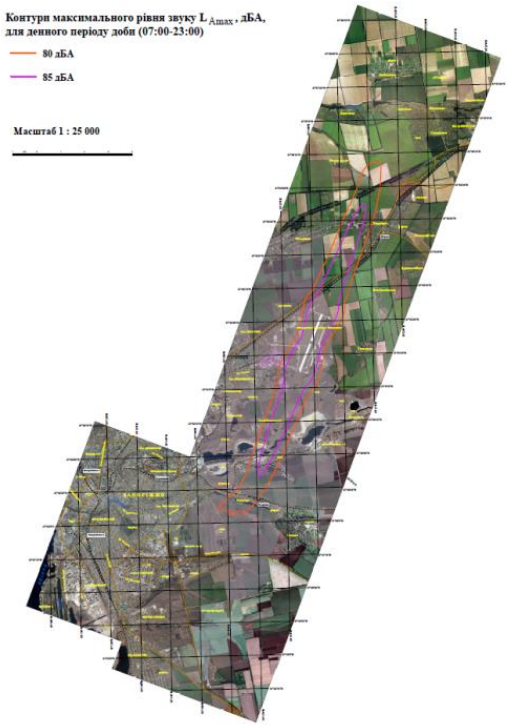
For strategic noise mapping, it is required by Aviation Rules AR- 381-2019 to use noise index such as L_{den} and L_{dn}, but there is a need to fully integrate those criteria in Ukrainian legislation for environment and human health protection. Although AR-381-2019 under the transposition of the END reference offers to use noise indicators Lden and Ldn – for evaluation of aircraft noise impact on population, the document does not contain normative noise levels for noise zones.

For calculation of noise contours on the basis of analysis of flight plans for the year 2019, the following flight traffic scenarios were elaborated:

1. The maximum intensity of aircraft movements reached in 2019, taking into account distributions between aircraft routes;
2. Perspective intensity of aircraft movements equal to maximum operational capacity of the airport runway-apron-terminal system.

4.4.3 Key Findings and Recommendations

As the result of calculations, noise protection zones are presented using maps



(Figure 4 and

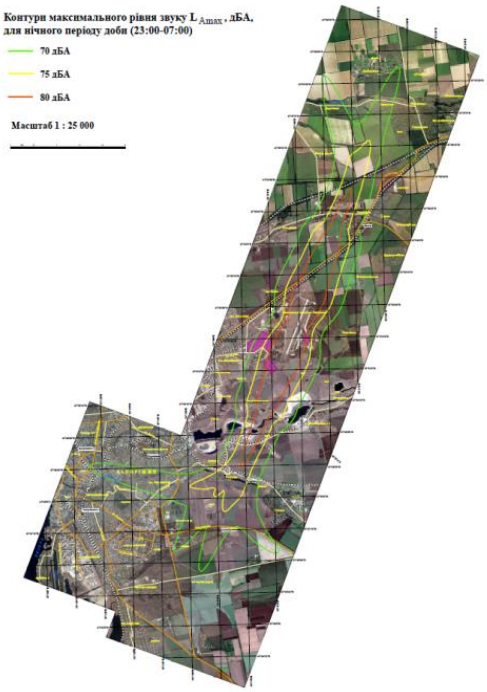


Figure 5). Different colours indicate normative values of $L_A$eq and L_{Amax}.

Analysis of the noise contours shows that noise contours overlay residential areas, therefore the complex program for land use planning is to be developed with recommendations for noise control measures within noise protection zones.

The results of noise measurement in the vicinity of Zaporizhzhia airport were analysed from several points of view: comparison with the normative values of

environmental noise in accordance with the requirements of national norms and rules; comparison with the results of noise certification of types of aircraft operated at the aerodrome; comparison with the results of the calculation, performed to justify the boundaries of the noise protection zones.

Comparison of the results of sound level measurements, including during certification tests of aircraft for compliance with international noise requirements, with the calculation results indicate slight differences between them (1-2 dBA), the assessment of which leads to the conclusion of sufficient accuracy, especially for aircraft type Boeing-737-800, which causes the main acoustic load on the environment among the other types of fleet.

In general, Ukrainian legislation follows the principal requirements of ICAO. The implementation of the ICAO Balanced Approach to noise control in Ukraine is focused on aircraft noise exposure assessment, establishment of noise protection zones and compatible land-use planning. On the other hand, the process of implementation of those requirements lags behind in comparison to western European countries due to investments needed. As the number of people affected by noise around the airport depends on the way in which noise protection zone land is used, there is a need to take into account interests of both sides: on one hand – airport operation mode and future development, and on the other hand – control of noise sensitive activities of community living in the vicinity of an airport.

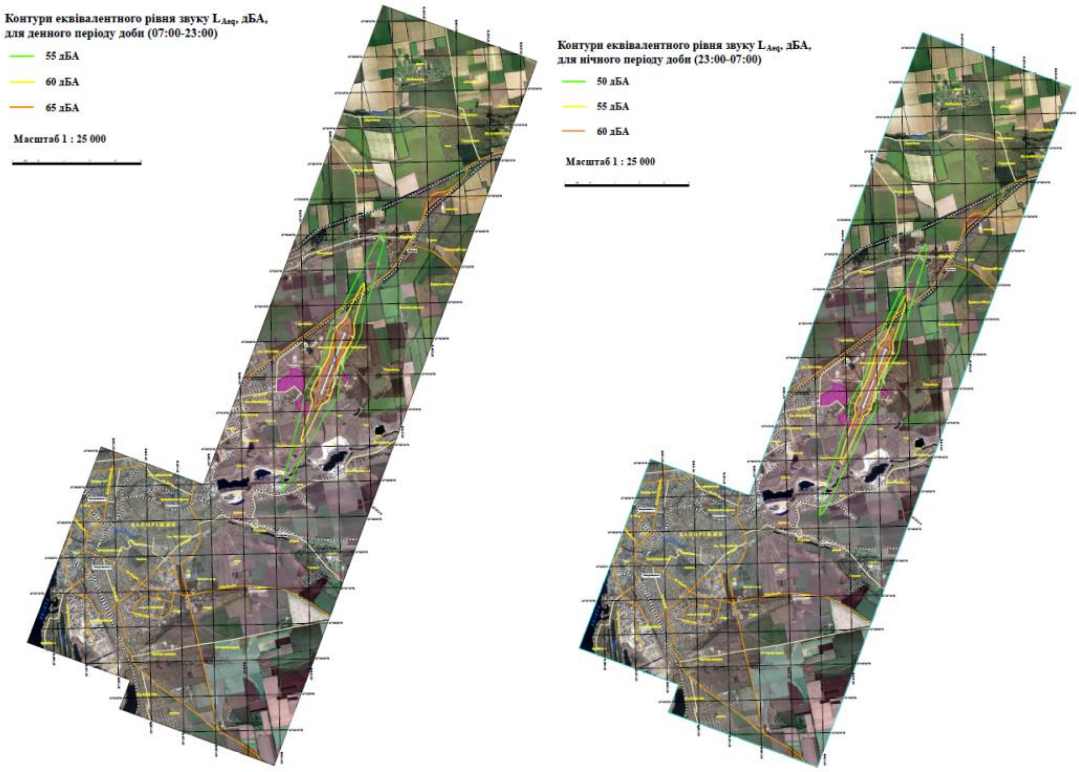


Figure 4. Noise contours (L_{Aeq}, dB(A)) for Zaporizhzhia International Airport: left – for daytime 7:00-23:00; right – for night-time 23:00-7:00

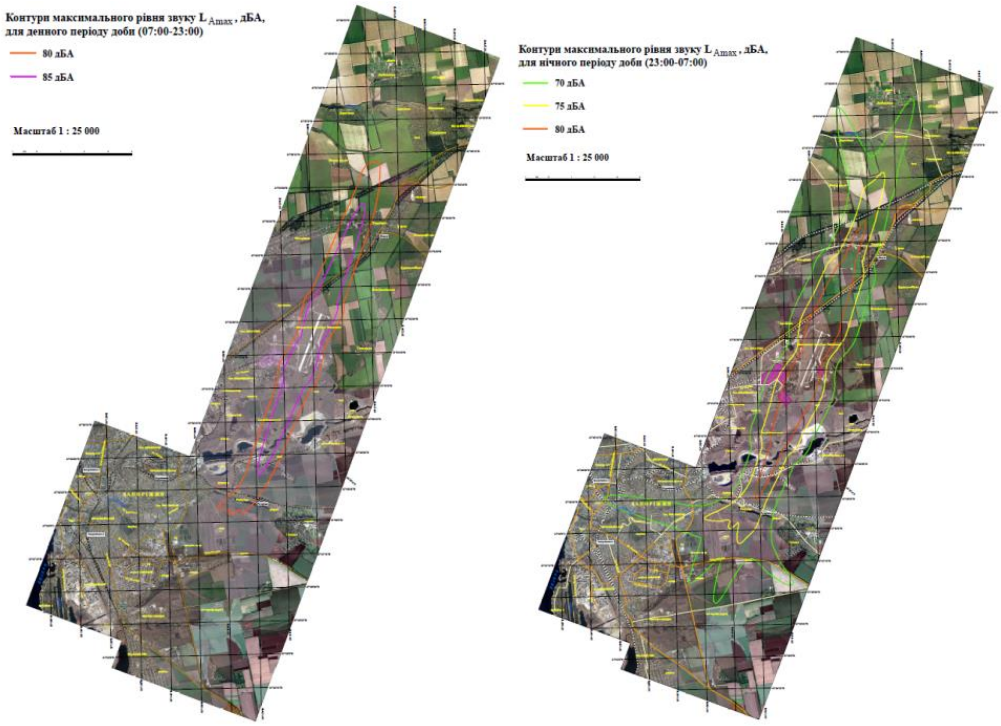


Figure 5. Noise contours ($L_A$max, dB(A)) for Zaporizhzhia International Airport: left – for daytime 7:00-23:00; right – for nighttime 23:00-7:00

Figure 6. Control points for aircraft noise measurements at Zaporizhzhia International Airport.

It is necessary to mention that existing legislation allows airports to build a systemic program to control noise exposure in their vicinity, taking into account both European and world best practice, which is very important because most Ukrainian airports can be considered as city airports surrounded by residential territories. Also, due to current low intensity of aircraft movements, and, as a result, low priority of noise as an environmental problem nowadays, there are several cases when development of cities can be found to have no respect to the predicted development of airports. The airport on its own cannot minimise noise

impacts, it has to work in partnership with all the stakeholders involved: CAA, the airlines and air traffic controllers, local communities. Minimising environmental impacts is essential in order for the airport to maintain current operations and enable potential sustainable growth.

Harmonisation of Ukrainian legislation related to noise challenges is one of the ways to improve the current noise situation and can contribute to further implementation of the ICAO Balanced Approach.

4.5 Case Study Iasi Airport (Land-use Planning)

4.5.1 Overview and Objective

Iasi Airport is one of the 16 Romanian airports dealing with encroachment due to the lack of mandatory LUP provisions. In this sense, the airport wanted to lead in establishing a collaboration context between all relevant parties to support the implementation of LUP provisions within the national legislative framework and to tackle potential issues.

The objectives were formulated (by drawing upon ANIMA learning) around: addressing the gaps that have been previously identified and support in investigating solutions, continuously engaging with stakeholders to support progress throughout the development of the case study, identifying priorities from each stakeholder and individual barriers in defining and implementing LUP provisions and supporting the implementation of an independent LUP policy or the harmonisation of existing legislation to cover LUP. Therefore, the main objective of this intervention is to support the development of a collaborative environment between relevant stakeholders through continuous communication and engagement.

4.5.2 Approach and Results

The design of the intervention started from existing ANIMA knowledge on this topic and of the needs in this context, as well as of the national legislative framework, through desk studies to support the organisation of focused discussions with relevant stakeholders.

The next steps within the intervention design process were to identify and engage with all relevant stakeholders for LUP, meaning all authorities that can influence airport noise management but are not included within the legislative scope yet. The aim was to engage in dialogue with them, identify the possibility for them to contribute to the efforts of managing noise around airports and engage in supporting policy-makers to define appropriate legislative statements that facilitate the implementation of LUP.

From previous ANIMA engagement (D2.5), the airport has already identified the responsible authorities for LUP and tried to engage with them. Territorial planning was outlined by legislation as being within the responsibility of City Halls and County Councils (i.e. local and regional authorities) and the Ministry in charge with territorial development and public administration. After initiating dialogue to raise awareness about the noise exposure and impact concerns in communities around the airport, all stakeholders agreed that land-use planning was required as a best

solution, but it was unapplicable in the context of an absent legislative context. Further engagement of the airport with different other potential stakeholders (Ministries of Environment, Health, Transport; local and regional authorities; Association of Romanian Airports; Civil Aviation Authority; Air Navigation Service Provider; airlines; noise experts; communities around the airport; representatives from airports experienced in noise management) shaped the understanding of opportunities to identify the gaps and limitations for implementing effective noise management strategies on Romanian airports. This initiative was of great importance, as it raised awareness about the urgency to foster communication and engagement and facilitated the development of a common understanding of the noise issues in Romania. After constructing a mutual understanding of the complexity of the noise issue and of the current management situation in Romania, the airport organised a workshop with many relevant stakeholders to identify first steps that could allow the definition of a national strategy for noise management. The most important proposals included the development of an updated noise legislation and changes within the Air Code to include noise management in order to ensure harmonization across the national legislation.

The implementation of LUP completely under the scope of the legislation for noise management was not possible, therefore the efforts were shifted towards the harmonisation of existing legislation applicable for all relevant stakeholders to include airport noise management provisions, such that this becomes the fundament allowing LUP to be implemented. To progress in this sense, various gaps have been identified, that influence the design and implementation of sustainable aviation noise policies.

Various stakeholders engaged actively to tackle this issue in order to increase the benefits from the existing legislation and to facilitate the links between different normative acts such that, land-use planning provisions could be defined effectively and in a harmonised manner.

The most important changes within the Noise Law regarding airport noise management, in comparison to the previous legislation, includes the definition of various responsible authorities for managing noise, as opposed to the case when the airport was the sole responsible as it was before. In addition, each stakeholder has different responsibilities and is actively involved throughout the development of Strategic Noise Maps and Noise Action Plans (especially in defining measures) to ensure that compliance with END specifications is addressed in a collaborative manner and that all available opportunities to reduce noise are addressed.

Communication of results (Strategic Noise Maps, Noise Action Plans) to the general public is also emphasised in various articles, highlighting that information should be clear, coherent, accessible and accompanied by a summary that bring to attention the most important points.

The updated version of the Air Code includes a definition of various noise related terms, such as noise mapping and noise protection areas. The definition of a noise protection area states that this is the area limited by the noise contour resulted from mapping and corresponding to the smallest limit values of noise indicators, for which constraints are imposed for land-use planning around an aerodrome. The

formulation of the definition of noise protection zones implies a strong connection to noise mapping and to the requirement to impose constraints over LUP around an airport, this being the first step to construct the missing link between Urbanism Plans and airport noise maps.

The next steps for implementing LUP and for establishing noise zoning provisions include the **definition of noise protection zones** in line with existing standards and the identification of possible links with the existing provisions. **Noise zoning performed specifically through the use of predictive noise map**s is not required, but this is an important aspect that needs to be addressed in the future to focus towards the implementation of LUP as a preventive measure against noise. Establishing the **criteria for introducing noise maps within the urbanism documentation** could be a challenge if not performed appropriately. **Completing the national legislative framework** with additional normative acts is also necessary to support the official implementation of the new noise law and consequently the preliminary LUP provisions. **Progress with legislative harmonisation** to ensure that the legislation for land-use planning and urbanism comprises the environmental aviation requirements and that its provisions are not formulated against the provisions from the Noise Law or from the Air Code.

4.5.3 Key Findings and Recommendations

Most gaps and necessities addressed by the airport as a result of discussions with different stakeholders were taken into account within the formulation of the new provisions of the Noise Law. The strength of the provisions has increased, as now they are under the form of a law, which has more judicial power than the previous format (Governmental Decision). Notable is the fact that the Noise Law describes which is the responsible authority, which are its obligations, how are these expected to be accomplished (tools, criteria), expected deadlines for implementation and sanctions. This is ensuring that the entire process is transparent, that the information is clear and can support the development of mutual understanding of the role of each stakeholder throughout the process to manage noise.

In practice, the implementation of the LUP provisions as stated by the Air Code is expected to start from the airports that develop noise maps and deliver them to local authorities. The local authorities, based on the noise mapping methodology, will develop noise zoning in line with the noise maps from airports. Next, the local authorities will include the criteria of noise zoning within the urbanism and land-use planning documentation, specifying the limits of noise protection zones, restrictions applicable for each zone, solutions to reduce noise in certain zones and requirements for the development of new buildings within the noise protection zones. In the end, the Environmental Guard verifies the application of these provisions and imposes sanctions for non-compliance.

Important to note is also the fact that airports now have the obligation to use noise mapping as a tool to determine a prediction of the impact that planned infrastructure developments could have over its vicinities. This requirement is applicable within the initiation of programmes related to airport infrastructure

expansions and is of great importance, as it allows a preventative approach on noise.

This case study aimed to find the opportunities to make the first steps towards defining LUP provisions, goal that was achieved but progress in this sense is still needed to ensure an effective definition, implementation and evaluation of LUP around airports. All stakeholders that were relevant to achieve this goal were identified from the policy level to the implementation level, but engagement is still necessary to ensure the effectiveness of the harmonisation effort initiated through this intervention. The short-term strategy for defining LUP provisions was accomplished through preliminary progress, but the long-term strategy to ensure that the complexity of noise is appropriately addressed, requires the involvement of additional stakeholders (e.g. Ministry of Health).

Continuous communication and engagement among relevant stakeholders were crucial to obtaining the outcomes of this study, which proved that collaborative efforts could lead to optimised results. The success of the intervention suggests that Airports should act pro-actively in establishing such collaborative stakeholders' environment. ANIMA project offered a solid support for the development of this LUP intervention by supplying BP knowledge, as well as a prestigious foundation for establishing a suitable involvement of the relevant stakeholders.

Future research is needed, focused on optimising results from existing provisions by tackling barriers in the implementation in order to highlight areas for potential improvement. Additionally, the existence of collaborative contexts (e.g. projects, task forces) that foster communication between experts, the industry and policy-makers are crucial in developing a mutual understanding of noise management, of different other environmental issues and of their cumulative impact, as well as in finding appropriate solutions and evaluating their outcomes.

4.6 Case Study Cluj International Airport (Interdependencies)

4.6.1 Overview and Objective

This case study aimed to understand the role of interdependencies within an airport context through the use of airline data analysis. The main objective of airline data analysis was to investigate if the initial purpose of using specific operational procedures will be confirmed by the results of this study. Research outcomes from this airline data analysis were formulated to complete the previous ANIMA findings from Catania Case Study (D2.5), in which a similar analysis was performed through the use of airport data.

Performing such a study was of interest to multiple stakeholders, from different points of view. From the point of view of the airport, such a study was considered necessary to complement existing knowledge about tackling environmental issues and to provide additional insight that could be later incorporated at the management level. Additionally, the importance of the study was also valuable for understanding possible correlations between existing environmental issues, especially in the context of their intermodal project, aiming for the airport to become the hub. Therefore, outcomes from such a study could serve as a

preliminary basis for addressing this topic in different complex ways, extending its analysis across other transportation sectors that would become active players within intermodality.

From the perspective of the airline (Blue Air), the absence of information regarding the environmental outcome from implementing different solutions to limit or reduce their impact, was considered a barrier in understanding the efficiency of their approach and a missing link within the evaluation of operations and also within decision-making processes for choosing the best possible solutions.

Another important area of interest was from the point of view of understanding how to address the environmental effect criteria during the design of a new operational procedure. In general, this criterion was associated with emissions in relation to fuel consumption, yet recent national regulatory changes have highlighted the need to also address noise appropriately, requiring the development of environmentally friendly operational procedures for most Romanian airports.

Important to highlight is also the active involvement of the Cluj-Napoca city (policy-makers, residents and existing organisations) within different on-going European initiatives (e.g. EUROCITIES), determining the proactive approach of Cluj Airport in developing and maintaining a good relationship with communities from its surroundings in order to contribute together in a sustainable manner to the development of the region. Since environmental issues are shared concerns for both the airport and the communities in its proximity, approaching the subject from this case study was considered essential by the airport in its pursuit to progress in a preventive manner towards overall community goals, especially since it is evaluated as a rapidly growing airport.

The main objective of this intervention was to investigate whether, and the manner in which the implementation of knowledge related to interdependencies (noise and emissions) can contribute to the environmental impact reduction at Cluj International Airport, thus facilitating discovering possibilities to identify efficient noise and emissions trade-offs in the future. Outcomes from this study are expected to provide insightful knowledge for the future definition of a locally tailored methodology to identify opportunities to reduce both noise and emissions.

4.6.2 Approach and Results

The decisions related to reducing the environmental impact at airports are often connected to noise and emissions and based on changes in operations. Such decisions are commonly made on the basis of a wide range of strategic, economic, operational and impact-related information. This study was designed to complement these efforts and support the airport in avoiding, where possible, unintended consequences and inform on possible outcomes associated with changes in operations.

In response to the main objective of the study, this intervention was focused on performing an analysis on noise and emissions from the use of NADP1 and NADP2 ICAO Noise Abatement Procedures. Performing such a study was of interest to both the airline and the airport, representing some first steps in developing a principled

approach to the mitigation of environmental issues through a collaborative approach with key stakeholders. Therefore, this intervention was focused on identifying existing benefits and opportunities that have not been captured yet, to understand where the challenges are and how to balance them, rather than evaluating or developing new procedures. Therefore, the final approach was formulated around finding possibilities to assess opportunities to reduce both noise and emissions, with minimum effort and associated cost.

The intervention was developed with the use of airline data. The airline data was analysed and only few data sets (certain flights) were selected for the analysis. This data set can be seen in Figure **7** (on the left), together with a superimposed representation of NADP1 (blue) and NADP2 (red) on the right side.

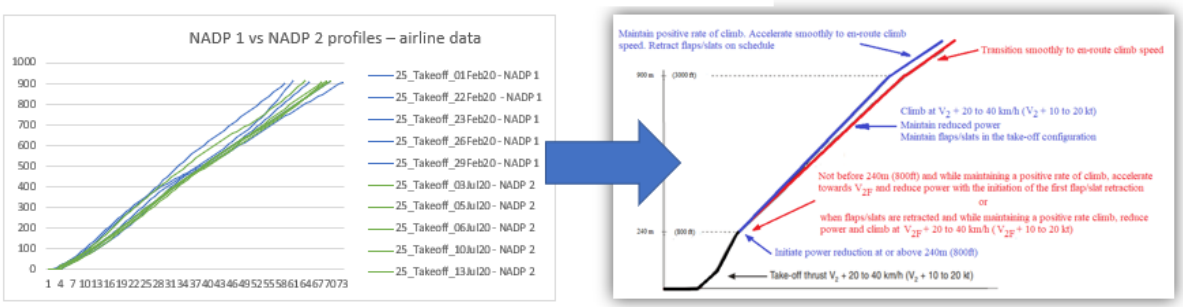


Figure 7. Airline data processing.

Noise contours were computed through the use of the L_{day} indicator, for a 12 hours interval and through the use of five NADP1 and five NADP2 procedures. Furthermore, an analysis related to the number of people exposed to different levels of noise was performed. Next, the fuel consumption data was analysed up to 3000 ft, according to the specifications of NADP procedures, to investigate the quantity of emissions that is produced through the use of the two procedures. From a preliminary additional analysis of atmospheric pollutants, it was determined that more in-depth information is needed to also address these issues. The investigation of CO started with determining the emission at the level of resident from the city of Cluj-Napoca, this being the largest community situated in the proximity of the airport. Next, the exposure of the population was determined in relation to different particle concentrations. A similar analysis for investigating NOx was performed, to determine the emission at the level of residents and the dispersion of pollution, supplemented with the outcomes in terms of number of people exposed to different concentrations.

By using two different procedures, it was already observed by the airline the fact that fuel consumption differed from one procedure to another. However, an understanding of their difference in terms of emissions/ air quality, as well as an overview in terms of real noise variation were missing. Therefore, this study tackled this gap and provided information related to all aforementioned issues, showing that the environmental outcome of such changes could be studied in terms of noise, emissions and atmospheric pollutants, providing relevant information that could aid relevant stakeholders (airport, airline, ANSP, communities) in establishing trade-offs between different priorities (noise, emission and fuel consumption, air quality).

In spite of the results obtained within this case study, recommending the use of NADP1 or NADP2 should also take into account other aspects that have not been covered within the study, such as the understanding of the noise burden over the real distribution of population from various communities and the perceived impact of the 'vast majority' that is actively engaged in filing complaints and engaging with the airport, over the 'silent minority' when making decisions related to noise distribution.

4.6.3 Key Findings and Recommendations

One important aspect is the fact that Cluj Airport has fostered good relations with key stakeholders (ANSP, airlines, the CAA, the Ministry of Transportation, other airports et. al.), which allowed the development of this study in a collaborative approach with both the airport and the airline. Therefore, continuous dialogue between stakeholders could support the deployment of future initiatives in a more efficient and timely manner.

Although communities were not included within the study, communication and dissemination activities related to the findings from this intervention could support the process of informing residents about the environmental context within this area. Future studies could also explore the possibilities to actively include communities within some of the steps of such an intervention (e.g. design, decision-making, implementation, evaluation).

Involving the airline within this study was essential not only for the delivery of necessary data sets, but also for drawing upon their experience and gaining insight into their point of view with respect to their priorities in terms of environmental objectives, information about previous actions in reducing environmental impact and understanding barriers that limit their efforts in this sense (e.g. trade-offs between different noise-related operational restrictions). From this, it was identified the need for further research about establishing trade-off criteria for decision-making in the context of existing different operational restrictions imposed to limit environmental impact, while allowing the identification and implementation of possible other solutions that avoid operational restrictions and limit/ reduce/ prevent environmental impact at the same time. Important to note is that the scope of directly involved stakeholders was planned to be limited at the start of the intervention and gradually expanded (other airlines, procedure designers), yet not achieved due to various barriers resulted from COVID-19 restrictions. However, such an approach in future studies could optimise the findings of such an initiative.

Future research regarding interdependencies (e.g. noise, emissions, air quality) could also be linked to new operational procedures, changes in scheduling flights or airspace changes, for assessing the environmental impact in a homogenous manner. Similarly, comparative studies containing all pollution sources connected directly or indirectly with the airport, could enhance the understanding of the overall environmental footprint. One interesting opportunity would be to perform such comparative studies during months with low levels of traffic and during months with high traffic demand (e.g. holiday months). Parallel studies related to quality-of-life could aid in completing the picture in understanding both exposure

and impact, thus resulting in the possibility to propose interventions that define appropriate correlation factors (and reduce uncertainties in correlation) between the two different types of studies, aiming to improve the quality-of-life of residents while allowing changes in operations, efforts specifically tailored for the local airport context.

Only a few factors that influence the differences between planned and real operations were taken into account within this study, therefore results could be improved in the future by including additional information to refine findings (e.g. delays, meteorological factors, use of different flight paths). An increased data set could also enhance the understanding of the real air traffic situation, given the fact that the data available for this study was limited as a result of a sudden decrease in the level of air traffic due to various COVID-19 restrictions. Future studies could also focus on understanding the influences of various factors, such as: different NADP initiation points, different meteorological conditions (e.g. normal, severe), the influence of the airport/ local community configuration, differences in MTOW/ MTOM, terrain and obstacle limitations (airport, ANSP, airline) and others.

Although this study focused on NADP procedures, it might be useful to extend the study through future research such that it includes all types of operational procedures used at an airport, to increase the capacity to identify and compare the advantages and disadvantages of all operations in terms of their environmental outcomes, and further in terms of other criteria of importance (e.g. safety, fuel consumption, costs, airport capacity, alignment with the airport Master Plans). Through this knowledge, the efforts could increase in supporting the development of environmental management methodologies in this sense, that take into account, in a particularised manner, most types of priorities of different stakeholders (e.g. airport, communities, airlines, ANSP).

In order to foster a common understanding of the overall environmental management elements and also of the particular components (e.g. noise management, emissions management, air quality management), more communication and engagement with relevant stakeholders (including communities) is needed at a national, European and international level, to support raising awareness about existing concerns, policies and practices, opening dialogue among relevant stakeholders, developing a mutual understanding of the issues and needs of each involved party, designing effective solutions, implementing and evaluating them. Joint initiatives are highly recommended, such as CEM, involvement in research projects and the existence of learning platforms that allow interaction (e.g. feedback from users, knowledge resources, management tools), such as the ANIMA Noise Platform. Similarly, more communication and dissemination events about airport practices, together with workshops focused on the exchange of information (best practices and lesson learning) between experienced airports and airports with little experience in environmental management, are recommended.

4.7 Continuous communication with the airport and the airline, throughout the development of this study, was very useful to fine-tune the delivery of relevant information that could serve as guidance for other stakeholders (e.g. policy-makers, ANSP, other airports/ airlines, communities). Additionally, the support from the Blue Air airline, with flight data, has helped the analysis of noise & emisions interdepdenencies. Case Study Cluj International Airport (Quality of Life)

4.7.1 Overview and Objective

The case study was focused on identifying opportunities that an airport can have to increase the quality-of-life (QoL) of residents living in the communities near the airport. This case-study was a test case of the D3.1 outcomes ("Study to identify the gaps – Quality of Life indicators"), in an airport environment. Noise exposure and noise annoyance have been integrated as relevant factors within the study.

Cluj Airport is a rapidly growing airport, that can be classified as a 'Starting the Journey' airport according to previous ANIMA classifications[3] in terms of experience in noise management. Its interests are focused on further development opportunities as an intermodal transport hub (air, rail and road), especially for cargo. Their aim is to become a Carbon Accredited Airport and address openly concerns related to noise, water and air quality, while fostering good relations with neighbouring communities.

The main issue in addressing QoL comes from its complexity and the absence of such studies in connection to airport activities led to the formulation of this intervention, as a first step in understanding QoL factors in this region.

All these reasons led to this initiative, focused on identifying potential opportunities to understand and possibly increase the quality-of-life of residents as an integrated part of future developments. Therefore, this study details the experience of the airport with this topic in order to support through its findings the definition of best practice for airports that have the intention to conduct such a study. In addition, gaps in knowledge are also emphasised to define potential future steps in progressing with this initiative beyond this study and possibly support the design of effective interventions to support future noise interventions.

The main objective of the study is to identify which QoL dimensions or indicators can be positively influenced by Cluj Airport to increase the wellbeing of the community influenced by the airport activity. Ultimately, an improved understanding of QoL from the perspective of residents could aid the design of future developments planned by the airport (e.g. operations, procedures) and optimize these efforts towards a positive impact on QoL. Further objectives include drawing upon available 'best practice' to develop an appropriate approach for the local context, furthering the current (preliminary) understanding of the QoL

[3] Heyes G., Dimitriu D., Hooper P., ANIMA D2.1 – Pan-European overview of Existing Knowledge and Implementation of Noise Reduction Strategies, July 2018, https://zenodo.org/record/2599726#.YPlfX-gza5g

complexity, identifying needs and opportunities for future research and summarise learning for the ANIMA Noise Platform.

4.7.2 Approach and Results

This intervention was designed as a study on quality-of-life around Cluj Airport. The study was conducted as part of the ANIMA EU Project and was formulated based on findings from WP2 and WP3. This initiative co-exists with another study related to interdependencies, conducted at the same airport. Both case studies are formulated in such a way that they feed into the ANIMA Noise Platform[4] with 'Best Practice'.

This case study assessed the point of views from both residents and Cluj Airport. Firstly, the perspective of residents was important to determine the priority of QoL elements (most and least important factors/ dimensions). Secondly, the perspective of the airport was relevant for determining what measures (with potential/ expected impact on QoL) have already been implemented and what possible opportunities exist for future interventions. Comparing both views, it was examined whether the QoL elements considered of importance for the airport were shared by the residents too.

The methods that were used were interviews and online surveys, focused on collecting feedback to determine the airport's and community's perspectives. Interviews were used for the airport to support the exploration of answers in a more comprehensive manner. An online survey was used for residents. Topics covered were, for example, people's QoL, satisfaction with various institutions, and sociodemographics (e.g. age, education, employment, location of residence etc.). For the analysis and comparison of results, the main approach was through desk research.

The formulation of airport questions was focused on the use of an increased number of open questions, with short explanations, and implemented through an interview approach, based on the assumption that the interviewee is of an expert nature, thus facilitating the discussion of items in more detail.

The Airport Audit was formulated based on different QoL elements, such as dimensions, topics, groups and corresponding indicators. The 9 QoL dimensions varied from health, to economic and physical safety to natural and living environment and were directly taken from D3.1. In this current case study, corresponding topics were defined that included items such as access to healthcare, economic safety and environmental conditions. Groups were further defined on a more specific basis and in relation to the topics addressed (e.g. psychological health, global/ regional/ local context), followed by indicators (e.g. annoyance, impact on water/ soil quality, emissions). Based on this structure, questions for the airport were formulated linked to each indicator, resulting in 29 questions.

[4] ANIMA EU Project, ANIMA Noise Platform, https://anima-project.eu/noise-platform/main-page

The formulation of survey questions started as a result of discussions with the airport to collect information about existing QoL-related interventions (from the airport's perspective), which supported tailoring the questions in a manner to aid the assessment of whether residents perceive the measures as influential for QoL as the airport does and to provide insight if airport actions are consistent with the expectations of residents. In addition, the level of detail of the survey was dependent on the feedback from the airport to ensure that findings are relevant to the local context. The adaptation focused on tackling QoL dimensions/ indicators that are/ could be influenced by the airport, as well as on the likelihood to achieve the aimed number of responses (e.g. by limiting the number of questions and reducing the time required for completing the survey).

The survey has been focused as much as possible on reflecting the general experience/ view and not certain experiences correlated with a specific moment in time. In addition, questions were formulated based on the assumption of having a non-expert audience. Thus, closed questions were used, accompanied by explanatory notes or examples.

4.7.3 Key Findings and Recommendations

According to the main focus of the case study and its intent, there are several opportunities that have been identified for the airport to increase the quality of life of residents living around the airport. QoL was a complex unknown in the absence of studies connected to the airport. Therefore, addressing QoL aimed at supporting the design of effective interventions to reduce noise and improve QoL concomitantly and thus point towards the need for understanding noise impact in a wider view at the level of the day-to-day experience of people.

This case study has been in pursuit of understanding how to address QoL, how to design steps to select appropriate QoL dimensions/indicators (tailored to the context) and how to capture the process of understanding individual QoL priorities. One important aspect to mention is the fact that the local context is very relevant within the design of such a study, especially for choosing particular QoL dimensions/indicators (e.g. if it is known that the future strategy of the city is oriented on solutions for GHG reductions and climate neutrality, then separate additional questions can be formulated on this topic to gain a more in-depth understanding of the intensity of the issue/ pressure). In the case in which it was assumed that some indicators can be weakly connected to the capabilities of the airport to influence QoL, they were approached at the level of general understanding, having limited the number of questions in this sense or combined different such QoL elements under the scope of one question when potential overlaps were identified (e.g. criminality, mortality, theft etc.). This facilitated the possibility to focus more on areas that were expected to be of more importance and more strongly connected to airport activities by addressing more questions in these areas, while having a limited number of questions - based on the assumption that a lower number of questions determine a lower period of time for responding the questions and therefore the response rate could increase (accounting for criteria such as focus of questions, response rate, quality of results, ability to gain insight both at general QoL level but also on specific QoL elements).

Capturing the process of understanding QoL priorities is complex at can be approached in a broader manner or at a more specific level (e.g. when focusing on understanding only few QoL dimensions/indicators). Depending on the level of detail of the understanding set to be reached, questions could vary also timewise in formulations from assessing the situation 'in the last 12 months' to 'during your last experience'. For example, if transportation is addressed in light of gaining a general perspective, then approaching each means of transportation might be out of focus; on the contrary, if this is the main generator of valuable input, then each transportation mode could be addressed separately in terms of different characteristics (e.g. affordability, connectivity, travelling conditions/ comfort, source of noise, source of emissions, exposure and impact from this source, contribution to AQ, expected changes in the future – such as changing buses from classical to electrical ones). Understanding different QoL perspectives on these key areas could further guide the design and implementation of different airport developments, operations or procedures (e.g. NADP implementation/ planning RWY extensions/ intermodal implementation tailored to resident expectations to optimise efforts towards achieving a positive QoL impact).

In terms of identifying opportunities for airports to influence in a positive manner QoL, it was considered necessary to identify what actions were specifically designed to influence QoL (directly or indirectly), what actions were not designed to impact QoL (directly/ indirectly) but have influenced it as unexpected outcome. In addition, completing this knowledge with the priorities identified from residents, this approach allowed the identification of main concerns of communities that could/ could not be influenced by the airport. Furthermore, this can guide the planning process for the identification of future activities to gain more QoL-related knowledge in relation to the airport to improve, by focusing on key areas of improvement. At the same time, progress in this sense is beneficial in terms of learning for other airports and can also identify gaps in knowledge in terms of novel approaches for airport noise management.

Understanding QoL from two different perspectives (airport and residents) was a successful but complex process. This can especially be the case in situations in which there is little or no available knowledge on the topic, as it was the case here. Therefore, in order to make the first steps in understanding how to increase the wellbeing of communities in the proximity of airports, such an approach could provide a basis for understanding the airport-community relationship.

Although most existing interventions about QoL in connection to airports focused mostly on an organisational and the aviation/ professional perspective, the current study has focused on a more community-centric approach, thus complementing existing knowledge in approaching interventions.

Since the aim of Cluj Airport, as a rapidly growing airport and as 'Starting the Journey' within noise management, is to focus on development opportunities (while fostering good relations with neighbouring communities), future research in connection to the environmental studies performed for the intermodal project could be performed to link findings from this study and refine environmental goals in line with population expectations. Another interesting link could be to the Level

1 carbon accreditation, to address openly the environmental concerns in an integrated manner.

Fostering good relations with stakeholders has always been in focus for the airport. The case study has shed some light on how an airport could start identifying opportunities to engage with communities based on their priorities and learn to address QoL in a more systematic manner, aiming at gaining benefits across stakeholders (aviation, communities, policy-makers, other industries) by understanding the relation between interventions and acceptability of outcomes. Understanding QoL priorities among most stakeholders could be in support of dialogue, communication and engagement and contribute to sustainable local/regional/national strategies and facilitate synergies with noise management (following correlation between aircraft and road noise annoyance) while avoiding unintended consequences (i.e. by reducing impact from one environmental issue and increasing another). A collaborative environment could later give the opportunity to investigate long-term QoL priorities for stakeholders, investigate priorities in terms of interdependencies (noise/annoyance, emissions, AQ, others) and gain an in-depth understanding of the perception of the role of the airport in the region (e.g. beneficial in terms of economic gain, social benefits from travelling opportunities etc.).

Research findings benefit a wide scope of stakeholders (academia, policy-makers, communities, industry) by providing knowledge and guidelines for future research directions needed with respect to QoL dimensions and indicators, raising awareness on the importance of understanding differences in QoL priorities and on the need to extend the investigation to include other actors. This aims at raising awareness about potential QoL benefits in the area through engagement opportunities, allowing the entire community (residents, industry, policy-makers) to identify common needs and resources, together with consensus solutions.

By having identified previously implemented measures by the airport, this can allow future research to make connections between different airport noise sources (especially in connection to the intermodal project) and QoL-related measures (intended and unintended) in a more practical manner. Since few studies about the relation of aircraft noise exposure and wellbeing, QoL and psychological ill-health exist, this remains a strong research need and gap and addressing directly non-acoustic factors such as annoyance and sleep disturbance under the scope of QoL could be beneficial to complete the understanding of this area of research. For example, in the current case (national context), evaluating sleep quality is approached as a health component and as a noise management component, being treated differently across legislations. In this case, the QoL spectrum is able to capture both approaches and connect any potential missing links.

Opportunities for future research exist in various forms. No discussion/ focus groups between the airport and residents could be done (due to COVID-related limitations), but might nevertheless be an insightful opportunity to discuss the findings from the present study. More in-depth knowledge could be gained from any future progress focused on the definition of the perspective of residents on QoL, especially by addressing other aspects (e.g. perception of physical safety at the premises of the airport vs. in the proximity of the airport). Moreover, repeating

the study in other contexts (e.g. post-COVID, other airports, different local culture) might help understand which findings could be generalised, and which ones are strongly context- or culture-dependent.

5 Discussion

The seven airport case studies powerfully illustrate the challenges that airports and other aviation stakeholders face when attempting to strike a balance between the benefits of air transport growth and the management of environmental impacts such as noise and air pollution. Overall, if airports do not work with communities to negotiate a 'licence to operate' then, as many of the case studies demonstrate, community resistance will begin to limit an airport's capacity to grow.

This poses the question of how best to achieve this balance? The cases illustrate some key points in answer to this question relating to:

- The need for early and comprehensive community engagement
- The conundrum of trade-offs
- The role of legislative frameworks and clear responsibilities if potential future problems are to be anticipated and avoided

Comprehensive community engagement

Experience demonstrates that early and in-depth community engagement can help ensure that airport noise management addresses issues of concern and thereby delivers changes that are valued by communities. But the process of engagement can be challenging and the outcomes inconsistent and, at times, even conflicting.

The Ljubljana Airport case study, for instance, demonstrates the frustration and opposition that can result from little/no communication or explanation of an operational change. This means that the airport and regional authorities have had to work hard to overcome mistrust as they seek to develop a more transparent framework for noise management in which the community voice can be heard. However, as other cases have shown, early community engagement is no guarantee that the road to effective noise management will be smooth.

The UK Airspace Modernisation process and ICAO (2017) guidance on aviation environmental management explicitly require early community engagement over the design principles of airspace management by way of shaping the development, appraisal and consultation on specific airspace change proposals later in the process. Whilst this approach aligns well with the 'ANIMA Methodology' (see D2.5) and is to be welcomed, it has raised some challenges in respect of:

- The emergence of potentially conflicting design principles for noise management
- A long process that could frustrate participants and lead to disengagement
- A lack of prioritisation in design principles which may make their application in proposal appraisal and consultation problematic
- An absence of any discussion of how to articulate performance against design principles (i.e. no agreement over the metrics to be used to illustrate the merits of different airspace change options against each design principle).

Thus, the lesson appears to be that care should be taken to ensure **efficient early engagement** that is 'extensive, consistent and factual' (ICAO, 2019), by tailoring engagement techniques to the task in hand. For example, the use of **focus groups and workshops appear best suited to early engagement** stages as they allow the in-depth level of interaction required to explain and discuss sometimes quite

complex issues; enabling the greater likelihood for participants to reach consensus outcomes. However, in so doing, participants should be made aware of the wider process in which such activities take place and be informed of the relevant timescales that may lie between (earlier) phases of discovery and learning, and (later) phases of implementation. Thereby, they may gain greater appreciation of the work being undertaken and may be less likely to become frustrated by the time taken. Demonstrating such a process may also help to assure residents that their perspectives are not only being taken into account, but that they are valued and being utilised through a process that can be evidenced, communicated, and evaluated. In this sense**, effective noise management practice could be seen less as seeking to 'do the right thing' and more as a process of 'doing things (i.e. deciding what to do) the right way'.**

Focus group and workshop techniques, examples of the face-to-face interactions that help build relationships with communities (ICAO, 2017), were also effective in enabling the illustration and discussion around the proposed departure route change at Rotterdam Airport, which although welcomed and appreciated by community representatives, did not reach a consensus given the identification of 'winners' and 'losers' in local communities. Potentially, an earlier discussion (before the specific change was proposed) about the principles by which operational changes should be made and evaluated could have been helpful. In such discussion, care taken to ensure information given was tailored, location specific and of appropriate volume and complexity so as to not overwhelm would have been in keeping with ICAO's 2017 guidance. For instance, if there had been agreement on prioritising noise reductions on the most noise-affected communities and/or acceptable levels of dis-benefit for those experiencing marginal increases in noise, a way forward might have been identified. It may also be pertinent to approach residents following an initial internal analysis by industry stakeholders to identify design options that are feasible and viable, and to communicate clearly why this is the case. Doing so will reduce the risk of stakeholders being offered any mitigation options that cannot be implemented, thus narrowing the discussion around viable options, and reducing opportunity for mistrust arising from unmet expectations. But even if there are no changes made in the process, it need not be seen as a failure: residents may prefer the current situation, and there was unanimous agreement that this negotiation structure helped in restoring trust in and dialogue with the airport.

