THE ROLE OF NOISE INSULATION SCHEMES IN AIRPORT NOISE MANAGEMENT

J. Baggaley Anderson Acoustics. Ltd. UK.
L. Dellatorre Anderson Acoustics. Ltd. UK.

ABSTRACT

The value of the connectivity provided by aviation to drive global trade and development is recognised. Air traffic is expected to grow substantially the near future with airlines predicting more than a 30% rise in passenger demand by 2017[1]. The aviation industry recognises that environmental and social responsibility is a critical component of its ability to grow. Among the environmental impacts with a social effect, aircraft noise is generally considered the most important issue for local communities. Using objective data gathered through noise survey work as well as subjective information gathered from the community, the aim of this paper is to understand the role noise insulation schemes play in airport noise management. Do they work? Do they make a real difference to the lives of the local community and can they make a difference to the view of the local community towards the airport.

1 INTRODUCTION

The noise environment at various airports has and will continue to change over the next decades. Whereas improvements in technology have made aircraft 75% quieter than they were 50 years ago, air traffic has increased by more than 150%[2]. According to Sustainable Aviation, aircraft noise (as measured by conventional metrics) is not likely to increase even with the doubling of movements over the next 40 years[3].

Noise management should now be seen as a critical element in obtaining a social licence to grow and therefore effective strategies should address local needs, deliver real value for communities and allow for sustainable growth.

Traditionally noise management strategies have focussed on reducing noise levels and the number of people exposed through advances in technology, optimising procedures and introducing operational restrictions. As a result, the number of people exposed to noise around airports has declined, however noise still remains the major cause for communities around airports.

Within this context, the aviation industry is facing a set of challenges including:

- The responsible management of the impacts of aircraft noise on health and quality of life. The quantification and monetisation of these effects are critical issue for policy and decision-making. These issues have been considered in our recent paper [4].
- The need for more targeted metrics to describe noise and its impacts in a meaningful and trans- parent way. This topic was explored in our recent paper [5].
- How to address the trade-off between sharing and concentrating the noise burden.
- Understanding the perceived value of respite for communities and delivering effective respite from aviation noise. At present there is a Respite Working Group in the UK that are considering the issues and are considering research needs in this area. At the time writing, a report from this group has yet to be published.

- Providing effective noise insulation schemes in terms of reducing noise levels while increasing community satisfaction and tolerance towards the airport.
- The development of actions that tackle community perception and integrate non-acoustic factors within current airports noise management strategies.

This paper focuses on the role of residential noise insulation schemes and is based on first-hand experience gained through designing and implementing a pilot noise insulation scheme at one of the UKs busiest airports.

2 IMPACTS

In order to understand the role residential noise insulation schemes play in airport management it is crucial to understand the impacts for communities living close to an airport.

From a purely acoustic perspective the obvious impact is aircraft noise. Aircraft noise can be considered in terms of decibels and then benchmarked against recognised standards that provide limits for habitable rooms within homes, See Table 1.

Table 1. Recognised acoustic standards for internal noise levels

	Day time $L_{Aeq,16hr}$ (Living Rooms)	**Night time $L_{Aeq,8hr}$**	**Night time $L_{Amax,8hr}$**
WHO [6]	**3**	**3**	**4**
BS 8233 [7]	**3**	**3**	**4**

It is widely recognised that exposure to high levels of noise can have negative effect on peoples health and quality of life. Potential indirect health impacts can be both physiological, such as cardio-vascular disease and hypertension as well as psychological, such as annoyance, sleep disturbance, mental health and cognitive development.

However humans are complex creatures and our responses to exposure are influenced by many elements besides the pure acoustical ones (noise characteristics), such as personal, attitudinal and social factors. So over and above the issue of noise are communication, empathy, trust and expectation, and if these aren't correctly managed, the effect of aircraft noise on annoyance and hypertension is likely to increase.

3 THE APPROACH

In collaboration with a major UK airport a pilot noise insulation scheme was designed to address these impacts and gauge community reaction.

At this airport the existing schemes, despite being aimed at both night-time noise, had seen low percentage of take-up of the insulation offer since their inception in the 1990s. These schemes present a 'one size fits all' noise insulation solution for homes with a single product specification, from a single supplier. Following stakeholder consultation in 2011, the airport developed a 'pilot' scheme to address some of the key issues identified – this pilot scheme included an individual property acoustic assessment, products to fit a range of acoustic specifications, multiple installers to provide resident choice and greater focus on community engagement.