It is worth noting that focus groups were also used in the QoL study at Cluj to refine understanding and ensure the online survey asked the most appropriate questions. Thus, a qualitative step was used to inform quantitative data collection, which ultimately provided numeric substantiation of findings. Indeed, researchers conducting the Cluj case study felt that this approach provided a better understanding of the local community engagement process. In a similar fashion in the UK Airspace Change process, it might be more appropriate to use more quantitative methods when specific airspace changes are being discussed as, by this point, the key issues should have been clarified and the respondents would be being asked their opinion on specific changes which could be illustrated in a concrete way (unlike theoretical concepts discussed earlier in the design process).

Trade-offs

Trade-offs between potentially competing priorities appear in almost all case studies. Zaporizhzhia and the interdependencies study at Cluj illustrate how technical assessments of noise exposure and noise and emissions respectively, can be used to highlight the consequences of future changes. However, whilst this **transparency can highlight the nature of the trade-off,** it does not necessarily make the decisions any easier, especially where there is no agreement or regulatory position on what to prioritise. Nevertheless, the footprinting work at Zaporizhzhia should provide the basis for interventions to prevent encroachment into areas where noise exposure will increase with airport growth and the resolution on the noise and emissions trade-offs between NADP1 and 2 at Cluj will inform future operational practice and allow them to be fine-tuned to local and global concerns. In both these contexts, feedback to communities on technical issues that shape decisions (ICAO, 2017) will be central to public understanding of outcomes.

Trade-offs between noise impacts on different communities were evident at Rotterdam and in the UK; highlighted, in the latter case, by the competing commitments to share noise whilst seeking to minimise the number of people affected by it. Again, to support rational decision-making **it is important to discuss, and ideally agree, the relative importance of design principles/noise management priorities** and have clarity on **how best to articulate performance against these priorities**. The latter may require use of supplementary noise and operational metrics that best 'capture' the quality being illustrated.

At the heart of the Iasi Airport case study is the need to balance local development with the long-term needs of the airport. Great strides have clearly been made here in respect of recognising the challenges of encroachment and assigning legal responsibilities for noise management; however, there remain concerns that the legislative process is slow and thus the problem of encroachment could increase at a time when there are few resources for reactive mitigation measures such as sound insulation, relocation, and compensation. A key learning here is that **getting noise management right in the first instance is the most effective way of reducing noise challenges** in the future, whatever 'the right' outcome may be.

Legislative frameworks governance responsibilities

At the airports with less experience of noise management, the case studies demonstrated the **critical role played by clear legislation providing ownership of noise management issues**. Whilst this is a key first step in establishing a framework for noise abatement, it is also necessary for key actors to work together, as highlighted at Ljubljana, Zaporizhzhia and Iasi, in the development of **transparent systems of accountability** and the implementation of regulatory controls. In this way, communities can fully understand the basis for key decisions relating to noise management interventions and develop trust in airports and control authorities. Noise Action Plans, as required by the Environmental Noise Directive, offer the opportunity for airports to develop long-terms strategies that are able to effectively outline the requirements for effective

noise management, including the assessment of relevant legislation and actors. However, previous ANIMA research (see D2.1) has suggested that noise action plans are too often developed as a legislative requirement, rather than as a valuable noise management tool. **Frameworks to help airports understand how to approach given noise management challenges at a strategic/higher-order level would likely enhance the propensity for more effective noise management interventions.** Nevertheless, such frameworks need to recognise the complexities of developing strategies over long periods in which the decision-making landscape can quickly change (i.e. through changes in legislation). Deliberate or planned strategic approaches (Porter, 1979) are useful in this context in providing an organisation with some purposeful direction. However, in reality, these case studies demonstrate that airports are developing their own definitions of good practice as they learn more about how best to manage noise based on their own circumstances. This appears to be more in line with concepts of emergent strategic thinking as advocated by Mintzberg (1994). The reality is likely that the answer, for noise management, lies somewhere between the two – airports need structure, as articulated through noise action plans, to give management direction and to make this clear to stakeholders, but such direction must remain flexible enough to be adapted over time as the operating environment evolves in response to external factors such as politics, economics, society, legislation, technology and the environment.

6 Conclusions and Recommendations

A fundamental take home message from the case studies is the **vital importance of community engagement in noise management if decisions are to be accepted and outcomes valued**. In general, the **earlier this engagement starts in the process of decision-making and implementation the better**; although care needs to be taken in the selection of methods of engagement to ensure the tools used are appropriate to the engagement and communication task faced. In this way, overly long and tortuous engagement should be avoided and with that the risk of increased uncertainty in outcomes. Such engagement should also ensure that decisions and subsequent interventions are tailored to local community concerns reflecting national, regional and cultural differences across Europe.

Consequently, key recommendations for communication and engagement are:

- Start early.
- If engaging as part of consultation, or design, clearly explain why this communication is taking place and the wider process into which the engagement is feeding, so as to manage resident and other stakeholder expectations.
- Accept that some issues are complex and will require the time and access to the expertise necessary to explain issues upon which opinions are being sought. This may require preparation and testing of communication materials in advance.
- Less extensive, but more intensive, qualitative tools can help foster quality dialogue.
- Communication with residents in forms that allow dialogue and mutual understanding are preferred over information sessions by the airport for all residents at the same time for a large audience
- When principles are discussed, it is important that they are prioritised in order to inform later decision-making over proposed actions.
- The noise & emissions trade-off case study illustrated the need to consider a holistic approach when dealing with management of noise or/and emissions. Particularly due to operational procedures, the assessment of interdependencies is the key for a good environmental policy at airport level and, particularly, to identify the impact of a new intervention.

7 Glossary

Abbreviation	Meaning
ACI	Airports Council International
AIP	Aeronautical Information Publication. This is a public manual containing aeronautic information usually issued on a national level. AIP includes all information about procedures, regulations and other aviation-related information necessary for air navigation in the related country. The AIP is internationally standardised and consists of three parts: Part »GEN« includes general information about regulations and the infrastructure. Part »ENR« contains information necessary for flights en-route in the related country. Part »AD« (aerodromes) provides information about the airports, e.g. about operating times, runways, relevant restrictions, aircraft noise management (as relevant for pilots). Every existing flight procedure has to be published in the AIP. For example, a new -> *SID* has to be first pre-published in advance to be studied by all the pilots that have to use it and then published in a final version as a flight procedure to be followed by all pilots.
BA	Balanced Approach
EIA	Environmental Impact Assessment
END	Environmental Noise Directive
ICAO	International Civil Aviation Organization
IFR	Instrument Flight Rules IFR flying means navigating a plane through rough weather conditions, heavy clouds or under the darkness of night, leveraging cockpit instruments as altimeters, GPS systems and vertical speed indicators.
JACL	Civil Aviation Agency
KZPS	Slovenia Control
L_{day}	The day noise level, the A-weighted equivalent continuous sound level (L_{Aeq}) over the 12 hour day period (6:00 – 18:00).
L_{den}	The day-evening-night noise level to express noise level over an entire day, expressed in decibels (dB).
LEPASO	Letališka partnerska skupina za okolje = Airport Environmental Partnership
L_{eq}	Equivalent continuous sound level
$L_{evenings}$	The evening noise level, the A-weighted equivalent continuous sound level (L_{Aeq}) over the 4 hour evening period (18:00 – 22:00).
L_{night}	The night noise level, the A-weighted equivalent continuous sound level (L_{Aeq}) over the 8 hour night period (22:00 – 6:00).
LUP	Land use planning
NAP	Noise Action Plan
RWY	Runway

Abbreviation	Meaning
RWY 12	The operating orientation. The number indicates the 12 = 120º from the north, which means SIDs from this head of runway.
RWY 30	The operating orientation. The number 30 means 300º from the north which is the other head of the runway RWY 12 120 +180 = 300º for SIDs, the other direction.
SID	Standard Instrumental Departure (The departure as it is designed in AIP to be followed by all the pilots)
SNP	Special needs plan
VFR	Visual Flight Rules VFR essentially exists to ensure that pilots flying visually don't lose visibility up in the clouds and crash into each other.

ANNEXES

The following annexes provide more information on the case studies described in this deliverable.

A. UK Airspace Modernisation Processes and Heathrow Airport – Lessons for Community Communication and Engagement

A.1. Summary

The UK has embarked on a radical process of Airspace Modernisation to optimise the benefits from the adoption of performance-based navigation (PBN) that has been gradually introduced across most airline fleets as newer planes incorporating this technological capability have been purchased. PBN has increasingly been replacing ground-based navigation systems with on-board systems incorporating satellite navigational aids with the result that aircraft are able to fly prescribed routes with increased predictability and accuracy. A key benefit of this feature of PBN according to the UK Government (DfT, 2018) is that it concentrates traffic and thus increases airspace capacity thereby 'unlocking' growth, improving safety and offering environmental gains through more direct routing. At the same time, the Department for Transport (2017) issued Air Navigation Guidance to the UK Civil Aviation Authority (CAA - responsible for overseeing airspace changes), which acknowledged the potential negative environmental impact of changes and highlighted objectives supporting 'a strong and sustainable aviation sector' (p.8). These are to:

- Limit and, where possible, reduce the number of people in the UK significantly affected by adverse impacts from aircraft noise
- Ensure that the aviation sector makes a significant and cost-effective contribution towards reducing global emissions; and minimise local air quality emissions and in particular ensure that the UK complies with its international obligations on air quality.'

Thus, from a noise perspective, the CAA and airports responsible for coming forward with airspace change proposals were charged with balancing economic and social benefits from a growing air transport system and any associated emissions outcomes with the potential adverse noise impacts on communities near airports. The aim of this case study was to critically reflect on the efficacy of arrangements made by the CAA and airports for arriving at airspace changes which reflect community noise concerns whilst attempting to deliver the wider social and economic benefits derived from aviation.

Drawing upon UK policy and regulatory documents the approach to airspace change was captured highlighting the stepwise process advocated in the Air Navigation Guidance and adopted by the CAA (CAP 1616, 2019 and updates). Airport responses to these requirements were critically reviewed drawing upon published information on the CAA's dedicated Airspace Change portal and insights into the specific approach followed at Heathrow Airport garnered from in-depth interviews with key sector actors. Reflections on the efficacy of the community engagement process and the critical issues that should underpin any decisions on airspace changes were extracted from a series of focus groups with amenity group members (mostly those living near Heathrow and Gatwick airports).

The critical review of 12 larger UK airports attempted to engage stakeholders and communities in a dialogue over airspace 'design principles' and revealed considerable efforts to consult with a wide range of stakeholders through various channels and utilising a range of different techniques. These enabled airports to identify key design principles that should guide the later development of specific airspace change proposals. These principles covered the following groups of issues:

- Safety
- Airspace users
- Technology
- Policy
- Capacity
- Emissions
- Noise

Despite apparent clarity on these design principles (DPs) two key omissions look set to reduce the value of this consultation stage on subsequent stages in the CAA process of airspace change development and implementation. First, there was a general lack of ranking/prioritising design principles, which is likely to make the process of trading-off between principles very challenging, particular where DPs appear to be conflicting such as the preference for dispersing tracks, whilst attempting to minimise the number of people overflown. Second, there appeared to be very little discussion, let alone agreement on how to capture performance against specific noise-related DPs using metrics that describe operations and their noise consequences (to allow the relative merits of different airspace change options to be illustrated and informed decisions made). Again, this would seem to make the appraisal and consultation around specific airspace change proposals all the more problematic.

Reflecting on engagement with the DP discussions from the perspective of airport amenity group members and the airspace change team at Heathrow led to the following conclusions:

- If airspace modernisation is to optimise the impact of PBN then it needs to address the balance between flight track concentration and dispersal, recognising that local circumstances will dictate when one option is preferred over the other.
- Starting community engagement early can help reveal the principles by which airspace proposals should be developed; but the former should be prioritised and the means of articulating the latter agreed, if outcomes from early engagement are to inform and streamline later stages in the development process.
- There is a need to develop simple illustrative materials that highlight changes in noise exposure on the ground, associated with concentration or dispersal, incorporating the number and noisiness of events
- Community expressed preference for noise sharing (flight track dispersal) may run counter to UK/EU policy to 'limit and, where possible, reduce the number of people significantly affected by adverse impacts from aircraft noise'

- There is a lack of evidence on the potential impacts associated with dispersal/concentration (annoyance response, sleep disturbance, long-term health consequences); especially as the former may increase the number of newly exposed people. This should be a focus for future research.
- It cannot be assumed that all stakeholders buy into existing government policy and thus airspace change sponsors would do well to acknowledge feedback that challenges policy as this should allow for policy commitments to be scrutinised and amended, if appropriate, in the light of implementation experience.

A.2. Overview of UK Airspace Modernisation process

A.2.1. Focus and Intent

This case study seeks to track the UK Airspace Modernisation process. It looks to understand how airports (the airspace change sponsors) and Heathrow, in particular, have followed stakeholder engagement processes prescribed by the UK Civil Aviation Authority (CAA) in the definition of 'design principles' used to determine, evaluate and consult upon 'airspace change proposals' (ACPs) as part of the decision-making process concerning UK airspace. This critical appraisal of intent, actual activity and achievements will help determine whether the prescribed airspace change process is likely to result in more acceptable changes to airspace from the perspective of noise-affected communities.

The aim is to understand to what extent the process can more likely facilitate acceptable outcomes to stakeholders. As such, we look to understand engagement processes and outcomes to determine the effectiveness of efforts to communicate and foster dialogue on issues which, by their very nature, are complex with varying consequences for a range of stakeholders. This will help develop core principles that can inform communication with communities over specific ACPs, helping them to understand how different options will affect them. In so doing, communities will be empowered to make robust contributions to the decisions over which ACPs are ultimately adopted. This will require that ACPs are accompanied by information/metrics that allow performance against key design principles to be demonstrated (and quantified where possible) and thus the basis for decisions to be transparently presented to all stakeholders.

A.2.2. Background Information

UK airspace is a finite resource of limited overall capacity which requires effective management if it is be used efficiently without compromising safety. In the most densely occupied areas of Controlled Airspace, systems of Air Traffic Control have been devised and operated to avoid conflict by maintaining separation between successive flights, primarily for safety reasons, but also to avoid excessive delays, and cater for all users, as far as possible. Air traffic control relies on complex radar systems to show the precise locations of each aircraft on a continuous basis and also on being able to predict to within relatively narrow limits where each aircraft is likely to be in the next few minutes or longer. This 'predictability' relies on both precise instructions given to each pilot and on accurate navigation in accordance with those instructions. The amount of separation necessary to ensure aircraft

safety is ultimately dependent on the degree of precision within which the relative position of each aircraft can be known, both at the time and in the immediate future. The amount of separation required to ensure safety consequently depends on both the accuracy of navigation and on the varied flying characteristics of different aircraft types under changing conditions. Maintaining adequate separation can contribute to increasing delays, particularly where aircraft must be sequenced in a particular order to maximise runway capacity at peak times. In many cases, a fine balance must be struck between maximising capacity and minimising delays, particularly where it is necessary (or at least – desirable) to provide some resilience to accommodate unforeseen events, such as runway go-arounds or other mishaps.

Over many years, UK airspace has been managed effectively with an impressive safety record, but excessive delays have occurred and continue to occur from time to time. However, continuing increases in capacity through both technological and other improvements have not avoided environmental impacts, in some cases leading to vocal and sustained objections from community representatives and amenity groups. This has led to legislation and government directions to the Civil Aviation Authority (CAA) to impose standardised procedures for public engagement and consultation on Airspace Change Sponsors to ensure that affected stakeholders are fully informed and given ample opportunity to make their views known. This is presumably because, in the past, not all stakeholders have been adequately consulted, and airspace changes have taken place which have subsequently led to significant criticism and complaint. While there can be no guarantees that more extensive consultation and engagement will actually lead to increased acceptance amongst community representatives who have been adversely affected, it could lead to more acceptable compromise solutions being adopted. In addition, by (possibly) providing 'better' explanations of the precise reasons behind airspace change proposals, this could either increase overall acceptance of the proposals, or at least provide a more cogent basis for objectors to argue against them. The ultimate problem here is that both the benefits and disbenefits of any proposed change are likely to apply diversely to different stakeholders. For example, both company and passenger beneficiaries of airspace change are not necessarily the same people as community dis-beneficiaries of the changes – the purpose of the UK Airspace Modernisation process is to ensure that these differing stakeholder perspectives are identified and addressed through a transparent engagement procedure from design, through option development and selections to, ultimately, implementation and post-implementation review.

Why now? The UK has embarked on a radical process of Airspace Modernisation to optimise the benefits from the adoption of performance-based navigation (PBN) that has been gradually introduced across most airline fleets as newer aircraft incorporating this technological capability have been purchased. PBN has gradually been replacing ground-based navigation systems with on-board systems incorporating satellite navigational aids with the result that aircraft are able to fly prescribed routes with increased predictability and accuracy. A key benefit of this feature of PBN according to the UK Government (DfT, 2018) is that it concentrates traffic and thus increases airspace capacity thereby 'unlocking' growth, improving safety and offering environmental gains through more direct routing.

A.2.3. Policy and Regulatory Framework

In 2017 the UK Government issued Air Navigation Guidance (DfT, 2017) in which powers were conferred to the CAA under Section 70(2) of the Transport Act 2000 to act in accordance with this guidance document. In essence, this guidance commits the UK to a full overhaul of controlled airspace for 0-66,000 feet with air traffic control provided by NATS above 24,000 feet and a combination of local providers (airports) and NATS below 24,000 feet. This modernisation process is part of the Single European Sky project which in turn is intended to integrate with the wider ICAO upgrade of international airspace.

At the heart of the guidance is an intent to ensure that aviation continues 'to make its important contribution to the UK economy' whilst also having regard to 3 key environmental objectives, which are to:

1. Limit and, where possible, reduce the number of people in the UK significantly affected by adverse impacts from aircraft noise
2. Ensure the sector makes a significant and cost-effective contribution to reducing global emissions
3. Minimise local air quality emissions and ensure compliance with international obligations

Importantly, critical terms with respect to noise control obligations such as 'limit', 'reduce' and 'significantly' are not defined (AEF, n.d.) in the guidance, as it is acknowledged there is 'no threshold at which all individuals are considered to be significantly adversely affected by noise'. Rather airspace change sponsors (airports) must assess all noise above the lowest observed adverse effect level when considering airspace changes below 7000 feet above which the priority is given to climate change emissions reductions whilst, where possible, avoiding overflying Areas of Outstanding Natural Beauty and National Parks. Between 7000 feet and 4000 feet the priority is to limit noise unless this disproportionately increases carbon emissions, whilst below 4000 feet the priority is to limit noise alone. Interestingly, the guidance notes that where options to change airspace below 4000 feet are similar in terms of the number of people affected, preference should be given to those options that are closest to existing published airspace; the inference being that newly exposing populations should be avoided unless there is clear benefit from doing this. Given the complexity of the potentially competing environmental objectives and indeed aspects of noise management, the guidance states that all changes below 7000 feet should take into account local circumstances and not be agreed by the CAA before appropriate community engagement has been conducted by the sponsor. The expectation is that this engagement will occur at an earlier stage than previously, at design and initial option appraisal.

This direction from the UK Government resulted in the CAA issuing CAP 1616 Airspace Change in 2018 in which the regulatory process for changing airspace is outlined. This establishes a 7-stage procedure that airspace change sponsors must complete including specific requirements for stakeholder engagement and CAA approval at pre-determined gateway points in the decision-making process. These stages are as follows:

1. **Define gateway** – this incorporates a *Statement of Need* (1A) for the change and the establishment of underlying '*design principles*' through 'engagement by the change sponsor with those potentially affected by the proposed change'(1B - p16). Change sponsors are expected to meet with the CAA to discuss the reasons for airspace changes and ultimately approve the outcomes from stakeholder engagement and agree timelines for each subsequent stage as part of the gateway.
2. **Develop and assess gateway** – informed by continuing interaction with stakeholders, the sponsor develops specific airspace change options and carries out an initial appraisal of both positive and negative potential impacts, which have to be approved by the CAA to pass through this gateway.
3. **Consult gateway –** involves the sponsor preparing consultation materials and identifying who should be consulted, including where appropriate local communities (3A). The CAA then reviews and approves, where appropriate, the consultation strategy and documentation, ensuring it is comprehensive and unbiased (3B), following which consultation is launched (3C) and responses collated, reviewed and published (3D).
4. **Update and submit gateway** – here the sponsor considers the outcomes of the consultation process, making changes to the change options as appropriate (4A) before submitting to the CAA for review (4B).
5. **Decide gateway** – the CAA assesses the proposed airspace change and may hold a 'Public Evidence Session' (5A), ultimately providing a decision as to whether to approve or reject the change (5B)
6. **Implement** – the sponsor implements the approved change working with the ANSP as required
7. **Post-implementation review** – usually 12 months after implementation, the CAA reviews how the airspace change has performed and whether anticipated impacts and benefits have been realised

A key feature of the overall process is intended to be transparency, which the CAA aims to foster through the provision of an Airspace Change portal[1] on which all documents produced by airspace change sponsors and the outcome of consultation exercises can be published. Examination of this portal reveals that most airspace change sponsors have paused airspace change procedures, as a result of COVID-19 impacts, after completing Stage 1B – consultation on design principles. Thus, it is to this stage of the CAA airspace change process that this case study will focus with the aim of exploring:

- Airport efforts to engage with stakeholders over the identification of core design principles for the development of subsequent airspace change proposals
- The outcomes of engagement in terms of levels of engagement achieved and the nature of specific design principles
- The extent to which the engagement process has revealed consensus in terms of design principles

- The influence of location on engagement processes and design principles outcomes
- The perceived effectiveness of the CAA process in fostering debate and reaching consensus over design principles
- The extent to which the core elements required to inform the development, appraisal and consultation on specific airspace change proposals have been identified and agreed upon
- Whether engagement over design principles is likely to result in more acceptable airspace changes from the perspective of stakeholders and most particularly noise affected communities.

A.3. Case Study

A.3.1. Motivation and Problem Statement

The overall motivation for this study is to minimise noise impact (however that may best be defined) from the introduction of new operational technology (PBN) and associated opportunities for airspace changes.

The problem being addressed here is that, whilst PBN brings with it a range of operational, commercial and safety benefits, there are implications for the distribution of noise exposure on the ground from the concentration of flight tracks enabled by this technology which are likely to negatively impact on communities under route (track) centrelines. The case study investigates whether airspace changes made possible by PBN capabilities can mitigate these potential negative impacts through tailored management of flight path distribution to address different operating environments and community concerns.

A.3.2. Objectives

These are to:

- Understand the consequences for aircraft noise distribution on the ground from the adoption of PBN technology
- Critically assess the UK's approach to the determination of airspace changes in order to:
    - Review stakeholder engagement processes and outcomes
    - Establish whether a dialogue on design principles usefully informs the determination, appraisal and consultation on specific airspace change proposals
    - Reflect on the likelihood that following this more open and transparent procedure will result in more acceptable outcomes for noise affected communities
- Distil core learning from the UK approach to airspace change to better understand the determinants of consensus outcomes and the core information required to illustrate performance against agreed priorities (design principles) thereby allowing stakeholders to make informed decisions about the relative merits of specific airspace change proposals

A.3.3. Intervention Design

In order to address the objectives defined above, the research intervention was undertaken in 4 distinct phases:

- **Phase 1** – background policy review to establish the motivation for UK airspace modernisation and identify the opportunities afforded by PBN for managing airspace differently to that which has predominated over the last 50 years using ground-based navigational aids. The main findings from this policy review are contained in the Overview section preceding this case study.
- **Phase 2** – a critical appraisal of the implementation of the CAA's approved airspace design protocol by airspace sponsors; namely, in the current case, UK airports. Given the impact of COVID-19 on progression of airspace changes most airports have paused the identification of airspace change proposal development and implementation at 'Design Principles' – Stage 1B of the CAA's procedure described in CAP 1616 (first published in 2018). Thus, our review focused on the processes and outcomes of discussions over design principles that airports have conducted with a range of stakeholders including members of local communities. This review, drawing on materials posted on the CAA's airspace change portal and airport websites, concentrated on 15 airports drawn from across the UK, subject to control under the EU Environmental Noise Directive and Regulation No 598/2014 covering the introduction of noise-related operating restrictions within the 'Balanced Approach', on the basis of aircraft movements in excess of the 50,000pa threshold. The results and analysis of this critical appraisal are presented in the case study implementation and evaluation sections below.
- **Phase 3** – a series of focus groups with representatives of airport amenity groups (i.e. groups set up to challenge airports over their noise and environmental performance) were undertaken to provide insight into community concerns over the introduction of PBN and management options that may by implemented as part of the airspace modernisation process; and also explore any experiences of involvement in the discussions over airspace modernisation conducted by airports. These individuals were primarily members of HACAN [2] and the Airport Environmental Federation and lived in the environs of SE airports including Heathrow, Gatwick, Stansted and Luton. Core themes are identified and analysed in the study implementation and evaluation sections below.
- **Phase 4 –** a workshop with Heathrow Airport's airspace change team, who are responsible for ensuring compliance with the CAA's airspace change procedures and determining design principles, drawing up potential airspace change proposals and undertaking their appraisal and consultation, and ultimately for implementing and evaluating specific airspace changes. This enabled an open discussion over the implications of emergent design principles for the subsequent identification, appraisal and consultation over specific airspace change proposals; with a particular focus on the nature of information that would need to be communicated to allow stakeholders to

make informed decisions as to the relative merits of different potential airspace change proposals. Emergent issues and their implications for subsequent stages in the airspace change modernisation process are presented and analysed in the case study implementation and evaluation sections below.

A.3.4. Tracking Implementation and Evaluation of each Phase

Phase 2 – Critical Review of Airspace Change 'Design Principles' consultation

CAP 1616 sets out the guidelines for the development of design principles by airspace change sponsors. It specifies that these principles be developed through local conversations: engagement with the local community, operational and other relevant stakeholders, so as to take account of different geographies, environmental and economic considerations, amongst other factors. The principles should describe the qualities a change should seek to achieve, such as (but not limited to) local priorities and trade-offs regarding the distribution of noise.

The questions a change sponsor might ask stakeholders to inform the development of the principles could include the following, although these are not prescriptive and others may be included:

- Are there noise-sensitive buildings that should be avoided, and if so what and where (i.e. hospitals, care homes, schools, higher education establishments, and so on)?
- How should the minimisation of overflight, or of night noise, or the difference between multiple respite routes and concentrated routes be traded off against one another?
- If multiple routes are considered in order to provide respite, what might constitute a sufficient period of respite?
- How should the needs of passengers be considered alongside the needs of communities at different times of day?
- Are there areas in which efficiency from a whole airspace perspective or expeditious routeing (shorter or faster routes) take precedence and areas in which other factors should take precedence?

Importantly, other than adherence to the principle of improving or maintaining safety, these factors are in no way absolute and, as a part of the process for the establishment of the airspace design principles, should be challenged in the ongoing dialogue with stakeholders.

The CAA expected that the outcome of this work will be a shortlist of principles to inform the development of airspace design options and against which they can be qualitatively evaluated. However, they recognise that some of the principles may contradict one another and some may be prioritised over others: this will be an iterative process and a qualitative one rather than a purely numerical exercise with binary answers.

The CAA expected to receive the following output from this activity:

- a list of those stakeholders engaged

- the methodology applied to identify them
- an explanation of the engagement methods employed
- a chronology of the engagement activity
- an explanation of the issues raised during the engagement process and of how stakeholder feedback influenced the final set of principles
- evidence of a two-way conversation, i.e. copies of all related correspondence between the change sponsor and stakeholders
- the design principles chosen
- the rationale behind the decision to adopt those principles including evidence of which of the principles chosen were agreed by stakeholders and, if universal agreement is not achieved, which were not; where design principles have not been agreed, objections must be clearly set out and attributed to relevant parties, as well as a clear rationale for the change sponsor's decision in light of this feedback (for example, a matrix or table illustrating how the design principles have evolved).

In addition, technical design principles looking at the design of airspace structures and instrument flight procedures that fall subject to the airspace change process must conform to various national and international standards and recommended practices.

That said, within that framework, there are many design techniques available to airspace designers. A change sponsor must therefore be able to justify the techniques being applied, especially where those techniques have a direct impact on local communities.

Also, with respect to environmental guidelines, the CAA is required to follow the Secretary of State's Air Navigation Guidance 2017. Within that guidance, there is a strong emphasis on taking into consideration local circumstances, especially when considering such matters as the potential value of respite routes. It is vital that the change sponsor takes into consideration the views of local communities when establishing airspace design principles, as set out above.

Below we set out our review of airport engagement with the 'design principles' engagement step 1B of the CAA process, focusing first on the processes of stakeholder engagement and then their outcomes.

Review of the Airspace 'Design Principles' consultation process

Introduction

The research began with a sift through CAA data for all UK airports to extract a dataset of those with >50000 aircraft movements a year in 2019 (given low volumes of traffic in 2020). This resulted in a list of 15 airports (or change sponsors) of which 3 had not provided evidence on the CAA airspace change portal, at the time of the research, to determine where they had reached in their change process. The twelve other airports (see Table 4) made up the cohort studied and described in this report.

Table 4. Aircraft movements by airport (2019).

Airport/Change Sponsor	Aircraft movements (2019)
Heathrow	478059
Gatwick	284987
Manchester	202892
Stansted	199925
Luton	141858
Edinburgh	131617
Glasgow	91812
Aberdeen	91248
London City	84260
East Midlands	74566
Bristol	69434
Liverpool	58968

Source: CAA Airport Data 2019 Table 03_01 Aircraft Movements @ https://www.caa.co.uk/uploadedFiles/CAA/Content/Standard_Content/Data_and_analysis/Datasets/Airport_stats/Airport_data_2019_annual/Table_03_1_Aircraft_Movements.pdf

Findings

In terms of the engagement process, among the cohort of airports studied, there was a clear attempt to address the CAA's priorities. This involved an element of specific engagement with regularly consulted stakeholders (such as consultative committees, local authorities, airlines and other industry representatives) and engagement with particular organisations/entities (such as AONBs, NGOs, NTSC, general aviation and elected officials) with interests within the geographic footprint of aircraft operating under 7000ft to and from the airport, the potentially affected area.

The online document review revealed that a number of airports had been asked to revise their design principles reports, suggesting that this had not been a simple rubber-stamping exercise by the CAA. The consultation described within the various reports tended to focus on questions around noise priorities and noise versus emissions, as well as technical and operational issues. Most airports had made an effort to build oversight into their design principles' development via the use of external consultants (e.g.Trax International, ComRes, Osprey CSL, YouGov) to manage the process and by having their materials evaluated by organisations such as The Consultation Institute, The Progressive Partnership and the Plain English Campaign.

With regard to the actual consultation and engagement, the main methods adopted were focus groups, workshops and online questionnaires, supplemented with email correspondence, dedicated websites and leaflets. In general, airports described a two-stage consultation process made up of an initial phase largely focussed on establishing potential design priorities, often through responses to structured questions following wider discussions. This resulted in a long list of potential design principles which was narrowed down to a short list by the airports and their partners before a proposed short list was sent out to, or shared with, a more restricted group of stakeholders (often subsets of those from the first round),

resulting in a finalised list of proposed design principles. This was considered to be a sound approach. However, it was sometimes the case that the short list was not shared with all consultees who had taken part in the first stage but, instead, with a smaller set of stakeholders, often those with whom regular engagement was already taking place. This may have been for practical reasons but some justification of the decision to do this would have been helpful to understand the process further. Nevertheless, there was evidence of efforts at consensus building in the process of engagement and consultation.

However, it was less clear, for a number of airports, how they had arrived at the initial long list that was then presented to stakeholders. Further detail on the process behind the development of the long list would strengthen the cases being made in the design principles' reports.

Similarly, it was often less than clear how the questions that were used during the consultation exercises had been drawn up (e.g. Were they based on internal discussions?, Had they been piloted with stakeholders?, How had the particular questions been selected when other options were not presented?) or, in some cases, what people had been specifically asked (see, for example, Edinburgh, Aberdeen and Bristol Airports). This issue is important to the resultant findings of the exercise as it could impede more creative, rounded expression of stakeholder views. For example, at Manchester Airport, although participants were advised that they could give an alternative view, they were presented with two answer options when asked a question, despite there being other potential options which could have been included (see Figure 8). The offer of a virtual 'either or' choice to some people who may not be very knowledgeable about airspace change may be seen to increase the likelihood of one of those options being chosen rather than there being more comprehensive individual consideration of other potential ideas and answers. Once again, more detailed discussion of these themes in the reports would give greater transparency to the process.

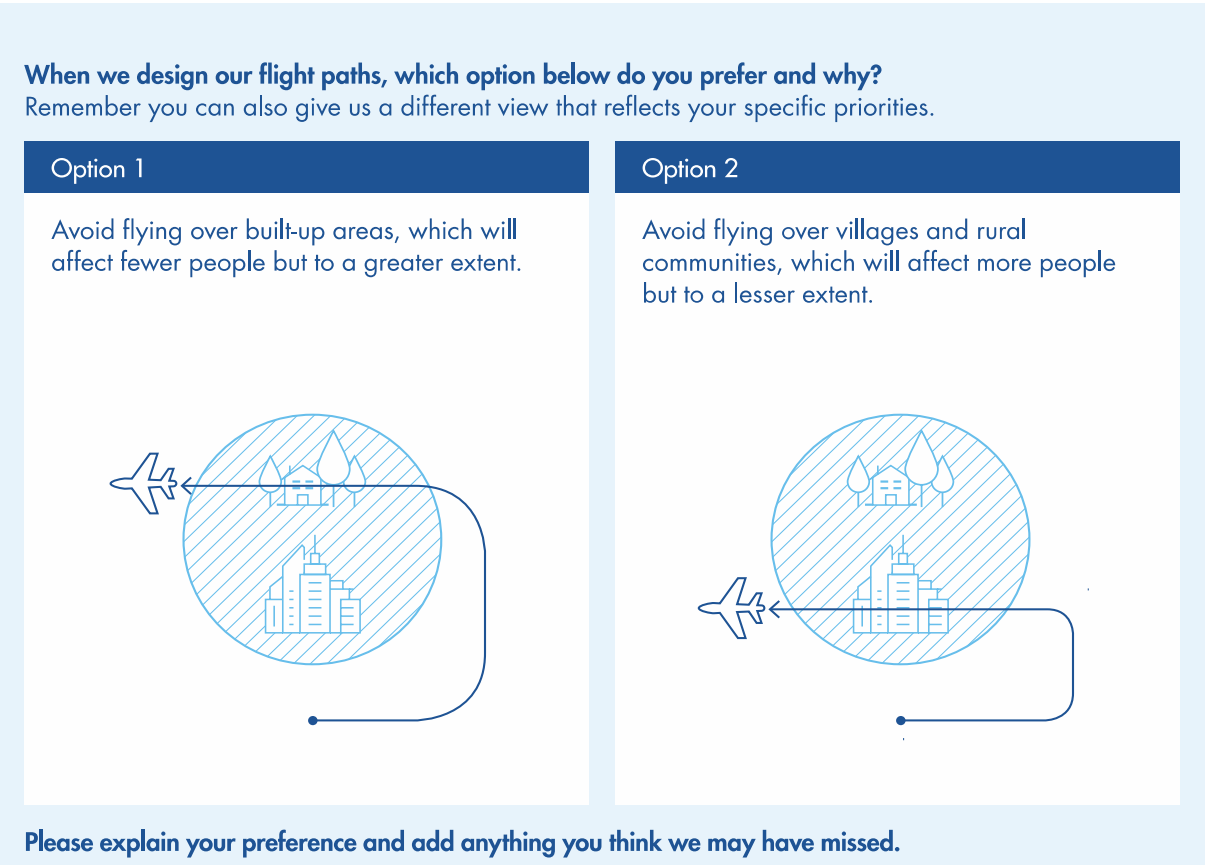


Figure 8. Example of questions to stakeholders.

Source: Step 1B Design Principles Report (V3), Manchester Airport

An important insight in relation to the consultation process was the difference in the tenor of responses between people attending focus groups and those using online feedback methods, within a single airport. For example, at Manchester Airport, in designing future flight paths, stakeholders were asked whether to prioritise keeping changes to a minimum to avoid overflying new areas or to start with a 'clean sheet' and design new routes that might reduce the effect of aircraft noise, cut emissions and make better use of modern technology but might fly over new areas as a result. The consistent feedback from focus groups was that a clean slate approach should be taken, whereas feedback from online questionnaires was described as 'more balanced' and favoured keeping changes to a minimum and avoiding flying over new areas.

While it is not possible to explain the reasons behind the different perspectives expressed by the two communities of participants, it can be noted that focus groups may build empathy and an ability to work through an issue. Thus, it may be that such interaction led to arrival at a common view that participants tended to agree with. Alongside this, there were likely to have been a higher number of invested stakeholders at such events. In contrast, online responses may have reflected personal views with greater clarity because of the anonymity afforded by this mode of interaction. Therefore, it may be that more self-centred responses or, perhaps, more accurate reflection of one's own views could be revealed through the online consultation. However, in this observation, assumptions across all

airports' engagement activities examined cannot be made. Indeed, East Midlands Airport (another member of the same group of airports – MAG) found much more consensus between focus group responses and those made online across the range of questions posed.

Some of the change sponsors listed themes that had not been discussed during the consultation. Some provided a list of proposed design principles that were not selected for discussion beyond the initial stage of consultation. For both these categories, airports tended to give their rationale for taking these decisions on a case-by-case basis which was helpful to the reader's understanding.

Some topics appeared to have been placed out of the scope of the discussions. In particular, while not a requirement of the CAA, due consideration of people's views on the national policies that informed the development of design principles may have encouraged increased participation and enabled in depth consideration of the way in which respondents' views on policy influenced their answers in face-to-face and online contact.

It is accepted that there would be a prerequisite for constraint on discussions for practical reasons. However, it is important to highlight that there is no opportunity within the process described for actual policy to be interrogated at all. Instead, it is taken as a given when some participants actually may not agree fundamentally with it and thus cannot realistically participate in a discussion if the fundamental background to the considerations is based on something in which they do not believe. Thus, policy is set and the design principles' discussion is simply focused on putting that policy in place without there being any room for challenge and no forum for comment on it during engagement. Without provision to give feedback on the policy, there may need to be more flexibility in governance and political decision-making systems to accommodate comment and enable potential change to the policy at the time it is determined. The absence of invitation to comment on policy leads to questions around the legitimacy of the discussion: it would appear to be limited.

Thinking further about legitimate discussion, there are a couple of other issues around the design principles' engagement process: one relates to the way in which people are engaged or chosen to participate in the consultation exercise and, the other, raises the wider question of who attends stakeholder workshops – and who does not.

Turning to the first theme, choice of people to invite to participate can easily influence outcomes of the engagement process if specific groups are not included, especially when others may be over-represented. In the consultation exercises reviewed, most airports had attempted to cover the main stakeholders in the potentially affected areas and had also employed external agencies to carry out the engagement who may have contributed to ensuring that a range of people and bodies were invited to take part. However, it was not readily evident across the cohort examined whether lists of stakeholders had come from the change sponsor or whether they had been drawn up in a more comprehensive manner. Therefore, the representativeness and legitimacy of the discussions may be subject to some challenge at some of the airports.

In general, people who attend stakeholder workshops tend to be motivated to do so because doing so is an employment obligation, the topic is of interest, they like the opportunity to discuss a subject with like-minded people or they are interested in the payment they may receive. This raises the question of their representativeness of the wider potentially affected population and of whether there may be others who tend not to take part in such activities (perhaps, because of lack of confidence, being time poor or feeling they would be challenged by those who do not share their views) but may represent important perspectives and experiences in potentially affected communities. In any consultation exercise, efforts to empathetically engage need to be holistic and encouraging to all who may be affected. It is not possible from this review to state with any confidence whether the design principles' development process as set out and carried out really reflects the true range of available perspectives in the communities of interest. Nevertheless, there is potential within the wider surveys, often accessed online, but promoted through means such as direct emailing and social media, to have tapped into a wider audience of local community members.

Design Principles Outcomes

In order to describe the range of DPs that have emerged from airport engagement with their local stakeholders, a classification of types of DP was needed. On examining the evidence produced by airports in support of proposed DPs, it became apparent that some had grouped DPs according to area of application/impact, in particular the airports under the Manchester Airports Group umbrella (Manchester, Stansted, and East Midlands) all adopted a similar approach of grouping DPs to support the rationale for selection and avoid implicit prioritisation from numbering. The least complex suite of categories that provides a framework for comparison across airports was that developed by Manchester Airport and is used here to describe the range and popularity of DPs across the 12 airports that have reported DP consultations on the CAA airspace portal. These categories of DPs are as follows:

- **Safety** – targeting changes to reduce risks and ensure compliance with industry standards and regulations
- **Airspace users** – these address the impact of changes on other airspace users, seeking to minimise impacts
- **Technology** – emphasis is placed on the utilisation of the latest navigational technology to deliver operational and environmental benefits
- **Policy** – relating to delivering on existing UK aviation policy and associated guidance
- **Capacity/continuity** – development of airspace that provides continuity of services and maximises utilisation of existing and planned new infrastructure
- **Emissions** – relating to the control of climate change and local air quality emissions
- **Noise** – those DPs designed to address noise effects

Before going on to review DPs by category, it is worth reflecting on a general lack of prioritisation of DPs with the MAG airports going as far as to remove numbering; using categories of DP to remove any sense of priority. An exception to this generality is Liverpool airport where DPs are presented in rank order, with some

given the same joint ranking. Arguably the general lack of prioritisation may make the next step of identifying, appraising and consulting on specific airspace change proposals more challenging.

Safety

The over-riding importance of airspace system safety is acknowledged by all airports with at least one safety-related DP in all cases. These emphasise the opportunity to harness new technology (PBN) to enhance safety levels to the benefit of airspace users and communities alike.

Airspace Users

All airports have at least one DP addressing airspace users highlighting the need to minimise the impact on other airspace users whilst optimising network performance in terms of resilience, predictability, adaptability, deconfliction and reduced complexity. This, in turn, is expected to minimise the amount of controlled airspace. In most cases it is assumed that these DPs will best be served by a 'clean sheet' approach to airspace design and therefore not be constrained by existing arrangements (e.g. East Midlands airport). However, this is not universally the case with Liverpool airport stating the procedures should fit within existing airspace constraints and boundaries and Aberdeen airport stating that they will minimise changes to tracks.

Technology

All airports excepting Liverpool and Aberdeen place emphasis on making best use of new technology to derive capacity and operational efficiency benefits.

Policy

With the exception of Gatwick and Liverpool airports all remaining airports have at least one DP relating to the delivery of aviation policy and guidance, in many cases specific mention is made of CAP 1711 in which the CAA laid out its airspace modernisation strategy in 2018. A key point here is that existing policy commitments are deemed to be beyond the remit of the DP consultation removing issues such as limiting air transport expansion for whatever reason (e.g. noise and/or emissions) from the discussion. Indeed, there is evidence that a lack of compatibility with existing agreed policy was given as grounds for removing some 'long-list' DPs from consideration as a final DP (e.g. at East Midlands airport a proposed DP to reduce the number of flights to cut emissions was rejected because it was deemed to be 'outside the scope of the airspace change process').

Capacity

All airports have at least one DP addressing airspace capacity, emphasising that airspace changes should support the resilience, efficiency, predictability and consistency of operations whilst utilising all available capacity. In some cases, specific operational procedures to enhance efficiency are mentioned such as continuous descent and climb operations and the avoidance of vectoring.

Emissions

All airports excepting Gatwick and Luton devote at least one DP to minimising emissions. All the remaining airports bar Heathrow commit to reducing climate change emissions. However, only 5 airports (Heathrow, Edinburgh, Glasgow, Liverpool and Aberdeen) prioritise efforts to minimise local air quality emissions

either directly or by implication from a commitment to improve the quality of life of local residents or locally tailored designs.

Noise

In general, the wording of all noise-related DPs implies that these are discretionary and should therefore be achieved where 'possible'/'practicable'. All airports excepting Luton and Aberdeen (see Table 5) commit to minimise the overall impact/effects of noise exposure whilst some supplement this with a principle to minimise the number of people affected (note it may be possible to reduce impacts whilst increasing the number of people affected if a larger population is exposed to lower levels of noise through, for example, the act of dispersal. Of course, this assumes that there is agreement over what constitutes impact).

Table 5. Summary of UK Airport Noise-Related Airspace Change Design Principles.

Noise DP Categories	**LHR**	**LGW**	**STN**	**MAN**	**LTN**	**EDI**	**BRS**	**GLA**	**LPL**	**ABZ[1]**	**LCY**	**EMA**
Minimise noise impact/effects	■	■	■	■		■	■	■	■		■	■
Minimise number people affected				■		■	■				■	
Minimise population newly overflown	■		■				■		■		■	
Multiple routes for Sharing/respite	■		■	■	■		■		■		■	■
Avoid noise sensitive areas	■		■	■		■		■	■			■
Avoid multiple routes over same community					■		■				■	

[1]: Whilst not referring to minimising impacts nor people exposed to noise Aberdeen Airport's DPs do refer to 'investigating steeper approaches…to reduce noise footprint' and also 'minimise changes to tracks', with the latter by implication minimising populations newly overflown.

Significantly, commitments seeking to minimise the total number of people overflown/affected by noise and to minimise the population newly overflown may conflict with the design principles intended to share noise/routes to allow for more equity and/or respite. These apparent internal inconsistencies are evident in the DPs of Heathrow, Stansted, Manchester, Bristol, Liverpool, London City and East Midlands airports. The challenge of trading-off between DPs at the airspace change proposal stage (Stage 2 and 3 in the CAA process) would appear to be all the more

difficult given the absence of any prioritisation between DPs evident in many submissions. A notable exception here is Liverpool where DPs are ranked in importance to the point where some are given the same joint ranking DPs. Similarly, the desire to create multiple routes to allow for dispersal of tracks and offer the potential of respite can be seen to be at odds with the avoidance of multiple routes over the same communities, especially where there are accompanying DPs seeking to minimise the number of people affected by noise/overflown (e.g. at Luton, Bristol and London City airports). An area of some consensus relates to DPs focusing on the avoidance of noise sensitive areas (these include Area of Outstanding Natural Beauty (AONBs), parks, schools, sites of historic interest, areas of low ambient noise levels, etc). Interestingly Heathrow airport confines these areas to AONBs only, indicating that routes will be located over commercial areas and open spaces (including parks) in order to avoid residential areas, somewhat in contrast to the majority of airports where parks are regarded as areas to protect from overflights. This may reflect the limited options available to Heathrow in such a densely populated location.

Overall, there appears to be little reported in the way of a discussion with stakeholders about the basis of weighing one DP against another, an omission that would seem to exacerbate the challenges associated with the identification, evaluation and consultation on specific airspace change proposals in the next two stages (2 and 3) of the CAA airspace modernisation process. Further, addressing these challenges would seem to require some agreement on how to capture performance against specific noise-related DPs using metrics that describe operations and their noise consequences (to allow the relative merits of different options to be illustrated and informed decisions made); again engagement with stakeholders over DPs appears to have completely omitted to consider this issue and thus made the appraisal and consultation around specific airspace change proposals all the more problematic.

Phase 3 – Community Focus groups

ANIMA project Deliverables have repeatedly highlighted the importance of taking community concerns into account when discussing noise management measures. To this end, we sought to provide insight into concerns over the introduction of PBN, general management options and decision-making processes tied to airspace modernisation, and experiences of involvement in the discussions over airspace modernisation conducted by airports previously. To do so, focus groups with representatives of airport community noise campaign groups were conducted, primarily with members of HACAN (Heathrow Association for the Control of Airport Noise) and the AEF (Aviation Environmental Federation). The focus groups sought to explore two main themes:

- to establish degrees of knowledge about PBN/airspace change processes and any concerns over noise impact that may arise from these measures, and
- to investigate participants' concerns regarding the possible impacts arising from the introduction of PBN and associated airspace changes.

Findings

Before describing the main findings of this empirical exercise, it should be noted that all participants were members of community noise action groups who had varying degrees of knowledge about airport operations, and about PBN in particular. The majority of participants had a reasonable and often surprisingly complex and/or technical understanding of noise management challenges, including PBN. Hence, the views obtained give a good insight into amenity group perceptions that may not be reflected by other community members who may lack such nuanced views and perspectives about noise issues (i.e. the silent majority of community members who do not complain or engage with airports regarding noise). This is not a critique of the approach taken – indeed, our intention was to canvas the perspectives of such groups, given the constraints of wider recruitment while social distancing was required, and our search for salient perspectives.

A consistent finding across all participants was that PBN is undesirable for communities. This was expressed by all participants, with the perception being largely driven by a general agreement that concentration would be catastrophic for any communities below concentrated flight paths. This is particularly the case in London where using PBN to avoid flying overpopulated areas would be impossible:

> *"PBN can't work in a highly populated area. There are huge protests in the US about PBN, it has been a catastrophe. We are still sensitised about PBN 6 years after the trials. The UK has a much higher density than the US, it will be a disaster here."*

> *"In a congested space such as London, how can you implement any form of PBN that gives meaningful respite? The major problem is that there is not enough separation."*

Participants at Luton and Gatwick – much more rural areas – did see some benefit in PBN, in terms of its potential to avoid overflying populated areas. However, they also expressed great sympathy for any people who would find themselves located near a concentrated flight path, and suggested that such residents would need significant compensation, although there would be no realistic level of compensation that would make living under such flight paths tolerable in their opinion.

Another factor contributing to participants seeing PBN in a negative light was the fact that they perceive it less as an opportunity to enhance noise management, and more as a way to increase the capacity at airports. Participants do not trust the airport to use PBN in any manner that doesn't put capacity first:

> *"The purpose of it is to get more planes in the sky, and to make fuel savings which they will dress up as carbon savings."*

> *"PBN is being implemented unethically"*

Participants also expressed concern about PBN's potential application as a method to provide noise respite by flying different and alternating concentrated flight paths. It was suggested that multiple alternating and low-capacity flight paths would themselves fill up over time, resulting in multiple heavily concentrated flight

paths rather than providing respite. Indeed, respite was itself questioned as a management opportunity:

> *"Respite means half a day of hell, a little respite, and back to hell."*

In short, there was a strong sense that the participants did not trust the aviation industry to implement PBN effectively, believing that environmental externalities are a secondary concern to growth, using the industry's importance to the economy and society as a means to justify such growth, whatever the local impacts. That said, there was a general consensus of opinion in one focus group that PBN in itself is not a bad thing, rather it is a neutral tool that can be used by airports as part of a suite of operational management instruments. Instead, participants stated that it is how PBN is implemented, rather than PBN itself, that is the key concern, and there was very little faith or trust in airports utilising it in a manner that the respondents would see as effective or appropriate.

> *"We are told it is for environmental reasons, but it is all about getting planes in the air."*

> *"Heathrow are a private company, they are not going to put human beings before profit" (it's about concentration)."*

On several occasions participants across different focus groups raised the idea that impacts of noise had reached a threshold where it had become an intolerable problem, some going as far as suggesting that there may be a need for a 'limits to growth' of noise, a term typically used in sustainability settings (Meadows, 1972) to describe the requirement to constrain global economic activity in line with planetary system-level boundaries. Participants expressed the belief that there existed a tipping point and that, after this point, noise becomes something that cannot be compensated for.

> *"You have been talking about sharing and fairness… the only people who never take a hit and never compromise are the aviation industry. We know that however many routes there are, and however many planes there are, there will be more in the future."*

> *"We are really keen to promote the volume management approach of 600k flights per year for the UK. We need to go back to the CAA and say hang on the world has totally changed, we need an environmental impact assessment into airspace modernisation."*

From a research perspective, it would be interesting to understand if such tipping points exist, and, if so, what responses they would engender, and what the ensuing implications for noise management could be. This could have potentially significant implications for noise management and the application of Balanced Approach measures.

Regarding communication, participants demonstrated some empathy for the industry in its efforts to convey complex information in simple ways that were comprehensible to non-experts. However, there was also a sense of frustration as to the industry's inability to do so effectively, with some participants believing that

poor communication was a purposefully adopted tactic to confuse residents about noise and to hide real noise figures.

> *"It means absolutely nothing to me whatsoever."*
>
> *"I think this could be manipulated […] to show you are getting respite when you are not."*

When presented with written and diagrammatic material, participants found it difficult to interpret, even amongst some of the more technically minded participants. There was a consensus that use of such materials in one-way communication, while providing some potential utility, is not enough. Participants particularly failed to understand communication methods that looked to describe many aspects of noise in one image. When participants were unable to understand information quickly, they tended to immediately lose interest and become frustrated.

> *"It shouldn't need explaining. This is the point!"*
>
> *"That is an appalling way to try to communicate, although I agree technically it is a good piece of work."*

The value of using such complex materials should therefore be challenged. If people are faced with difficulties in interpretation and understanding of such resources, despite the positive intentions of the industry provider, there is a danger of frustration and mistrust towards the source of the materials. This suggests that the use of more difficult to follow resources should be avoided, and that multiple simpler approaches to communication may be more suitable than complex all-in-one approaches. The need for simpler approaches to communication was also found to be desirable in terms of the use of language, for instance, forgoing industry terms such as capacity, by seeking out more straightforward terms.

The general perception of the focus groups was that PBN is being communicated poorly, that is, with no proper introduction of what it is or why it is being implemented. Residents were particularly frustrated at PBN trials taking place without prior communication – whether PBN had been implemented or not.

In terms of useful or pertinent information, participants indicated a preference for maximum noise levels alongside the number of aircraft movements and the type and altitude of aircraft flying on particular routes as these were the key attributes that people notice and that can trigger an emotional response. This suggests that different factors may influence the perceptions of noise and aircraft operations at different locations and, thereby, affect people's priorities.

All participants raised notions regarding the idea of 'fairness' and PBN. One person noted that they believed PBN has benefits close to airports by offering control of routes between populated conurbations, although they thought that at altitudes higher than 4000ft the effect would be harmful because aircraft would be more concentrated at that altitude than with conventional navigation technology. They believed that "The target of reducing the numbers of people 'severely impacted' is achieved. However, rather than a larger number of people being moderately affected, fewer people are massively impacted for no reason other than to meet a

misguided measure." This participant was one of many who believed that there was opportunity for PBN to be used only as a means to mimic 'natural' (conventional technology) distribution of aircraft to better achieve noise sharing.

> *"What worries me about PBN, and it worries me a lot, is that it is a political decision if you annoy a lot of people a little or a few people a lot. The Government prefer the latter. There is an important issue here of fairness. If people are going to suffer from airport noise it needs to be spread around a lot."*

> *"I think we need to ask the question in different ways depending on which communities you are talking about. It is not a one size fits all question. The concept of sharing routes in a rural area is not going to work. It should be local decisions for each individual airport. It should not be national policy but let local people decide at each airport."*

Noise sharing is preferred by those who are exposed to noise, although this runs counter to government policy to avoid newly overflying people. It appears then that there is an imperative for policy to be revisited as part of the processes of airspace modernisation. Disjuncts between policy and community preferences could become a major challenge to an airport's ambitions to manage noise. If policy does not reflect what residents view as successful, then an important part of the noise management strategy should be looking to identify how best to mitigate impacts - for example, by engaging with policy makers, if not to change policy, then to at least impress upon them the importance of consultation and a requirement that no decisions should be made without local engagement.

Phase 4 – Heathrow Airspace Change Workshop

A workshop was held with Heathrow airspace change personnel to discuss engagement with the airspace modernisation process to date, community responses and challenges likely to be faced as design principles are applied to arrive at specific airspace change proposals.

The design principle critical review provided insight into how the process described in CAP1616 has been evolving across UK airports. It was clear that the hiatus due to the pandemic had meant that there had been little opportunity for moving through the various stages for over a year.

Nevertheless, in order to gain insight around the challenge of responding to CAP1616 and the impacts of COVID-19 on this, a workshop was held with Heathrow airspace change personnel to discuss engagement with the airspace modernisation process to date, community responses and challenges likely to be faced as design principles are applied to arrive at specific airspace change proposals.

The key points arising from this workshop are discussed here with accompanying commentary around the implications of the main themes explored in Phases 2 and 3 of the research described above.

Key findings

Consultation over a length of time

- There is **inherent challenge in meeting requirements of the airspace change process when policy priorities vary over the time the process entails**. The longer process is more likely to be affected by external factors. While length of process may give greater opportunity to involve a range of stakeholders, it may also increase uncertainty characterised by, for example, frustration (amongst both the consulted and those planning for and carrying out the consultation exercise). Overall, there is a **tension between the desire to engage early over key principles but a lack of specificity, and iterative approaches make the process arduous for all involved**. In addition, length can mean mission drift as stakeholder groups may be represented by different individuals over time.
- Also associated with the lengthy process, there **needs to be a wider understanding of the engagement journey and the importance of identifying what is required at each stage** of that process in order that output from each stage is beneficial further along the journey. This approach **avoids revisiting issues previously agreed upon** and any ensuing associated weariness at over-engagement amongst the community and other stakeholders, and waste of resources in terms of employee time, economic costs and other internal investment by the change sponsor.
- Stakeholders want early engagement and expect a level of specificity that is simply impossible and, arguably, premature at an initial stage. This suggests that there **needs to be careful management of expectations** from the start and through to the end of the airspace change engagement process.
- **Early engagement prolongs uncertainty and may lead to adverse community response**. Community engagement needs to be well-planned and not result in repeated, burdensome and tiresome interaction with stakeholders. it is **difficult to achieve and determine success when the prescribed process is lengthy and subject to shifts in the political environment** and other external risks (such as COVID-19).
- It is evident that length of engagement comes with attendant dangers. The **risk of loss of impetus by the consulted may be mitigated by early clear communications** about the overall process and nature of each stage, accompanied by further, rolling messaging about the progress of the airspace change journey.

Communicating and avoiding preconceptions

- In terms of specific commentary on the airspace change environment, **planning for consultation is on-going** at Heathrow and reflection on past consultation experience is being fed into the future engagement approach. For example, there was reference to a common misconception about PBN arising in previous engagement and the fact that people do not want it take place over their own homes. This was a conversation that had quickly dominated previous engagement exercises in local communities when 'lines io a map' had been shown and participants then focussed on these in relation

to their home locations, thereby **diverting discussion from actual design principles.** Whilst there has been reference to the emergence of PBN in consultation in potentially affected areas and this has been accompanied with messaging about how airspace modernisation may help accentuate the positive and minimise its negative aspects in early CAA communications, the **key points around its potential do not appear to have really registered with communities.**

- **PBN has been arriving for some years** now as new aircraft come into use equipped with the new navigational capability. This has **resulted in some concentration of flights around route centrelines**. However, as there has been slight variation between each operator in the creation of 'overlays' to interpret route centrelines, these areas of concentration can vary around the route centreline (see CAA CAP 1378, p6). The current UK Airspace Modernisation programme seeks to systematise this use of PBN to optimise benefits from the technology and minimise any adverse effects. To that end, many airports are/have consulted on the principles by which airspace change should be driven. Some of the points raised in focus groups for the ANIMA project (e.g. a desire among overflown communities to use PBN to share traffic by implementing multiple routes) have been evident but the extent to which the airspace change proposals put forward by airports deliver on these principles has yet to be seen (since much of the Airspace Modernisation process has been paused during COVID-19). Nevertheless, **the challenge going forward will be in defining specific proposals** (i.e arrival and departure routes - bounded by what is technically feasible) to address the priorities highlighted by all stakeholders (including communities) and, most importantly, **capturing the implications of these proposals (through use of appropriate metrics and illustrations) so effective consultation on specific proposals can take place.**

Prioritisation of design principles

- Looking at prioritisation (ranking) of design principles, discussions with Heathrow indicated that this is being seen as **essential if the Stage 1B outcomes of the CAP1616 process were to facilitate more effective and efficient determination, appraisal and consultation on specific airspace change proposals** (ACPs).

Effective engagement

- The **value of engagement through focus groups was another key theme in the workshop.** Interaction enabled by this approach can lead to more nuanced understandings of concepts such as fairness and help elucidate differences and similarities between participants' experiences and views. The real benefit of this type of interaction is that it highlights evidence of empathy building and can result in a moderating of views towards a common goal. The dichotomy between consultation as an engagement practice and use of focus groups was also brought out. It was apparent that

consultation appeared to be for the motivated, while focus groups were more proactively formed through targeted audience invitation and were likely to yield more balanced and nuanced insights and understandings.

Demonstrating success

- When the workshop discussions turned to methods of demonstrating performance against design principles, reflections on statements made in previous engagement indicated that different people appear to want different metrics, although early reference during such interaction was reported to be made to WHO noise guidance and the number of events being more useful than Leq. **There is no consensus on how to demonstrate that a design principle is being addressed and it may be that success factors may be more usefully demonstrated in varied ways.**
- Noise sharing and respite are common design principles that may require further examination of **what it is that the public views as important to help guide the determination of success factors.** It would appear that there **needs to be a better understanding of what people expect sharing and respite to bring.** If this can be described by consultees, it may then be possible to demonstrate achievement (or otherwise) of these expectations. Within this context, it is important to establish what comparator should be used: should this be the original situation, or the original situation with addition of concentration of flight routes, or other alternative airspace change proposals? **By working with communities and other stakeholders to determine these factors, change sponsors may better communicate effects of airspace modernisation** in terms that have resonance with people in potentially affected areas. This may also be regarded as a more empathetic mode of information exchange.

Final comments

- For Heathrow, the COVID-19 hiatus has meant there has been a leaning of the business, making it more agile. There are on-going efforts at recovery, although there has been some loss of depth of knowledge with staff departures from the business. **The delays caused by pausing the airspace change process have exacerbated some of the challenges highlighted earlier.**

A.4. Conclusions

CAP 1616 Airspace Change (first published December 2017 and revised March 2021) sets out the current procedures which airspace change sponsors are required to follow. Paragraph 7 states:

> *"The CAA, as the UK's independent aviation regulator, has responsibility for deciding whether to approve changes proposed to the design of airspace over the UK – the airspace structure and instrument flight procedures within it that are used by aircraft".*

Airspace changes can have both positive and negative economic, social, and environmental impacts on different stakeholders. It is increasingly accepted that achieving an optimum balance between positive and negative impacts can be difficult and might not satisfy all stakeholder requirements and preferences.

Under CAP 1616, the CAA requires Airspace Change Sponsors (Airports, NATS, MoD, etc) to follow an extensive sequence of 'stakeholder' consultation and engagement procedures to first devise and confirm a consensus list of '**design principles**' and then propose, appraise, and consult on alternative design options, from which they should select their final proposal to be submitted to the CAA for regulatory approval. Any changes arising due to PBN (or anything else) are expected to be assessed via this process. While most major airports have by now published their lists of design principles, the procedures have been 'paused' until traffic builds back up again.

The CAA approach is to be welcomed as it aligns well with ANIMA's IDEAL approach to communication explained in other deliverables and outputs (e.g. D3.9 and the ANIMA book). In Table 6, we demonstrate how aspects of the DP process reviewed here address particular elements of the IDEAL model.

Table 6. Performance of the CAA Airspace Change Process against element of the 'IDEAL' model.

I	**Inclusive and diverse** – wide range of SHs engaged through a variety of methods. Stage 2 engagement over draft DPs often more limited.
	Information provision – DP options presented in as options/questions highlighting potential implications
	Impartial – extensive use of third parties to oversee/inform the engagement process
	Interrogate – through FGs and consultation events SHs had opportunities to question the information provided and the opinions of others
D	**Decisions** – reporting of SH feedback and how this informed derivation of DPs
	Direct – extensive materials made available and evidence often of input from third party experts (e.g. Plain English Campaign)
E	**Early** – DPs are at the very start of the airspace change process
	Easy - extensive materials made available often with input from third party experts (e.g. Plain English Campaign)
	Explain – explanations of how SH feedback was used to define and then refine DPs was evident. However, a lack of clarity over how initial DP questions were determined, how DPs long lists were derived and then narrowed down to proposal short-list DPs
	Empathy – interesting differences between outcomes from FGs and feedback from direct online surveys indicate a different dynamic in FGs that *may* be indicative of empathy leading to consensus building
A	**Accessible** – range of techniques used to engage SHs and also range of materials provided to explain choices underpinning DPs
	Authentic – questions posed to explain the spectrum of design options and their implications. The binary nature of the response options may have limited capacity for SH to express more nuanced views
	Accurate – airports define much of the material presented for interaction at consultation events and FGs provided opportunities for wider issues to be discussed. However, evidence that certain issues were beyond the remit of the DP

	process (e.g. questioning the national policy of supporting aviation growth to address climate change concerns)
	Amenable – two stage DP derivation process provided opportunity for some SHs to feedback on draft DPs. Evidence of refinement following stage 2 feedback
L	**Legitimacy** – FGs provided opportunities for different opinions to be heard with some evidence of the modification of the positions held by participants before engagement as a result of the interaction made possible. However, it is often unclear how FG representatives were selected and the representativeness of online responses.

Overall, the efforts of airports to engage with, and represent SH views, in arriving at DPs should be applauded. However, there are some experiences with the CAA process that suggest it could yet be enhanced and also that the outcomes to date may not make subsequent stages of the airspace modernisation process any less challenging than would have been the case had early community engagement not been present. In particular, the following issues may undermine the value of DP discussions to subsequent stages of the prescribed route for the introduction of airspace changes:

- **Constraining engagement** to how best to deliver on UK aviation policy clearly alienates some members of the community who feel that aviation growth is incompatible with environmental protection, be it noise, climate change or local air quality. This may undermine the overall airspace change process and be an obstacle to wider community acceptance of outcomes. Each list of design principles as published on the CAA Airspace Change Portal to date can be divided into two categories; a) primary design principles that directly comply with over-riding Government policy, which is essentially to manage airspace in such a way that capacity is provided to meet all airspace user requirements without compromising safety or unduly increasing cost; and b), secondary design principles (such as limit and reduce noise) which cannot always be met without conflicting with other stated design principles. Unfortunately, where increased traffic results, airspace change more often than not will unavoidably increase environmental impacts.
- A **lack of ranking of DPs** - There is little or no evidence (thus far) of any attempt to establish or determine relative priorities where conflicts arise between identified design principles, other than statements that, where such conflicts exist, they will be managed through further consultation at a later stage. A prime example is the ongoing debate between flight track concentration vs. flight track dispersion, where there are not only 'winners' and 'losers' in different locations on the ground, but also technical differences between the two theoretical options which could affect the practical feasibility of either choice. For example, the following statement appears in the Airspace Change stage 1B engagement report for Southampton Airport; "Where airspace design options may bring certain principles into conflict with one another, we will make trade-offs decisions based on an assessment of the overall impacts and two-way conversations with the affected stakeholder". In summary, the lack of DP ranking looks

set to create problems at the airspace change proposal and appraisal stage let alone over the subsequent consultation stage demanded by CAP 1616.

- **The omission of any meaningful discussion over how best to articulate performance against emerging DPs**. This means that there is no SH mandate for the metrics that airports may choose to use when illustrating the relative merits of different airspace change options, resulting in potential confusion and frustration with the overall process and outcomes. This problem is all the more exacting as existing standard preferred metrics are not always as useful as is often supposed. For example; while long time averaged LAeq contours have been used as proxies for the likely prevalence of different human effects for many years, the actual correlations between objective physical metrics, such as LAeq, and what are largely subjective reports of noise annoyance and other effects are relatively weak and not really suitable at all for making definitive predictions of impact. Additional so-called supplementary metrics have been proposed but research in this area has been at best inconclusive and even controversial. In the absence of definitive metrics, it is unwise to just assume that all consulted stakeholders have the same understanding or expectation of the likely effects of any proposed changes.
- **The length of the overall process** is such that some airport representatives are questioning the appetite of communities to continue to engage in the airspace change process. Whilst it has to be acknowledged that COVID-19 has exacerbated this issue, it may well be that there is a need to balance administrative efficiency with the desire for early community engagement. Indeed, the feedback from Heathrow airspace change representatives suggests that the qualities of FGs may make them particularly effective vehicles for informing the early stages of design (given the opportunity they represent to investigate issues in depth and allow for explanation and interrogation of emergent themes). Whereas wider community engagement may be more appropriate at later stages when the points under discussion are more specific and thus easier to communicate in terms of the consequences for particular SH groups.

Considered overall, the CAA Airspace change process and the DP Stage, in particular, do provide multiple opportunities for community and wider SH engagement from an early stage in the development process. However, a number of features of the reviewed experiences suggest that the balance between engagement, administrative efficiency and utility is not quite what it might be. In particular, not all engagement vehicles appear appropriate for the more open-ended, theoretical discussions required at an early stage when principles are being explored and details of specific consequences, by definition, lacking. Thus, as the UK CAA undertakes a review of the CAP 1616 procedures it would do well to consider the balance between procedural duration and delivery as experiences point to the arduous nature of the process and the uncertainties and associated frustrations created. It may well be that tailoring engagement techniques to the different challenges explored at each stage may help streamline the process

(saving costs and reducing duration) and yet still yield valuable insights. For example, use of FGs to explore the desired outcomes of the process and thus inform the principles to be addressed may be a more useful vehicle than more widespread surveys, as the opportunity is provided for detailed explanation and interrogation of issues. Surveys, on the other hand, may be more appropriate later in the development process once there is a choice between concrete airspace change options, the impacts of which can be demonstrated and relative merits decided upon by all consulted. Concentrating on more interactive engagement with limited numbers of SHs (including community representatives) early in the process could provide the guidance an airport needs to deliver airspace change proposals that address SH mandated priorities. Of course, this does mean that any DPs might be challenged at a later stage in the development process; but this seems likely anyway given the prevalence of 'not over my backyard' attitude when the specific location of impacts is known.

A.5. Recommendations and Lessons Learnt

- If airspace modernisation is to optimise the impact of PBN then it needs to address the balance between flight track concentration and dispersal, recognising that local circumstances will dictate when one option is preferred over the other.
- Starting community engagement early can help reveal the principles by which airspace proposals should be developed; but the former should be prioritised and the means of articulating the latter agreed, if outcomes from early engagement are to inform and streamline later stages in the development process.
- There is a need to develop simple illustrative materials that highlight changes in noise exposure on the ground, associated with concentration or dispersal, incorporating the number and noisiness of events
- Community expressed preference for noise sharing (flight track dispersal) may run counter to UK/EU policy to 'limit and, where possible, reduce the number of people significantly affected by adverse impacts from aircraft noise'
- There is a lack of evidence on the potential impacts associated with dispersal/concentration (annoyance response, sleep disturbance, long-term health consequences); especially as the former may increase the number of newly exposed people. This should be a focus for future research.
- It cannot be assumed that all SHs buy into existing government policy and thus airspace change sponsors would do well to acknowledge feedback that challenges policy as this should allow for policy commitments to be scrutinised and amended, if appropriate, in the light of implementation experience

A.6. References

AEF (Aviation Environment Federation) Understanding Airspace Policy. https://www.aef.org.uk/guides/understanding-airspace-policy/

Civil Aviation Authority (UK), *Airspace change: Guidance on the regulatory process for changing the notified airspace design and planning and permanent distribution of air traffic, and on providing airspace information*(CAP1616), 2019.

Civil Aviation Authority (UK), Performance Based Navigation – Airspace design Guidance: Noise mitigation considerations when designing PBN departure and arrival procedures (CAP1378), 2016.

Meadows, D.H., Meadows, D.L., Randers, J. and Behrens, W.W. (1972) *The Limits to Growt*h. Universe Books, New York.

UK Department for Transport, *Aviation 2050: The Future of Aviation – A consultation* (Green Paper), Cm9714, 2018.

UK Department for Transport, *Air Navigation Guidance 2017*, 2017.

---

[1] https://airspacechange.caa.co.uk

[2] Heathrow Association for the Control of Aircraft Noise was set up over 50 years ago to 'give a voise to residents under Heathrow flight paths'. https://hacan.org.uk/?page_id=1478

B. Letališče Jožeta Pučnika Ljubljana Case Study

B.1. Summary

Ljubljana Airport is a small airport with around 35,000 aircraft movements per year. The average annual noise pollution of the environment is a problem mainly in the summer and in the evenings.

In 2013 the unannounced change of take-off direction over Kranj caused a long time agitation, dissatisfaction and distrust among local authorities and communities. Therefore, the mayors of the nearest municipalities organized a meeting in 2019 and demanded explanations (Call of Mayors) from authorities / responsible stakeholders and the abolition of the new take-off route. They also questioned the performance and reliability of the noise measurements.

To respond to the Call of Mayors, in June 2019, Fraport Slovenija initiated the Airport Environmental Partnership or LEPASO ("Letališka partnerska skupina za okolje"), which will discuss the main issues.

To facilitate the dialogue among stakeholders (including local Authorities and communities), a workshop was organized in December 2019 as part of the ANIMA project. All identified stakeholders were invited to present their views and suggest possible solutions for the future. The workshop gave room for fruitful discussions that are summarized in the workshop report "Transparent noise management and community engagement in the Ljubljana Airport area". After the workshop the ANIMA-team proposed to set up a forum for an open dialogue, identifying all the stakeholders needed with duties and responsibilities including local communities to allow for an open dialogue relevant to airport-related environmental issues.

The key problem to be solved in the near future is to establish a transparent information policy that would allow constant access to information and explanations from the responsible authorities and furthermore to solve the existing problems in a constructive dialogue. Land use planning policy should also be included in the agenda to provide a long-term sustainable development. ANIMA also proposes the introduction of additional noise indicators as part of noise measurements, which will enable a more accurate assessment of the impact on human health and well-being. These indicators would make it possible to estimate the short-term noise load for individual overflights, such as maximum noise level or noise levels for a shorter period of the day.

It is expected that a Dialogue Forum should consider the problems in the context of a broader picture including interdependencies (air pollution), land use planning and quality of life.

ANIMA Best practice portal includes a number of intervention examples from different airports and represents a possible source for ideas and guidance. In case of establishing a dialogue forum, a case from the Vienna and Frankfurt Airport will be considered. In establishing the dialogue forum, we will follow the specifications from EUROCONTROL Collaborative Environmental Management - CEM.

Keywords: Dialogue forum, local communities' voice, small airport, noise indicators, CEM

B.2. Overview of Airport Context

This case study explores the possibilities to establish an open dialogue among stakeholders including local authorities and communities to reach an agreement in solving problems like excess noise exposure of citizens in case of changed and/or dispersed routes and introduction of additional noise indicators.

B.2.1. Background Information

General information

Company name: Fraport Slovenija (https://www.fraport-slovenija.si/en/company/presentation/)

Technical information available at: https://www.fraport-slovenija.si/en/business-users/technical-data/

Aerodrome name and location:	Letališče Jožeta Pučnika Ljubljana, Brnik, Slovenia
Start of operations:	24. 12. 1963
Elevation:	388 m/1,272 feet
Reference Temperature:	27.5°C
Types of traffic permitted:	IFR (Instrument Flight Rules) and VFR (Visual Flight Rules)

Airport location

Reference point:	N 46 13 28.16, E 14 27 21.77
Area:	320 ha/791 acres
Distance from cities: Ljubljana	20 km/12.4 miles northwest from the capital city

Figure 1. Satellite picture of Ljubljana airport.

Air traffic information

Total number of passengers: 1727,136 (in 2019)

Total number of aircraft movements: 31,489 (in 2019)

Cargo no. [t]: 24,875 t (in 2019)

Scheduled / Charter flight connections: 30 / 23 (in 2019)

Table 1. Traffic figures by year.

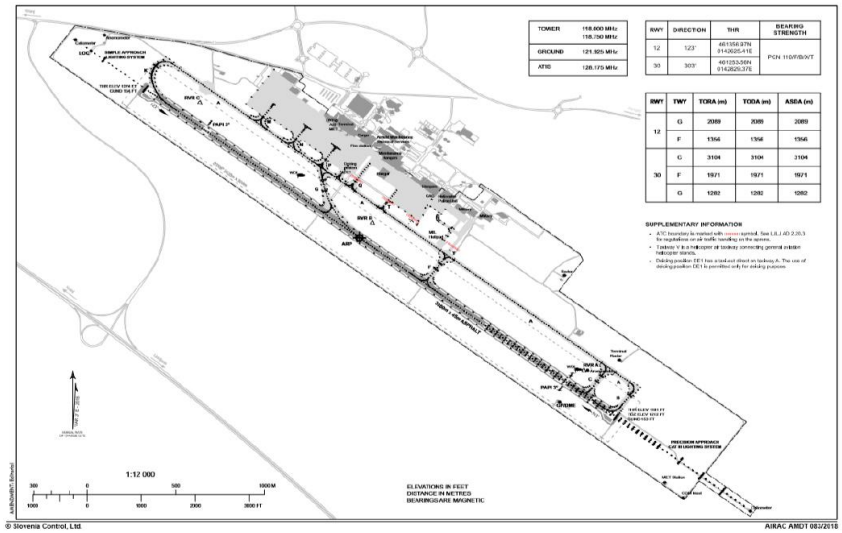
Year	2013	2014	2015	2016	2017	2018	2019
Movements	33,112	31,405	32,894	32,701	34,444	35,512	31,489

The aviation industry is recovering very slowly due to the COVID-19 health crisis. Airports Council International (ACI) as the umbrella association of airports is planning for a sustainable recovery for the world's airports exposing the commitment to achieve net zero CO_2 emissions by 2050 (https://www.aci-europe.org/industry-topics/covid-19.html). The preliminary estimates at Ljubljana Airport show that this process will take several years.

Specific information related to the airport

The airport is surrounded by high mountains, which limit the available space for landings and take-offs of aircraft. In the southeast it borders on a relatively large forest area. A highway runs parallel to the runway in a southerly direction at a distance of 1.3 kilometers. The nearest settlements to the airport are Šenčur, which is 1.3 kilometers from the threshold of the 12 RWY (runway) in the northwest direction. The settlement of Voglje, 1.44 kilometers in a southwesterly direction from the runway. And the settlement of Spodnji Brnik, which is 1.6 kilometers north of the threshold of 30 RWY.

One runway: 3.300 m x 45 m; Runway orientation: 30/12



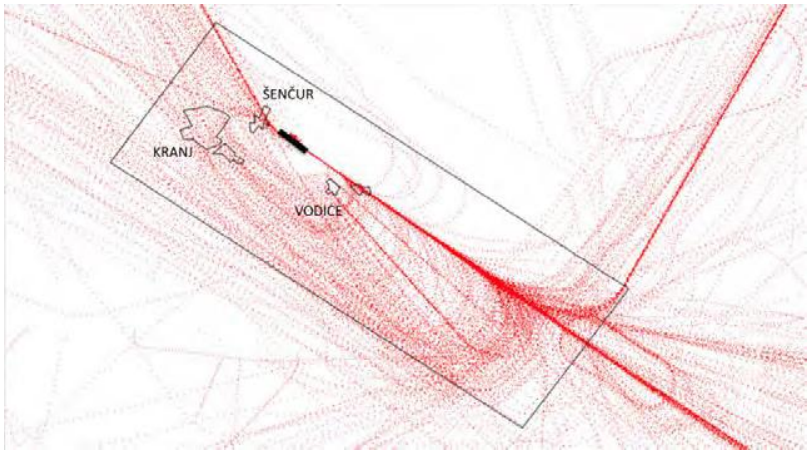


Figure 2. Airport and aircraft arrival trajectory to Ljubljana Airport (Master Plan Summary).

Other relevant information for the topic of this case study

Airport Ljubljana is being active as a member of various expert groups operating under ACI Europe (Airports Council International Europe). The company is involved in the Advisory Group within the Policy Committee with its task to prepare strategic guidelines for ACI Europe management and to coordinate and provide links to other committees and work groups. The airport is also a member of Regional Airport's Forum and Digital Communications Forum.

B.2.2. National Legislative Framework

General Legislative and Regulatory framework

- Decree on the assessment and management of environmental noise – "Uredba o ocenjevanju in urejanju hrupa v okolju (Uradni list RS, št. 121/04 in 59/19)" http://www.pisrs.si/Pis.web/pregledPredpisa?id=URED2682
- Decree on limit values for environment noise indicators – "Uredba o mejnih vrednostih kazalcev hrupa v okolju (Uradni list RS, št. 43/18 in 59/19)" http://www.pisrs.si/Pis.web/pregledPredpisa?id=URED7531
    - Limit values for non-mayor airport (under 50.000 civil aircraft movements per calendar year)

- Limit values of the peak noise level L_1 caused by the operation of the airport, heliport
- Limit values of the peak noise level L_1 caused by the operation of the airport, heliport
- An airport with a runway longer than 2,100 meters must obtain an environmental permit for the operation of a noise source.

Table 2. Noise protection zone and noise limits.

Noise protection zone	L_{day} (dBA)	$L_{evening}$ (dBA)	L_{night} (dBA)	L_{den} (dBA)	L_1 - period of evening and night (dBA)	L_1 – period of the day (dBA)
IV. zone	73	68	63	73	90	90
III. zone*	58	53	48	58	70	85
II. zone	52	47	42	52	65	75
I. zone	47	42	37	47	60	75

*Nearby Ljubljana airport, most people live in the third noise protection zone.

- Rules on initial measurements and operational monitoring of noise sources and on conditions for their implementation – "Pravilnik o prvem ocenjevanju in obratovalnem monitoringu za vire hrupa ter o pogojih za njegovo izvajanje (Uradni list RS, št. 105/08)" http://www.pisrs.si/Pis.web/pregledPredpisa?id=PRAV8901
  - Operational monitoring for noise measurement for the airport and helicopter take-off must be provided once every five years.
- The transposition of the Council Directive 89/629/EEC of 4 December 1989 on the limitation of noise emission from civil subsonic jet aeroplanes – "Direktiva Sveta 89/629/EGS z dne 4. decembra 1989 o omejevanju hrupa civilnih podzvočnih reaktivnih letal (UL L št. 363 z dne 13. 12. 1989, str. 27)". https://op.europa.eu/en/publication-detail/-/publication/762541b9-74a8-4bce-abcf-a05905ab170a/language-en
  - Member States shall ensure that civil subsonic jet aeroplanes in their territory, may not be operated in their territory or in the territory of another Member State unless granted a noise certificate.
- Rules on noise emission of aircraft. "Pravilnik o hrupu zrakoplovov (Uradni list RS, št. 55/00, 18/01 – ZLet, 40/04 in 75/08)" http://www.pisrs.si/Pis.web/pregledPredpisa?id=PRAV2866
  - This regulation lays down and regulates the maximum permissible noise levels of aircraft, the conditions for issuing a noise certificate, the obligations relating to the noise certificate, the procedures for evaluating aircraft noise and the restrictions on the use of aircraft in relation to the noise they cause.

- Rules on operational restrictions applicable to certain aircraft. "Pravilnik o omejitvah operacij določenih zrakoplovov (Uradni list RS, št. 40/04 in 75/08)" http://pisrs.si/Pis.web/pregledPredpisa?id=PRAV5784
- Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (Aarhus Convention). 2014. United Nations Economic Commission for Europe. Slovenia: signed 25 Jun 1998, ratified 29 Jul 2004 https://treaties.un.org/Pages/ViewDetails.aspx?src=TREATY&mtdsg_no=xxvii-13&chapter=27&lang=en
- Environmental Protection Act. Article 26. Public participation. "Zakon o varstvu okolja (Uradni list RS, št. 39/06 – uradno prečiščeno besedilo, 49/06 – ZMetD, 66/06 – odl. US, 33/07 – ZPNačrt, 57/08 – ZFO-1A, 70/08, 108/09, 108/09 – ZPNačrt-A, 48/12, 57/12, 92/13, 56/15, 102/15, 30/16, 61/17 – GZ, 21/18 – ZNOrg in 84/18 – ZIURKOE)" http://pisrs.si/Pis.web/pregledPredpisa?id=ZAKO1545
- Spatial Planning Act. "Zakon o urejanju prostora (Uradni list RS, št. 61/17)" http://www.pisrs.si/Pis.web/pregledPredpisa?id=ZAKO7341

Recommendations and guidelines

- ANIMA report - Deliverable D2.5 Critical review of Balanced Approach Implementation across EU Member States describes several case studies that were studied in used as guideline in planning intervention in Ljubljana Airport case study (https://zenodo.org/record/3146128#.X0eciHtS9aQ).
- Best practice portal – case studies:
  - Vienna mediation study and Dialogue Forum establishment (https://www.dialogforum.at/)
  - Frankfurt's dialogue process (https://www.forum-flughafen-region.de/)
- EUROCONTROL Specification for Collaborative Environmental Management (CEM) https://www.eurocontrol.int/publication/eurocontrol-specification-collaborative-environmental-management-cem

Responsible Authorities for regulatory implementation and guidelines relevant to the case study

- Slovenia Control (Kontrola zračnega prometa Slovenije) - Controls air traffic and safety
- JACL (Javna agencija za civilno letalstvo Republike Slovenije) - Approves new flight procedure
- Ministry of the Environment and Spatial Planning - Establishes environmental noise limits
- Ministry of Health - Gives opinion on impact assessment for land use planning
- Ministry of Infrastructure - Coordinates a new construction/land use plan

Airport activities for environmental protection

From December 2008 until the end of March 2019 in Ljubljana Airport were performing continuous noise monitoring in the most noise exposed areas. From 2019 they were continuing with annual (occasional) noise measurements in the

summer season and thus continue to monitor the noise levels during the day, evening and night time in the busiest period of the year.

Annual reports are produced by Fraport Slovenija on general and sustainability issue.

- Annual report 2019: https://www.fraport-slovenija.si/pripone/2588/Annual%20Report%20FS%202019_zadnja%20verzija.pdf
- Sustainability report 2019: https://www.fraport-slovenija.si/pripone/2595/prelom_v12_ANGL_splet%20(1).pdf

B.3. Case Study

B.3.1. Definition

Airport

Ljubljana Airport is the largest Slovenian airport. However, it is not reaching 50,000 movements per year which would mean a mandatory preparation of strategic noise maps and action plans according to implemented EU Directive 2002/49/EC. Also, the Balanced Approach Regulation (EU) 598/2014 is not binding. Aviation noise is regulated on a national level by Decree on limit values for environmental noise indicators.

Problem – Noise pollution

Although the airport is small, the noise assessment showed that the limit values (53 dBA) for the evening indicator ($L_{evening}$) were reached in summer time. In the past, citizens required several improvements for reduction of aviation noise at local community meetings [Minutes for those meetings are available mainly on paper; https://www.sencur.si/objava/214085 (Skupni sestanek županov za omejitev letalskega prometa nad Šenčurjem in Kranjem, 11.9.2019). Residents were asking for improving quality of life near the airport. Until now several of those requirements were met. However, the solutions may not be the best as there was not sufficient discussion to evaluate all possible options. It took a long time and a lot of efforts to identify the responsible authorities/stakeholders for further discussions and reach understanding and agreement. At communities meeting the understanding about which authority is responsible for what were different, therefore a clarification was needed in case of noise, land use planning and flight procedures decisions responsibilities and need for public involvement. In 2019 several municipalities joined in action to reach a better dialogue and solutions with a Call of Mayors in which the most critical issues were presented again.

Call of Mayors

After six years of complaints, seven mayors of the surrounding municipalities signed the Call of mayors – to warn that municipalities (Kranj, Šenčur, Vodice, Škofja Loka, Cerklje, Mengeš and Komenda) require noise reduction of aircraft overflights taking-off or landing at the Ljubljana Airport. This call has been sent to all relevant state and private institutions.

The demands were:

- "To abolish air routes established in 2013 and use of take-off and landing routes to avoid densely populated areas";

- "To establish noise abatement by strictly applying aircraft landing and take-off procedures for all air carriers and flying at adequate altitude";
- "To provide all relevant documentation connected to the new departure procedure from 2013";
- "To verify the suitability of the selected noise measuring points";
- "To adopt the legislation allowing compensation for the most burdened municipalities and the exercise of continuous monitoring of proper usage of flight procedures".

On top of these demands, mayors expressed their support for the further development of the airport as everyone recognized the economic benefits it brings. JACL responded to this request with the conclusion that the situation should be further examined with all involved stakeholders.

It shows that an open dialogue among all stakeholders is needed to discuss all possible options and reach an overall agreement for the most suitable solutions.

Establishment of LEPASO

To respond to the Call of Mayors Fraport Slovenija initiated Airport Environmental Partnership or LEPASO including stakeholders

- Fraport Slovenija (coordinator of LEPASO),
- Slovenia Control (KZPS),
- Civil Aviation Agency (JACL),
- Domestic airline (Adria Airways),
- Ministry for Infrastructure and
- an independent expert for noise monitoring and modelling.

The main issues that the group plans to discuss are:

- legislation (Decree on limit values for environmental noise indicators) and
- options to reduce noise at the airport like rapid taxiway, restriction of flights at night, changes in take-off and landing operations and directions.

However, the LEPASO doesn't address all issues mentioned in the Call of Mayors.