The key elements of the pilot scheme are:

- A visit to each property to undertake attended noise measurements of aircraft noise and determine existing conditions.

- An acoustic assessment of the building envelope undertaken on each property to determine the need for noise insulation, with a view to achieving internal noise levels as close as possible to BS82336 and WHO guidelines [7].
- A range of noise insulation in the form of replacement double or secondary glazing (on existing windows), acoustic specification ventilation, upper floor ceiling linings and loft insulation. The double-glazing and ventilation products available providing differing levels of acoustic performance – Standard, High and Enhanced (with both high and enhanced providing a higher level of sound insulation provided under current scheme).
- Varied contribution from the airport to the cost of installation based on zones relating to proximity to airport and noise exposure level: Zone 1 (>69dB) - 100% contribution, Zone 2 (>66dB) - 50%, Zone 3 (>63 dB) - 25%. In all cases, the airport met 100% of the cost of ventilation, loft insulation and secondary glazing.

At the end of the pilot, residents were surveyed and feedback gathered, to try to answer key questions such as:

- Can noise insulation schemes make a real difference to people's quality of life?
- Can a hands-on assessment approach influence a community's opinion towards an Airport?
- Is financial contribution a dominant factor affecting take-up, or is it other factors such as product range and engagement?

3.1 Take Up - What people thought

Residents around the airport were informed of their eligibility for the pilot scheme via leaflets dropped through the letterbox. It was the responsibility of residents to respond to the leaflet by registering for the scheme online or by telephone.

Table 2. Pilot scheme

	% Financial contribution	Leaflets sent	Properties assessed	% Take up
Zone 1	100	329	130	40
Zone 2	50	909	55	6
Zone 3	25	1,089	105	10
Total		2,327	290	12

It can be seen from Table 2 that overall take up of the scheme was low, particularly in Zones 2 and 3. Take up in Zone 1 was highest, however given that 100% contribution to noise insulation was offered the 40% take-up was lower than expected. There are many factors that could affect the take- up however these numbers indicate that the financial contribution of the airport could play an important role in overall take-up.

To investigate low take-up, residents who were eligible but did not register with the scheme were visited during the day-time in each zone. Overall, 48 residents agreed to complete the survey:

- 62% were aware of the scheme.
- 42% said they had received the leaflet.
- 80% read it with 20% deciding not to read the booklet.

Residents were then asked why they chose not to engage with the scheme; the findings are presented in Figure 1.

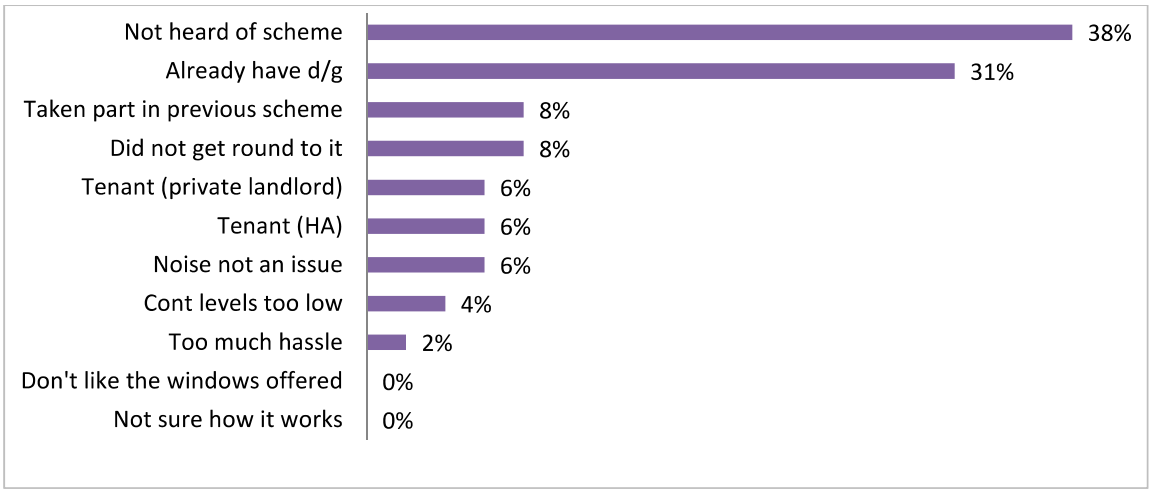

Figure 1. Reasons why residents chose not to register with the scheme

The residents were then given a breakdown of the key features offered by the pilot scheme to gauge what they found most interesting/appealing, displayed in Figure 2.

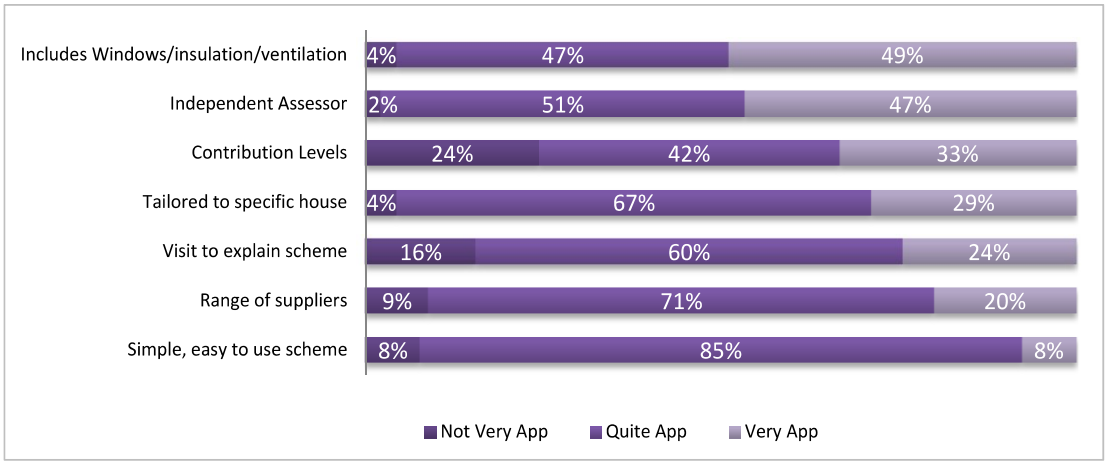

Figure 2. Scheme elements valued by residents

It is recognised that this is not an exhaustive survey, however this feedback suggests:

- Effective marketing at the initial information stage is vital. The primary reason cited by residents who did not register with the scheme was a lack of awareness.
- Not all properties are relevant, a large proportion of residents already had double-glazing (or had taken part in an existing scheme) and so did not feel there was any value in taking part. Indicating that they thought all “double glazing” has the same acoustic performance and so could not be made better. Marketing of the scheme is again important to rise of awareness that an alternative may improve performance.
- The elements offered under the pilot scheme are considered appealing - 80% of the residents found the elements ‘quite appealing’ or ‘very appealing’.
- The appeal of the financial contribution varied between areas, with those in Zone 1 finding it “very appealing”, those in Zone 3 “not very appealing”.

4 THE ASSESSMENT

One of the key aspects of the pilot scheme was the introduction of the visit to the property to undertake an individual noise assessment, an overview of the process is presented in Figure 3.