Issue 1: Lack of transparent communication between all relevant stakeholders (including affected communities)

The main cause of complaints still remains the introduction of a new take-off corridor in 2013 without prior public consultation and/or without acceptable justification. Airplanes are now flying over Kranj, the largest town near the airport (~ 38,000 citizens). The justification for such a decision was reduction in fuel consumption which was presented as an important saving for national airline company Adria Airways. An open question remains why there was no open dialogue and consideration for Environmental Impact Assessment (EIA) in case of such a change of operations at the airport.

Furthermore, Fraport Slovenija decided to stop non-mandatory real-time monitoring as a decade of monitoring provided a lot of data that show the characteristics of noise exposure that was not changing considerably in time, so continuation of monitoring would not add much to the gathered information.

Instead noise monitoring is performed occasionally in summer, the busiest period for flying in Slovenia.

Confusion in regard to eligibility for the noise pollution compensations remains an open question.

These changes caused concerns in communities around the airport including distrust due to lack of explanation from authorities that were expected by communities and possibilities to include communities with their observations.

Issue 2: Management of complaints
Local community needs clear information on responsibilities of authorities including management of complaints. Currently complaints are dispersed between different stakeholders, possibly causing loss of some complaints. A single focal point is needed for contacts with the public even in cases of responsibilities spread among stakeholders. Reports should include all complaints and proposals from the public to show potential improvement.

Objectives

The main outcome expected from this case study is to find a way to facilitate an open dialogue, increase trust, ensure transparent information policy and encourage a proactive involvement of all relevant stakeholders in the process of discussion and assessment of claims and other issues in order to assess realistic options for efficient solutions. All relevant stakeholders should be identified. It is essential to integrate community and local authorities' voices into the discussions that concern their quality of life and environmental policy including land use planning and aviation noise management but also the development of the airport and increase of traffic in the future.

To achieve such communication, the establishment of an open dialogue forum is proposed as an intervention.

As the LEPASO gives a good option to explore its enlargement that would present a dialogue forum including communities and other stakeholders this seems to be the most realistic way to carry out the above proposed intervention.

ANIMA suggested steps to achieve the objectives:

- Reach agreement on which stakeholder would coordinate the enlarged Dialogue Forum;
- Identifying and informing all stakeholders;
- Organisation of a workshop for presentation of ANIMA project and involvement of stakeholders to present themselves and their responsibilities and duties in case of aviation noise at Ljubljana Airport;
- Presentation of claims and issues that cause concerns for communities near the airport regarding their quality of life and health;
- Identification of stakeholders that would have a proactive role in specific issues to be discussed as priorities;
- Second workshop to be organised possibly including representative from Vienna or Frankfurt Airport as an example of best practice to follow;

- Formal decision on establishment of forum for open dialogue;
- Identification of key problems and the most acceptable and efficient options for solutions.

Table 1. Definition of goals within case study.

Issue 1: Transparent communication between all relevant stakeholders		
Goals	Success factors	Assessment
1.1. General interest and participation	Stakeholders are willing to participate in the case study	X number of participating stakeholders on the case study workshops
1.2. All relevant stakeholders are identified and known to each other	Large majority understands who the stakeholders are and what is their specific role, and does not miss someone.	Number of questions raised and doubts stated about who the responsible parties/stakeholders are, and, perhaps, who is missing
1.3. All relevant stakeholders understand the basic technical language	Large majority understands and follows the discussions	Number and type of questions raised Number of presentations/issues discussed
1.4. Improvement in community engagement & communication (Suggestion for establishment of an open dialogue forum)	- Large majority is satisfied with the initiative (Establishment of the group)	- Questionnaire at the phase 1 and phase 2. - (Past group meetings.)

Issue 2: Management of noise complaints		
Goals	Success factors	Assessment
2.1. Focal point for noise complaints is suggested	Focal point suggestions and agreement for selection	Appointed focal point
2.2. Affected communities are informed of the focal point	Contact information available: website, leaflets, mail, meetings	Use of new contact information for questions and clarifications
2.3. Complaints are regularly examined / reports are publicly available	Summary report available once per year: on website or other media	Number of complaints, number of complainers Number of (un)solved issues Report

B.3.2. Implementation Processes

ANIMA project - Workshop 1

Organisation of workshops/discussions among stakeholders to clarify responsibilities/duties and possibilities to introduce any measure/change in short-, mid- and long-term.

The first workshop "Transparent noise management and community engagement in the Ljubljana Airport area" was organised by ANIMA and City Municipality of Kranj on 12. December 2019 in Kranj. All invited stakeholders were participating. All together the forum of 30 participants was attending presentations of stakeholders and discussions lead by ANIMA project members.

The event was also an opportunity for the stakeholders related to the operations of Ljubljana Airport to discuss their activities and to incorporate more stakeholders than before. After each panel, much needed debate and Q&A (question and answer) sessions took place, involving all the parties present. The main questions mentioned in the discussions were:

- The role that introducing more legal indicators would have on the understanding of noise annoyance and sleep disturbance of people living in surrounding communities;
- Evaluating noise issues in more detail, through specific analysis of events and characteristics, could be the answer to average noise levels not presenting accurate global pictures;

- The way to assess the effectiveness and the real gain of intervention against noise before the start of the implementation process;
- The dispersion of the flight path and how to concentrate the tracks;
- Annoyance of people needs identifying in detail before establishing new procedures or interventions – in order to make sure to gain public acceptance, and solve the actual problem, rather than present a solution to a non-existing one.

The main takeaway message of this ANIMA event is that when it comes down to noise management, prevention and proactivity are key. If legislation is not yet available at the degree of needed protection, initiatives to increase the quality of life must still be taken at the national, regional and municipal level. Often, the level of awareness is not the same among stakeholders, hence the importance of working collaboratively towards common noise policy which benefits all parties. Better awareness and knowledge on different noise sources and indicators would support the understanding of the impact that noise has on human health and well-being.

This event has restarted a much-needed dialogue around Ljubljana Airport, and the ANIMA project expects to continue this trend in other locations.

The report from the workshop is published on ANIMA project website: https://f4d.c07.myftpupload.com/wp-content/uploads/2020/07/ANIMA-Kranj.pdf

Best Practice Portal (BPP) example

After organising a successful workshop in December 2019 and following good practices at Vienna and Frankfurt Airports, where stakeholders established a Dialogue Forum after extensive environmental mediation, another workshop would be organised in Slovenia including representative from Vienna or/and Frankfurt Airport/s Dialogue/s Forum to exchange the experiences and find best practices that would be reasonable also for Ljubljana Airport.

Proposal - Workshop 2

Program of the next workshop should include outcomes from the first workshop and proposal from Vienna or Frankfurt Dialogue Forum and ANIMA partners. Which way are possible to progress and search for efficient dialogue and for solutions for reduction of noise and annoyance, maintenance of health and quality of life in communities with a future vision for development of the airport together with improving overall quality of life in communities. Lessons learnt from Vienna and Frankfurt Airports should be examined and considered when relevant in case of Ljubljana Airport.

Possibilities for introduction of additional noise indicators and reducing dispersion of flight tracks should be discussed among other identified issues in the workshop. It is important that the Ministry of the Environment and Spatial Planning takes and active role in this task and establish dialogue with relevant authorities in Austria, Germany and other countries to search for the best solution to introduce additional noise indicators in Slovenian legislation.

Expected outcomes

The main outcome of the second workshop should be appointment of coordinator for the dialogue group if different from coordinator of LEPASO and preparation of agenda and responsibilities for the following tasks:

- Establishment of the rules that the dialogue forum should follow to achieve transparent and trustful communication and information policy
- Discuss the change in the direction of take-off flights over Kranj and reduction of number of citizens exposed to excessive noise from the airport
- Discuss the possible implementation of new noise indicators in national legislation following the examples in other EU states (Spain – Barcelona airport)

B.3.3. Evaluation of Results and Post-Implementation Changes

Evaluation is planned to be performed after the firs workshop and before the following workshop performed with an on-line questionnaire to assess the outcomes of the first workshop and the objectives of the stakeholders before the next meeting.

The evaluation after the second workshop performed with an on-line questionnaire to find out how different stakeholders perceived new information and options and how these could be used in Dialogue Forum establishment for solving current environmental issues.

An example of a questionnaire is presented in Annex 1.

A questionnaire (on-line) can be prepared for reaching all stakeholders and get feedback information. The analysis of this information would be presented at latest at the end of the project.

Other outcomes

Due to the current situation, (Adria Airways bankruptcy and Covid-19 reduction of movements at the airport – less noise) we can expect that the interest to establish the dialogue forum would be decreased. Still we believe this time is good to discuss these issues with less annoyance and pressure from different stakeholders.

B.3.4. Other Relevant Information

Environmental noise is only one important issue to be discussed withing the Dialog Forum. Other kinds of environmental issues should be considered including air pollution and protection of ground water and surface water. Furthermore, municipality and national land use planning procedures should involve future perspective of the airport development and enlargement. Long-term predictions should always be considered.

B.4. Conclusions

After analysing the first part of the stakeholder questionnaire at the end of the first workshop and the expectations of the second workshop, we received confirmation that the workshop was effective, the stakeholders would attend the next workshop again. The importance of cooperation and integration of various professional fields has been shown, which is crucial for solving problems in the future.

At the second stakeholder workshop, which took place in Kranj on 5. May 2021, examples of good practice in noise management at the airport and especially in cooperation with residents living in the area were presented. We paid special attention to the discussion on the organization of a dialogue forum. We discussed current issues with stakeholders, and highlighted the issue of Ljubljana Airport. Stakeholders also reported on current tasks and plans for change. It was agreed that all plans be kept informed of the members of the Airport Dialogue Forum (extended LEPASO group with representatives of municipalities and representatives of citizens).

From 10 stakeholders, 6 responded to our questionnaire at the end of the second workshop.

Stakeholders which did not respond to the questionnaire: a representative of the municipalities, a representative of the population and the Civil Aviation Agency. This shows that stakeholders need to be further informed abot the importance of their action at all levels. Raising awareness is one of the priority tasks to provide efficient forum dialog.

The analysis showed that the workshop was effective. Stakeholders agree to create a single point for complains. The dialogue forum will operate as an enlarged LEPASO group. Changes in formal organisation may be expected in the future.

B.5. Recommendations and Lessons Learnt

The main lesson learned is that when it comes down to noise management, prevention and proactivity are key. If legislation is not yet available at the degree of needed protection, initiatives to increase the quality of life must still be taken at the national, regional and municipal level. Often, the level of awareness is not the same among stakeholders, hence the importance of working collaboratively towards common noise policy which benefits all stakeholders.

The ANIMA workshop with stakeholders has restarted a much-needed dialogue around Ljubljana Airport, and the ANIMA project expects to continue this trend in other locations.

More awareness on importance of transparent communication in reduction of noise annoyance through raising trust in authorities is still needed. The mechanisms of non-acoustic factors on noise annoyance should be better understood among all stakeholders.

However, also knowledge on acoustic factors should be improved to better distinguish among different noise indicators and understand the importance for their role in evaluation of relevant health impacts. For example, the level of sound energy important in evaluation of hearing impairment is not relevant in the same way in the evaluation of annoyance. To evaluate sleep disturbance, the indicator of noise at night including indicator of number and loudness of discrete events should be taken into consideration.

Land-use planning legislation should be discussed and explained in case of changes introduced at the airport (construction changes) and in aviation (traffic changes

like number of flights, time of flying, corridors, etc.). It is important to identify changes and considering public consultation in a very early stage of the project is mandatory.

More workshops and exchange of information with all stakeholders at the international level would be beneficial. A common network of all stakeholders at the international level would be a good solution. International networks and exchange of guidelines and solutions like ANIMA Best Practice Portal would be very useful in efficient decision making for the interventions at specific airports.

Awareness of noise impact on human health should increase among stakeholders. More information exchange, listening and learning from each other is needed. Availability and understanding of public information on noise exposure and health impacts is crucial for communities to understand the issues and to trust the authorities and professionals in this field. Including lessons of noise and health at different levels and sectors in education system is highly recommended.

Working together with all stakeholders including communities and establishing an open dialog forum is an example of good practice, so much needed in several environmental land use projects in Slovenia. We intend to present the establishment of the airport dialog forum to the network of Municipalities in Slovenia to learn from this example and to get support in other community engagement events.

B.6. Annex: Additional information

B.6.1. Questionnaires

- Questionnaire after the 1st workshop in Kranj and about expectations of the 2nd workshop
- Questionnaire after the 2nd workshop in Kranj
- Questionnaire after eventual establishment of Dialogue Form or other discussion platform

Table 2. Questionnaire after the 1st workshop in Kranj and about expectations of the 2nd workshop

Question number	**Questionnaire for stakeholders at the end of 1st workshop**	
1.	Who do you represent?	Local authority / Airport / Noise measurement expert / Community member/ Airline / Civil aviation agency / Slovenia Control / Ministry of environment and spatial planning / Ministry of infrastructure /Other…
2.	Did you attend the first workshop on December 12, 2019 in Kranj?	- Yes - No (continue with question nu. 12)

3.	How would you rate the workshop regarding learning new information and receiving useful information?	Response scale (1 = very poor, 5 = excellent): /1 / 2 / 3 / 4 / 5 /
4.	How would you rate the workshop regarding networking possibilities?	Response scale (1 = very poor, 5 = excellent): /1 / 2 / 3 / 4 / 5 /
5.	Did you miss consideration of any important topic?	- Yes - No If you replied Yes, write any topic you missed in the first workshop:
6.	Was the presentation of stakeholder responsibilities satisfactorily explained?	- Yes - No, where would you like further explanation...?
7.	Can you think of any other organization that could be involved and invited to the second workshop?	Suggest someone else to include (Open question)
8.	Do you think that local communities have a sufficiently important role in decision making regarding the operation of the airport (land use planning, changed take off track, etc.)?	- Yes (continue with question n. 10) - No
9.	In what areas do you see room for improvement?	(Open question)
10.	Are there currently any issues / obstacles regarding solving key issues related to aviation noise?	(Open question)
11.	How do you assess the presented initiative to establish a Dialogue Forum in Slovenia?	Response scale (5 = excellent, 1 = very poor): /1 / 2 / 3 / 4 / 5 /

12.	How would you rank the relevance of aspects in case of Ljubljana airport?	Evaluate from the most relevant aspect of implementing good practices to the least important. Enter numbers from 1 to 7, number 1 is the most important aspect, and number 7 is the least important aspect. _ Legislation for airports with less than 50.000 movements _ Legislation for insulation and compensation _ Noise metrics _ Public consultations _ Centralised / unified point for complains _ Operational solutions _ Penalty system for aircrafts
	Questionnaire for stakeholders on 2nd workshop expectations	
13.	Would you be interested to attend the second workshop?	- Yes - No Comment:
14.	What did you think are the main noise problems of the airport?	(Open question)
15.	Which of these problems should be solved? Several answers are possible.	- The lack of proper noise indicators to show the real noise annoyance. - The lack of regulation for small airports, with less than 50.000 movements per year (sound insulation programs and compensation) - The lack of regulation and control of small aircrafts around the airport that do not follow the scheduled flight lines (the dispersions of the flight path). - The design of the flight lines (tracks) - The lack of communication and engagement looking for a better solution for everybody
16.	What do you expect from participating in the second workshop?	(Open question)
17.	Which question or topic do you find most important to address in the second workshop?	(Open question)
18.	Would you like to add anything else?	(Open question)

Table 2: Questionnaire after the 2nd workshop in Kranj

Question number	**Questionnaire for stakeholders at the end of 2nd workshop**	
1.	Who do you represent?	Local authority / Airport / Noise measurement expert / Community member/ Airline / Civil aviation agency / Slovenia Control / Ministry of environment and spatial planning / Ministry of infrastructure / Other…

2.	How would you rate the workshop regarding receiving new information?	Response scale (, 1 = very poor, 5 = excellent): /1 / 2 / 3 / 4 / 5 /
3.	How would you rate the workshop regarding networking possibilities with other participants?	Response scale (1 = very poor, 5 = excellent): /1 / 2 / 3 / 4 / 5 /
4.	How would you rate the workshop regarding receiving useful information?	Response scale (1 = very poor, 5 = excellent): /1 / 2 / 3 / 4 / 5 /
5.	Did the workshop meet your expectations?	- Yes - In part - No
6.	Which information was considered useful to you?	(Open question)
7.	Would you consider it useful to organise another workshop? If yes, on what topic?	- Yes, on the topic: - Maybe over time, when the results of the first two workshops are shown - No
8.	What are some good practices of transparent communication and information policy, as presented at the workshop, that you believe could be adopted at Ljubljana airport?	(Open question)
9.	What are some good practices of management of noise complaints, as presented at the workshop, that you believe could be adopted at Ljubljana airport?	(Open question)
10.	Do you think that we could create a unified point for complaints?	- Yes, where...? - No, why not...?
11.	Do you think that a Dialogue Forum, as presented at the workshop, is needed in Slovenia?	- Yes - Yes, but other improvements are needed, which...? - No, where do you see a better solution…?
12.	Is the presented procedure for the Dialogue Forum establishment suitable for Slovenia or would you suggest a different approach?	(Open question)
13.	Would you like to add anything else?	(Open question)

Table 3. Questionnaire after eventual establishment of Dialogue Form or other discussion platform

Question number	**Evaluation after eventual establishment of Dialogue Form**	
1.	Who do you represent?	Local authority / Airport / Noise measurement expert / Community member/ Airline / Civil aviation agency / Slovenia Control / Ministry of environment and spatial planning / Ministry of infrastructure / - Other…
2.	Was the open dialogue forum implemented in Slovenia?	- Yes - Eventual problems encountered:
3.	Does the Dialogue Forum meet your expectations?	- Yes, significant - Some, but room for improvement - Does not work
4.	What kind of expectations you had for the Dialogue forum?	(Open question)
5.	What are the priority tasks of the forum?	(Open question)
6.	Have you noticed improvements in informing citizens? What information are citizens informed about?	(Open question)
7.	From your point of view, how do you perceive changes in the stakeholder participation?	(Open question)
8.	Were new noise indicators discussed, accepted, suggested for implementation?	- No - Yes, which...?
9.	Do you perceive an improvement in collaborative approach to solving key issues?	- Yes, the situation has improved - Yes, but it could be better - No
10.	Do you observe a difference in noise perception since the establishment of a dialogue forum?	- Yes, the situation has improved, in what ways...? - Yes, but it could be better - No
11.	Do you perceive an improvement of quality of life of residents since the establishment of a dialogue forum?	- Yes, the situation has improved, in what ways ...? - Yes, but it could be better - No
12.	Do you participate in the handling of aircraft noise complaints?	- Yes - No (continue with question nu. 14)

13.	If you are involved in dealing with complaints about aircraft noise, do you estimate that the number of complaints has changed since the change in communication with public and how?	(Open question) If you are not involved in handling complaints, skip this question.
14.	How satisfied are you with your role in collaborating?	(Open question)
15.	Where do you see room for further improvement?	(Open question)

C. Route Evaluation for Rotterdam The Hague Airport[5]

C.1. Introduction

The case study required a way to compare the current take-off procedure of runway 06 with the alternative procedure. As the study took place during the COVID'19 pandemic, the area was under national lockdown regulations in order to strongly reduce any person-to-person contacts. Organizing physical meetings during that time were not possible, so an alternative way had to be found to approach and evaluate the proposed route change. One of the main challenges in this case study was to compare the noise levels between the routes, while community members were not expected to (fully) understand the notion of the decibel values and scale that were presented in the noise report. The approach that NLR applied in earlier studies, the use of the Virtual Community Noise Simulator (VCNS) that can demonstrate calibrated aircraft flyover sounds, was due to required personal contact not possible. So, a solution had to be found to let community members evaluate the differences in noise level, and help them to advise the CRO whether the change of this procedure is preferred or not.

C.2. Requirements

The comparison between the two procedures should be objective: those involved in the evaluation should not know beforehand which procedure or which location they were evaluating to prevent bias based on their own preference and location where they live. The study should be an alternative way to compare the different routes, next to the information from the noise report. For this reason, the VCNS would also be less useful as it also visually displays the aircraft flyover and the location where the user is.

Another requirement is the need to do the comparison remotely: due to the COVID'19 restrictions, a remote/online comparison would still make it possible to conduct the evaluation. It does, however, limit the possibility to do a calibration if people were to use their own equipment (computer).

For practical reasons, the evaluation should not take too long: community members are willing to invest their time for their own well-being, but a noise evaluation should not take too long to prevent people from stopping the test prematurely. The maximum time a test should take is therefore set to be a half hour.

Finally, due to privacy regulations, people should not be traced back to the results they have provided.

C.3. Implementation

The goal of the evaluation is the comparison of two departure procedures at different locations around the airport. Due to the limitations of the lockdown, a decision was made to let people evaluate the differences using their own computer

[5] This annex only contains the description of the approach to evaluate the two routes. The full case study can be found in the main part of this document.

or mobile device (iPad or telephone), and use headphones (preferably) or earphones to evaluate the sounds. People should compare the two sounds and indicate if, and in what way, they found one of the two sounds more annoying than the other. So, they were evaluating relative differences, not absolute sound levels. Also, opposed to other evaluations, background sounds were not added to the samples. They are normally added to make sound evaluation more realistically and give a reference towards normal background sounds, but because accurate calibration was not possible, background sounds were not used. Also, background sounds may be different for the used locations and the time of day, so it may have other influences that we tried to avoid.

Five location around the evaluated route were chosen by the project group that would represent the affected areas. Some of the locations were also chosen where there may be concern about the route change, but where the noise report did not report significant changes in noise level.

For the purpose of the evaluation, a website was developed that would work on most commonly used platform (PCs, Apple computers, tablets or mobile phones). Due to screen resolution, a computer or tablet screen was recommended. The website consisted of the following sections:

1. Two introduction screens.
2. A calibration screen.
3. The comparison section where five locations were evaluations and the two procedures.
4. A result screen with the result code that should be passed on.

The introduction screen gives a short explanation, how the data would be used, and a reference to the ANIMA project, See Figure 1. The following screen (not displayed) is an explanation of what to expect as a user. The third screen is the calibration screen and is used to do a simple calibration for the sound level of the computer. For this purpose, a prerecorded (by NLR) hand-rubbing sound is played, and the user has to adjust their own volume that this sound is equal to the sound from rubbing their own hands. This method was borrowed from Stéphane Pigeon, who published a website https://hearingtest.online to do a hearing test.

The comparison sections consisted of five comparison for the five chosen locations. One procedure was represented by 'Sound A' and the other procedure was presented by 'Sound B', but it was not known in advance by the participants which sounds was the current procedure, and which was the alternate procedure. In this comparison, first 'Sound A' is played, then 'Sound B' is played (the whole departure procedure that can be heard from the used location). After that, the two procedure are alternating played with a 4-seconds interval. During this alternation, the screen shows whether sound A or sound B at that moment. These alternating sounds helps the comparison especially if the sounds do not differ that much, e.g. loudness differs less than 3 dB(A). Because of this alternating playing of the two sounds, it could happen that one of the sounds may be played at its peak level, while the other sound already passed the peak level. Therefore, half participants heard

sound A first, and the others heard sound B first and these results were later compared as well.

The participants rated the sound samples for each of the five locations on a 7-point scale, by pressing one of 7 buttons indicating the relative perceived annoyance between the two samples. This scaling was translated internally to a scale from -3 to +3. When both routes were perceived equally annoying in noise level the rating would be zero. If the alternative route was perceived as more annoying than the current route, the score would be between -3 for much more annoying and -1 for a little bit more annoying. If the current route was perceived a little less annoying the score would be +1, and +3 for much more annoying.

At the end of the evaluation, the user receives a 7-digit code that represents their score. This code must be emailed back to a CRO representative, who collects all codes and anonymizes the data so that they can be analyzed without any privacy concerns. The reason for returning the result of the evaluation in this way was for a practical reason: it did not require an additional computer server to check and collect the evaluation. This way may be more sensitive for manipulation, but as the participants did not know the location or the procedure, it was difficult if not nonsensical to do so.

The evaluation would first be conducted by a small group from the CRO itself. These were either from the community, the local government, the airport, or the domain experts. The second group would be community members, recruited by the community representatives.

Figure 1: The introduction page (in Dutch) of the website.

Figure 2: The page that is presented to rate the different sounds. In the middle in the purple colour, an indicator shows the sound that is played ('Geluid A' or 'Geluid B'). Below with the yellow button, the 7-scale selection buttons are available to indicate which sounds is more annoying.

C.4. Results

In total 25 participants did the evaluation in two groups. The first group were 13 people from the CRO. The second group of 12 people were only community members recruited by the community representatives within the CRO.

Table 1: Results of departure procedure evaluation

	All results		CRO members		Community members	
Total people	25		13		12	
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**
Location 1	1.8	1.2	1.1	1.3	2.5	0.5
Location 2	1.4	1.2	1.0	1.2	1.8	1.1
Location 3	-1.8	0.7	-1.5	0.7	-2.0	0.7
Location 4	-1.2	1.0	-1.0	0.9	-1.3	1.2
Location 5	0.1	0.4	0.1	0.3	0.1	0.5

The results are presented in *Table 1*. A t-test measured for an alpha=0.05 only showed significant differences for Location 1 with $t(16) = 3.59$, $p=0.0024$.

Due to the alternating sounds, the participants were also randomly divided into two groups, where the first group first started with hearing sound A, while the second group first started with hearing sound B.

Table 2: Comparison of two groups divided by which sound is played first.

Alternating group	Group A		Group B	
Total people	13		12	
	Mean	**SD**	**Mean**	**SD**
Location 1	1.6	1.0	1.9	1.5
Location 2	1.3	0.6	1.5	1.7
Location 3	-1.3	0.5	-2.3	0.6
Location 4	-0.8	0.8	-1.6	1.1
Location 5	0.1	0.3	0.1	0.5

For these groups, also a t-test was conducted to check differences between the groups. For locations 3 and 4 significant differences were found. For location 3 with $t(21) = 4.21$, $p = 0.0004$ and for location 4 with $t(21) = 2.09$, $p = 0.049$.

C.5. Discussion

If we compare the results from the evaluation and the measured noise levels, we can clearly see the participants of the evaluation could very good judge the annoyance in relation to the presented sound level. This would conclude that a sound evaluation using a website and a primitive way of calibration is a useful tool for non-experts to compare aircraft procedures with different or similar sound levels. There are also indications that when comparing similar sound level differences, those pairs with higher sound levels are rated more extreme with respect to annoyance than the lower sound levels. This would translate into an indication that reducing noise for higher exposed areas reduces annoyance more than the same reduction for lower exposed areas.

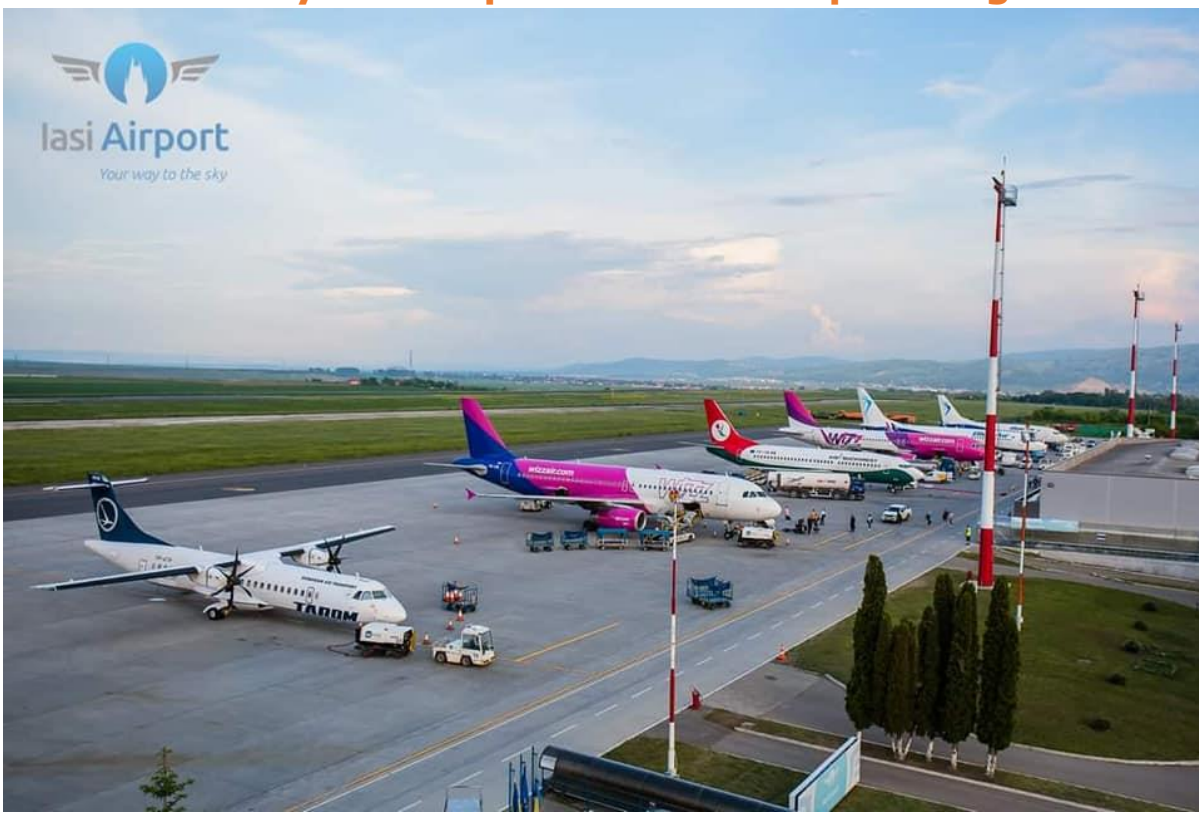
Table 3: Results from the acoustic comparison of the current and alternative departure procedure

Location	**Calculated LAmax, current route**	**Calculated LAmax, alternative route**	**Change in noise level**	**Mean Listening test score (-3 to +3)**	**Standard Deviation**
1	76.2 dB SPL	72.7 dB SPL	-3.5 dB	1.8	1.2
2	69.2 dB SPL	66.5 dB SPL	-2.7 dB	1.0	1.2
3	65.4 dB SPL	69.7 dB SPL	+4.3 dB	-1.8	0.7
4	60.7 dB SPL	65.1 dB SPL	+4.4 dB	-1.2	1.0
5	73.2 dB SPL	73.6 dB SPL	+0.4 dB	0.1	0.4

When looking at the different groups, the CRO members and the community members, the community member rate the annoyance higher when there are differences, but for only location 1 can this be statistically supported. We also expected that the alternation of sound, which helps in evaluating the two sounds side-by-side, may have an adverse effect as the peak of the event may fall within one of the two events and is not evenly split. To divide the participants in two groups, we were able to make sure this effect would be middled out, and at the same time was it possible to compare those groups. The result of this comparison

showed that for two locations (3 and 4) these differences were significant. Fortunately, in both cases the difference only emphasized the annoyance and did not lead to a different conclusion that one or the other sound was more annoying. Randomly dividing the groups for this purpose is therefore considered a good practice when dealing with evaluation of alternating sounds. An other alternative way would be to provide each participant with two comparisons of the same paired sounds (where in each one of the comparison, one or other starts first), but that would require one extra sound comparison per location per participant. This should only be considered if the participant time to perform the total comparison is not restrained.

D. Case Study Iasi Airport – Land-use planning



D.1. Overview of Airport Context

D.1.1. Focus and Intent

This case study was focused on understanding how to support the definition of LUP (Land-Use Planning) provisions at a national level in an effective manner, through communication and engagement with relevant stakeholders. Being one of the many Romanian airports dealing with encroachment, Iasi airport wanted to lead in establishing a collaboration context that involved all relevant stakeholders in order to support the implementation of mandatory LUP provisions.

D.1.2. Background Information

General Information about the airport

Iasi International Airport, known officially as "Aeroportul Internațional Iași, România", is administered by a private organisation, although its premises are the property of the County Council of Iasi. It is located in the North-Eastern side of Romania, at a distance of approx. 3.5 km East from the Iasi city, the biggest community around its premises. The airport has an elevation of 411 FT, with a reference temperature of 30° C[6].

[6] AIP ROMANIA, AD2.10-1, 31 DEC 2020, LRIA AD 2.1 AERODROME LOCATION INDICATOR AND NAME, LRIA – IASI/ Iasi, https://www.aisro.ro/

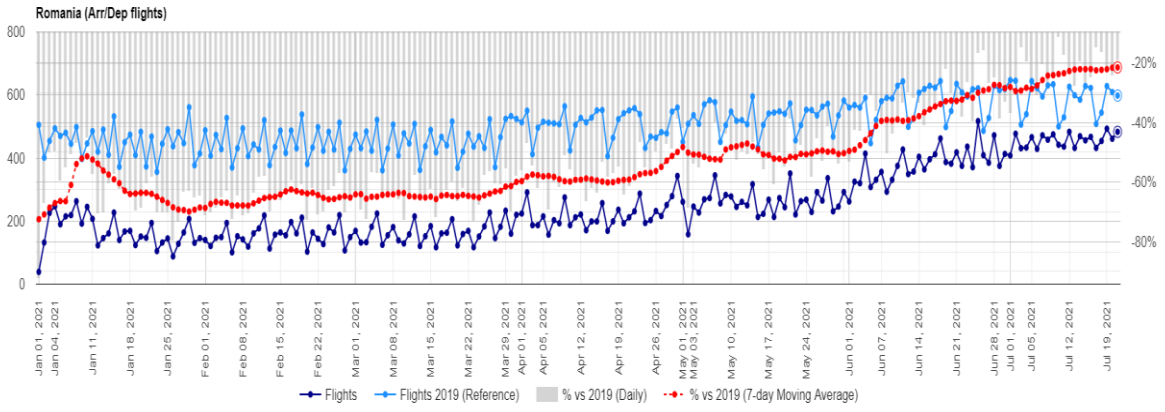
Airport location

The Iasi region is part of the North-Eastern class of Macroregions in Romania, Iasi city being evaluated as the second biggest city in Romania with respect to the number of people with residence in the city (362142 residents). Additionally, Iasi was evaluated as being the second city in which the number of the population increased in one year (9.9 thousand people between 2015-2016)[7]. This information highlights the importance of this region at a national level and thus the valuable role of the airport, which is located within the boundaries of Iasi city.

Figure 1 - Location of Iasi Airport, Romania (Google Maps, Iasi International Airport, 2021)

Air traffic information

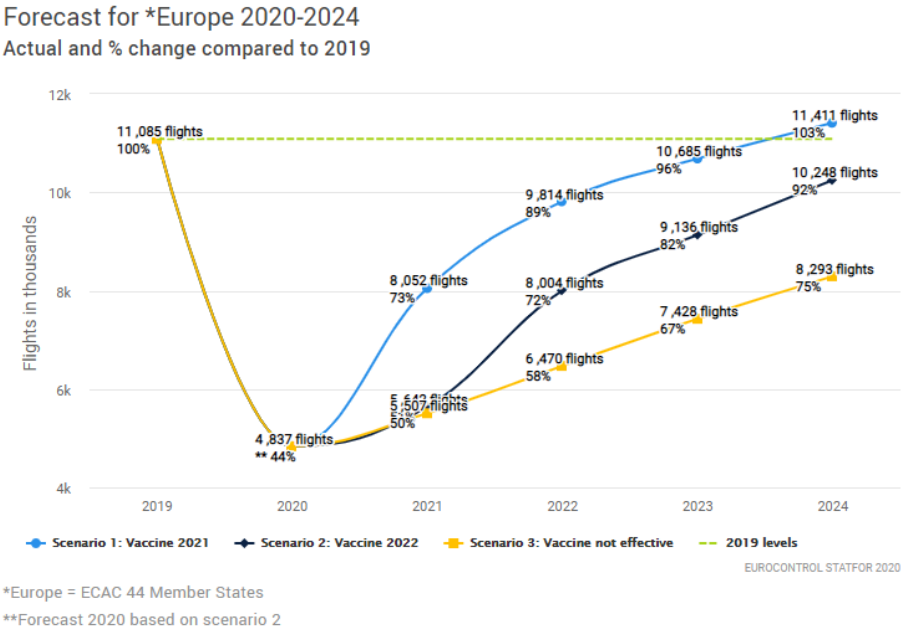
At the level of Romania, there are significant differences between the air traffic before and after the pandemic. The situation from the 1st of January, 2021 can be observed in the figure below.



[7] INSTITUTUL NATIONAL DE STATISTICA, POPULATIA ROMANIEI PE LOCALITATI, 1 IANUARIE 2016, https://insse.ro/cms/sites/default/files/field/publicatii/populatia_romaniei_pe_localitati_la_1ianuarie2016_0.pdf

Figure 2 – Romania (Arr/Dep flights) [8]

Within the summary of forecast IFR movements per traffic zone, it can be observed that for Romania the traffic was listed and predicted as it follows (thousands): 598 (2014), 635 (2015), 621 (2016), 673 (2017), 738 (2018), 747 (2019), 306-308 (2020), 343-496 (2021), 410-628 (2022), 479-693 (2023), 540-750 (2024). This shows an air traffic growth of 4.5% (2015-2019 compared to 2014) before the pandemic and an evolution within the interval from -6.3% to 0.1% (2020-2024 compared to 2019). At the level of forecast IFR movement growth per traffic zone, the data for Romania is the following: 17% (2014), 6.1% (2015), -2.2% (2016), 8.5% (2017), 9.6% (2018), 1.2% (2019), -59% (2020), 12%-61% (2021), 20%-47% (2022), 10%-17% (2023), 8.3%-14% (2024)[9]. These figures can show the high air traffic growth situation within Romania before 2019, during the pandemic, but also the range of possibilities for recovery in the period 2020-2024. Although the expectations at the European level is to reach in 2024 a traffic level similar to 2019, the situation is still uncertain due to the influence of various factors (e.g. strength of worldwide future waves of COVID-19, strength and timing of public health restrictions and social distancing, availability 'and uptake' of vaccine, global economy impact, state aid differences, bankruptcy risks in the aviation industry, reductions in air traffic demand) and was formulated on 3 possible scenarios, as it can be observed in the figure below.



[8] EUROCONTROL, Daily Traffic Variation – States, https://www.eurocontrol.int/Economics/DailyTrafficVariation-States.html

[9] EUROCONTROL STATFOR, EUROCONTROL 5-Year Forecast 2020-2024, Detailed Forecasts, Traffic table detailed forecasts, November 2020, https://www.eurocontrol.int/publication/eurocontrol-five-year-forecast-2020-2024

Figure 3 - Forecast for Europe 2020-2024[10]

Noteworthy is that scenario 1 assumes a recovery to 2019 levels in 2024, while scenarios 2 and 3 assume similar levels in 2026, respectively in 2029. Additional risks also include Brexit, future airspace and network changes, changes in route preferences by airlines and also economic recovery.[11]

The current global situation led to uncertainties regarding air traffic growth predictions for the next 10 years, therefore the perspective at the local level is still uncertain. In 2019, the airport offered three domestic routes (Bucharest, Cluj-Napoca and Timisoara; extended to include Bacau, Sibiu, Suceava in 2020) and various international connections to 15 countries (Israel, France, Great Britain, Italy, Spain, Belgium, Germany, Cyprus, Netherlands, Denmark, Austria – regular; Egypt, Tunisia, Turkey, Greece – seasonal). At the moment (July 2021), most flight connections have been restored and other new ones were opened (e.g. Frankfurt, Heathrow, Dublin). In 2019, eight airlines used to operate on the airport (TAROM, BLUE AIR, WIZZ AIR, AUSTRIAN AIRLINES, AMC AIRLINES, AIR BUCHAREST, AEGEAN and ONUR), the situation at the level of 2021 increasing the list with two other new operators (LUFTHANSA and HISKY).

Table 1. Traffic figure in the period 2016-2021.

Year	Number of passengers (Total number in commercial traffic)
2016[12]	879.981
2017[13]	1.143.904
2018[14]	1.251.358
2019[15]	1.312.611

[10] EUROCONTROL, EUROCONTROL 5-Year Forecast 2020-2024, Detailed Forecasts, website, November 2020, https://www.eurocontrol.int/publication/eurocontrol-five-year-forecast-2020-2024

[11] EUROCONTROL STATFOR, EUROCONTROL 5-Year Forecast Europe 2020-2024, European Flight Movements and Service Units, Three Scenarios for Recovery from COVID-19, November 2020, https://www.eurocontrol.int/publication/eurocontrol-five-year-forecast-2020-2024

[12] INSTITUTUL NATIONAL DE STATISTICA, TRANSPORTUL AEROPORTUAR DE PASAGERI SI MARFURI, ANUL 2016, https://insse.ro/cms/sites/default/files/field/publicatii/transportul_aeroportuar_de_pasageri_si_marfuri_in_anul_2016.pdf

[13] INSTITUTUL NATIONAL DE STATISTICA, TRANSPORTUL AEROPORTUAR DE PASAGERI SI MARFURI, ANUL 2017, https://insse.ro/cms/sites/default/files/field/publicatii/transportul_aeroportuar_de_pasageri_si_marfuri_in_anul_2017.pdf

[14] INSTITUTUL NATIONAL DE STATISTICA, TRANSPORTUL AEROPORTUAR DE PASAGERI SI MARFURI, ANUL 2018, https://insse.ro/cms/sites/default/files/field/publicatii/transportul_aeroportuar_de_pasageri_si_marfuri_in_anul_2018.pdf

[15] INSTITUTUL NATIONAL DE STATISTICA, TRANSPORTUL AEROPORTUAR DE PASAGERI SI MARFURI, ANUL 2019, https://insse.ro/cms/sites/default/files/field/publicatii/transportul_aeroportuar_de_pasageri_si_marfuri_in_anul_2019.pdf

2020[16]	466.698

The air traffic information related to 2021 is still unavailable and the final real traffic levels and statistics for the year 2021 will be published in 2022.

Specific information related to the airport

Iasi Airport is a rapidly growing European airport, therefore connectivity to the airport was ensured through both road and railway infrastructures in order to facilitate the access from and to nearby communities and also from and to different big cities in Romania.

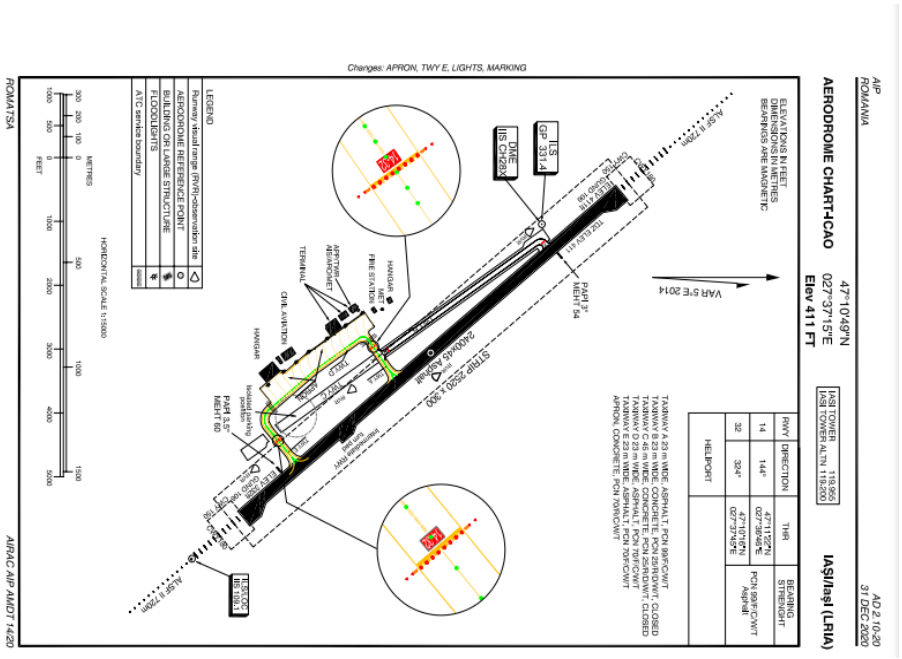


Figure 4. Aerodrome Chart[17].

The airport has one runway in operation (RWY14/32), made of asphalt and with the dimensions of 2400m x 45m.

D.1.3. Legislative and regulatory framework

General information

The most important legislative acts regarding environmental protection, which are applicable for the Civil Aviation sector in Romania, are listed below[18].

Table 2. European legislation.