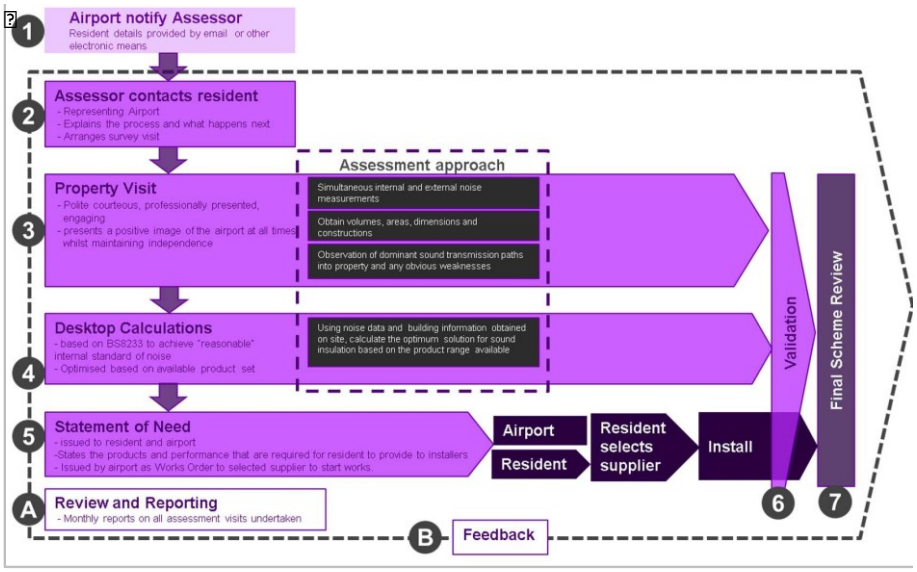

Figure 3. Pilot Scheme – Assessment Process

4.1 The Assessment Visit

Each individual property was visited. During the visit simultaneous sound level measurements were obtained inside and outside the property. Additionally, since a key aspect of this pilot was to engage with the community at an individual level - care was taken to explain the scheme and answer questions about the airport.

Simultaneous aircraft sound levels were measured inside and outside a minimum of two habitable rooms within the property, the rooms were chosen on case by case basis but where possible a living room and a bedroom were assessed on the side of the property that most commonly face aircraft. During the survey all windows and existing ventilators were closed. Sound level meters were set up to record continuous aircraft noise levels every 0.1 seconds for approximately 30 minutes per room. Third octave band noise levels were obtained using the 'Fast' and 'Slow' time weightings.
Post-processing of the results enabled us to determine aircraft event maximum noise levels and aircraft specific noise event information. A measurement period of 30 minutes allowed us to gather noise levels for a representative mix of aircraft.

Simultaneous internal and external measurements enabled us to determine the sound reduction performance of the existing building envelope.

During the survey period the time and type of aircraft, room dimensions, external element areas and external building fabric constructions and condition were noted. The data gathered enabled us to tailor mitigation measures specifically to each property which we then issued to the resident and airport in a short report (known as a "statement of need") which identified the products and specification considered necessary.. The suppliers were then informed so that they could make arrangements to visit to provide a quotation for the works required in the "statement of need".
In total 290 properties were assessed with varying acoustic specifications provided, a summary of the typical mitigation measures for properties across the three zones is presented below in Table 3.

Table 3. Range of mitigation

	Properties assessed	Noise insulation solution
Zone1	130	Enhanced spec glazing and ventilation throughout with ceiling overboard in bedrooms.
Zone 2	55	Enhanced spec glazing and ventilation in bedrooms with ceiling overboard. High spec glazing and enhanced ventilation in living rooms.
Zone 3	105	High spec glazing and enhanced ventilation in bedrooms. Standard spec glazing and high spec ventilation in living rooms.

4.2 Resident Feedback

To gauge what the residents thought about the process a survey questionnaire was sent out with each report, 40 responses were received (16%). Analysis of the survey responses provided the following feedback,

- 97% of residents felt the contact time from assessor after initial registration was reasonable.
- 100% of residents found us polite and courteous when visiting their homes to undertake the assessment.
- 95% of residents had a good understanding of the scheme after our assessment visit.
- 100% of residents were satisfied with the assessment process, 96% said they were either satisfied or very satisfied.
- 100% of residents felt the assessment was a valuable element of the scheme, 70% thought it was very valuable.
- 75% residents think that any future scheme should include a noise assessment process
- 93% of the residents felt positive about the scheme as a whole

5 RESULTS

Once a resident had gone through the process and had, had a noise insulation package installed a validation survey (repeating the noise survey procedure) was undertaken. This enabled us obtain an indication of the improvement of internal noise level as a result of the installed package. Approximately 10% of the properties involved were validated. During each validation visit subjective feed- back was obtained from the resident.

The airport appointed an independent research company (Circle Research) to survey residents in the scheme and to compared feedback gathered on the existing schemes.

5.1 Objective Results

In all cases we found that the internal noise level and sound reduction performance of the external building envelope improved in all cases. The level of improvement varied from property to property due to contributing factors such as the condition and type of previous glazing, proportion of glazed area in the external wall and quality of workmanship. The before and after results are summarised in Table 4 below.

With reference to the standards set out in Table 1 the measured internal ambient levels generally met the criteria in living rooms and marginally exceeded the criteria in bedrooms.

Table 4. Aircraft noise levels in homes (before and after scheme)

	Before	After
Living Room $L_{Aeq,T}$	40-50 dB	35-40 dB
Bedroom $L_{Aeq,T}$	35-45 dB	30-35 dB
Bedroom $L_{max,T}$	50-60 dB	45-50 dB

5.2 Subjective Results

In support of the objective results, feedback from residents was also positive. In each of the properties validated the resident confirmed that subjectively noise from aircraft inside their home has reduced.

Following completion of the scheme the airport commissioned Circle Research (an independent research company) to gather feedback from residents. They sampled 25 properties that took part in the pilot scheme as well as 25 properties that had previously taken part in the existing schemes.

The research found the following

- Residents participating in the pilot scheme felt more positive towards the airport than those who had previously taken part in the existing schemes:

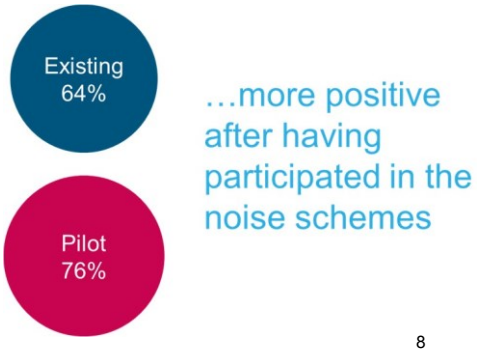

Figure 4. Positivity towards airport[8]

- The residents taking part in the pilot scheme felt that there had been a greater improvement on their quality of life than those in the existing schemes:

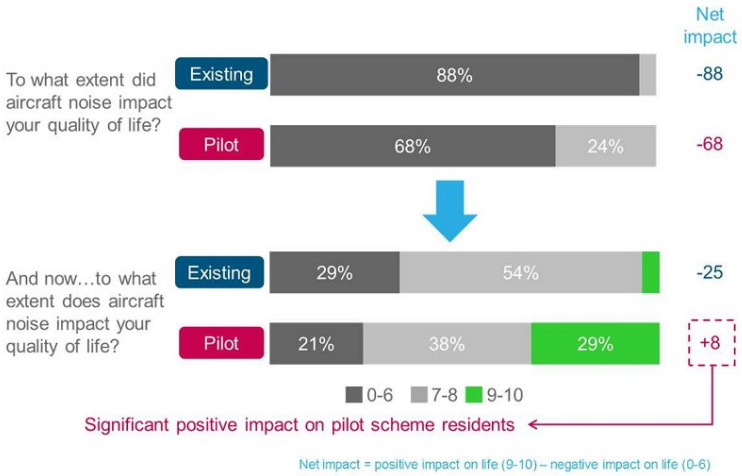

Figure 5. Impact on quality of life [8]

6 CONCLUSIONS

The results of this pilot indicate that noise insulation schemes do work - they do make a difference to the lives of the community surrounding the airport. However, to address the real needs of the people and deliver real value schemes must not rest at tackling noise but must also focus on non-acoustic factors such as communication, trust and empathy.

Feedback gathered during the pilot scheme indicated that by listening and engaging with the community through a more detailed approach with tailored solutions can not only reduce noise levels in people's homes and improve their quality of life but can also improve public opinion towards the airport.

The inclusion of a detailed noise survey had a significant effect on attitudes towards the airport and satisfaction with the scheme. It had a hugely positive effect on people's opinions towards the airport because it incorporated a human touch. The airport was showing a personal interest in the individual's experience of aircraft noise through having a noise expert visit their property and undertake a detailed scientific assessment.

What we also learnt was that no matter how effective the elements of your noise insulation scheme are without high engagement its effectiveness will be limited because it will not touch enough people. We learnt that on the whole that the financial contribution of the airport towards noise insulation is a critical element to drive take up, we also learnt that effective marketing is key to raising awareness.

Air traffic is expected to grow substantially in the near future and noise insulation schemes have a very important role to play in managing the impact this has on local communities. If this growth is to be sustainable noise insulation schemes must look beyond the decibel and focus on non-acoustic factors by taking time to understand and communicate with its community.

This paper was presented at the 22nd International Congress on Sound and Vibration, Florence, on 12th - 16th July 2015.

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