Short designation	Title

[16] INSTITUTUL NATIONAL DE STATISTICA, TRANSPORTUL AEROPORTUAR DE PASAGERI SI MARFURI, ANUL 2020, https://insse.ro/cms/sites/default/files/field/publicatii/transportul_aeroportuar_de_pasageri_si_marfuri_in_anul_2020_0.pdf

[17] AIP ROMANIA, AD2.10-20, 31 DEC 2020, AERODROME CHART – ICAO, IASI/Iasi (LRIA), https://www.aisro.ro/

[18] ROMANIAN CIVIL AVIATION AUTHORITY, ENVIRONMENTAL LEGISLATION, https://www.caa.ro/ro/pages/legislatie-mediu

Council Decision (EU) 2020/954 of 25 June 2020[19]	Council Decision (EU) 2020/954 of 25 June 2020 on the position to be taken on behalf of the European Union within the International Civil Aviation Organization as regards the notification of voluntary participation in the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) from 1 January 2021 and the option selected for calculating aeroplane operators' offsetting requirements during the 2021-2023 period
Council Decision (EU) 2020/768 of 9 June 2020[20]	Council Decision (EU) 2020/768 of 9 June 2020 amending Decision (EU) 2016/915 as regards the reference period intended to be used for measuring the growth of CO2 emissions, to take account of the consequences of the COVID-19 pandemic in the context of CORSIA
Council Decision (EU) 2018/2027 of 29 November 2018[21]	Council Decision (EU) 2018/2027 of 29 November 2018 on the position to be taken on behalf of the European Union within the International Civil Aviation Organization in respect of the First Edition of the International Standards and Recommended Practices on Environmental Protection — Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA)
Council Decision (EU) 2016/915 of 30 May 2016[22]	Council Decision (EU) 2016/915 of 30 May 2016 on the position to be taken on behalf of the European Union with regard to the international instrument to be drawn up within the ICAO bodies and intended to lead to the implementation from 2020 of a single global market-based measure for international aviation emissions
Regulation (EU) No 598/2014 of the European Parliament and of the Council of 16 April 2014[23]	Regulation (EU) No 598/2014 of the European Parliament and of the Council of 16 April 2014 on the establishment of rules and procedures with regard to the introduction of noise-related operating restrictions at Union airports within a Balanced Approach and repealing Directive 2002/30/EC

Table 3. National legislation.

Short designation	Specifications

[19] Council Decision (EU) 2020/954 of 25 June 2020, https://eur-lex.europa.eu/eli/dec/2020/954/oj
[20] Council Decision (EU) 2020/768 of 9 June 2020, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32020D0768&qid=1626952157435
[21] Council Decision (EU) 2018/2027 of 29 November 2018, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32018D2027&qid=1626952227880
[22] Council Decision (EU) 2016/915 of 30 May 2016, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32016D0915&qid=1626952303886
[23] Regulation (EU) No 598/2014 of the European Parliament and of the Council of 16 April 2014, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32014R0598&qid=1626952446021

OMT nr. 1.043/16.07.2019[24]	Related to the implementation of Regulation (EU) No 598/2014
Legea nr. 121/03.07.2019[25]	Noise law (evaluation and management of ambient noise)
Ordin comun MTI & MMP nr. 169/1.801/11.03.2011 (consolidat)[26]	The approval of the National action plan regarding the reduction of greenhouse gas emissions within civil aviation (2011-2020)
RACR-PM "Protecția mediului"(consolidată)[27]	Romanian Regulation regarding environmental protection
HG nr. 1.074/05.09.2007[28]	Civil aircraft operations restrictions (Part 2, Cap. 3, Vol. I, Annex 16, ICAO)
HG nr. 780/14.06.2006 (consolidată)[29]	Establishing the trading scheme for certificates for greenhouse gas emissions
Legea nr. 86/10.05.2000 (consolidată)[30]	Access to information, public participation in decision-making and access to justice in environmental issues
Ghidul autorităților publice[31]	The Guide of public authorities for the access of information related to the environment

Other available acts include a procedure regarding issuing permits for the temporary use of a certain type of subsonic civil aircraft[32] and a circular with a guide regarding safety criteria applicable for the introduction of noise abatement operational measures around airports (2016)[33].

[24] OMT nr. 1.043/16.07.2019, http://legislatie.just.ro/Public/DetaliiDocument/216711
[25] Legea nr. 121/03.07.2019, http://legislatie.just.ro/Public/DetaliiDocument/216510
[26] Ordin comun MTI & MMP nr. 169/1.801/11.03.2011 (consolidat), http://legislatie.just.ro/Public/DetaliiDocument/130479
[27] RACR-PM "Protecția mediului"(consolidată), http://legislatie.just.ro/Public/DetaliiDocumentAfis/184764
[28] HG nr. 1.074/05.09.2007, http://legislatie.just.ro/Public/DetaliiDocument/85426
[29] HG nr. 780/14.06.2006 (consolidată), http://legislatie.just.ro/Public/DetaliiDocument/72971
[30] Legea nr. 86/10.05.2000 (consolidată), http://legislatie.just.ro/Public/DetaliiDocument/22438
[31] Ghidul autorităților publice, https://www.caa.ro/uploads/pages/Ghidul%20autorit%C4%83%C8%9Bilor%20publice%20pt.%20accesul%20publicului%20la%20informa%C8%9Bia%20de%20mediu%202020.pdf
[32] RACR DECISION, https://www.caa.ro/AACR/Mediu/Legislatie%20mediu/PIAC-PM-EATU_editia_02_din_nov._2013.pdf
[33] RACR CIRCULAR, Ghid privind cerinte de siguranta aplicabile la introducerea unor masuri operationale pentru reducerea zgomotului in preajma aeroporturilor, https://www.caa.ro/AACR/Mediu/Legislatie%20mediu/CA-PM-PORZ1.pdf

Notable is that the Environmental Noise Directive[34] was transposed within the national legislative framework since 2005[35]. Since 2019, a new noise law was used to replace the previous transposition, having more clarifications regarding responsible authorities for managing noise and various other updates[36]. Therefore, Strategic Noise Maps and Action Plans are mandatory for major airports, but also for several other airports in spite of having less than 50 000 movements/ year. Iasi Airport is one of the airports that is bound under these criteria. Various other existing legislative acts on noise management are not applicable yet for Iasi Airport. Noise Abatement Departure Procedures are recommended on Iasi Airport[37].

Responsible Authorities

The responsible authority for managing environmental issues in Romania is the Ministry of Environment. Its structure is formulated on three institutions, having different roles: the Ministry (legislative power), the Environmental Agency (issuing approvals in compliance with the law) and the Environmental Guard (checking compliance with the law and issuing fines for non-compliance).

Although the airport is under the administration of a private organisation, it is owned by the state and under the control of the Regional (County) Council of Iasi.

Airport Policies For Environmental Protection

The long-term strategy of the airport was formulated around continuous identification of sustainable measures focused on preventing noise, rather than controlling/ limiting/ mitigating solutions which were mostly short-term based. In this sense, one of the key objectives of the airport became the intention to support the implementation of land-use planning strategies to ensure a coordinated approach on noise management in the region, such that the number of people exposed to noise is reduced, while the economic gains from both airport operations and residential developments are facilitated in a sustainable manner.

D.2. Case Study

D.2.1. Motivation and Problem Statement

Land-Use Planning is a big concern for most Romanian airports, as encroachment is already a severe problem in some cases, this also being the case for Iasi Airport. In this sense, the airport has engaged in establishing a collaboration context

[34] DIRECTIVE 2002/49/EC of the European Parliament and of the Council of 25 June 2002 relating to the assessment and management of environmental noise – Declaration by the Commission in the Conciliation Committee on the Directive relating to the assessment and management of environmental noise, https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02002L0049-20200325&from=EN

[35] HOTARARE nr. 321 din 14 aprilie 2005 privind evaluarea si gestionarea zgomotului ambient, http://legislatie.just.ro/Public/DetaliiDocument/61215

[36] LEGE nr. 121 din 3 iulie 2019 privind evaluarea si gestionarea zgomotului ambient, http://legislatie.just.ro/Public/DetaliiDocument/216510

[37] AIP ROMANIA, AD 1.1-3 08 NOV 2018, 6.1 Noise abatement departure procedures, https://www.aisro.ro/

between all relevant parties to support the implementation of mandatory LUP provisions within the national legislation and clarify possible issues.

Given the fact that various airports located in the Eastern side of Europe (Romanian airports included) were evaluated in 2018[38] as expected fast-growing airports until 2040, it became obvious from an overview of the available air traffic evolution data at Iasi Airport that a corrective and preventative LUP approach is needed to be able to respond to future demand. In order to be able to implement LUP around the airport, it is essential to have such provisions defined within the national legislation, which were absent. Additional pressure to respond to noise concerns was emphasised by the unmet noise goals, such as the construction of a new runway in 2014 to avoid overflying areas that are highly populated, as a measure to reduce the number of people exposed to noise. In spite of these efforts, the aim of reduction was not achieved due to increases in residential developments in the areas below the flight paths, which consequently resulted in significant difference between expected and real noise exposure scenarios. However, LUP cannot be implemented by the airport according to the national legislation and LUP provisions related to noise around airports were absent in Romania. This situation determined the airport to start communication and engagement actions towards raising awareness about the importance of the issue, of its direct and indirect effects and offer active support in progressing towards making the first steps to define appropriate LUP provisions.

D.2.2. Objectives

The objectives were formulated (by drawing upon ANIMA learning) around: addressing the gaps that have been previously identified and support in investigating solutions, continuously engaging with stakeholders to support progress throughout the development of the case study, identifying priorities from each stakeholder and individual barriers in defining and implementing LUP provisions and supporting the implementation of an independent LUP policy or the harmonisation of existing legislation to cover LUP. Therefore, the main objective of this intervention is to support the development of a collaborative environment between relevant stakeholders through continuous communication and engagement.

D.2.3. Intervention Design

The design of the intervention started from existing ANIMA knowledge on this topic and of the needs in this context, as well as of the national legislative framework, through desk studies to support the organisation of focused discussions with relevant stakeholders.

[38] EUROCONTROL, "EUROPEAN AVIATION IN 2040, CHALLENGES OF GROWTH, ANNEX1, FLIGHT FORECAST TO 2040", 2018, https://www.eurocontrol.int/sites/default/files/2019-07/challenges-of-growth-2018-annex1_0.pdf

Analysis of the national legislative framework

The Environmental Noise Directive (END) was transposed within the national legislation in 2005, through a Governmental Decision[39] that was later modified and updated in 2007[40], 2012[41] and 2016[42]. One of the main updates was the extension of the applicability requirements for compliance with END from major airports to major airports and urban airports. As a main result, the development of Strategic Noise Maps and Action Plans became mandatory for various other Romanian Airports, Iasi Airport included.

The Air Code had no specific connections related to airport noise management and the existing legislation for territorial planning has only recommendations in this sense.

Airport experience with noise management

The reporting activities of the airport in compliance with END provisions were completed in 2014[43] (first round) and 2018[44] (second round). Important to note is the air traffic forecast included within the most recent Noise Action Plan, that indicated the expected air traffic growth on the airport until 2022, as it can be seen in the figure below. This was developed before COVID-19.

An	2016	2017	2018	2019	2020	2021	2022
Nr. mișcări	10269	12220	14175	15876	17464	19210	21131
Creștere față de anul precedent (%)		*19%*	*14%*	*12%*	*10%*	*10%*	*10%*
Creștere față de anul 2016 (%)		19%	38 %	55%	70%	87%	105%

[39] HOTARARE nr. 321 din 14 aprilie 2005 privind evaluarea si gestionarea zgomotului ambiental, http://legislatie.just.ro/Public/DetaliiDocumentAfis/61215

[40] HOTARARE nr. 674 din 28 iunie 2007 pentru modificarea si completarea Hotararii Guvernului nr. 321/2005 privind evaluarea si gestionarea zgomotului ambiental, http://legislatie.just.ro/Public/DetaliiDocument/83733

[41] HOTARARE nr. 1.260 din 12 decembrie 2012 pentru modificarea si completarea Hotararii Guvernului nr. 321/2005 privind evaluarea si gestionarea zgomotului ambiant, http://legislatie.just.ro/Public/DetaliiDocument/144470

[42] HOTARARE nr. 944 din 15 decembrie 2016 pentru modificarea si completarea Hotararii Guvernului nr. 321/2005 privind evaluarea si gestionarea zgomotului ambiant, http://legislatie.just.ro/Public/DetaliiDocument/185147

[43] IASI AIRPORT, NOISE ACTION PLAN, 2014, https://www.aeroport-iasi.ro:5000/docs/download/Plan_actiune_zgomot_2014.pdf

[44] IASI AIRPORT, NOISE ACTION PLAN, 2018, https://www.aeroport-iasi.ro:5000/docs/download/Plan_de_Actiune_Aeroport_Iasi_2018.pdf

Figure 5. Forecast related to the number of aircraft movements (2017-2022)[45].

In 2015, the airport was also involved within the first Romanian annoyance case study[46] of this kind, observing from findings that the expected increase in residential buildings around the airport will also increase the noise impact, along with noise exposure, in spite of its efforts to control and limit noise.

From previous ANIMA engagement (D2.5), the airport has already identified the responsible authorities for LUP and tried to engage with them. Territorial planning was outlined by legislation as being within the responsibility of City Halls and County Councils (i.e. local and regional authorities) and the Ministry in charge with territorial development and public administration. After initiating dialogue to raise awareness about the noise exposure and impact concerns in communities around the airport, all stakeholders agreed that land-use planning was required as a best solution, but it was unapplicable in the context of an absent legislative context. Further engagement of the airport with different other potential stakeholders (Ministries of Environment, Health, Transport; local and regional authorities; Association of Romanian Airports; Civil Aviation Authority; Air Navigation Service Provider; airlines; noise experts; communities around the airport; representatives from airports experienced in noise management) shaped the understanding of opportunities to identify the gaps and limitations for implementing effective noise management strategies on Romanian airports. This initiative was of great importance, as it raised awareness about the urgency to foster communication and engagement and facilitated the development of a common understanding of the noise issues in Romania. After constructing a mutual understanding of the complexity of the noise issue and of the current management situation in Romania, the airport organised a workshop with many relevant stakeholders to identify first steps that could allow the definition of a national strategy for noise management. The most important proposals included the development of an updated noise legislation and changes within the Air Code to include noise management in order to ensure harmonization across the national legislation.

The next steps within the intervention design process were to identify and engage with all relevant stakeholders for LUP, meaning all authorities that can influence airport noise management but are not included within the legislative scope yet. The aim was to engage in dialogue with them, identify the possibility for them to contribute to the efforts of managing noise around airports and engage in supporting policy-makers to define appropriate legislative statements that facilitate the implementation of LUP.

[45] IASI AIRPORT, NOISE ACTION PLAN, 2018, https://www.aeroport-iasi.ro:5000/docs/download/Plan_de_Actiune_Aeroport_Iasi_2018.pdf

[46] D. Dimitriu, G. Dinu, C. Vesel, A. Toma, D. Radulescu, N. Burtea, M. Deaconu, S. Runcan, D. Tofan, "An investigation of the Romanian aviation noise policy and its implementation: where is Romania placed on the European noise mitigation map?", May 2018, Crete, Greece, EURONOISE 2018, https://www.researchgate.net/publication/326683104_An_Investigation_of_the_Romanian_aviation_noise_policy_and_its_implementation_where_is_Romania_placed_on_the_European_noise_mitigation_map

D.2.4. Implementation Processes

The implementation of LUP completely under the scope of the legislation for noise management was not possible, therefore the efforts were shifted towards the harmonisation of existing legislation applicable for all relevant stakeholders to include airport noise management provisions, such that this becomes the fundament allowing LUP to be implemented. To progress in this sense, various gaps have been identified, that influence the design and implementation of sustainable aviation noise policies. The unclear view of responsible authorities and their obligations was the first step that was approached. Further, several other issues that hindered the implementation of existing noise legislative provisions were addressed. For example, the unavailability of stable economic resources to support the development of Strategic Noise Maps and Noise Action Plans has determined in many cases the occurrence of delays in their development and submission in line with END deadlines. Another important issue was the lack of transparency in decision-making of different stakeholders that was not allowing the availability of data to support the understanding of priorities that influence trade-offs. Since the airport was the only responsible entity for noise management, the actions of other relevant stakeholders were also influencing its strategy. In addition, the limited number of specialists regarding aviation noise at a national level was a limitation for the progress of aviation noise management in Romania.

In order to address all identified gaps, the intervention started with the continuation of the analysis of the ICAO Balanced Approach (BA)[47] pillars, in order to identify responsible authorities for the implementation of solutions appropriate to each pillar. According to the transposition of END, the airport was the responsible authority to implement noise measures, but its capacity to influence any ICAO BA pillar was limited. For example, the implementation of Noise Abatement Departure Procedures was impossible without the engagement of the Air Navigation Service Provider and of airlines, as well as in the absence of a regulatory framework. Similarly, land-use planning implementation without legislative provisions and harmonization across legislations was not possible either. Upon the identification of relevant stakeholders, other concerns were raised with respect to optimising the existing provisions related to noise management, including the absence of an efficient information exchange process/ system between the airport and the organisations that provide data necessary for the development of Strategic Noise Maps, the specification of a certain format for data sets and the missing connection between Urbanism Plans and Strategic Noise Maps and Action Plans. All these points were addressed in periodic discussions with the Ministry of Environment, the Ministry of Transport, the Civil Aviation Authority, the Air Navigation Service Provider, airlines, other airports, local and regional authorities (Iasi and Bucharest), leading to various changes within the national legislative framework, that allowed for the definition of preliminary requirements for LUP.

[47] INTERNATIONAL CIVIL AVIATION ORGANIZATION, AIRCRAFT NOISE, BALANCED APPROACH TO AIRCRAFT NOISE MANAGEMENT, https://www.icao.int/environmental-protection/pages/noise.aspx

Legislative changes

Various stakeholders engaged actively to tackle this issue in order to increase the benefits from the existing legislation and to facilitate the links between different normative acts such that, land-use planning provisions could be defined effectively and in a harmonised manner.

A. The Noise Law48

A first step for bringing clarifications that would speed-up the implementation of noise-related provisions, was the specification of responsible authorities. In the case of airport noise management, these are: the local public administration authorities and economic operators required to develop Strategic Noise Maps and Action Plans, local public administration authorities that have under their administration localities adjacent to major and urban airports, airport administrators, economic operators (airport administrators), the Bucharest Airports National Company, the Air Navigation Service Provider, the Civil Aviation Authority, the Ministry of Transport, the regional agencies for environmental protection and the National Agency for Environmental Protection, the Environmental National Guard, the Ministry of Environment, the local and regional councils and the Ministry of Health.

The most important changes within the Noise Law regarding airport noise management, in comparison to the previous legislation, includes the definition of various responsible authorities for managing noise, as opposed to the case when the airport was the sole responsible as it was before. In addition, each stakeholder has different responsibilities and is actively involved throughout the development of Strategic Noise Maps and Noise Action Plans (especially in defining measures) to ensure that compliance with END specifications is addressed in a collaborative manner and that all available opportunities to reduce noise are addressed.

The exchange of information between the airport and the organisations that have data necessary for the development of Strategic Noise Maps and Noise Action Plans has been strengthened by imposing time limits for providing feedback, specific file types and sanctions for non-compliance.

Various other clarifications have been made with respect to the definition of conditions and criteria to revise/ re-develop Strategic Noise Maps and Noise Action Plans, as this was one aspect that was highlighted as being too general. Another clarification was made by offering clear indications to progress through all necessary steps to ensure compliance with END provisions (e.g. who are the authorities to which Strategic Noise Maps and Noise Action Plans have to be sent), followed by deadlines and accompanied by sanctions for non-compliance. In addition, clear guidance was provided on how to establish noise management measures and on specific information to be included when developing Strategic Noise Maps and Noise Action Plans.

Communication of results (Strategic Noise Maps, Noise Action Plans) to the general public is also emphasised in various articles, highlighting that information should

[48] PARLAMENTUL ROMANIEI, LEGE nr. 121 din 3 iulie 2019 privind evaluarea si gestionarea zgomotului ambiant, http://legislatie.just.ro/Public/DetaliiDocument/216510

be clear, coherent, accessible and accompanied by a summary that bring to attention the most important points.

Another important point is the requirement to develop a geospatial database to encompass all data (GIS data, noise maps, input data for noise mapping, evaluation data, thematic layers) required to be delivered for compliance with the provisions of the Noise Law. This aims to ensure that data can be stored in a common repository that increases the data management capabilities, together with monitoring and evaluating progress throughout time.

As previously highlighted as a gap, the availability of funding necessary for Strategic Noise Mapping and development of Noise Action Plans is now specified, together with the responsible authority to ensure the budget.

Quiet zones are established and their limits have to be introduced within the General Urbanistic Plan. For them, the local authorities have to establish specific restrictions and recommendations that lead to ensuring appropriate noise insulation of existing buildings, as well as to imposing construction limitations (this is only under the form of recommendation for the case of residential buildings).

B. The Air Code[49]

The updated version of the Air Code includes a definition of various noise related terms, such as noise mapping and noise protection areas. The definition of a noise protection area states that this is the area limited by the noise contour resulted from mapping and corresponding to the smallest limit values of noise indicators, for which constraints are imposed for land-use planning around an aerodrome.

The central public authority for environmental protection is appointed to be the responsible authority to monitor the implementation level of both national and European regulations related to environmental protection applicable for certified civil Romanian aerodromes, including the regulations regarding the evaluation and management of noise (Art. 60). The list of certified civil aerodromes that have the mandatory requirement to develop Strategic Noise Maps and Noise Action Plans, together with the criteria necessary for their development, is to be established through a Governmental Decision by the Ministry of Environment (Art. 63 (1)). The Ministry of Environment is also responsible for developing the methodology for mapping noise in order to forecast the impact of current and future aerodrome activities over its surroundings. The methodology is instructed to be published through a Governmental Decision (Art. 63 (4)).

Operating restrictions for certain types of civil aircraft operating on all certified civil aerodromes in Romania or operating within the national airspace will be implemented through a Governmental Decision that will be initiated by the Ministry of Transport. This also includes the registration of these types of aircraft depending on their noise certificate in Romania. The applicability of this provision is stated only if this is not already defined through European regulations that are directly applicable (Art. 61).

[49] PARLAMENTUL ROMANIEI – CODUL AERIAN DIN 18 MARTIE 2020, https://www.caa.ro/CAA/Informatii%20generale/Legislatie%20generala/Codul_Aerian_2020.pdf

The Air Navigation Service Provider has the mandatory obligation, as a main priority, to account for safety, ensure air traffic fluxes decongestion and, whenever possible, to apply possible measures to limit the environmental impact of air traffic, when this is not against the safety objectives (Art. 62).

The administrators of certified Romanian civil aerodromes that have the obligation to develop Strategic Noise Maps and Noise Action Plans must use noise mapping to predict the impact of future activities over the vicinities of the aerodromes, when they initiate development programmes related to aerodrome infrastructure expansions (Art. 63 (2)).

The local public administration authorities must integrate Strategic Noise Maps and airport expansion projects (together with results from noise mapping) within the documentation for Urbanism and land-use planning (Art. 63 (3)). The authorities that have under their administration territories within the proximity of aerodromes have the obligation to develop noise zoning for aerodrome vicinities, in compliance with the methodology for noise mapping that will be published by the central public authority for environmental protection (Art. 64 (1)). The noise zones around certified civil aerodromes in Romania and the associated restrictions will be integrated within the documentation for urbanism and land-use planning, in compliance with national and European regulations related to the evaluation of environmental impact (Art. 64 (2)). Next, the authorities must develop development and land-use planning policies for the territories from the vicinity of certified civil Romanian aerodromes by taking into account the restrictions associated with the noise protection zones (Art. 64 (3)).

Outlining the future strategy

The next steps for implementing LUP and for establishing noise zoning provisions include the **definition of noise protection zones** in line with existing standards (STAS 10183/4-75) and the identification of possible links with the existing provisions (recommendations for noise zoning around airports) published by the Ministry of Health ("Norms of hygiene and public health regarding the living environment of the population"[50]). Another important step is the development of the methodology for noise mapping by the Ministry of Environment, according to the provisions from the Air Code, which will influence the definition and implementation of noise zones and corrective measures against noise exposure.

Noise zoning performed specifically through the use of predictive noise maps is not required, but this is an important aspect that needs to be addressed in the future to focus towards the implementation of LUP as a preventive measure against noise. Also, there is **no specified date for implementing noise zoning and LUP provisions** and this remains as a legislative gap at the moment but needs attention in the future, i.e. to identify in which legislation can this be integrated and by which responsible authority.

Establishing the **criteria for introducing noise maps within the urbanism documentation** could be a challenge if not performed appropriately. One existing

[50] MINISTERUL SANATATII, ORDIN nr. 119 din 4 februarie 2014 pentru aprobarea Normelor de igiena si sanitate publica privind mediul de viata al populatiei, https://cnmrmc.insp.gov.ro/images/Ordin-MS-Nr-119-2014.pdf

example of integrated zoning criteria around airports that could provide some guidelines in this sense could be the aeronautic servitudes. These specifications have to be developed in the future.

Completing the national legislative framework with additional normative acts is also necessary to support the official implementation of the new noise law and consequently the preliminary LUP provisions. This includes: the guide for developing noise maps, the guide for developing Noise Action Plans, the guide for evaluating noise maps and action plans, the methodology for noise mapping (that will be used for noise zoning) and norms for evaluating noise in the context of noise-related operational restrictions.

Progress with legislative harmonisation to ensure that the legislation for land-use planning and urbanism comprises the environmental aviation requirements and that its provisions are not formulated against the provisions from the Noise Law or from the Air Code. Discussions have been initiated in this sense with urban planners (experts) as the current legislation for urbanism is under significant changes.

In practice, the implementation of the LUP provisions as stated by the Air Code is expected to start from the airports that develop noise maps and deliver them to local authorities. The local authorities, based on the noise mapping methodology, will develop noise zoning in line with the noise maps from airports. Next, the local authorities will include the criteria of noise zoning within the urbanism and land-use planning documentation, specifying the limits of noise protection zones, restrictions applicable for each zone, solutions to reduce noise in certain zones and requirements for the development of new buildings within the noise protection zones. In the end, the Environmental Guard verifies the application of these provisions and imposes sanctions for non-compliance.

D.2.5. Evaluation of Results and Post-Implementation Changes

Noise Law

Most gaps and necessities addressed by the airport as a result of discussions with different stakeholders were taken into account within the formulation of the new provisions. The strength of the provisions has increased, as now they are under the form of a law, which has more judicial power than the previous format (Governmental Decision). Notable is the fact that the Noise Law describes which is the responsible authority, which are its obligations, how are these expected to be accomplished (tools, criteria), expected deadlines for implementation and sanctions. This is ensuring that the entire process is transparent, that the information is clear and can support the development of mutual understanding of the role of each stakeholder throughout the process to manage noise.

Air Code

The formulation of the definition of noise protection zones implies a strong connection to noise mapping and to the requirement to impose constraints over LUP around an airport, this being the first step to construct the missing link between Urbanism Plans and airport noise maps.

The Ministry of Environment was appointed as the responsible authority to monitor the implementation of regulations (national and European) related to environmental protection that are applicable for Romanian airports. In addition, it is also within the responsibility of the Ministry to publish a Governmental Decision through which will be published the list of airports required to develop Strategic Noise Maps and Noise Action Plans, together with the criteria to be followed for their development. Another responsibility is the requirement to publish through a Governmental Decision the methodology for noise mapping that allows capturing the impact of current and future airport activities over its surroundings.

Operating restrictions have started to be tackled by outlining the necessity to formulate preliminary provisions in this sense and by appointing the responsible authority (Ministry of Transport) and the means to do this (through a Governmental Decision).

The Air Navigation Service Provider has been appointed as a responsible authority that has to implement measures that limit the environmental impact due to air traffic. The conditions for the applicability of these measures have also been specified in terms of priorities, therefore environmentally friendly solutions can only be implemented if the safety objectives are ensured. **However, the manner in which the ANSP determines when is possible to implement solutions to limit the environmental impact are not formulated. In addition, knowledge at the national level about existing solutions from this category is limited, together with methods to evaluate the intended environmental goals from the implementation of such solutions**.

Airports now have the obligation to use noise mapping as a tool to determine a prediction of the impact that planned infrastructure developments could have over its vicinities. This requirement is applicable within the initiation of programmes related to airport infrastructure expansions and is of great importance, as it allows a preventative approach on noise.

The local public administration authorities, which are the main actors in developing and implementing urbanism strategies, have the obligation to include both Strategic Noise Maps and airport expansion projects (together with results from noise mapping) within the urbanism and land-use planning documentation, therefore a strong link was created to support the definition of sustainable land-use planning in the region. The authorities that have under administration the areas from the vicinity of airports must perform a noise zoning of vicinities in compliance with the methodology for noise mapping published by the Ministry of Environment. This decision has defined the implementation of noise zones around airports in Romania and also ensured the necessary means for implementation. **However, a specified deadline for implementation is not specified and at this moment the methodology is still under development, therefore the legislation for noise zoning is still incomplete**. After noise zones and associated restrictions are defined, they have to be integrated within the urbanism and land-use planning documentation and the policies for the development and land-use planning of the areas from the vicinity of airports must take into account the restrictions associated with the noise protection zones.

LUP provisions are still in an incipient phase in Romania. The future airport planned agenda to be followed is to continue to address gaps (e.g. absence of deadlines for implementation, methodologies to evaluate expected outcomes), to highlight the necessity to define both short-term and long-term LUP goals, to support the definition and implementation of provisions related to the application of preventive and corrective LUP and engage in identifying existing solutions in the case of corrective LUP (e.g. noise insulation) to support their introduction within the scope of the national legislative framework.

D.2.6. Other Relevant Information

The airport is planning to undergo major infrastructure changes, therefore a project is currently on-going as part of the Iasi Airport Integrated Master Plan for development. Two feasibility studies are currently launched, one for developing a feasibility study to expand the movement surfaces and the control tower and to create cargo facilities at the airport and another one for the expansion of passenger terminals and of parking facilities at the airport premises. The main steps progressed in this direction include the following activities, in line with the existing national legislation:

- Submission to the local Environmental Agency of the official request to issue the environmental agreement/ approval for a part of the project *(Feasibility study for the expansion of movement surfaces, control tower and development of cargo facilities)*; the announcement about the submission of the request is available on the airport website and the entire documentation related to the project are available for public consultation on a daily basis at the airport premises and at the Environmental Agency[51]; the same process was followed for another part of the project *(Feasibility study for the expansion of passenger terminals and of parking facilities at the airport premises)*[52];
- The publication of the official response/ communication from the local Environmental Agency related to the approval of the request (environmental agreement) for the *Feasibility study regarding the expansion of movement surfaces, control tower and development of cargo facilities*[53], with the obligation to inform the public about this requirement according to certain guidelines provided by this institution and through publication in local press, by displaying it at the airport headquarters and on the airport website. The requirement was formulated mainly in compliance with the Law for the

[51] IASI AIRPORT WEBSITE, AIRPORT DEVELOPMENT, DOCUMENTS FOR PUBLIC INTEREST, "ANUNT PUBLIC – depunere solicitare emitere acord mediu – Studiu Fezabilitate", https://www.aeroport-iasi.ro:5000/docs/download/Anunt_solicitare_acord_de_mediu_SF2.pdf

[52] IASI AIRPORT WEBSITE, AIRPORT DEVELOPMENT, DOCUMENTS FOR PUBLIC INTEREST, "ANUNT PUBLIC – depunere solicitare emiterer acord mediu – Studiu Fezabilitate", https://www.aeroport-iasi.ro:5000/docs/download/Anunt_solicitare_acord_de_mediu_SF1.pdf

[53] IASI AIRPORT WEBSITE, AIRPORT DEVELOPMENT, DOCUMENTS FOR PUBLIC INTEREST, "ANUNT PUBLIC – ADRESA APM – MASTERPLAN INTEGRAT SI STUDIU FEZABILITATE", July 2021, https://www.aeroport-iasi.ro:5000/docs/download/Adresa_APM_Iasi_Decizie_evaluarea_impactului_RIM.pdf

evaluation of environmental impact of certain public and private projects[54] (July, 2021);

- In response to the aforementioned requirement, the airport published officially an announcement to inform the interested public about the decision of the Environmental Agency to appoint to the airport study the requirement to develop the environmental impact evaluation (*for the feasibility study related to the expansion of movement surfaces, control tower and development of cargo facilities*). The information includes the address of the Environmental Agency and the days and time intervals during which the public could consult all documentation, together with an online address that provides the same information. This is available such that the interested public is able to submit proposals related to future content of the development of the environmental impact report, in 10 days after the publication of the announcement (July, 2021)[55].

The importance of advancing the progress for defining LUP provisions is even more stringent given the fact that the infrastructure expansion project is expected to increase the airport capacity to respond to the increased demand in air travel. In order to be able to benefit from this investment and also from future similar ones in an efficient manner (e.g. economical gains in the region), LUP legislative provisions are needed to be developed as soon as possible and to be focused on capturing such scenarios in a preventative approach towards noise management.

The absence of effective LUP provisions within the national legislative framework has determined the development of a deficient organic phenomenon that hindered airport expansion projects (e.g. limitations, refining the strategy to control noise exposure) as a measure to control the number of people exposed to noise, while the number of residential buildings continued to increase significantly, thus increasing the number of people exposed to noise at the same time. Important to note is the fact that the efforts of many Romanian airports shifted from limitations in infrastructure developments to remain within noise limits towards operational restrictions, but increasing encroachment led to both undesired outcomes in terms of environmental targets (reducing the number of exposed people) and operations, due to the unpredictability of constructions in the area. As a result, the negative economic impact from imposing operating restrictions that have become a short-term noise measure in the context of uncontrolled LUP (leading to limitations in the number operations and of the airport capacity), has switched from a local impact towards becoming a national financial problem, determining many regional airports to be evaluated as loss-making[56]. Consequently, operating losses were covered by public financing on a yearly basis. Iasi Airport, together with many other Romanian airports are in this situation. Therefore, defining LUP provisions at

[54] LEGE nr. 292 din 3 decembrie 2018 privind evaluarea impactului anumitor proiecte publice si private asupra mediului, http://legislatie.just.ro/Public/DetaliiDocumentAfis/208590

[55] IASI AIRPORT WEBSITE, AIRPORT DEVELOPMENT, DOCUMENTS FOR PUBLIC INTEREST, "ANUNT PUBLIC – luarea deciziei etapei de incadrare – Masterplan integrat si Studiu Fezabilitate", July 2021, https://www.aeroport-iasi.ro:5000/docs/download/Anunt_public_luarea_deciziei_etapei_de_incadrare.pdf

[56] EUROPEAN COMMISSION, "COMMISSION DECISION of 27.9.2016 ON STATE AID SA.30931 (2011/C) (ex N 185/2010) for Romanian regional airports", Brussels, 27.9.2016, https://ec.europa.eu/competition/state_aid/cases/240754/240754_1880514_278_3.pdf

a national level became crucial due to the complexity of the undesired outcomes from encroachment.

D.3. Conclusions

This case study aimed to find the opportunities to make the first steps towards defining LUP provisions, goal that was achieved but progress in this sense is still needed to ensure an effective definition, implementation and evaluation of LUP around airports. All stakeholders that were relevant to achieve this goal were identified from the policy level to the implementation level, but engagement is still necessary to ensure the effectiveness of the harmonisation effort initiated through this intervention. The short-term strategy for defining LUP provisions was accomplished through preliminary progress, but the long-term strategy to ensure that the complexity of noise is appropriately addressed, requires the involvement of additional stakeholders (e.g. Ministry of Health).

D.4. Recommendations and Lessons Learnt

Given the fact that the latest forecast (2017-2022) related to aircraft movements was designed before COVID-19 impacted the operations of the airport, it is considered necessary for airports to re-evaluate the noise goals proposed within previous Noise Action Plans in compliance with the actual air traffic levels from this period of time and also in line with proposed forecasts for the next 5, 10 and 15 years. This will allow airports to formulate noise management strategies that take into account all air traffic recovery scenarios and that are also compatible with efforts taken to progress in aligning with European strategic aviation environmental goals up to 2050[57].

Continuous communication and engagement among relevant stakeholders were crucial to obtaining the outcomes of this study, which proved that collaborative efforts could lead to optimised results. The success of the intervention suggests that Airports should act pro-actively in establishing such collaborative stakeholder's environment. ANIMA project offered a solid support for the development of this LUP intervention by supplying BP knowledge, as well as a prestigious foundation for establishing a suitable involvement of the relevant stakeholders.

Developing and implementing LUP provisions has revealed that the complexity of this ICAO BA pillar can be different from one context to another (e.g. from one country to another), requiring a constant adaptation of the strategy to ensure that all stakeholder priorities and capabilities are captured to ensure an efficient future implementation of environmental measures that fosters environmental benefits.

Future research is needed, focused on optimising results from existing provisions by tackling barriers in the implementation in order to highlight areas for potential improvement. Additionally, the existence of collaborative contexts (e.g. projects, task forces) that foster communication between experts, the industry and policy-makers are crucial in developing a mutual understanding of noise management, of

[57] NLR, SEO, "DESTINATION 2050, A ROUTE TO NET ZERO EUROPEAN AVIATION", February 2021, https://www.destination2050.eu/wp-content/uploads/2021/03/Destination2050_Report.pdf

different other environmental issues and of their cumulative impact, as well as in finding appropriate solutions and evaluating their outcomes.

D.5. ANNEX – ROUNDTABLE

INTRODUCTION

As a final action to complete the information from the three case studies on Iasi and Cluj airports (LUP, interdependencies and QoL), a roundtable was organised. The findings from the three case studies were presented and later discussed among participants. Participants included representatives from MMU, INCD-T COMOTI, Cluj Airport, Iasi Airport, ROMATSA Bucharest, ROMATSA Cluj and BLUEAIR.

1. INTERDEPENDENCIES CASE STUDY (COMOTI in partnership with Cluj Airport and BlueAir)

This study was specifically performed for the context of Cluj Airport. Therefore, results are expected to vary in the case of another airport context, due to various factors, such as the real distribution of population and topography. Furthermore, different study outcomes are expected in terms of noise and emissions from one city to another due to the real number of inhabitants and distribution of residential buildings, possibly having differences in the concentration of houses in a district in a city, as well as from the proximity to the airport. These different characteristics of a city/ village, when cumulated, they could further support the development of a more accurate depiction of the communities describing the airport context. At the same time, the Cluj region has a certain topography that influences the superposition of noise maps over the area, therefore one can assume that the study results from one airport context are not necessarily applicable to another airport context (e.g. existence of hills in the Cluj region). Therefore, such studies cannot be generalized to all airports and they need to be tailored according to the local context to obtain appropriate results for each local context. In this sense, it is very important to continue the case study that was started in Cluj to improve the existing model and the results such that they could depict different air traffic scenarios for a more accurate distribution of population, such that this model could support the capacity of airports to be equipped with prediction methodologies/ tools regarding noise, emissions and air quality. At the same time, the development and validation of such resources could further facilitate knowledge transfer to other airports. These actions should further support the investigation of means and solutions through which the current situation can be improved.

It was highlighted that some airports will be interested to reduce their noise exposure, while others will focus more on emissions and air quality. Therefore, the role of interdependencies, apart from understanding the effect of operational procedures, is to aid in implementing specific procedures that focus more on noise or emissions. In this sense, these types of studies are supporting key aviation stakeholders in decision-making processes related to implementing operational procedures favourable towards reducing noise, emissions or both (e.g. CDA).

It is important to keep in mind that interdependencies involve three major actors: the airport, the airline and the ANSP. This acknowledgement is crucial for implementing environmentally friendly operational procedures, taking as an example the NADPs that were studied in this case study. One key asset of this case study was specifically the involvement of the three major actors during the exploration of the idea of interdependencies, since airports are not usually engaged in such changes, even though this is the main actor that is the frontline agent with communities. Although airlines and ANSPs are generally in favour of operations focused on reducing emissions (especially in connection to climate change and costs related to emissions), airports face noise as the biggest challenge and are in a situation far from beneficial due to the unavailability of means to express in terms of needs (since the airport cannot influence operational procedures and, in most cases, it can only act on ground operations). Therefore, the aim of this case study was achieved in an additional manner by supporting the airport to become integrated in a working group that wants to continue with similar studies within future projects in the next 5 years.

The interdependencies case study has made the first steps towards creating a methodology on studying interdependencies in Romania, which can further contribute to the European research agenda. In this respect, the local team that is still under development (airport, ANSP, airline, communities), will focus on such topics to explore and exploit the results of these studies and also to support knowledge-building in the area and facilitate knowledge-transfer to other airports from Europe.

2. QUALITY OF LIFE CASE STUDY (COMOTI in partnership with Cluj Airport, MMU, NLR, ZEUS)

The QoL study was considered to be very important to the airport context. One aspect important to highlight was the fact that, although it was available only in an online format for all surrounding communities, as it was performed during the COVID19 pandemic, a high number of responses were collected (more specifically, 256). The results were analysed by the research team and disseminated with the airport and this was very important because the airport is highly interested in understanding the quality of life of the population from Cluj. In order to be equipped with the necessary means to implement measures in this sense, a local group was developed to further progress on this topic too.

The usefulness of this study is first at the local level and extends towards the European strategy that is citizen centric. Therefore, the continuation and development of this study is desired. If possible, it is considered to be useful the involvement of additional Romanian airports, at least at the level of awareness (e.g. dissemination through regular meetings of the Romanian Association of Airports). In the future, studying QoL could go into investigating certain indicators in a more in-depth manner, from noise to emissions and to impact over climate change, especially since aviation has high targets on reducing emissions in the next years. Such a study could represent a parallel support for defining a methodology related to how to balance noise and emissions over climate change and air quality (with health impact). Therefore, connecting this study with health impact and with a wider QoL study, focused on environmental issues, could be an

opportunity for the key aviation stakeholders in the community (airport, ANSP, airline) to engage with Cluj Municipality to start a methodology at the level of communities and explore wider opportunities together. Such engagement is considered to be very important, since the Cluj Municipality is highly active in different types of studies related to the wellbeing of residents and also in assuming a leadership role at the level of Romania in terms of becoming a smart, clean and green city.

By keeping in mind that airports cannot influence the process of selecting the use of either NADP1 or NADP2 (or others), one additional stakeholder was identified as being able to support throughout this process. In the case of regional airports (in connection to county councils), the Environmental Agency could also contribute within the decision-making process (for the selection of different types of operational procedures) with the provision of a methodology in favour of residents living in communities near airports. This methodology could guide airports and all other relevant stakeholders in implementing ICAO Balanced Approach solutions.

3. LAND-USE PLANNING CASE STUDY (COMOTI in partnership with Iasi Airport)

Starting from the discussion related to the implementation of noise-related operational restrictions, it was acknowledged that the expected future air traffic growth will limit the efficiency of these measures. Therefore, such solutions are only short-term oriented, as they are not applicable to their full extent all the time and they are restricted by different other factors (e.g. meteorological factors, safety etc.). In order to try to be properly equipped with the necessary means to tackle future challenges related to the increase of the noise risk, apart from a noise monitoring system, other actions should be initiated in partnership with Municipalities. It was emphasised that it is desired in the future to have the ability to include the environmental risks (such as aircraft noise) within construction permits, to ensure that the information describing the real context is available to real-estate planners and potential residents in the area and that all risks are properly understood and possibly managed in a preventive manner (e.g. through noise insulation of buildings). Therefore, noise management should be tackled on multiple facets and this could be another solution. This could be seen as a short-term measure before the entire legislation related to land-use planning will change.

In the case of the airline, noise is one of the most pressing issues and the company has developed throughout time many noise policies, which are already implemented in different European airports (e.g. Paris Charles de Gaulle, Barcelona). Even so, the greatest challenge is the fact that managing noise has become a trade-off between noise solutions. More specifically, in spite of the efforts (development of policies, training of personnel, costs) of the company to be proactive in tackling noise for the benefit of communities and for becoming compliant with existing measures to reduce noise (e.g. by using NADPs), noise taxation systems still increase, therefore the expected outcomes in terms of environmental targets and costs are not achieved of intangible and cannot be quantified. Therefore, it is considered that there is a great opportunity in Romania to collaborate with airports and the ANSP towards the development of operational procedures that support the efforts to protect the population, but this opportunity

should progress in parallel with a proactive approach at the level of Romania related to LUP, in order to support and enforce the implementation of environmental management solutions before the complexity of these issues increase.

Noise maps are considered to be very useful tools. The manner in which they are developed is very important, especially when taking into account the existence of noise measurements along the flight path, together with measurements at the airport level and extrapolations towards communities through the use of mathematical models. It is desired in the future to have a comparison between both approaches in order to build a more realistic view about the noise context in communities. In order to correlate noise measurements in the city with the mathematical model, by taking into account the configuration of Cluj-Napoca city, it is considered necessary in the future to perform such measurements in different points to reduce uncertainties in evaluating existing noise and predicting noise (e.g. at the ground level, at the roof level). This should also support in building knowledge about the contribution of the architecture of the city towards noise propagation and therefore to understand how is this influencing the noise perceived by residents.

In terms of future studies in this region, it is necessary for the ANSP, for airlines and for the airport to properly understand how noise produced by air traffic is perceived by residents at the ground level. This is highly important and a need in terms of knowledge to support noise management efficiently, especially in the case in which airlines implement different types of operational procedures for noise abatement and are compliant with noise limits, yet noise is perceived differently by communities. Briefly, a study that comprises noise measurements in different community areas (both at the ground level and at the level of the roofs of buildings) is a necessity at the moment, in order to advance in understanding the real noise exposure context. This should be performed before measures are implemented at the Municipality level (i.e. LUP), in order to support the definition and implementation of appropriate provisions. This need comes directly from constant discussions with residents and communities and from their questions towards the airport and the ANSP and as a result of the unavailability of such complex studies in the region, both stakeholders are unable to be equipped with the necessary knowledge to support actively in improving their life in this communities.

The last point is suggested as complementary to the approach started within Iasi case study, as one main target was the appropriate distribution of responsibilities among all relevant stakeholders. This was followed especially in pursuit of creating a fruitful environment for the application of solutions for noise management and avoid situations similar to airlines implementing noise reduction operational procedures (in the air) and still get fined for noise (exposure and impact at the ground level). At the same time, compliance with noise operational procedures might have a penalty on emissions, leading to an increase in fuel consumption and additional costs too. Therefore, the approach should divide responsibilities among all participants and beneficiaries of air transport, from the citizen that travels (with a medium to higher income), the community that has economic benefits from

being situated in the vicinity of the airport, the airport, local administrations and so on.

Distributing responsibilities was key within this case study for pursuing an improvement related to aviation noise management. The case study was useful for identifying certain legislative gaps, for example the necessity for changes within authorisations for constructions to include provisions related to the environmental context. In this sense, legislative changes have been encompassed within the legislation, but have not been detailed yet in a methodologic manner such that they could be implemented, to have a clear situation about who is responsible with the evaluation of compliance with provisions, who imposes the obligations to the local administration/ terrain owners regarding the nature of constructions, for the land from the vicinity of airports.

4. OPEN DISCUSSION. OUTCOMES AND FUTURE PROGRESS BEYOND ANIMA PROJECT

At the level of Cluj Airport, a team of experts on environmental issues was formed. At the airport level, it includes experts from the environmental management office, from the operational office (responsible for noise monitoring and communication with the ANSP). The external level includes representatives from airlines, the ANSP and representatives of surrounding communities. The main focus of this working group is currently on an operational procedure that was developed by the airport with the ANSP. This action is strongly connected to improving the manner in which noise is managed, with a focus on aircraft that overfly the Cluj-Napoca city during the night time (23:00-07:00). Further, the team aims to explore all existing options to improve communication and engagement with communities in pursuit of designing and implementing environmentally friendly and sustainable solutions that protect the residents in the vicinity of the airport, while allowing a harmonised development of airport operations.

In general, most airport efforts are focused on dealing with environmental issues, mainly focusing on reducing the exposure and impact effects over residents. Therefore, this goal is mainly going to be monitored in relation to the number of noise complaints, aiming to reach and maintain noise targets and ensure compliance with legislative provisions as a first step. This approach is formulated as a result of recent legislative changes and proposed to be accomplished with a parallel communication and engagement campaign with communities. Therefore, the airport is always in contact with residents. Future progress for improving this relationship will possibly include constant updates on the website of the airport, information that could also be relevant to other interested parties, outside communities from its vicinity.

Previous relevant airport efforts include the development of a study related to the health of the population and also the deployment of a continuous noise monitoring campaign, that is currently only at the airport level.

Notable to mention is also the infrastructure development plan (medium and long-term) that was tailored based on environmental targets. Currently, the runway extension project is ongoing, aiming to support indirectly the reduction of noise (e.g. through ensuring a longer surface that allows different take-off and landing

points, therefore influences the height at which aircraft overfly communities). Another important on-going project is the construction of a taxiway that facilitates the fast movement of aircraft at the ground level, therefore supporting indirectly reductions in noise and emissions due to the shorter distance for aircraft to move on the ground and to the reduction in fuel consumption. On the medium and long-term, the development of a stationary platform is planned, which is going to be placed near the Apahida village, which is in the opposite side of the Cluj-Napoca city. Other future plans include the development of a cargo terminal and also the active engagement in future European projects tackling environmental issues (reducing noise, improving QoL).

At the level of Iasi Airport, the approach that started on supporting the definition and implementation of LUP provisions within the national legislative context is desired to be continued up to reaching its outcomes. More specifically, this means that the moment when the implementation of air traffic noise restrictions for the construction of residential buildings/ schools/ hospitals will occur within Urbanisation Plans, then the legislation could be evaluated if it has achieved its outcomes. This should further secure the wellbeing of the population in the region and support airports and air transport on the long-term. In order to achieve this, the support of all key aviation actors from Romania will be needed and the airport is open to future collaborations in this sense.

CONCLUSIONS

The most important premise for developing the three case studies was to develop knowledge mainly for airports in understanding how to protect residents around airports from the existing and future noise context, followed by some investigation around other environmental factors and QoL implications. Although progress was made through this research, future needs still include the active engagement of all relevant stakeholder in how to balance properly airport, ANSP and airline efforts for reducing/ mitigating these issues in a context of high expected air traffic growth and uncoordinated increase in residential areas.

E. Case Study Cluj - Interdependencies

E.1. Overview of Airport Context

E.1.1. Focus and Intent

This case study aimed to understand the role of interdependencies within an airport context through the use of airline data analysis. The main objective of airline data analysis was to investigate if the initial purpose of using specific operational procedures will be confirmed by the results of this study. Research outcomes from this airline data analysis were formulated to complete the previous ANIMA findings from Catania Case Study, in which a similar analysis was performed through the use of airport data.

E.1.2. Background Information

General Information about the airport

The airport "Aeroportul Internaţional Avram Iancu Cluj" is administered by a private organisation and is located 9 km East from Cluj-Napoca city. The elevation of the airport is of 1039 FT, having a reference temperature of 26.3o C. The types of traffic permitted are both IFR and VFR, helicopter flights being also permitted.

Airport location

Classified as a component of the North-Western Macroregion in Romania, the Cluj region is mentioned within the last statistical issue regarding the population within Romanian localities (2016) with an emphasis on Cluj-Napoca city being the fourth biggest city in Romania based on the number of people with city residence (321 687 residents). This increases the importance of the airport from different points of view (e.g. strategic, economic, mobility), as its location is within the limits of this city . On a larger scale, Cluj County has approximately 700 000 inhabitants, making possible a comparation between Cluj Airport with other European city airports such as Geneva or Stuttgart that register annual traffic of 9 to 12 million passengers. Important to mention is also that the Transylvania region counts for about 7 million inhabitants (over 35% of the population of Romania), and therefore to emphasise the strategic importance of the airport, being the main airport in this region and the first regional airport in Romania.

Air traffic information

At the level of Romania, there are significant differences between the air traffic before and after the pandemic. The situation from the 1st of January, 2021 can be observed in the figure below.

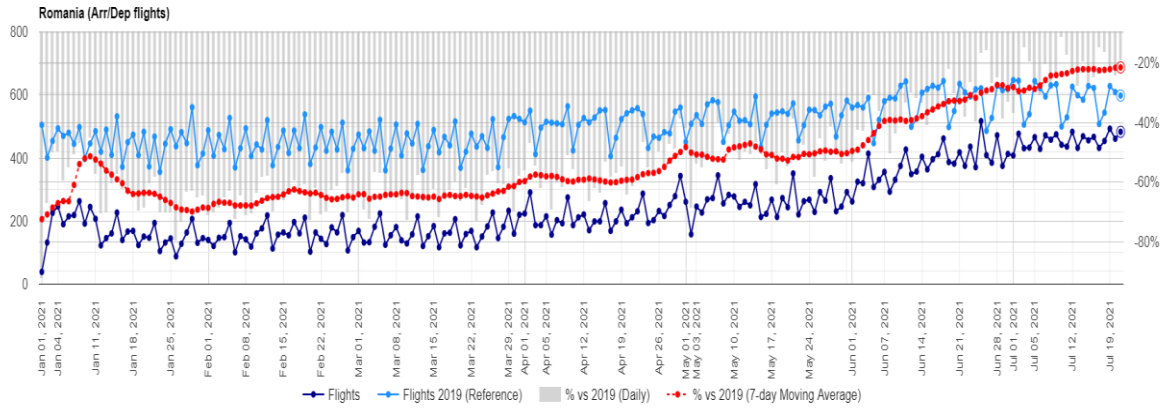


Figure 1. Romania (Arr/Dep flights) [58].

Within the summary of forecast IFR movements per traffic zone, it can be observed that for Romania the traffic was listed and predicted as it follows (thousands): 598 (2014), 635 (2015), 621 (2016), 673 (2017), 738 (2018), 747 (2019), 306-308 (2020), 343-496 (2021), 410-628 (2022), 479-693 (2023), 540-750 (2024). This shows an air traffic growth of 4.5% (2015-2019 compared to 2014) before the pandemic and an evolution within the interval from -6.3% to 0.1% (2020-2024 compared to 2019). At the level of forecast IFR movement growth per traffic zone, the data for Romania is the following: 17% (2014), 6.1% (2015), -2.2% (2016), 8.5% (2017), 9.6% (2018), 1.2% (2019), -59% (2020), 12%-61% (2021), 20%-47% (2022), 10%-17% (2023), 8.3%-14% (2024)[59]. These figures can show the high air traffic growth situation within Romania before 2019, during the pandemic, but also the range of possibilities for recovery in the period 2020-2024. Although the expectations at the European level is to reach in 2024 a traffic level similar to 2019, the situation is still uncertain due to the influence of various factors (e.g. strength of worldwide future waves of COVID-19, strength and timing of public health restrictions and social distancing, availability 'and uptake' of vaccine, global economy impact, state aid differences, bankruptcy risks in the aviation industry, reductions in air traffic demand) and was formulated on 3 possible scenarios, as it can be observed in the figure below.

[58] EUROCONTROL, Daily Traffic Variation – States, https://www.eurocontrol.int/Economics/DailyTrafficVariation-States.html

[59] EUROCONTROL STATFOR, EUROCONTROL 5-Year Forecast 2020-2024, Detailed Forecasts, Traffic table detailed forecasts, November 2020, https://www.eurocontrol.int/publication/eurocontrol-five-year-forecast-2020-2024

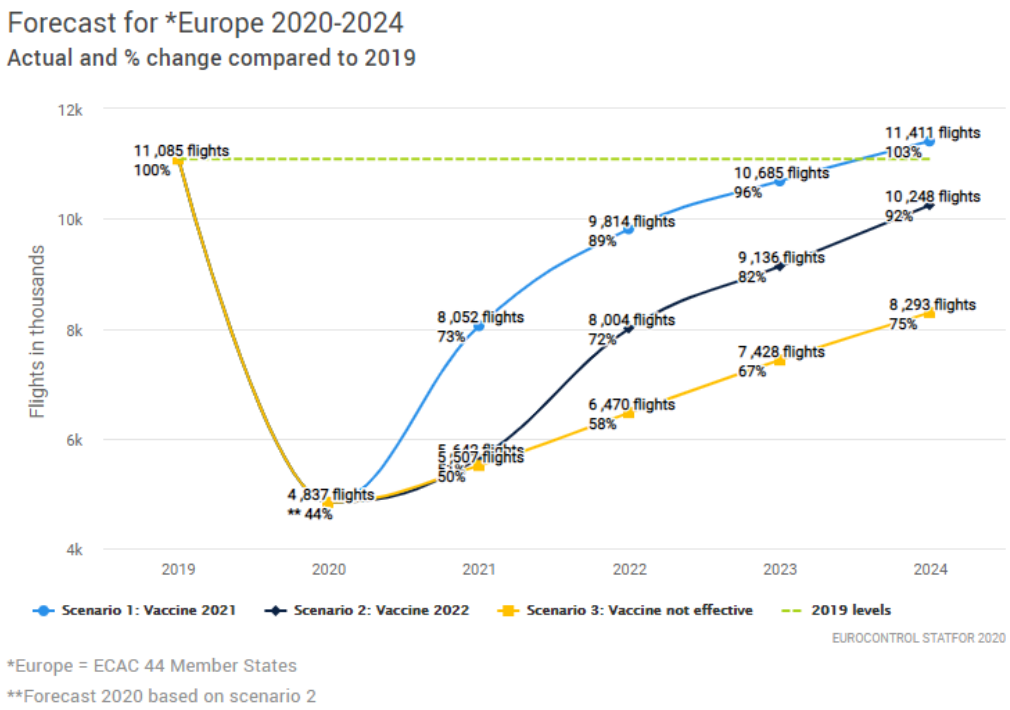


Figure 2. Forecast for Europe 2020-2024.

Noteworthy is that scenario 1 assumes a recovery to 2019 levels in 2024, while scenarios 2 and 3 assume similar levels in 2026, respectively in 2029. Additional risks also include Brexit, future airspace and network changes, changes in route preferences by airlines and also economic recovery.[60]

The current global situation led to uncertainties regarding air traffic growth predictions for the next 10 years, therefore the perspective at the local level is still uncertain, but estimated according to the figure below which shows a tendency to become again a fast-growing airport, as it was the case before the pandemic.

[60] EUROCONTROL STATFOR, EUROCONTROL 5-Year Forecast Europe 2020-2024, European Flight Movements and Service Units, Three Scenarios for Recovery from COVID-19, November 2020, https://www.eurocontrol.int/publication/eurocontrol-five-year-forecast-2020-2024

Figure 3a. Passenger traffic growth (1996-2019) on Cluj Avram Iancu International Airport.

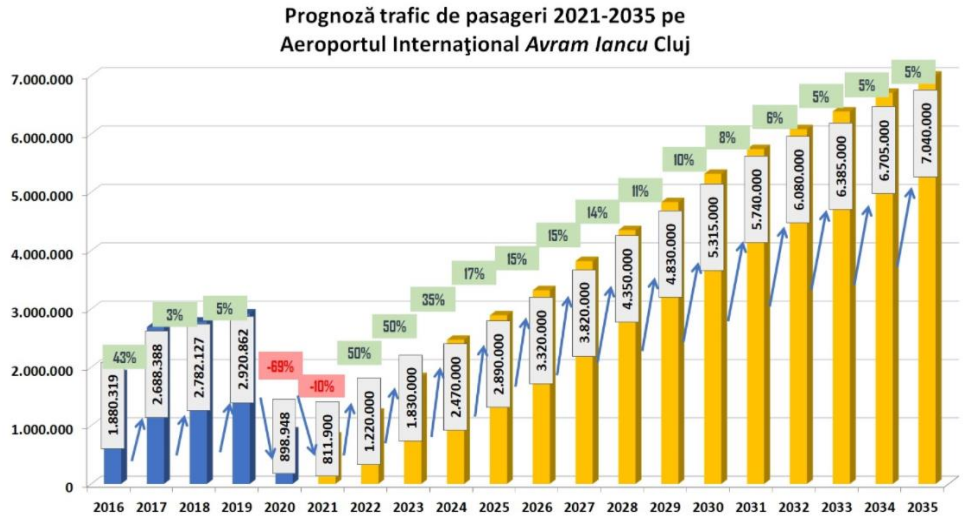


Figure 3b. Passenger traffic forecast 2021-2035 on Cluj Avram Iancu International Airport[61].

Specific information related to the airport

[61] CLUJ AIRPORT, Passenger traffic forecast 2021-2035, https://airportcluj.ro/despreaeroport/trafic/

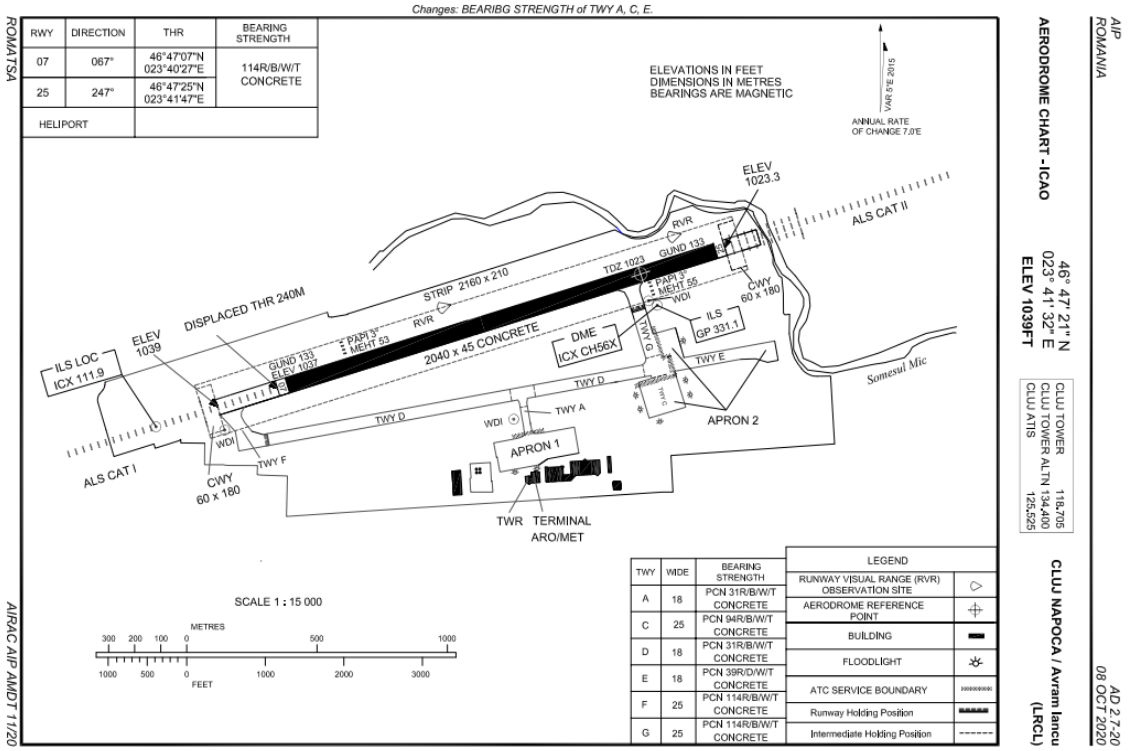


Figure 4. Aerodrome Chart[62].

The airport has one runway in operation (RWY 07/25), made of concrete and with the dimensions of 2040m x 45m. In terms of infrastructure, new passenger terminals and a new runway were inaugurated between 2008-2009, respectively 2013, together with new taxiways and aircraft aprons, most recently being built in 2017 and 2018. Direct connections include 42 international scheduled destinations to 19 countries (Europe, Middle East) and 12 charter flights (popular travel destinations). Notable changes include the fact that the airport management has required handling companies to have electric equipment, the airport replaced the existing illumination system from the airport area (airport infrastructure and buildings) with LED technologies.

Other relevant information for the topic of this case study

At the level of 2019, within the Local Single Sky Implementation overview of Romania, it is specified than RNP APCH procedures were approved and published for Cluj Airport (NAV10). In addition, CCO (Continuous Climb Operations) implementation was still an on-going process at the airport (70% implementation level), with RNAV-1 (DME/DME) SIDs being implemented in NAPOC TMA for LRCL since November 2016 (ENV03). The SID routes were developed based on CCO principles are were developed in co-ordination with Romanian aircraft operators[63].

[62] AIP ROMANIA, AD2.7-20, 08 OCT 2020, CLUJ NAPOCA / Avram Iancu (LRCL), https://www.aisro.ro/

[63] EUROCONTROL, LSSIP 2019 https://www.eurocontrol.int/sites/default/files/2020-06/eurocontrol-lssip-2019-romania-level1.pdf

In 2020, Cluj-Napoca was one of the finalist twelve cities within the "European Capital of Innovation 2020" contest[64] and is also one of the members of "The Mayors Alliance for the European Green Deal" and subsequently of EUROCITIES[65], a network of more than 200 cities in 38 countries working together on ensuring a good quality of life for people. Cluj Airport is one of the ACI Europe members, currently preparing for carbon accreditation (Airport Carbon Accreditation programme, Level 1)[66]. Also, the airport has signed an agreement to monitor noise in the airport area. Cluj Airport has always focused on developing a strong connection with the surrounding communities in order to increase the gains of the region as a direct result from their operations. For example, they are actively engaged with the Cluj-Napoca city and the figure below depicts the interconnection in terms of economic impact.

Figure 5. Economic impact of Cluj Airport.

E.1.3. Legislative and Regulatory Framework

General information

The most important legislative acts regarding environmental protection, which are applicable for the Civil Aviation sector in Romania, are listed below[67].

Table 1. European legislation.

Short designation	Title

[64] EUROPEAN COMMISSION, "European Capital of Innovation 2020: 12 cities make it into the final round", https://ec.europa.eu/info/news/european-capital-innovation-2020-12-cities-make-it-final-round-2020-aug-05_en

[65] EUROCITIES, https://eurocities.eu/cities/cluj-napoca/

[66] AIRPORTS COUNCIL INTERNATIONAL, ACI EUROPE, "ACI EUROPE MEMBERS LIST", 23 APRIL 2021, https://www.aci-europe.org/downloads/members/2021-04-23%20ACI%20EUROPE%20LIST%20OF%20MEMBERS.pdf

[67] ROMANIAN CIVIL AVIATION AUTHORITY, ENVIRONMENTAL LEGISLATION, https://www.caa.ro/ro/pages/legislatie-mediu

Council Decision (EU) 2020/954 of 25 June 2020[68]	Council Decision (EU) 2020/954 of 25 June 2020 on the position to be taken on behalf of the European Union within the International Civil Aviation Organization as regards the notification of voluntary participation in the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) from 1 January 2021 and the option selected for calculating aeroplane operators' offsetting requirements during the 2021-2023 period
Council Decision (EU) 2020/768 of 9 June 2020[69]	Council Decision (EU) 2020/768 of 9 June 2020 amending Decision (EU) 2016/915 as regards the reference period intended to be used for measuring the growth of CO2 emissions, to take account of the consequences of the COVID-19 pandemic in the context of CORSIA
Council Decision (EU) 2018/2027 of 29 November 2018[70]	Council Decision (EU) 2018/2027 of 29 November 2018 on the position to be taken on behalf of the European Union within the International Civil Aviation Organization in respect of the First Edition of the International Standards and Recommended Practices on Environmental Protection — Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA)
Council Decision (EU) 2016/915 of 30 May 2016[71]	Council Decision (EU) 2016/915 of 30 May 2016 on the position to be taken on behalf of the European Union with regard to the international instrument to be drawn up within the ICAO bodies and intended to lead to the implementation from 2020 of a single global market-based measure for international aviation emissions
Regulation (EU) No 598/2014 of the European Parliament and of the Council of 16 April 2014[72]	Regulation (EU) No 598/2014 of the European Parliament and of the Council of 16 April 2014 on the establishment of rules and procedures with regard to the introduction of noise-related operating restrictions at Union airports within a Balanced Approach and repealing Directive 2002/30/EC

[68] Council Decision (EU) 2020/954 of 25 June 2020, https://eur-lex.europa.eu/eli/dec/2020/954/oj
[69] Council Decision (EU) 2020/768 of 9 June 2020, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32020D0768&qid=1626952157435
[70] Council Decision (EU) 2018/2027 of 29 November 2018, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32018D2027&qid=1626952227880
[71] Council Decision (EU) 2016/915 of 30 May 2016, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32016D0915&qid=1626952303886
[72] Regulation (EU) No 598/2014 of the European Parliament and of the Council of 16 April 2014, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32014R0598&qid=1626952446021

Table 2. National legislation.

Short designation	Specifications
OMT nr. 1.043/16.07.2019[73]	Related to the implementation of Regulation (EU) No 598/2014
Legea nr. 121/03.07.2019[74]	Noise law (evaluation and management of ambient noise)
Ordin comun MTI & MMP nr. 169/1.801/11.03.2011 (consolidat)[75]	The approval of the National action plan regarding the reduction of greenhouse gas emissions within civil aviation (2011-2020)
RACR-PM "Protecția mediului"(consolidată)[76]	Romanian Regulation regarding environmental protection
HG nr. 1.074/05.09.2007[77]	Civil aircraft operations restrictions (Part 2, Cap. 3, Vol. I, Annex 16, ICAO)
HG nr. 780/14.06.2006 (consolidată)[78]	Establishing the trading scheme for certificates for greenhouse gas emissions
Legea nr. 86/10.05.2000 (consolidată)[79]	Access to information, public participation in decision-making and access to justice in environmental issues
Ghidul autorităților publice[80]	The Guide of public authorities for the access of information related to the environment

Other available acts include a procedure regarding issuing permits for the temporary use of a certain type of subsonic civil aircraft[81] and a circular with a guide regarding safety criteria applicable for the introduction of noise abatement operational measures around airports (2016)[82].

[73] OMT nr. 1.043/16.07.2019, http://legislatie.just.ro/Public/DetaliiDocument/216711
[74] Legea nr. 121/03.07.2019, http://legislatie.just.ro/Public/DetaliiDocument/216510
[75] Ordin comun MTI & MMP nr. 169/1.801/11.03.2011 (consolidat), http://legislatie.just.ro/Public/DetaliiDocument/130479
[76] RACR-PM "Protecția mediului"(consolidată), http://legislatie.just.ro/Public/DetaliiDocumentAfis/184764
[77] HG nr. 1.074/05.09.2007, http://legislatie.just.ro/Public/DetaliiDocument/85426
[78] HG nr. 780/14.06.2006 (consolidată), http://legislatie.just.ro/Public/DetaliiDocument/72971
[79] Legea nr. 86/10.05.2000 (consolidată), http://legislatie.just.ro/Public/DetaliiDocument/22438
[80] Ghidul autorităților publice, https://www.caa.ro/uploads/pages/Ghidul%20autorit%C4%83%C8%9Bilor%20publice%20pt.%20accesul%20publicului%20la%20informa%C8%9Bia%20de%20mediu%202020.pdf
[81] RACR DECISION, https://www.caa.ro/AACR/Mediu/Legislatie%20mediu/PIAC-PM-EATU_editia_02_din_nov._2013.pdf
[82] RACR CIRCULAR, Ghid privind cerinte de siguranta aplicabile la introducerea unor masuri operationale pentru reducerea zgomotului in preajma aeroporturilor, https://www.caa.ro/AACR/Mediu/Legislatie%20mediu/CA-PM-PORZ1.pdf

Notable is that the Environmental Noise Directive[83] was transposed within the national legislative framework since 2005[84]. Since 2019, a new noise law was used to replace the previous transposition, having more clarifications regarding responsible authorities for managing noise and various other updates[85]. Therefore, Strategic Noise Maps and Action Plans are mandatory for major airports, but also for several other airports in spite of having less than 50 000 movements/ year. Cluj Airport is one of the airports that is bound under these criteria. Various other existing legislative acts on noise management are not applicable yet for Cluj Airport. Noise Abatement Departure Procedures are mandatory on Cluj Airport, on RWY25. Specifically, NADP1 is mandatory and NADP2 is recommended[86].

Responsible Authorities

The responsible authority for managing environmental issues in Romania is the Ministry of Environment. Its structure is formulated on three institutions, having different roles: the Ministry (legislative power), the Environmental Agency (issuing approvals in compliance with the law) and the Environmental Guard (checking compliance with the law and issuing fines for non-compliance). Although the airport is under the administration of a private organisation, it is owned by the state and under the control of the Regional Council of Cluj.

Airport policies for environmental protection

Apart from the national legislative requirements, the airport is dedicated to being compliant with both European and international regulations regarding environmental protection and preventive solutions. Currently, their focus is around the prevention and limitation of the environmental impact from air traffic and airport operations, through noise level evaluation and monitoring, adopting measures to reduce noise pollution, minimising emissions (air, water and soil pollutants), reducing the energy consumption and the consumption of natural resources, preventing risks regarding environmental contaminants (e.g. de-icing fluids, aircraft fuel, oils) and appropriate management of waste.

The implementation of environmental policies is of high importance at all levels, through the communication of results obtained from the implementation of different environmental protection measures, as well as through the active engagement and motivation of employees to increase awareness regarding the impact of their activities on the surrounding environment and to support their involvement in environmental protection actions. In addition, as part of the internal policy strategy for managing environmental issues, continuous dialogue with responsible authorities and citizens is specified as important for the exchange of

[83] DIRECTIVE 2002/49/EC of the European Parliament and of the Council of 25 June 2002 relating to the assessment and management of environmental noise – Declaration by the Commission in the Conciliation Committee on the Directive relating to the assessment and management of environmental noise, https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02002L0049-20200325&from=EN

[84] HOTARARE nr. 321 din 14 aprilie 2005 privind evaluarea si gestionarea zgomotului ambient, http://legislatie.just.ro/Public/DetaliiDocument/61215

[85] LEGE nr. 121 din 3 iulie 2019 privind evaluarea si gestionarea zgomotului ambient, http://legislatie.just.ro/Public/DetaliiDocument/216510

[86] AIP ROMANIA, AD 1.1-3 08 NOV 2018, 6.1 Noise abatement departure procedures, https://www.aisro.ro/

information, ensuring specific compliance with standards and adopting a proactive attitude to ensure environmental protection[87].

E.2. Case Study

E.2.1. Motivation and Problem Statement

Cluj Airport is a rapidly growing airport, that can be classified as a 'Starting the Journey' airport according to previous ANIMA classifications[88] in terms of experience in noise management. Its interests are focused on further development opportunities as an intermodal transport hub (rail and road), especially for cargo. Their aim is to become a Carbon Accredited Airport and address openly concerns related to noise, emissions and air quality, while fostering good relations with neighbouring communities. This study co-exists with a QoL study performed also at Cluj Airport. The main problem addressed by this study is that environmental issues are always in a trade-off relation during operational procedures. Consequently, the implementation of individual and specific operations for reducing noise while disregarding emissions (and vice-versa) might result in undesired and inefficient outcomes.

E.2.2. Objectives

The main objective of this intervention was to investigate whether and the manner in which the implementation of knowledge related to interdependencies (noise and emissions) can contribute to the environmental impact reduction at Cluj International Airport, thus facilitate discovering possibilities to identify efficient noise and emissions trade-offs in the future. Outcomes from this study are expected to provide insightful knowledge for the future definition of a locally tailored methodology to identify opportunities to reduce both noise and emissions. Objectives include the increase in understanding of the criteria to evaluate environmental outcomes from current operations, the assessment of differences in terms of environmental footprint resulted from intended and real assumptions during decision-making (e.g. preferences in operations), the identification of possible options to define criteria for assessing the environmental outcomes of different operational procedures, the identification of other opportunities to understand and investigate interdependencies and the delivery of guidance for other stakeholders to understand and address this topic.

E.2.3. Intervention Design

The decisions related to reducing the environmental impact at airports are often connected to noise and emissions and based on changes in operations. Such decisions are commonly made on the basis of a wide range of strategic, economic, operational and impact-related information. This study was designed to complement these efforts and support the airport in avoiding, where possible,

[87] AEROPORT CLUJ, Protejarea mediului inconjurator, https://airportcluj.ro/calitmediu/protmed/

[88] Heyes G., Dimitriu D., Hooper P., ANIMA D2.1 – Pan-European overview of Existing Knowledge and Implementation of Noise Reduction Strategies, July 2018, https://zenodo.org/record/2599726#.YPlfX-gza5g

unintended consequences and inform on possible outcomes associated with changes in operations. In response to the main objective of the study, this intervention was focused on performing an analysis on noise and emissions from the use of NADP1 and NADP2 ICAO Noise Abatement Procedures. Performing such a study was of interest to both the airline and the airport, representing some first steps in developing a principled approach to the mitigation of environmental issues through a collaborative approach with key stakeholders. Therefore, this intervention was focused on identifying existing benefits and opportunities that have not been captured yet, to understand where the challenges are and how to balance them, rather than evaluating or developing new procedures. Therefore, the final approach was formulated around finding possibilities to assess opportunities to reduce both noise and emissions, with minimum effort and associated cost.

Methodology

Aiming to understand and investigate the differences between the intended purpose of a procedure and their real outcome (in relation to the environmental effect), this study was formulated around developing an understanding and identifying the relation between noise and emissions at Cluj Airport, identifying the needs and opportunities for further research about interdependencies, identifying opportunities for defining criteria to define effective changes in operations, completing existing knowledge related to environmental management practices at Cluj Airport and delivering useful information in light of the perspective of CEM (Collaborative Environmental Management), as well as learning for the ANIMA Noise Platform.

The study started with discussions with the airport regarding their most stringent needs in dealing with environmental issues in order to define appropriately the intervention, such that it complements existing efforts and brings added value to available knowledge. After understanding the context, needs and requirements of the airport in terms of environmental management, from both discussions with the airport and from previous ANIMA findings (D2.5), the intervention was outlined accordingly, being tailored on interdependencies also with the support of information available in previous case studies in ANIMA. The approach was planned in consultation with the airport and through desk research on existing requirements at the national level in this sense and the intervention was implemented with the support of the airport and the airline throughout the process, by providing the necessary data for the study, as well as for refining the approach such that it responds to their needs (e.g. focus on the region with most flights). The air traffic data was collected from the airline after establishing the period of time for which they will be recorded, the necessary input data (e.g. aircraft type, engine type, time of departure, runway of departure, type of procedure in use), together with a jointly defined list of parameters that the airport monitored and provided (e.g. general data, meteorological data, delays). After all data sets were provided by the airport and the airline, they were used as input into dedicated software tools and used for calculations for evaluating noise, emissions and air quality. Results were shared with the airport and the airline and refined according to their recommendations throughout the study.

The efficacy of the approach was established to be assessed in terms of the extent to which agreed outcomes were achieved and of the potential importance of the results for stakeholders in influencing future decisions and actions (e.g. the capacity to negotiate consensus outcomes). This was performed through continuous communication and discussions with the airport and the airline, throughout the development of this study, in order to capture the extent to which outcomes were understood, accepted and can be of use for future developments. In this sense, the alignment with stakeholder expectations and priorities was key, in pursuit of developing the potential to unfetter airports from noise and other environmental constraints through understanding possible approaches to reduce the exposure of residents around the airport to different environmental issues and thus, simultaneously improve their quality of life.

After identifying the existing operational procedures on Cluj Airport, NADP1 and NADP2 were documented from the existing legislative requirements. The AIP (Aeronautical Information Publication) requirements stated that for certain aerodromes and RWYs, NADP1 must be applied for all take-offs, having the aim to avoid excessive noise over sensitive areas, i.e. populated areas that are situated under and adjacent to the take-off flight path. Within the list of airports, Cluj Airport is included and NADP1 is specified to be applicable on RWY25. This specification also determined the focus of this intervention on RWY25. For all other airports (not included in the list) and other runways from all airports (not covered under the NADP1 mandatory requirement), it is only recommended to routinely implement either NADP1 or NADP2 for take-offs.

The specifications for NADP1 state that the noise abatement procedure "is not to be initiated at less than 800 ft (240 m)"[89] above the elevation of the aerodrome, which is 1039 ft. The initial climbing speed towards the initiation point of noise abatement is instructed to be greater than V_2+10 kt (20 km/h). At or after reaching the altitude of 800 ft (above aerodrome elevation), it is required to adjust and maintain the engine power/ thrust in line with the noise abatement power/ thrust schedule that is provided within the operating manual of the aircraft. Further, it is instructed to maintain a specified climbing speed, i.e. V_2+10 to 20 kt (20 to 40 km/h), with the requirement to have flaps and slats in the take-off configuration. Next, before reaching 3000 ft (above aerodrome elevation), it is required to accelerate and retract flaps/ slats on schedule, while maintaining a positive rate of climb and when reaching this altitude to accelerate to en-route climb speed.

The specifications for NADP2 start from requiring that the noise abatement procedure must start above 800 ft (above aerodrome elevation). The initial climbing speed towards the initiation of noise abatement is V_2+10 to 20 kt (20 to 40 km/h). At or after reaching the altitude of 800 ft (above aerodrome elevation), the aircraft body angle/ angle of pitch must be decreased while maintaining a positive rate of climb, then accelerate towards V_{ZF} and perform one of two instructions: either reduce power with the initiation of the first flaps/ slats retraction, either reduce power after flaps/ slats retraction. Further, it is instructed to maintain a positive rate of climb and also accelerate to (and maintain) a specified climb speed, i.e. V_{ZF}+10 to 20 kt to 3000 ft (above aerodrome elevation).

[89] AIP ROMANIA, AD1.1-3, 08 NOV 2018, https://www.aisro.ro/

Similarly, on 3000 ft (above aerodrome elevation), it is instructed to transition to normal en-route climb speed.

Although the existence of the mandatory requirement to implement NADP1 and the recommendation to implement NADP2 were formulated by the AIP and later implemented, an understanding of the trade-off between noise and emissions was missing. Therefore, the current study aimed to complete this knowledge gap with the identification of possible links between noise, air quality and emissions in order to further support the understanding process regarding existing challenges in this sense and how to balance them.

One of the first steps of this study was the identification of airlines operating on Cluj Airport, that have already implemented NADP procedures. This led to the selection of one airline study partner, which provided airline data that was further used for the development of noise, emissions and air quality analyses.

The airline engaged within this study has various regular flights across European airports (information gathered before COVID-19 pandemic), Cluj Airport included. According to the airline, NADPs have been implemented first on a voluntary basis, as part of their aim to reduce the noise exposure of residents living in communities around the airport. In this sense, both NADP1 and NADP2 have been used. Through the use of different types of procedures, it was already known and observed by the airline that the fuel consumption was different from the use of NADP1 to the use of NADP2. However, an assessment of the difference in terms of emissions/ air quality and real noise variation was never performed, which defined the need for this study.

The agreed parameter list to be provided was determined in consultation with the airline. Given the fact that additional data was necessary, existing FDR (Flight Data Recorder) data could not provide additional data necessary for the study and therefore a specific data collection process was established in this sense and re-evaluated with the airline, especially during a period of time when the airline had no operation at Cluj Airport as a result of COVID-19 restrictions. The time period of collection was highly influenced by the availability of air traffic operations in the pandemic context. Therefore, two data sets were delivered (February 2020 and July 2020). The data sets were formed of departure and arrival data for both runways (07/25), performed by the same type of aircraft, having the same type of engine. The MTOW was taken as a constant of approx. 78 tonnes. Some of the parameters that were used from this data include: aircraft type, engine type, time interval in seconds between X and Y coordinates and FL, LAT, LONG, fuel consumption. An initial representation of data can be observed in the figure below.

Figure 6. Flight path data delivered by the airline.

Even though the airline was implementing NADP1, the intention to also implement NADP2 on several airports has started from the assumption that NADP2 will have a smaller fuel consumption (than NADP1), starting from the hypothesis of the "clean wing" configuration that implies a decrease in drag. In addition, the more rapid transition towards climbing in a "clean configuration" is assumed to decrease the necessary time to reach an optimum cruise altitude. The use of both procedures is done on a preferential basis according to the available legislations applicable at the airport/ country of operation. When the option of using either NADP1 or NADP2 is available, NADP2 is preferred on the assumption of reducing both noise and emissions. During the period of time for this intervention, the main applicable regulation regarding operations was to ensure safety, thus giving the opportunity to assess both procedures.

E.2.4. Implementation Processes

For performing this intervention, an objective analysis based on calculations and simulations was used, having as main input airline data, airport data and AIP information.

The software model was designed starting from the development of a GIS map that includes the airport, its runway and a uniform population distribution in the area (due to unavailable precise data). Further, AIP flight tracks were also defined. The airline data was analysed, performing certain transformations (e.g. related to time conversion, units of measurements) and only few data sets (certain flights) were selected for a preliminary analysis. One take-off and one approach for each runway were selected and analysed in order to establish a reference for comparison. The process continued with preliminary iterations with respect to noise and the emission model. The final data set was reduced to the use of ten NADP procedures (on RWY25) and the final model was later refined by adding meteorological data received from the airport. This data set can be seen in the figure below (on the left), together with a superimposed representation of NADP1 (blue) and NADP2 (red) on the right side.

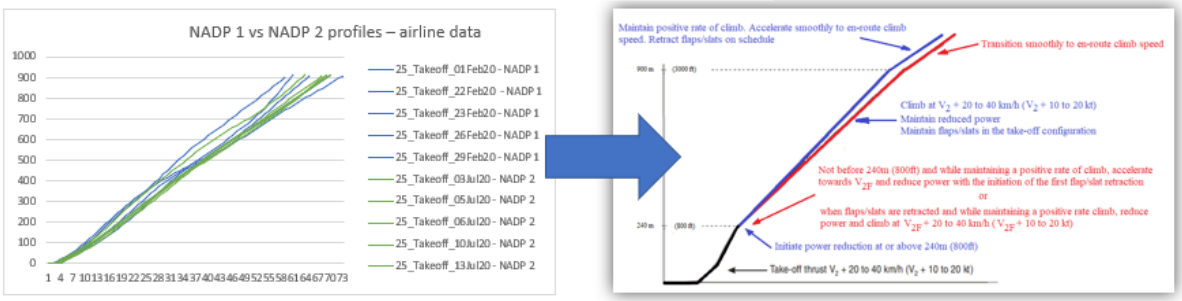


Figure 7. Airline data processing.

Noise contours were computed through the use of the L_{day} indicator, for a 12 hours interval and through the use of five NADP1 and five NADP2 procedures. Furthermore, an analysis related to the number of people exposed to different levels of noise was performed.

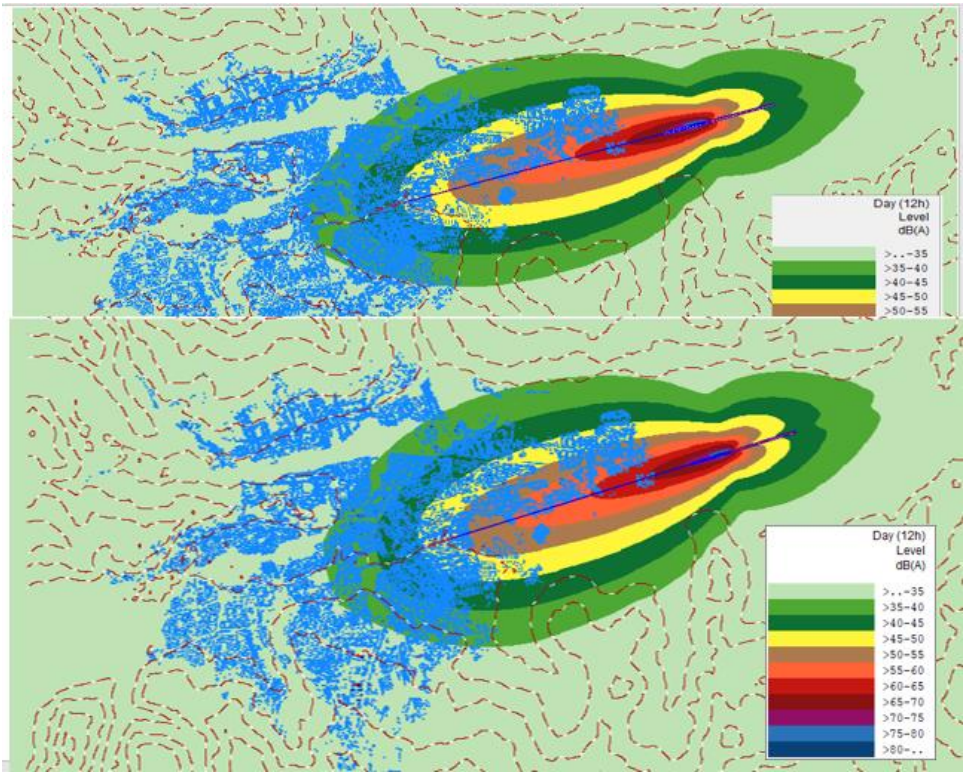


Figure 8. Noise contours.

The two maps show the noise contours for the use of five NADP1 procedures in an interval of 12 hours (top) and the use of five NADP2 procedures in an interval of 12 hours (bottom). In the case of noise contours, there are no major differences from the use of one procedure or another. Therefore, the analysis was furthered into more details through an investigation of the number of people exposed to certain levels of noise. The representation that can be seen below depicts the number of people exposed to noise levels, as defined by the noise contours.

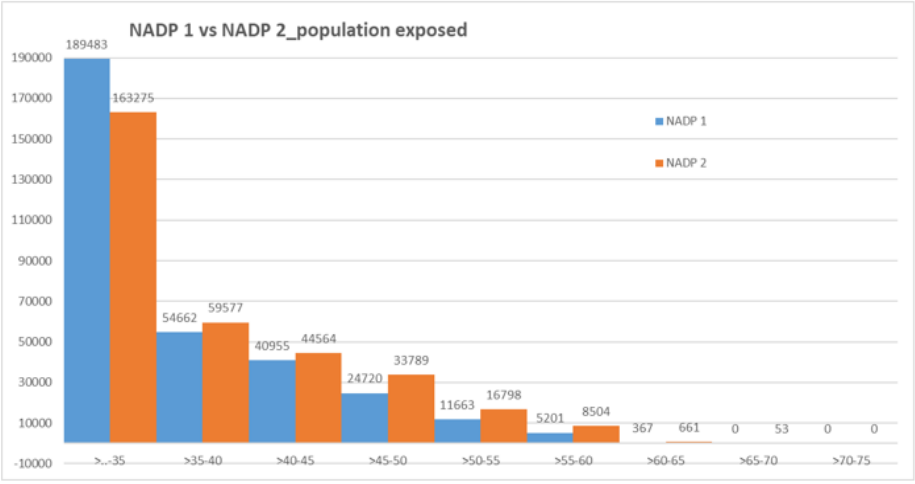


Figure 9. Population exposed to noise.

Next, the fuel consumption data was analysed up to 3000 ft, according to the specifications of NADP procedures, to investigate the quantity of emissions that is produced through the use of the two procedures. The 5 NM distance was established in accordance with available data for all flights, this being the maximum common track distance available in the data set, from the start of roll of the aircraft. A centralisation of results can be seen in the figure below, together with an additional preliminary analysis of atmospheric pollutants.

NADP TYPE	Fuel at 3000 ft	CO2 at 3000 ft	Fuel at 5 NM from start of roll	CO2 at 5 NM from start of roll	NOx 3000 ft	CO 3000 ft
NADP1	+1.1 %	+1.1 %	+ 9.3%	+9.3 %		
NADP2					+1.7 %	+ 1.8 %

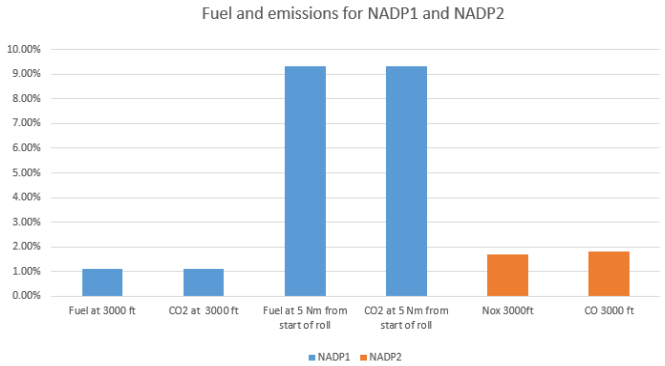


Figure 10. Fuel consumption analysis.

Observing that NADP2 analysis resulted in higher values in CO and NO_x, the study of atmospheric pollutants continued into a more detailed approach by determining the emission at the level of residents and the dispersion of pollution.

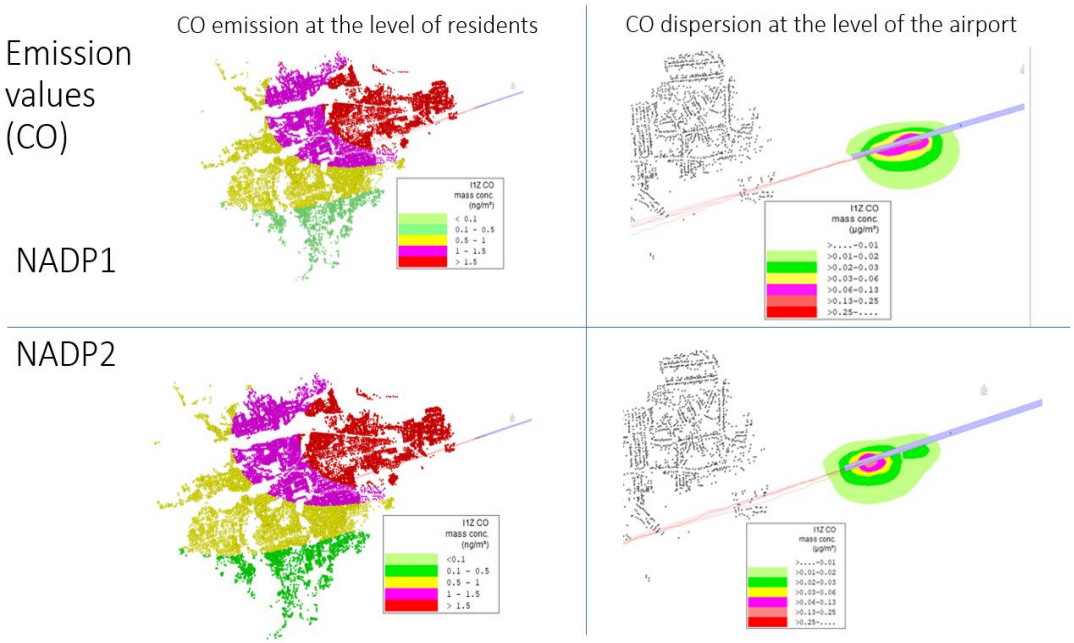


Figure 11. CO analysis for NADP1 and NADP2.

The investigation of CO started with determining the emission at the level of resident from the city of Cluj-Napoca, this being the largest community situated in the proximity of the airport. This can be observed in the figure above, on the left side. On the right side, it is displayed the dispersion of pollution at the level of the airport. The representations indicate the use of NADP1 on the top and the use of NADP2 on the bottom. Next, the exposure of the population was determined in relation to different particle concentrations.

CO (ng/m³)		<0.1	0.1 - 0.5	0.5 - 1	1 - 1.5	>1.5
Inhabitants	NADP 1	137031	182966	9427	1660	211
	NADP 2	139854	179980	9138	1920	403

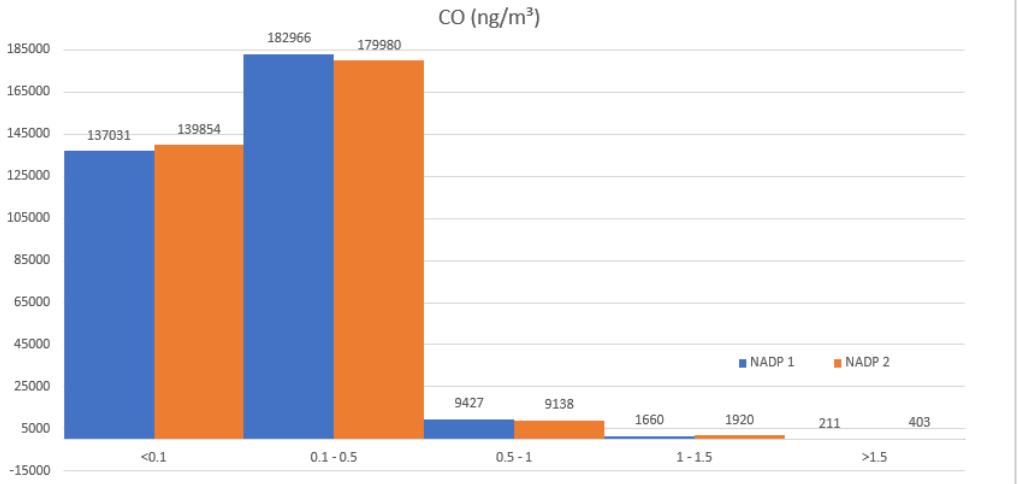


Figure 12. Number of people exposed to different particle concentrations (CO).

The above representation shows the number of people exposed to CO the use of either NADP1 (in blue) or NADP2 (in orange), at different particle concentrations.

A similar analysis for investigating NOx was performed, to determine the emission at the level of residents (left) and the dispersion of pollution (right), as it is showed in the figure below.

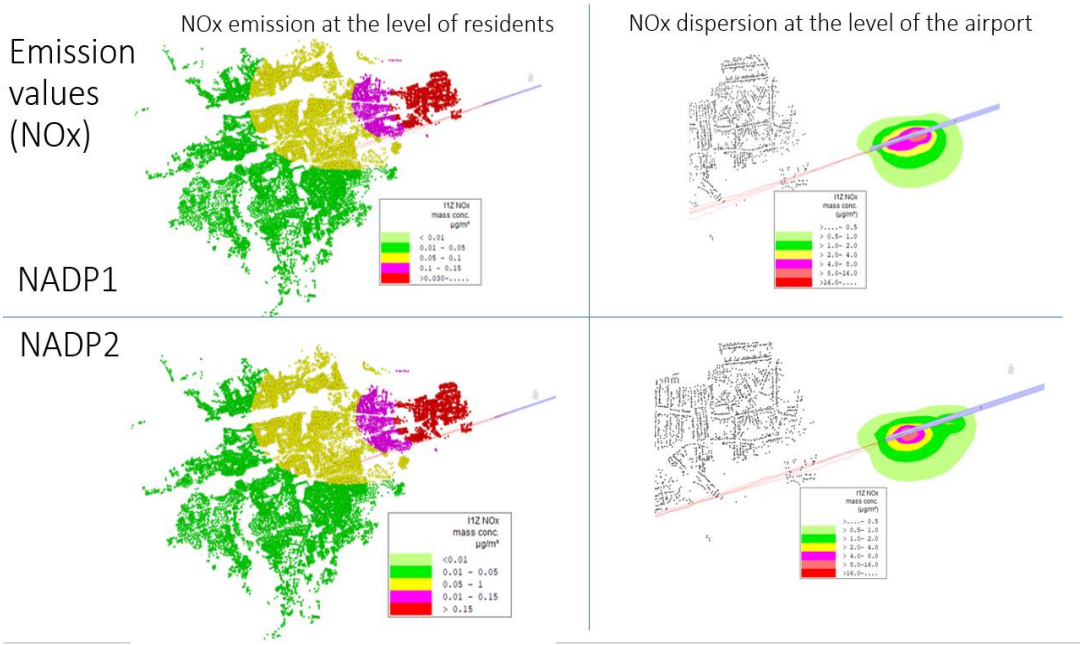


Figure 13. NOx analysis for NADP1 and NADP2.

As it was the case for the CO analysis, the NO_X investigation was supplemented with the outcomes in terms of number of people exposed to different concentrations, as it is detailed in the following figure.

NOx / 1h (µg/m³)		<0.01	0.01 - 0.05	0.05 - 0.1	0.1 - 0.15	>0.15
Inhabitants	NADP 1	156771	166153	7196	1165	10
	NADP 2	159937	162600	7170	1462	126

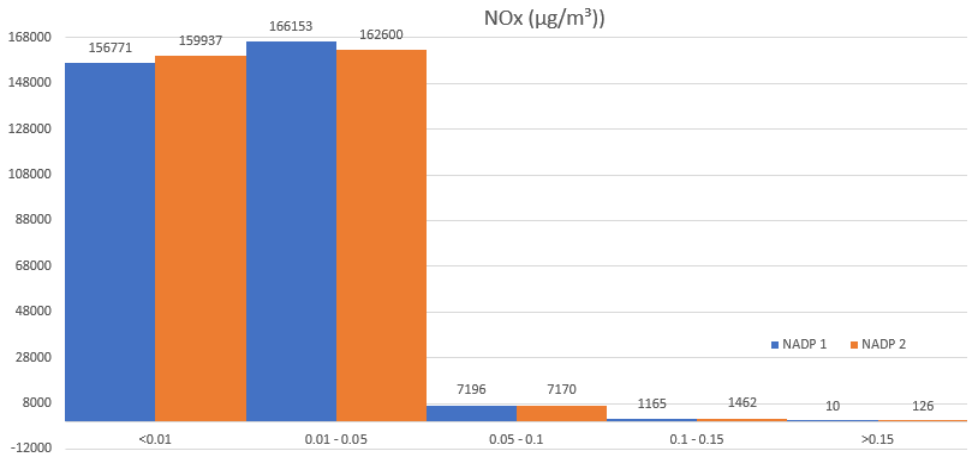


Figure 14. Number of people exposed to different particle concentrations (NOx).

Communities were not involved within this intervention, but conducting studies on environmental effects due to aircraft operations was one of the needs raised by communities during public consultations for Noise Action Plans.

E.2.5. Evaluation of Results and Post-Implementation Changes

By using two different procedures, it was already observed by the airline the fact that fuel consumption differed from one procedure to another. However, an understanding of their difference in terms of emissions/ air quality, as well as an overview in terms of real noise variation were missing. Therefore, this study tackled this gap and provided information related to all aforementioned issues, showing that the environmental outcome of such changes could be studied in terms of noise, emissions and atmospheric pollutants, providing relevant information that could aid relevant stakeholders (airport, airline, ANSP, communities) in establishing trade-offs between different priorities (noise, emission and fuel consumption, air quality).

After computing noise contours and observing small differences between the contours computed for NADP1 and the ones for NADP2, the analysis was continued to also determine the number of people exposed to noise. According to the representation of the number of people exposed to noise levels, it was observed that NADP2 exposes more people to higher levels of noise than NADP1. At an initial overview of results, it can be observed that for noise contours ≤ 35 dB(A), NADP2 could be a better choice for residents living farther from the airport, while for noise contours ≥ 35 dB(A), NADP1 might be a better choice for residents close to the airport. However, the use of one of the other should also take into account other aspects such as the understanding of the noise burden over the real distribution of population and the perceived impact of the 'vast majority' that is actively engaged in filing complaints and engaging with the airport, over the 'silent minority' when making decisions related to distributing the noise.

From the fuel consumption data, it was observed that the resulted quantity of CO_2 emission up to 3000 ft is higher in the case of NADP1, than it is the case for NADP2. This finding confirmed the assumption of the airline. From this analysis, atmospheric pollutants were also included to describe their contribution. Observing the preliminary results, the investigation continued with a more in-depth approach to understand their contribution. The CO analysis showing the number of people exposed to different particle concentrations shows that NADP2 exposes more people to higher particle concentrations than NADP1. Similarly, the NO_x analysis has also showed that NADP2 exposes more people to higher concentration levels. However, the results may differ in the case of using exact statistical data related to the population (number and distribution).

E.2.6. Other relevant information

When an operational procedure is under design, one of the mandatory criteria to be taken into account is its effect on the environment. However, this is generally associated with emissions in relation to fuel consumption. In the context of developing operations on Cluj Airport, one current challenge encountered by the

ANSP under their recent regulatory requirements to design environmentally friendly procedures (for most Romanian airports) is the fact that noise became the main focus in terms of assessing environmental outcomes. Therefore, the importance of this study increased, as its findings could also benefit other stakeholders (e.g. ANSP, CAA, other airports and airlines) during the regulation/ design/ implementation/ evaluation of operational procedures, apart from the ones involved within the study (airport and airline). The contribution brought by this research can be emphasised especially through its support in developing an initial understanding of the challenge to balance noise and emissions in terms of exposure and impact, in a context in which prior similar investigations are absent. Likewise, the outcomes from this study could also strengthen the need to continue the efforts towards implementing CEM (Collaborative Environmental Management) in the future, initiative that has been formally started in an incipient manner under the form of a protocol between the airport and the ANSP for the design and implementation of environmentally friendly operational procedures. During the development of the study, the protocol extended to also include an airline and a local research institute.

Another factor that has strongly emphasised the need for such a study was the intermodal project proposal (having Cluj Airport as a hub), as it is highly important to understand various possible correlations between different environmental issues, especially in the case of having different types of sources. Therefore, the investigation of aviation-related interdependencies was approached as a first step that could later feed in knowledge to address this topic across other individual industries (i.e. among other transportation sectors) and synergies. In support of developing future investigations such as the aforementioned possibilities, additional useful information from existing ANIMA research could also be complementary, e.g. 'policy and practice in other noise-affected sectors'[90].

Starting from the active involvement of the Cluj-Napoca city within different current and future European initiatives (e.g. EUROCITIES), Cluj Airport aims to support these efforts by wanting to develop and maintain a good relationship with communities from its surroundings, in pursuit of contributing together to the development of green, digital and innovative solutions in the region and work towards improving their well-being. Since tackling environmental issues is one of the most important concerns of residents, it was considered essential by the airport to approach subjects such as the one from this study in order to progress towards its goal.

The outcomes from this study could also inform the on-going efforts to develop noise zoning policies and legislations in Romania, possibly by linking 'Land-Use

[90] Galatioto F., Ferguson-Moore J., Schreckenberg D., Großarth S., Roosien R., "ANIMA D2.8 – Critical review of policy and practice in other noise affected sectors", ANIMA EU PROJECT (This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 769627), https://zenodo.org/record/3046853#.YQA7KOgza5g

Planning and Management' and 'Noise Abatement Operational Procedures' pillars from the 'Balanced Approach'[91] proposed by ICAO.

E.3. Conclusions

This intervention has provided additional knowledge to the quantification of environmental consequences of operational changes by validating the initial assumptions of the airline and the airport through results. Even so, it raised awareness on the importance of understanding the noise burden and environmental impact across different communities, to serve as basis for future decision-making related to limiting or reducing environmental impact (at the level of interdependencies) over surrounding communities. In spite of the fact that NADP1 was determined to be a better solution in terms of noise and atmospheric pollutants and that NADP2 has shown better performances in terms of emissions, a more complex study (with data pertinent for a normal traffic scenario) is necessary in order to draw an appropriate conclusion in this sense.

Conclusions were communicated at European level within an ANIMA dissemination event[92]. It is intended by the airport to also present findings as an important topic for discussion at the country level (e.g. within the regular Romanian Airport Association meetings).

E.4. Recommendations and Lessons Learnt

One important aspect is the fact that Cluj Airport has fostered good relations with key stakeholders (ANSP, airlines, the CAA, the Ministry of Transportation, other airports et. al.), which allowed the development of this study in a collaborative approach with both the airport and the airline. Therefore, continuous dialogue between stakeholders could support the deployment of future initiatives in a more efficient and timely manner.

Although communities were not included within the study, communication and dissemination activities related to the findings from this intervention could support the process of informing residents about the environmental context within this area. Future studies could also explore the possibilities to actively include communities within some of the steps of such an intervention (e.g. design, decision-making, implementation, evaluation).

Involving the airline within this study was essential not only for the delivery of necessary data sets, but also for drawing upon their experience and gaining insight into their point of view with respect to their priorities in terms of environmental objectives, information about previous actions in reducing environmental impact and understanding barriers that limit their efforts in this sense (e.g. trade-offs

[91] INTERNATIONAL CIVIL AVIATION ORGANIZATION, AIRCRAFT NOISE, BALANCED APPROACH TO AIRCRAFT NOISE MANAGEMENT, https://www.icao.int/environmental-protection/pages/noise.aspx

[92] ANIMA EU PROJECT (This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 769627), "Webinar on Airport Environmental Challenges: from Noise to Emissions", 28 September 2020, https://anima-project.eu/news/details/airport-environmental-challenges-from-noise-to-emissions-1

between different noise-related operational restrictions). From this, it was identified the need for further research about establishing trade-off criteria for decision-making in the context of existing different operational restrictions imposed to limit environmental impact, while allowing the identification and implementation of possible other solutions that avoid operational restrictions and limit/ reduce/ prevent environmental impact at the same time. Important to note is that the scope of directly involved stakeholders was planned to be limited at the start of the intervention and gradually expanded (other airlines, procedure designers), yet not achieved due to various barriers resulted from COVID-19 restrictions. However, such an approach in future studies could optimise the findings of such an initiative.

Future research regarding interdependencies (e.g. noise, emissions, air quality) could also be linked to new operational procedures, changes in scheduling flights or airspace changes, for assessing the environmental impact in a homogenous manner. Similarly, comparative studies containing all pollution sources connected directly or indirectly with the airport, could enhance the understanding of the overall environmental footprint. One interesting opportunity would be to perform such comparative studies during months with low levels of traffic and during months with high traffic demand (e.g. holiday months). Parallel studies related to quality-of-life could aid in completing the picture in understanding both exposure and impact, thus resulting in the possibility to propose interventions that define appropriate correlation factors (and reduce uncertainties in correlation) between the two different types of studies, aiming to improve the quality-of-life of residents while allowing changes in operations, efforts specifically tailored for the local airport context.

Only a few factors that influence the differences between planned and real operations were taken into account within this study, therefore results could be improved in the future by including additional information to refine findings (e.g. delays, meteorological factors, use of different flight paths). An increased data set could also enhance the understanding of the real air traffic situation, given the fact that the data available for this study was limited as a result of a sudden decrease in the level of air traffic due to various COVID-19 restrictions. Future studies could also focus on understanding the influences of various factors, such as: different NADP initiation points, different meteorological conditions (e.g. normal, severe), the influence of the airport/ local community configuration, differences in MTOW/ MTOM, terrain and obstacle limitations (airport, ANSP, airline) and others.

Although this study focused on NADP procedures, it might be useful to extend the study through future research such that it includes all types of operational procedures used at an airport, to increase the capacity to identify and compare the advantages and disadvantages of all operations in terms of their environmental outcomes, and further in terms of other criteria of importance (e.g. safety, fuel consumption, costs, airport capacity, alignment with the airport Master Plans). Through this knowledge, the efforts could increase in supporting the development of environmental management methodologies in this sense, that take into account, in a particularised manner, most types of priorities of different stakeholders (e.g. airport, communities, airlines, ANSP).

In order to foster a common understanding of the overall environmental management elements and also of its particular components (e.g. noise management, emissions management, air quality management), more communication and engagement with relevant stakeholders (including communities) is needed at a national, European and international level, to support raising awareness about existing concerns, policies and practices, opening dialogue among relevant stakeholders, developing a mutual understanding of the issues and needs of each involved party, designing effective solutions, implementing and evaluating them. Joint initiatives are highly recommended, such as CEM, involvement in research projects and the existence of learning platforms that allow interaction (e.g. feedback from users, knowledge resources, management tools), such as the ANIMA Noise Platform. Similarly, more communication and dissemination events about airport practices, together with workshops focused on the exchange of information (best practices and lesson learning) between experienced airports and airports with little experience in environmental management, are recommended.

Continuous communication with the airport and the airline, throughout the development of this study, was very useful to fine-tune the delivery of relevant information that could serve as guidance for other stakeholders (e.g. policy-makers, ANSP, other airports/ airlines, communities).

E.5. ANNEX – ROUNDTABLE

INTRODUCTION

As a final action to complete the information from the three case studies on Iasi and Cluj airports (LUP, interdependencies and QoL), a roundtable was organised. The findings from the three case studies were presented and later discussed among participants. Participants included representatives from MMU, INCD-T COMOTI, Cluj Airport, Iasi Airport, ROMATSA Bucharest, ROMATSA Cluj and BLUEAIR.

1. INTERDEPENDENCIES CASE STUDY (COMOTI in partnership with Cluj Airport and BlueAir)

This study was specifically performed for the context of Cluj Airport. Therefore, results are expected to vary in the case of another airport context, due to various factors, such as the real distribution of population and topography. Furthermore, different study outcomes are expected in terms of noise and emissions from one city to another due to the real number of inhabitants and distribution of residential buildings, possibly having differences in the concentration of houses in a district in a city, as well as from the proximity to the airport. These different characteristics of a city/ village, when cumulated, they could further support the development of a more accurate depiction of the communities describing the airport context. At the same time, the Cluj region has a certain topography that influences the superposition of noise maps over the area, therefore one can assume that the study results from one airport context are not necessarily applicable to another airport context (e.g. existence of hills in the Cluj region). Therefore, such studies

cannot be generalized to all airports and they need to be tailored according to the local context to obtain appropriate results for each local context. In this sense, it is very important to continue the case study that was started in Cluj to improve the existing model and the results such that they could depict different air traffic scenarios for a more accurate distribution of population, such that this model could support the capacity of airports to be equipped with prediction methodologies/ tools regarding noise, emissions and air quality. At the same time, the development and validation of such resources could further facilitate knowledge transfer to other airports. These actions should further support the investigation of means and solutions through which the current situation can be improved.

It was highlighted that some airports will be interested to reduce their noise exposure, while others will focus more on emissions and air quality. Therefore, the role of interdependencies, apart from understanding the effect of operational procedures, is to aid in implementing specific procedures that focus more on noise or emissions. In this sense, these types of studies are supporting key aviation stakeholders in decision-making processes related to implementing operational procedures favourable towards reducing noise, emissions or both (e.g. CDA).

It is important to keep in mind that interdependencies involve three major actors: the airport, the airline and the ANSP. This acknowledgement is crucial for implementing environmentally friendly operational procedures, taking as an example the NADPs that were studied in this case study. One key asset of this case study was specifically the involvement of the three major actors during the exploration of the idea of interdependencies, since airports are not usually engaged in such changes, even though this is the main actor that is the frontline agent with communities. Although airlines and ANSPs are generally in favour of operations focused on reducing emissions (especially in connection to climate change and costs related to emissions), airports face noise as the biggest challenge and are in a situation far from beneficial due to the unavailability of means to express in terms of needs (since the airport cannot influence operational procedures and, in most cases, it can only act on ground operations). Therefore, the aim of this case study was achieved in an additional manner by supporting the airport to become integrated in a working group that wants to continue with similar studies within future projects in the next 5 years.

The interdependencies case study has made the first steps towards creating a methodology on studying interdependencies in Romania, which can further contribute to the European research agenda. In this respect, the local team that is still under development (airport, ANSP, airline, communities), will focus on such topics to explore and exploit the results of these studies and also to support knowledge-building in the area and facilitate knowledge-transfer to other airports from Europe.

2. QUALITY OF LIFE CASE STUDY (COMOTI in partnership with Cluj Airport, MMU, NLR, ZEUS)

The QoL study was considered to be very important to the airport context. One aspect important to highlight was the fact that, although it was available only in an online format for all surrounding communities, as it was performed during the

COVID19 pandemic, a high number of responses were collected (more specifically, 256). The results were analysed by the research team and disseminated with the airport and this was very important because the airport is highly interested in understanding the quality of life of the population from Cluj. In order to be equipped with the necessary means to implement measures in this sense, a local group was developed to further progress on this topic too.

The usefulness of this study is first at the local level and extends towards the European strategy that is citizen centric. Therefore, the continuation and development of this study is desired. If possible, it is considered to be useful the involvement of additional Romanian airports, at least at the level of awareness (e.g. dissemination through regular meetings of the Romanian Association of Airports). In the future, studying QoL could go into investigating certain indicators in a more in-depth manner, from noise to emissions and to impact over climate change, especially since aviation has high targets on reducing emissions in the next years. Such a study could represent a parallel support for defining a methodology related to how to balance noise and emissions over climate change and air quality (with health impact). Therefore, connecting this study with health impact and with a wider QoL study, focused on environmental issues, could be an opportunity for the key aviation stakeholders in the community (airport, ANSP, airline) to engage with Cluj Municipality to start a methodology at the level of communities and explore wider opportunities together. Such engagement is considered to be very important, since the Cluj Municipality is highly active in different types of studies related to the wellbeing of residents and also in assuming a leadership role at the level of Romania in terms of becoming a smart, clean and green city.

By keeping in mind that airports cannot influence the process of selecting the use of either NADP1 or NADP2 (or others), one additional stakeholder was identified as being able to support throughout this process. In the case of regional airports (in connection to county councils), the Environmental Agency could also contribute within the decision-making process (for the selection of different types of operational procedures) with the provision of a methodology in favour of residents living in communities near airports. This methodology could guide airports and all other relevant stakeholders in implementing ICAO Balanced Approach solutions.

3. LAND-USE PLANNING CASE STUDY (COMOTI in partnership with Iasi Airport)

Starting from the discussion related to the implementation of noise-related operational restrictions, it was acknowledged that the expected future air traffic growth will limit the efficiency of these measures. Therefore, such solutions are only short-term oriented, as they are not applicable to their full extent all the time and they are restricted by different other factors (e.g. meteorological factors, safety etc.). In order to try to be properly equipped with the necessary means to tackle future challenges related to the increase of the noise risk, apart from a noise monitoring system, other actions should be initiated in partnership with Municipalities. It was emphasised that it is desired in the future to have the ability to include the environmental risks (such as aircraft noise) within construction permits, to ensure that the information describing the real context is available to

real-estate planners and potential residents in the area and that all risks are properly understood and possibly managed in a preventive manner (e.g. through noise insulation of buildings). Therefore, noise management should be tackled on multiple facets and this could be another solution. This could be seen as a short-term measure before the entire legislation related to land-use planning will change.

In the case of the airline, noise is one of the most pressing issues and the company has developed throughout time many noise policies, which are already implemented in different European airports (e.g. Paris Charles de Gaulle, Barcelona). Even so, the greatest challenge is the fact that managing noise has become a trade-off between noise solutions. More specifically, in spite of the efforts (development of policies, training of personnel, costs) of the company to be proactive in tackling noise for the benefit of communities and for becoming compliant with existing measures to reduce noise (e.g. by using NADPs), noise taxation systems still increase, therefore the expected outcomes in terms of environmental targets and costs are not achieved of intangible and cannot be quantified. Therefore, it is considered that there is a great opportunity in Romania to collaborate with airports and the ANSP towards the development of operational procedures that support the efforts to protect the population, but this opportunity should progress in parallel with a proactive approach at the level of Romania related to LUP, in order to support and enforce the implementation of environmental management solutions before the complexity of these issues increase.

Noise maps are considered to be very useful tools. The manner in which they are developed is very important, especially when taking into account the existence of noise measurements along the flight path, together with measurements at the airport level and extrapolations towards communities through the use of mathematical models. It is desired in the future to have a comparison between both approaches in order to build a more realistic view about the noise context in communities. In order to correlate noise measurements in the city with the mathematical model, by taking into account the configuration of Cluj-Napoca city, it is considered necessary in the future to perform such measurements in different points to reduce uncertainties in evaluating existing noise and predicting noise (e.g. at the ground level, at the roof level). This should also support in building knowledge about the contribution of the architecture of the city towards noise propagation and therefore to understand how is this influencing the noise perceived by residents.

In terms of future studies in this region, it is necessary for the ANSP, for airlines and for the airport to properly understand how noise produced by air traffic is perceived by residents at the ground level. This is highly important and a need in terms of knowledge to support noise management efficiently, especially in the case in which airlines implement different types of operational procedures for noise abatement and are compliant with noise limits, yet noise is perceived differently by communities. Briefly, a study that comprises noise measurements in different community areas (both at the ground level and at the level of the roofs of buildings) is a necessity at the moment, in order to advance in understanding the real noise exposure context. This should be performed before measures are

implemented at the Municipality level (i.e. LUP), in order to support the definition and implementation of appropriate provisions. This need comes directly from constant discussions with residents and communities and from their questions towards the airport and the ANSP and as a result of the unavailability of such complex studies in the region, both stakeholders are unable to be equipped with the necessary knowledge to support actively in improving their life in this communities.

The last point is suggested as complementary to the approach started within Iasi case study, as one main target was the appropriate distribution of responsibilities among all relevant stakeholders. This was followed especially in pursuit of creating a fruitful environment for the application of solutions for noise management and avoid situations similar to airlines implementing noise reduction operational procedures (in the air) and still get fined for noise (exposure and impact at the ground level). At the same time, compliance with noise operational procedures might have a penalty on emissions, leading to an increase in fuel consumption and additional costs too. Therefore, the approach should divide responsibilities among all participants and beneficiaries of air transport, from the citizen that travels (with a medium to higher income), the community that has economic benefits from being situated in the vicinity of the airport, the airport, local administrations and so on.

Distributing responsibilities was key within this case study for pursuing an improvement related to aviation noise management. The case study was useful for identifying certain legislative gaps, for example the necessity for changes within authorisations for constructions to include provisions related to the environmental context. In this sense, legislative changes have been encompassed within the legislation, but have not been detailed yet in a methodologic manner such that they could be implemented, to have a clear situation about who is responsible with the evaluation of compliance with provisions, who imposes the obligations to the local administration/ terrain owners regarding the nature of constructions, for the land from the vicinity of airports.

4. OPEN DISCUSSION. OUTCOMES AND FUTURE PROGRESS BEYOND ANIMA PROJECT

At the level of Cluj Airport, a team of experts on environmental issues was formed. At the airport level, it includes experts from the environmental management office, from the operational office (responsible for noise monitoring and communication with the ANSP). The external level includes representatives from airlines, the ANSP and representatives of surrounding communities. The main focus of this working group is currently on an operational procedure that was developed by the airport with the ANSP. This action is strongly connected to improving the manner in which noise is managed, with a focus on aircraft that overfly the Cluj-Napoca city during the night time (23:00-07:00). Further, the team aims to explore all existing options to improve communication and engagement with communities in pursuit of designing and implementing environmentally friendly and sustainable solutions that protect the residents in the vicinity of the airport, while allowing a harmonised development of airport operations.

In general, most airport efforts are focused on dealing with environmental issues, mainly focusing on reducing the exposure and impact effects over residents. Therefore, this goal is mainly going to be monitored in relation to the number of noise complaints, aiming to reach and maintain noise targets and ensure compliance with legislative provisions as a first step. This approach is formulated as a result of recent legislative changes and proposed to be accomplished with a parallel communication and engagement campaign with communities. Therefore, the airport is always in contact with residents. Future progress for improving this relationship will possibly include constant updates on the website of the airport, information that could also be relevant to other interested parties, outside communities from its vicinity.

Previous relevant airport efforts include the development of a study related to the health of the population and also the deployment of a continuous noise monitoring campaign, that is currently only at the airport level.

Notable to mention is also the infrastructure development plan (medium and long-term) that was tailored based on environmental targets. Currently, the runway extension project is ongoing, aiming to support indirectly the reduction of noise (e.g. through ensuring a longer surface that allows different take-off and landing points, therefore influences the height at which aircraft overfly communities). Another important on-going project is the construction of a taxiway that facilitates the fast movement of aircraft at the ground level, therefore supporting indirectly reductions in noise and emissions due to the shorter distance for aircraft to move on the ground and to the reduction in fuel consumption. On the medium and long-term, the development of a stationary platform is planned, which is going to be placed near the Apahida village, which is in the opposite side of the Cluj-Napoca city. Other future plans include the development of a cargo terminal and also the active engagement in future European projects tackling environmental issues (reducing noise, improving QoL).

At the level of Iasi Airport, the approach that started on supporting the definition and implementation of LUP provisions within the national legislative context is desired to be continued up to reaching its outcomes. More specifically, this means that the moment when the implementation of air traffic noise restrictions for the construction of residential buildings/ schools/ hospitals will occur within Urbanisation Plans, then the legislation could be evaluated if it has achieved its outcomes. This should further secure the wellbeing of the population in the region and support airports and air transport on the long-term. In order to achieve this, the support of all key aviation actors from Romania will be needed and the airport is open to future collaborations in this sense.

CONCLUSIONS

The most important premise for developing the three case studies was to develop knowledge mainly for airports in understanding how to protect residents around airports from the existing and future noise context, followed by some investigation around other environmental factors and QoL implications. Although progress was made through this research, future needs still include the active engagement of all relevant stakeholder in how to balance properly airport, ANSP and airline efforts

for reducing/ mitigating these issues in a context of high expected air traffic growth and uncoordinated increase in residential areas.

F. Case Study Cluj - Quality of Life

F.1. Overview of Airport Context

The case study was focused on identifying opportunities that an airport can have to increase the quality-of-life (QoL) of residents living in the communities near the airport. Noise exposure and noise annoyance have been integrated as relevant factors within the study.

F.1.1. Background Information

See Annex E.1.2 for the background information of the airport "Aeroportul Internaţional Avram Iancu Cluj".

F.2. Case Study

F.2.1. Definition

Motivation and problem statement

Cluj Airport is a rapidly growing airport, that can be classified as a 'Starting the Journey' airport according to previous ANIMA classifications[93] in terms of experience in noise management. Its interests are focused on further development opportunities as an intermodal transport hub (air, rail and road), especially for cargo. Their aim is to become a Carbon Accredited Airport and address openly concerns related to noise, water and air quality, while fostering good relations with neighbouring communities. The main issue in addressing QoL comes from its complexity and the absence of such studies in connection to airport activities led to the formulation of this intervention, as a first step in understanding QoL factors in this region. All these reasons led to this initiative, focused on identifying potential opportunities to understand and possibly increase the quality-of-life of

[93] Heyes G., Dimitriu D., Hooper P., ANIMA D2.1 – Pan-European overview of Existing Knowledge and Implementation of Noise Reduction Strategies, July 2018, https://zenodo.org/record/2599726#.YPlfX-gza5g

residents as an integrated part of future developments. Therefore, this study details the experience of the airport with this topic in order to support through its findings the definition of best practice for airports that have the intention to conduct such a study. In addition, gaps in knowledge are also emphasised to define potential future steps in progressing with this initiative beyond this study and possibly support the design of effective interventions to support future noise interventions.

Objectives

The main objective of the study is to identify which QoL dimensions or indicators can be positively influenced by Cluj Airport to increase the wellbeing of the community influenced by the airport activity. Ultimately, an improved understanding of QoL from the perspective of residents could aid the design of future developments planned by the airport (e.g. operations, procedures) and optimize these efforts towards a positive impact on QoL. Further objectives include drawing upon available 'best practice' to develop an appropriate approach for the local context, furthering the current (preliminary) understanding of the QoL complexity, identifying needs and opportunities for future research and summarise learning for the ANIMA Noise Platform.

F.2.2. Intervention Design

This intervention was designed as a study on quality-of-life around Cluj Airport. The study was conducted as part of the ANIMA EU Project and was formulated based on findings from WP2 and WP3. This initiative co-exists with another study related to interdependencies, conducted at the same airport. Both case studies are formulated in such a way that they feed into the ANIMA Noise Platform[94] with 'Best Practice'.

Connection to ANIMA expertise

In order to gain a more practical understanding of available research in ANIMA, this initiative started from drawing upon existing knowledge about QoL, aiming to investigate the extent to which general airport efforts to engage with communities have led to results that could be compared to expected outcomes. While previous ANIMA initiatives aimed to explore the relationship between noise management, airport efforts towards communication and engagement with communities and broader QoL outcomes, the present case study was focused on tailoring this available information to the local context in order to identify opportunities to increase QoL in this area.

Methodology

This case study assessed the point of views from both residents and Cluj Airport. Firstly, the perspective of residents was important to determine the priority of QoL elements (most and least important factors/ dimensions). Secondly, the perspective of the airport was relevant for determining what measures (with potential/ expected impact on QoL) have already been implemented and what possible opportunities exist for future interventions. Comparing both views, it was

[94] ANIMA EU Project, ANIMA Noise Platform, https://anima-project.eu/noise-platform/main-page

examined whether the QoL elements considered of importance for the airport were shared by the residents too. The entire study design was depicted in the figure below.

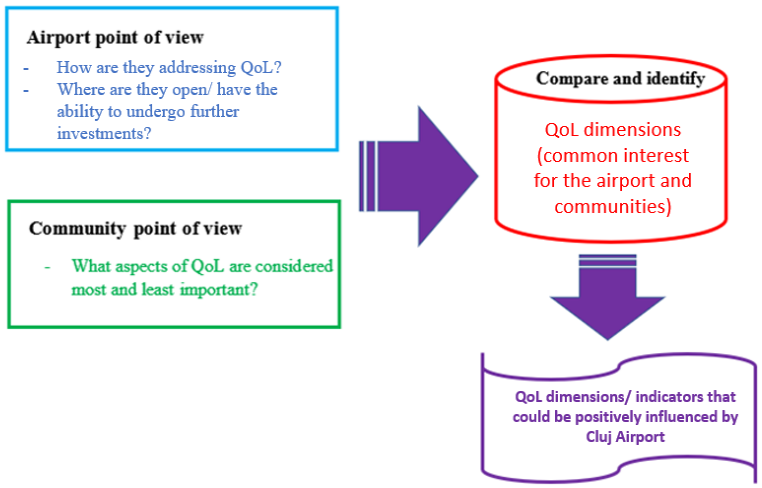


Figure 1. QoL study design.

The methods that were used were interviews and online surveys, focused on collecting feedback to determine the airport's and community's perspectives. Interviews were used for the airport to support the exploration of answers in a more comprehensive manner. An online survey was used for residents. Topics covered were, for example, people's QoL, satisfaction with various institutions, and sociodemographics (e.g. age, education, employment, location of residence etc.). For the analysis and comparison of results, the main approach was through desk research.

Research questions

Various research questions were formulated within the design phase of the case study, based on the objectives that were previously established, including the following:

- What QoL factors do people living in communities surrounding the airport consider most and least important?
- What QoL factors has the airport tried to (or is aiming to) influence, based on its past efforts/ future plans?
- How – if at all – does the community perspective on the importance of various QoL factors differ from the QoL factors targeted in previous actions/ future plans by the airport?

These research questions were investigated through two perspectives, i.e. the airport view and the residents' view. The last research question was formulated to support the observation and identification of insights that facilitate a better understanding for the airport. This was expected to help the airport in assessing

whether its current or planned efforts in addressing/ improving QoL are consistent with community expectations or priorities.

Expected outcomes

The expected outcomes were of a great variety. Notable is the ability to understand individual airport and community priorities and concerns related to QoL, respectively linked to practices and expectations. Also, obtaining a correlated view from both data sets of responses is expected to deliver insights into possible links between QoL importance as seen by the airport and QoL priorities as described by residents, as well as to highlight possibilities for the airport to positively influence QoL. On a broader view, the research of QoL in relation to airport activities and dissemination of learning through the ANIMA Noise Platform is expected to benefit different stakeholders, mainly: ANIMA partners and wider research community (gaining additional insight into QoL dimensions and indicators and delivering guidance on 'auditing' an airport with respect to QoL efforts), aviation stakeholders and policy-makers (awareness and understanding of community priorities, support in priority setting), residents (opportunity to benefit from improved QoL).

Initial and COVID-19 related risks

The initial approach focused on collecting residents' feedback through an online survey and face-to-face interviews (with the support of local organisations) to enrich data. This was not possible due to travelling and social distancing restrictions. Similarly, the intention to collect responses through the support of a independent organisation in the region (both online survey and face-to-face interviews), as well as to organise live focus groups and roundtables (local stakeholders, other 'Starting the Journey' airports) was not possible due to communication and timing issues resulted from switching from office work to online work/ no work at all (cases of furlough). Also, the initial proposal to correlate the survey responses with air traffic operations (aiming for a period of time that reflects the general traffic dynamic, i.e. avoid summer/ winter) was not relevant due to the low/ absent number of aircraft movements in the period of the implementation of the survey.

F.2.3. Implementation Processes

The study started by gathering the data required for its development, notably the audit framework from previous ANIMA deliverables (D3.1). For conducting the study, a guidance document (study outline) was generated to establish the steps and methodology for the audit, define an introductory text for the survey and for the interview and to aid in developing questions. Next steps included the development of short introductory descriptions for both the interview and for the survey, followed by the development of a set of questions for the interview and another set of questions for the survey. The formulation of airport questions was focused on the use of an increased number of open questions, with short explanations, and implemented through an interview approach, based on the assumption that the interviewee is of an expert nature, thus facilitating the discussion of items in more detail.

Airport interview rationale

In order to gain understanding regarding the airport perspective, the interview was conducted in three steps, each of the last two having a set of questions established.

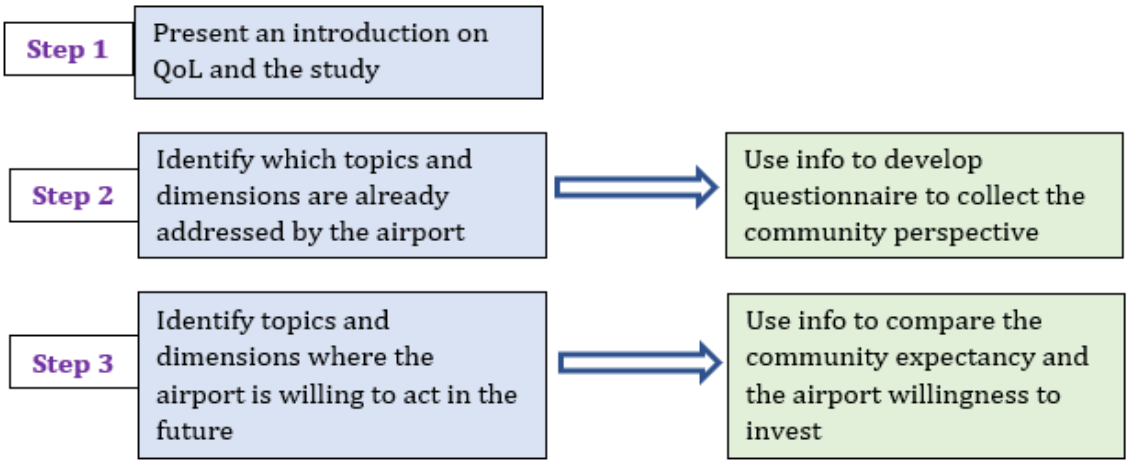


Figure 2. Airport interview.

The first step was to inform the airport about QoL on a general basis and also on a local basis (airport case), together with a short description of the study aim and the concept. The second step was focused on questions based on the audit framework that was previously developed in WP3 in ANIMA, on GRI (Global Reporting Initiative) Standards[95] and on EUROSTAT insights[96], while the third step included questions aimed to identify the intention of the airport to act upon QoL in the future (e.g. "Has the airport investigated the opinion of residents about how QoL could be improved?", "How could the airport act upon QoL in the next 2-5 years?").

The Airport Audit was formulated based on different QoL elements, such as dimensions, topics, groups and corresponding indicators. The 9 QoL dimensions varied from health, to economic and physical safety to natural and living environment and were directly taken from D3.1. In this current case study, corresponding topics were defined that included items such as access to healthcare, economic safety and environmental conditions. Groups were further defined on a more specific basis and in relation to the topics addressed (e.g. psychological health, global/ regional/ local context), followed by indicators (e.g. annoyance, impact on water/ soil quality, emissions). Based on this structure, questions for the airport were formulated linked to each indicator, resulting in 29 questions.

[95] GLOBAL REPORTING INITIATIVE, GRI GSSB, GRI STANDARDS, "GRI 101: FOUNDATION 2016"

[96] EUROSTAT, Quality of life indicators – overall experience of life, Overall life satisfaction in the context of quality of life, https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Quality_of_life_indicators_-_overall_experience_of_life#Overall_life_satisfaction_in_the_context_of_quality_of_life

Survey rationale

The formulation of survey questions started as a result of discussions with the airport to collect information about existing QoL-related interventions (from the airport's perspective), which supported tailoring the questions in a manner to aid the assessment of whether residents perceive the measures as influential for QoL as the airport does and to provide insight if airport actions are consistent with the expectations of residents. In addition, the level of detail of the survey was dependent on the feedback from the airport to ensure that findings are relevant to the local context. The adaptation focused on tackling QoL dimensions/ indicators that are/ could be influenced by the airport, as well as on the likelihood to achieve the aimed number of responses (e.g. by limiting the number of questions and reducing the time required for completing the survey).

The survey has been focused as much as possible on reflecting the general experience/ view and not certain experiences correlated with a specific moment in time. In addition, questions were formulated based on the assumption of having a non-expert audience. Thus, closed questions were used, accompanied by explanatory notes or examples. The survey started with a brief description with general information (e.g. purpose of the study, who is conducting it, the duration of the study), followed by a first set of questions related to general information about the respondent, which allowed the classification of the respondents (e.g. age, gender, location of residence/ work). Further, a second set of questions was included to gain information related to the same 9 QoL dimensions addressed within the airport interview and indicators. Overall, the QoL survey included 47 questions.

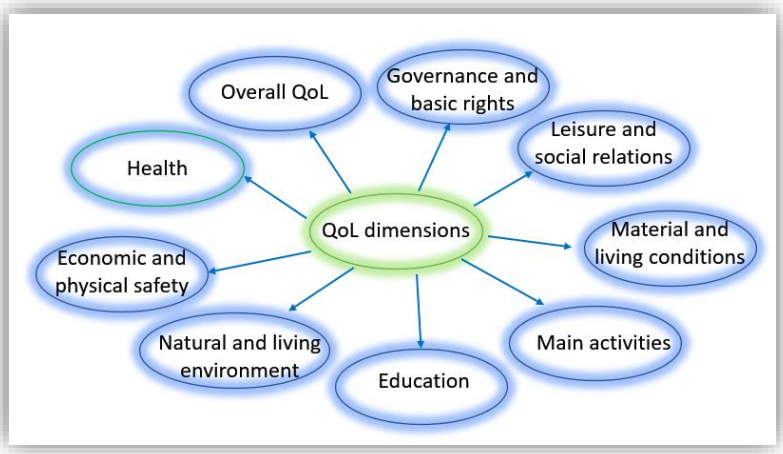


Figure 3. QoL dimensions used within the design of the airport interview and population survey.

To reduce the chance of a potential priming effect, the questions were formulated in a more general manner and not strictly focused on the airport operations. At the same time, approaching a general evaluation of QoL was acknowledged as a solution to decrease the possibility of bias influenced by the pandemic context. Some examples included the influence on the importance of health concerns, the perception of pollution sources in their absence (different from the usual context) or of the aviation-related influence on QoL with decreased numbers of aircraft movements. Thus, it was recognized that generalisability with respect to time due

to the COVID-19 restrictions/ outcomes could be an important bias source that could further influence the results, the assessed priorities for residents or the main concerns of the population.

The survey questions were presented and agreed with the airport to ensure that selected QoL dimensions and indicators are relevant for the local context, and that these aspects could be influenced by the airport directly or indirectly. In addition, the questions were validated with approx. 20 trial respondents, sourced with the support of the airport, of a local university and of ANIMA partners. The validation was performed mainly to determine whether questions are clear and if they can be answered easily. A modified version of the questionnaire followed upon validation. The period of time for the implementation of the survey was (09.09.2020-07.10.2020) and it was selected to also take into account COVID-19 limitations and holiday periods (or lack thereof). The area of implementation was selected based on the proximity to Cluj Airport (i.e. cities/ villages in its close vicinity). Non-probability sampling was used as the sampling method. The 256 responses were accepted as being a sufficiently large enough sample for this case study. Furthermore, a strategy for collecting responses was established and the survey was designed using an online tool (Google Forms).

The next step was the translation of questions into the local language and the implementation of the interview and of the survey in parallel. Responses were collected from the airport through an interview approach, aiming to identify mainly what measures has the airport implemented in the past that intended to influence/ have influenced indirectly QoL, as well as to identify which is the scope of measures that the airport is open/ able to act upon in the future. The feedback was recorded and sent for further clarifications/ completions from the airport to reach a final and more complete version.

The questions for residents were formulated in a survey approach, which was published online, aiming to identify QoL dimensions/ indicators considered important by the local population for their wellbeing, or seen as helpful in increasing their QoL. After being officially launched, the data collection process from the survey was monitored periodically, with an emphasis on checking the category or respondent (based on age, education etc.) to specifically target underrepresented respondents. The survey was disseminated officially on the website of ANIMA partners and on a volunteer basis (residents/ organisations from the Cluj area), as well as on different online communication platforms (e.g. Social Media). After the data collection processes were finalised, responses were translated into the English language.

F.2.4. Evaluation of Results and Post-Implementation Changes

Quantitative research

In total, 256 people participated in this survey. As 6 participants either responded to less than 50 % of the questions or neither worked nor lived in Cluj, they were excluded from further analysis. Of the remaining 250 participants, 152 were female (60.8 %) and the mean age was 38.6 (*SD* = 12.3; ranging from 18 to 70). 62.4 % have a university degree. Almost three quarters of the participants (72 %)

live in Cluj and 74 % work there. Half of the participants have an income level between L 2,000 and L 6,000 (ca. € 409 to € 1,227) per month (53.3 %).

First, the descriptive statistics (mean, standard deviation, frequency) were calculated for all variables of interest as well as the correlations between the variables. On average, participants rated their sleep quality as moderate (*M* = 3.65, *SD* = 0.94). The environment in participants' area was regarded as moderately polluted (*M* = 3.33, *SD* = 1.00). With respect to selecting the top three main sources of different types of pollution, only a few participants judged aviation to be a main source of water (5.6 %) or soil pollution (4.4 %). One fifth evaluated aviation as one main source of air pollution (22 %). Most participants did not mention aviation as one main source for any of these three types of pollution (76.4 %).

Noise annoyance was assessed for various noise sources using a 5-point verbal scale ranging from 1 (not at all) to 5 (extremely annoyed and disturbed) over a period of the past 12 months. Participants were most annoyed and disturbed by road (*M* = 2.94, *SD* = 1.10) and construction noise (*M* = 2.93, *SD* = 1.19), although the standard deviations imply a lot of variance. Aircraft noise annoyance averages to 2.42 (*SD* = 1.10), indicating a low to moderate level of aircraft noise annoyance. Interestingly, aircraft noise is mentioned by 44.4 % as being in the top three noise sources in participants' communities. Overall, 16 % of participants can be defined as highly annoyed by aircraft noise (% HA; scoring 4 or 5 on the scale).

One third of the sample (31.2 %) reported having a negative feeling towards the airport transport system. On average, participants do not think that their interests are considerably taken into account by the air transport system (*M* = 2.26, *SD* = 1.07). Further, the extent to which the air transport system can positively contribute to QoL is rated as rather low (*M* = 2.60, *SD* = 1.13). It is important to note that some questions specifically refer to the local airport in Cluj and others encompass the air transport system as a whole, the latter including the airport, but also airlines and other stakeholders acting as part of the system.

When asked about different categories influencing QoL, participants rated several aspects as having a large influence on QoL. Health was rated as having the most influence on QoL with an average of 4.27 (*SD* = 1.00), followed by living conditions (*M* = 4.22, *SD* = 0.91) and education (*M* = 4.20, *SD* = 0.94). Political aspects are thought to have the least impact on QoL (*M* = 2.79, *SD* = 1.21). For further analysis, two outcome variables were of interest: 1) percentage of highly annoyed people (% *HA*) and 2) the air transport system's positive contribution to aspects of residents' quality of life. Only relevant variables were included as predictors in these analyses. A logistic regression analysis was used examining which factors predict the percentage of highly annoyed people (% *HA*). A logistic regression indicates the probability of a binary outcome, i.e. being highly annoyed by aircraft noise. Three variables reached significance and the resulting model explains approximately 32% of the variance. The variables are: road traffic noise annoyance, the number of times aviation is mentioned as one main pollution source in different pollution categories (e.g. soil, water, air), and the influence of the natural and living environment on QoL. Results show that the odds of being

highly annoyed by aircraft noise (% *HA*) are 1.8 times greater for each 1-point increase in annoyance due to road traffic noise. This relation could be based on another factor such as noise sensitivity. Moreover, participants are 4.3 times more likely to be highly annoyed by aircraft noise for each 1-point increase in the number of times aviation is mentioned as one main source of pollution. This means that people who view aviation as a source of soil *and* air pollution are more likely to be highly annoyed than people who only view aviation as a source of soil *or* air pollution. Last, the odds of being highly annoyed by aircraft noise are 1.7 times greater for each 1-point increase in the rating of the influence of the natural and living environment on QoL. One explanation for this result is that people who view their natural and living environment as important for quality of life are more annoyed by factors interfering with their environment, like aircraft noise.

A stepwise multiple linear regression analysis was carried out using the *air transport system's positive contribution to quality of life* as the outcome variable and aviation-related variables as well as QoL items as predictors. Results show that interests taken into account by air transport, the influence of QoL on health as well as travelling by aircrafts and feeling negative towards the airport transport significantly predict the air transport systems' positive contribution to QoL. For example, a 1-point increase in the rating of the extent to which one's interests are taken into account by the air transport system is significantly linked to a higher rating regarding the air transport system's positive contribution to quality of life. This underlines the importance of communication, engagement and dialogue with communities, as highlighted by the ANIMA project.

Further, a 1-point increase in the rating regarding the influence health has on one's quality of life is linked to a 0.23 higher rating for the outcome variable. At first glance, this might seem a little contradicting: participants viewing health as strongly impacting QoL rate the air transport system's positive contribution as higher compared to participants to whom health is not as important for QoL. An explanation for this could be that participants link the air transport system with cargo flights carrying important medical equipment and medication. However, this is merely an interpretation and this result needs further examination. Using the airplane to go on holiday is also associated with a 0.29 increase in the rating of the air transport system's positive contribution to quality of life.

A surprising finding is that having a negative feeling towards the airport transport is related to a 0.33 increase in the rating regarding the air transport system's positive contribution to quality of life. This inconsistent result could also relate to the fact that participants distinguish between their local airport and the aviation industry as a whole. The question regarding participants' feelings towards certain institutions refers to the airport transport, thus the local airport in Cluj. The outcome variable rather deals with aviation as a whole. It is possible that participants generally perceive aviation as being able to positively contribute to QoL, but that they have some issues with the local airport transport. Overall, the four predictors account for 32% of the variance in the outcome variable (Adjusted $R^2 = 0.321$). Figure 4 and 5 visually depict the effects of the different predictors on % *HA* and the *air transport system's positive contribution to QoL*, respectively. For % *HA*, the odds ratios (OR) and confidence intervals are displayed and for the

air transport system's positive contribution to QoL the regression coefficient B and the corresponding confidence intervals are shown.

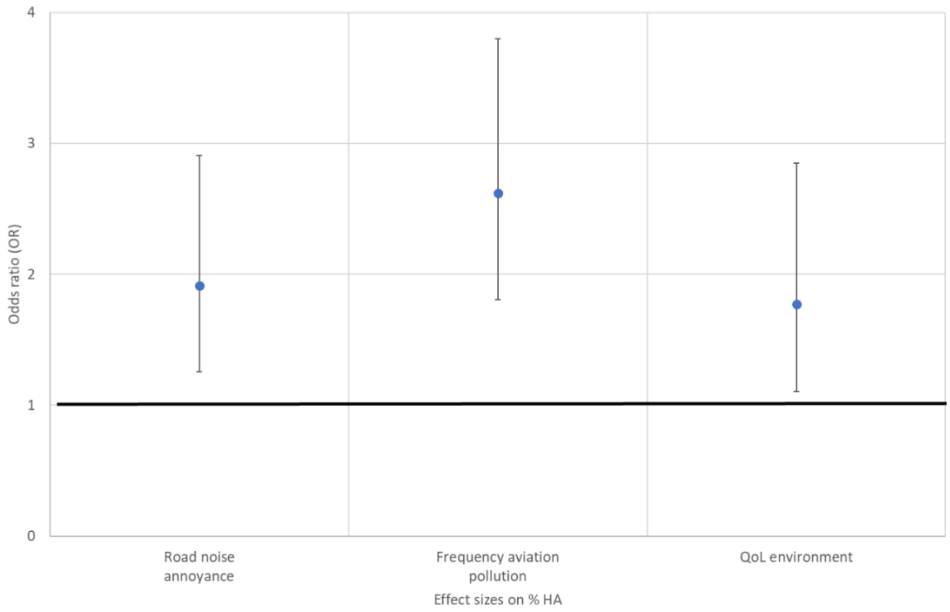


Figure 4: Odds ratios (OR) of the predictors to %HA derived from the logistic regression analysis.

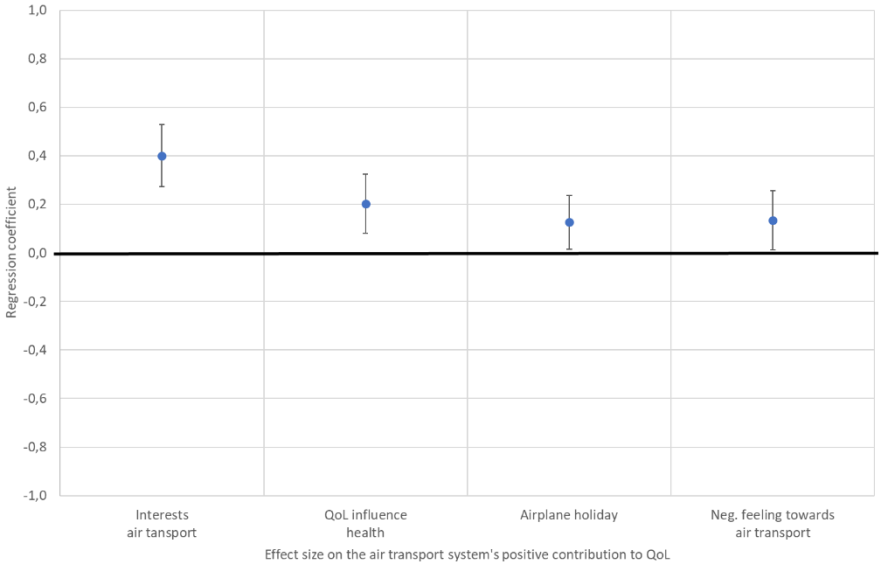


Figure 5: Regression coefficient B and confidence intervals of the predictors to the air transport system's positive contribution to QoL derived from the multiple regression analysis.

There are some limitations that need to be considered when interpreting the data. As most of the questions (incl. the scales) that were used in the questionnaire are not standardized, i.e. have not been used in other studies and were not tested for validity (accuracy) and reliability (consistency), the results must be interpreted with caution.

Further, some questions ask about the *air transport system* and others about *airport transport*, which could be confusing for participants and it is not clear what

participants' understanding of these terms is (e.g. is airport transport the transportation to the airport or local air traffic). In some questions the airport is not specifically mentioned as a category but is rather summarized under the terms local authority and/or government. Therefore, directly relating the answers to these questions to the airport is not possible as it is unclear whether participants included the airport in these categories. Future studies should address these limitations.

Implications from the survey and potential opportunities

In addition to the insights the quantitative research results bring, a number of other outcomes may have relevant implications for the airport. Regarding facilities, work and education, various indicators were investigated. Some relevant examples of conclusions include the evaluation of transportation services, where most participants evaluated they were "Neither satisfied, nor dissatisfied" with the air transport infrastructure. Out of this evaluation exercise, the airport could further investigate which are the factors that determine the overall satisfaction with the airport infrastructure to get a more in-depth understanding of how this area could be improved to positively influence residents' QoL.

Another relevant finding shows that people prefer to use the airplane as the second most preferred transportation mode for going on holidays (1) own car, 2) airplane, 3) train), out of 7 answer options. From these findings, the airport could further investigate how future decisions could ensure a more environmentally friendly option for reaching holiday destinations. Another approach could also be engaging communities for input related to holiday preferences to explore options to establish direct connections from the airport, and thus actively contribute to reductions in pollution from road traffic.

In terms of education, the actors considered that should invest more in this area are the local authorities, the government and the members of the local community. In addition, the three most rated areas that are perceived as most important for further investment are the educational infrastructure, the availability of educational camps and the availability of resources for studying (such as – books, digital devices etc). Although the airport is not seen as a major actor in contributing to education (quality), some opportunities for improving the quality of life of residents would be to support communities with career opportunities whenever possible and raising awareness about the most important investment needs in education.

Regarding the social and governing aspects, the leisure activities were addressed first, showing that the most preferred three options are concerts and outdoor festivals, followed by outdoor shows and indoor performances. By using this information as input during decision-making processes or planning strategies for public events, the airport has the opportunity to tailor their strategies to account for these preferences and address local needs.

When asked about visiting different organisations during events such as "open-days", the airport was rated as the 8th most preferred option, out of a total of 12 answer options. In addition, 80% of respondents indicated they found it interesting to participate in such events. Although the interest in participation in such events

is high, few people indicated having participated in airport open days. In this sense, the airport has the opportunity to look into further details about what determines an increase in participation to such events to be able to understand local needs, especially since the airport also periodically organises several such events.

Another question was regarding the general feeling about certain institutions, areas and services, where the air transport was rated with most responses for "Neutral feeling", followed by "Positive feeling" and with only few responses for "Negative feeling". Keeping in mind these results, the airport could further investigate the rationale behind these general feelings to understand how to strengthen the "positive feeling".

When asked about how much their interests are taken into account from different institutions, the responses for the air transportation system, rated "Sometimes", followed by "Never" and "Seldom". In this case, there is the opportunity to look into further details with respect to identifying and understanding the underlying factors that determine this response, as well as to get insight into the manner in which the residents would like to be further engaged.

At the question discussing the role of residents within decision-making processes in different institutions, most responses were "to be informed", "I have no role", or "to make proposals/ recommendations". When further asked in which institutions they would like to be involved, the top three answers were the "local authorities", "the educational system" and "the Government". Even though the airport is rated among the last options of interest for being involved, this feedback still could represent an opportunity to reinforce communication and engagement with communities, such that we raise awareness about the measures and strategies developed for environmental protection and for the wellbeing of communities. Although this finding could also be interpreted as is (that people are satisfied with their involvement), the finding that people mostly felt their interests to be taken into account only sometimes contrasts that interpretation.

Regarding the quality of the environment from the area of the respondent, most respondents rated it as being "moderately polluted", followed by "very polluted". In terms of separate collection of waste for recycling, the most rated options were plastics, paper or cardboard and glass and some respondents also emphasised the absence of individual containers in their region, to collect waste separately. Since the airport is also actively engaged in separate collection of waste for recycling, raising awareness about options that the airport could have to offer to communities in this sense, could benefit the residents that are interested in engaging in such actions, especially since the absence of individual containers for separate collection was highlighted as an issue.

With respect to energy efficient solutions that are commonly used by the population, most people rated economical lightbulbs, house insulation and energy efficient devices as being the most used options. In this respect, the airport is familiar with many such solutions, that have been already implemented within its premises, therefore raising awareness about the available options at the airport and others that are planned for the future, could benefit the community in learning about possibilities to implement within their own houses.

The three main air pollution sources are rated to be the road traffic, construction sites and urbanisation activities. However, additional options were added by respondents to the initial choices of answering, most of them being formulated around waste management. The three main sources for water pollution were related to industrial activities, urbanisation activities and construction sites and in the case of soil pollution, the three main sources list urbanisation activities, industrial activities and road traffic. Regarding biodiversity, the three main factors with negative impact in the area are deforestation and habitat loss, pollution from road traffic and urbanisation activities. In all these areas, the airport has the opportunity to increase communication efforts towards being open and transparent about all actions pursued in all these areas, especially when undergoing infrastructure development activities, one example being the plan for developing the intermodal project. In this sense, it could raise awareness about how the airport is taking measures to reduce the environmental impact during construction operations, as well as how the impact is expected to be after finishing the development process, both for the environment and for the quality of life of residents, as well as learn about community concerns that could further be taken into account by the airport.

In the section for rating the three main noise pollution sources, road traffic, construction sites and air traffic were mentioned by most participants. In addition, another question was formulated around the annoyance from different sources from the last 12 months. In the case of air traffic, most responses were for the answer "Slightly annoyed", followed by "Moderately" and "Not at all". In addition, for the sleep quality, most people rated, "Good sleep", followed by "Fair" and by "Very Good". Approximately 10% rated the sleep quality as being poor or very poor. By considering the fact that noise has been highlighted as being the most important environmental issue in connection to the airport, this gives the opportunity to the airport to focus on this issue more in the future, both in operation as well as in possible further studies. One other potential direction of research could be to investigate the relationship between noise, annoyance and sleep quality, to understand how to maintain or reduce annoyance and increase sleep quality in this local context.

Respondents indicated their houses were mostly insulated for heat, followed by situations in which insulation was applied for both heat and noise. Some respondents indicated having no insulation, or not knowing about it. Most insulation actions were performed through personal investments. In the absence of noise zoning provisions within the national legislative framework, the airport could only support authorities in their efforts to develop effective noise insulation schemes, especially since noise has been concluded to be the most important environmental issue in connection to airport operations.

When asked about from which organisations they would like to receive more information related to environmental issues, most respondents selected the Government and local authorities, NGOs and companies from the industry, placing airlines and airports on the fifth selection, out of a total of 8 options. The most preferred data formats for receiving information about these aspects are under the form of short articles, audio-visual content and reports or evaluation documents.

The least preferred option was through posters and announcement boards. Despite being the fifth option of interest for residents, communication and engagement with communities is necessary, by initiating, facilitating and maintaining open-dialogue and an environment of trust and transparency. This feedback also gives the airport an insight into what communication tools are considered to be more efficient and could support it in its future planned actions for dissemination of information.

Discussion

According to the main focus of the case study and its intent, there are several opportunities that have been identified for the airport to increase the quality of life of residents living around the airport. QoL was a complex unknown in the absence of studies connected to the airport. Therefore, addressing QoL aimed at supporting the design of effective interventions to reduce noise and improve QoL concomitantly and thus point towards the need for understanding noise impact in a wider view at the level of the day-to-day experience of people.

This case study has been in pursuit of understanding how to address QoL, how to design steps to select appropriate QoL dimensions/indicators (tailored to the context) and how to capture the process of understanding individual QoL priorities. One important aspect to mention is the fact that the local context is very relevant within the design of such a study, especially for choosing particular QoL dimensions/indicators (e.g. if it is known that the future strategy of the city is oriented on solutions for GhG reductions and climate neutrality, then separate additional questions can be formulated on this topic to gain a more in-depth understanding of the intensity of the issue/ pressure). In the case in which it was assumed that some indicators can be weakly connected to the capabilities of the airport to influence QoL, they were approached at the level of general understanding, having limited the number of questions in this sense or combined different such QoL elements under the scope of one question when potential overlaps were identified (e.g. criminality, mortality, theft etc.). This facilitated the possibility to focus more on areas that were expected to be of more importance and more strongly connected to airport activities by addressing more questions in these areas, while having a limited number of questions - based on the assumption that a lower number of questions determine a lower period of time for responding the questions and therefore the response rate could increase (accounting for criteria such as focus of questions, response rate, quality of results, ability to gain insight both at general QoL level but also on specific QoL elements).

Capturing the process of understanding QoL priorities is complex at can be approached in a broader manner or at a more specific level (e.g. when focusing on understanding only few QoL dimensions/indicators). Depending on the level of detail of the understanding set to be reached, questions could vary also timewise in formulations from assessing the situation 'in the last 12 months' to 'during your last experience'. For example, if transportation is addressed in light of gaining a general perspective, then approaching each means of transportation might be out of focus; on the contrary, if this is the main generator of valuable input, then each transportation mode could be addressed separately in terms of different characteristics (e.g. affordability, connectivity, travelling conditions/ comfort,

source of noise, source of emissions, exposure and impact from this source, contribution to AQ, expected changes in the future – such as changing buses from classical to electrical ones). Understanding different QoL perspectives on these key areas could further guide the design and implementation of different airport developments, operations or procedures (e.g. NADP implementation/ planning RWY extensions/ intermodal implementation tailored to resident expectations to optimise efforts towards achieving a positive QoL impact).

In terms of identifying opportunities for airports to influence in a positive manner QoL, it was considered necessary to identify what actions were specifically designed to influence QoL (directly or indirectly), what actions were not designed to impact QoL (directly/ indirectly) but have influenced it as unexpected outcome. In addition, completing this knowledge with the priorities identified from residents, this approach allowed the identification of main concerns of communities that could/ could not be influenced by the airport. Furthermore, this can guide the planning process for the identification of future activities to gain more QoL-related knowledge in relation to the airport to improve, by focusing on key areas of improvement. At the same time, progress in this sense is beneficial in terms of learning for other airports and can also identify gaps in knowledge in terms of novel approaches for airport noise management.

F.2.5. Other Relevant Information

Findings from this study could support the existing collaborative initiatives between aviation stakeholders (e.g. airport-ANSP protocol), including the intention of establishing CEM (Collaborative Environmental Management)[97], by offering insight for possibilities to improve existing/ future decisions related to operations (at the airport and in low-level airspace), for example by establishing trade-offs when addressing interdependencies between noise and emissions. Results also can contribute through a better understanding of community priorities or concerns (e.g. noise sources) to the implementation of the intermodal project, such that it explores options to increase QoL (e.g. facilitate access to hospitals/ schools) or prevent potential negative impacts. Similarly, this information can feed relevant information to LUP ongoing national efforts on defining legislative provisions, through insight on noise zoning and noise insulation to prevent or control encroachment.

F.3. Conclusions

A rapidly-growing city airport, Cluj Airport is actively engaged in being an innovator in terms of transport investment in transport and air side infrastructure, such that all changes are contributing to the path of becoming a carbon neutral airport. Therefore, focusing on identifying best practices and tailoring solutions for their context, the airport is always interested in understanding QoL and health impact in a way that allows the identification of benefits for citizens in the region. The importance of this study is highlighted by its successful approach on the overall ANIMA aim, being an example of designing an effective intervention, especially in spite of the existence of various barriers due to the COVID-19 context.

97 https://www.eurocontrol.int/publications/eurocontrol-specification-collaborative-environmental-management-cem

Additionally, it has represented a strong relevant extension to the QoL audit framework previously developed in ANIMA (D3.1) and the extensiveness of the study has aided in the identification of various areas of improvement, emphasising the need to understand noise exposure and its impact through a wider investigation of the daily experience of residents.

F.4. Recommendations and Lessons Learnt

Understanding QoL from two different perspectives (airport and residents) was a successful but complex process. This can especially be the case in situations in which there is little or no available knowledge on the topic, as it was the case here. Therefore, in order to make the first steps in understanding how to increase the wellbeing of communities in the proximity of airports, such an approach could provide a basis for understanding the airport-community relationship.

Although most existing interventions about QoL in connection to airports focused mostly on an organisational and the aviation/ professional perspective, the current study has focused on a more community-centric approach, thus complementing existing knowledge in approaching interventions. Since the aim of Cluj Airport, as a rapidly growing airport and as 'Starting the Journey' within noise management, is to focus on development opportunities (while fostering good relations with neighbouring communities), future research in connection to the environmental studies performed for the intermodal project could be performed to link findings from this study and refine environmental goals in line with population expectations. Another interesting link could be to the Level 1 carbon accreditation, to address openly the environmental concerns in an integrated manner.

Fostering good relations with stakeholders has always been in focus for the airport. The case study has shed some light on how an airport could start identifying opportunities to engage with communities based on their priorities and learn to address QoL in a more systematic manner, aiming at gaining benefits across stakeholders (aviation, communities, policy-makers, other industries) by understanding the relation between interventions and acceptability of outcomes. Understanding QoL priorities among most stakeholders could be in support of dialogue, communication and engagement and contribute to sustainable local/regional/national strategies and facilitate synergies with noise management (following correlation between aircraft and road noise annoyance) while avoiding unintended consequences (i.e. by reducing impact from one environmental issue and increasing another). A collaborative environment could later give the opportunity to investigate long-term QoL priorities for stakeholders, investigate priorities in terms of interdependencies (noise/annoyance, emissions, AQ, others) and gain an in-depth understanding of the perception of the role of the airport in the region (e.g. beneficial in terms of economic gain, social benefits from travelling opportunities etc.).

Research findings benefit a wide scope of stakeholders (academia, policy-makers, communities, industry) by providing knowledge and guidelines for future research directions needed with respect to QoL dimensions and indicators, raising awareness on the importance of understanding differences in QoL priorities and on the need to extend the investigation to include other actors. This aims at raising

awareness about potential QoL benefits in the area through engagement opportunities, allowing the entire community (residents, industry, policy-makers) to identify common needs and resources, together with consensus solutions.

By having identified previously implemented measures by the airport, this can allow future research to make connections between different airport noise sources (especially in connection to the intermodal project) and QoL-related measures (intended and unintended) in a more practical manner. Since few studies about the relation of aircraft noise exposure and wellbeing, QoL and psychological ill-health exist, this remains a strong research need and gap and addressing directly non-acoustic factors such as annoyance and sleep disturbance under the scope of QoL could be beneficial to complete the understanding of this area of research. For example, in the current case (national context), evaluating sleep quality is approached as a health component and as a noise management component, being treated differently across legislations. In this case, the QoL spectrum is able to capture both approaches and connect any potential missing links.

Opportunities for future research. No discussion/ focus groups between the airport and residents could be done (due to COVID-related limitations), but might nevertheless be an insightful opportunity to discuss the findings from the present study. More in-depth knowledge could be gained from any future progress focused on the definition of the perspective of residents on QoL, especially by addressing other aspects (e.g. perception of physical safety at the premises of the airport vs. in the proximity of the airport). Moreover, repeating the study in other contexts (e.g. post-COVID, other airports, different local culture) might help understand which findings could be generalised, and which ones are strongly context- or culture-dependent.

F.5. ANNEX – ROUNDTABLE

INTRODUCTION

As a final action to complete the information from the three case studies on Iasi and Cluj airports (LUP, interdependencies and QoL), a roundtable was organised. The findings from the three case studies were presented and later discussed among participants. Participants included representatives from MMU, INCD-T COMOTI, Cluj Airport, Iasi Airport, ROMATSA Bucharest, ROMATSA Cluj and BLUEAIR.

1. INTERDEPENDENCIES CASE STUDY (COMOTI in partnership with Cluj Airport and BlueAir)

This study was specifically performed for the context of Cluj Airport. Therefore, results are expected to vary in the case of another airport context, due to various factors, such as the real distribution of population and topography. Furthermore, different study outcomes are expected in terms of noise and emissions from one city to another due to the real number of inhabitants and distribution of residential buildings, possibly having differences in the concentration of houses in a district in a city, as well as from the proximity to the airport. These different characteristics

of a city/ village, when cumulated, they could further support the development of a more accurate depiction of the communities describing the airport context. At the same time, the Cluj region has a certain topography that influences the superposition of noise maps over the area, therefore one can assume that the study results from one airport context are not necessarily applicable to another airport context (e.g. existence of hills in the Cluj region). Therefore, such studies cannot be generalized to all airports and they need to be tailored according to the local context to obtain appropriate results for each local context. In this sense, it is very important to continue the case study that was started in Cluj to improve the existing model and the results such that they could depict different air traffic scenarios for a more accurate distribution of population, such that this model could support the capacity of airports to be equipped with prediction methodologies/ tools regarding noise, emissions and air quality. At the same time, the development and validation of such resources could further facilitate knowledge transfer to other airports. These actions should further support the investigation of means and solutions through which the current situation can be improved.

It was highlighted that some airports will be interested to reduce their noise exposure, while others will focus more on emissions and air quality. Therefore, the role of interdependencies, apart from understanding the effect of operational procedures, is to aid in implementing specific procedures that focus more on noise or emissions. In this sense, these types of studies are supporting key aviation stakeholders in decision-making processes related to implementing operational procedures favourable towards reducing noise, emissions or both (e.g. CDA).

It is important to keep in mind that interdependencies involve three major actors: the airport, the airline and the ANSP. This acknowledgement is crucial for implementing environmentally friendly operational procedures, taking as an example the NADPs that were studied in this case study. One key asset of this case study was specifically the involvement of the three major actors during the exploration of the idea of interdependencies, since airports are not usually engaged in such changes, even though this is the main actor that is the frontline agent with communities. Although airlines and ANSPs are generally in favour of operations focused on reducing emissions (especially in connection to climate change and costs related to emissions), airports face noise as the biggest challenge and are in a situation far from beneficial due to the unavailability of means to express in terms of needs (since the airport cannot influence operational procedures and, in most cases, it can only act on ground operations). Therefore, the aim of this case study was achieved in an additional manner by supporting the airport to become integrated in a working group that wants to continue with similar studies within future projects in the next 5 years.

The interdependencies case study has made the first steps towards creating a methodology on studying interdependencies in Romania, which can further contribute to the European research agenda. In this respect, the local team that is still under development (airport, ANSP, airline, communities), will focus on such topics to explore and exploit the results of these studies and also to support knowledge-building in the area and facilitate knowledge-transfer to other airports from Europe.

2. QUALITY OF LIFE CASE STUDY (COMOTI in partnership with Cluj Airport, MMU, NLR, ZEUS)

The QoL study was considered to be very important to the airport context. One aspect important to highlight was the fact that, although it was available only in an online format for all surrounding communities, as it was performed during the COVID19 pandemic, a high number of responses were collected (more specifically, 256). The results were analysed by the research team and disseminated with the airport and this was very important because the airport is highly interested in understanding the quality of life of the population from Cluj. In order to be equipped with the necessary means to implement measures in this sense, a local group was developed to further progress on this topic too.

The usefulness of this study is first at the local level and extends towards the European strategy that is citizen centric. Therefore, the continuation and development of this study is desired. If possible, it is considered to be useful the involvement of additional Romanian airports, at least at the level of awareness (e.g. dissemination through regular meetings of the Romanian Association of Airports). In the future, studying QoL could go into investigating certain indicators in a more in-depth manner, from noise to emissions and to impact over climate change, especially since aviation has high targets on reducing emissions in the next years. Such a study could represent a parallel support for defining a methodology related to how to balance noise and emissions over climate change and air quality (with health impact). Therefore, connecting this study with health impact and with a wider QoL study, focused on environmental issues, could be an opportunity for the key aviation stakeholders in the community (airport, ANSP, airline) to engage with Cluj Municipality to start a methodology at the level of communities and explore wider opportunities together. Such engagement is considered to be very important, since the Cluj Municipality is highly active in different types of studies related to the wellbeing of residents and also in assuming a leadership role at the level of Romania in terms of becoming a smart, clean and green city.

By keeping in mind that airports cannot influence the process of selecting the use of either NADP1 or NADP2 (or others), one additional stakeholder was identified as being able to support throughout this process. In the case of regional airports (in connection to county councils), the Environmental Agency could also contribute within the decision-making process (for the selection of different types of operational procedures) with the provision of a methodology in favour of residents living in communities near airports. This methodology could guide airports and all other relevant stakeholders in implementing ICAO Balanced Approach solutions.

3. LAND-USE PLANNING CASE STUDY (COMOTI in partnership with Iasi Airport)

Starting from the discussion related to the implementation of noise-related operational restrictions, it was acknowledged that the expected future air traffic growth will limit the efficiency of these measures. Therefore, such solutions are only short-term oriented, as they are not applicable to their full extent all the time and they are restricted by different other factors (e.g. meteorological factors,

safety etc.). In order to try to be properly equipped with the necessary means to tackle future challenges related to the increase of the noise risk, apart from a noise monitoring system, other actions should be initiated in partnership with Municipalities. It was emphasised that it is desired in the future to have the ability to include the environmental risks (such as aircraft noise) within construction permits, to ensure that the information describing the real context is available to real-estate planners and potential residents in the area and that all risks are properly understood and possibly managed in a preventive manner (e.g. through noise insulation of buildings). Therefore, noise management should be tackled on multiple facets and this could be another solution. This could be seen as a short-term measure before the entire legislation related to land-use planning will change.

In the case of the airline, noise is one of the most pressing issues and the company has developed throughout time many noise policies, which are already implemented in different European airports (e.g. Paris Charles de Gaulle, Barcelona). Even so, the greatest challenge is the fact that managing noise has become a trade-off between noise solutions. More specifically, in spite of the efforts (development of policies, training of personnel, costs) of the company to be proactive in tackling noise for the benefit of communities and for becoming compliant with existing measures to reduce noise (e.g. by using NADPs), noise taxation systems still increase, therefore the expected outcomes in terms of environmental targets and costs are not achieved of intangible and cannot be quantified. Therefore, it is considered that there is a great opportunity in Romania to collaborate with airports and the ANSP towards the development of operational procedures that support the efforts to protect the population, but this opportunity should progress in parallel with a proactive approach at the level of Romania related to LUP, in order to support and enforce the implementation of environmental management solutions before the complexity of these issues increase.

Noise maps are considered to be very useful tools. The manner in which they are developed is very important, especially when taking into account the existence of noise measurements along the flight path, together with measurements at the airport level and extrapolations towards communities through the use of mathematical models. It is desired in the future to have a comparison between both approaches in order to build a more realistic view about the noise context in communities. In order to correlate noise measurements in the city with the mathematical model, by taking into account the configuration of Cluj-Napoca city, it is considered necessary in the future to perform such measurements in different points to reduce uncertainties in evaluating existing noise and predicting noise (e.g. at the ground level, at the roof level). This should also support in building knowledge about the contribution of the architecture of the city towards noise propagation and therefore to understand how is this influencing the noise perceived by residents.

In terms of future studies in this region, it is necessary for the ANSP, for airlines and for the airport to properly understand how noise produced by air traffic is perceived by residents at the ground level. This is highly important and a need in terms of knowledge to support noise management efficiently, especially in the case

in which airlines implement different types of operational procedures for noise abatement and are compliant with noise limits, yet noise is perceived differently by communities. Briefly, a study that comprises noise measurements in different community areas (both at the ground level and at the level of the roofs of buildings) is a necessity at the moment, in order to advance in understanding the real noise exposure context. This should be performed before measures are implemented at the Municipality level (i.e. LUP), in order to support the definition and implementation of appropriate provisions. This need comes directly from constant discussions with residents and communities and from their questions towards the airport and the ANSP and as a result of the unavailability of such complex studies in the region, both stakeholders are unable to be equipped with the necessary knowledge to support actively in improving their life in this communities.

The last point is suggested as complementary to the approach started within Iasi case study, as one main target was the appropriate distribution of responsibilities among all relevant stakeholders. This was followed especially in pursuit of creating a fruitful environment for the application of solutions for noise management and avoid situations similar to airlines implementing noise reduction operational procedures (in the air) and still get fined for noise (exposure and impact at the ground level). At the same time, compliance with noise operational procedures might have a penalty on emissions, leading to an increase in fuel consumption and additional costs too. Therefore, the approach should divide responsibilities among all participants and beneficiaries of air transport, from the citizen that travels (with a medium to higher income), the community that has economic benefits from being situated in the vicinity of the airport, the airport, local administrations and so on.

Distributing responsibilities was key within this case study for pursuing an improvement related to aviation noise management. The case study was useful for identifying certain legislative gaps, for example the necessity for changes within authorisations for constructions to include provisions related to the environmental context. In this sense, legislative changes have been encompassed within the legislation, but have not been detailed yet in a methodologic manner such that they could be implemented, to have a clear situation about who is responsible with the evaluation of compliance with provisions, who imposes the obligations to the local administration/ terrain owners regarding the nature of constructions, for the land from the vicinity of airports.

4. OPEN DISCUSSION. OUTCOMES AND FUTURE PROGRESS BEYOND ANIMA PROJECT

At the level of Cluj Airport, a team of experts on environmental issues was formed. At the airport level, it includes experts from the environmental management office, from the operational office (responsible for noise monitoring and communication with the ANSP). The external level includes representatives from airlines, the ANSP and representatives of surrounding communities. The main focus of this working group is currently on an operational procedure that was developed by the airport with the ANSP. This action is strongly connected to improving the manner in which noise is managed, with a focus on aircraft that overfly the Cluj-Napoca city during

the night time (23:00-07:00). Further, the team aims to explore all existing options to improve communication and engagement with communities in pursuit of designing and implementing environmentally friendly and sustainable solutions that protect the residents in the vicinity of the airport, while allowing a harmonised development of airport operations.

In general, most airport efforts are focused on dealing with environmental issues, mainly focusing on reducing the exposure and impact effects over residents. Therefore, this goal is mainly going to be monitored in relation to the number of noise complaints, aiming to reach and maintain noise targets and ensure compliance with legislative provisions as a first step. This approach is formulated as a result of recent legislative changes and proposed to be accomplished with a parallel communication and engagement campaign with communities. Therefore, the airport is always in contact with residents. Future progress for improving this relationship will possibly include constant updates on the website of the airport, information that could also be relevant to other interested parties, outside communities from its vicinity.

Previous relevant airport efforts include the development of a study related to the health of the population and also the deployment of a continuous noise monitoring campaign, that is currently only at the airport level.

Notable to mention is also the infrastructure development plan (medium and long-term) that was tailored based on environmental targets. Currently, the runway extension project is ongoing, aiming to support indirectly the reduction of noise (e.g. through ensuring a longer surface that allows different take-off and landing points, therefore influences the height at which aircraft overfly communities). Another important on-going project is the construction of a taxiway that facilitates the fast movement of aircraft at the ground level, therefore supporting indirectly reductions in noise and emissions due to the shorter distance for aircraft to move on the ground and to the reduction in fuel consumption. On the medium and long-term, the development of a stationary platform is planned, which is going to be placed near the Apahida village, which is in the opposite side of the Cluj-Napoca city. Other future plans include the development of a cargo terminal and also the active engagement in future European projects tackling environmental issues (reducing noise, improving QoL).

At the level of Iasi Airport, the approach that started on supporting the definition and implementation of LUP provisions within the national legislative context is desired to be continued up to reaching its outcomes. More specifically, this means that the moment when the implementation of air traffic noise restrictions for the construction of residential buildings/ schools/ hospitals will occur within Urbanisation Plans, then the legislation could be evaluated if it has achieved its outcomes. This should further secure the wellbeing of the population in the region and support airports and air transport on the long-term. In order to achieve this, the support of all key aviation actors from Romania will be needed and the airport is open to future collaborations in this sense.

CONCLUSIONS

The most important premise for developing the three case studies was to develop knowledge mainly for airports in understanding how to protect residents around airports from the existing and future noise context, followed by some investigation around other environmental factors and QoL implications. Although progress was made through this research, future needs still include the active engagement of all relevant stakeholder in how to balance properly airport, ANSP and airline efforts for reducing/ mitigating these issues in a context of high expected air traffic growth and uncoordinated increase in residential areas.