

**Summary Report of the FAA Workshop on Aircraft Noise Impacts Research**  
San Diego, CA – March 4, 2010

**INTRODUCTION**

The FAA continues to work towards providing the safest, most efficient aviation system in the world that operates in an environmentally responsible manner. Improving efficiency through airspace redesign, airport capacity expansion, and other initiatives of the FAA Next Generation Air Transportation System (NextGen), may be hampered without an aggressive program to address the environmental consequences of aviation noise.

Accordingly, the FAA Office of Environment and Energy has developed a research roadmap addressing critical noise impacts research needs, in collaboration with and participation of researchers across numerous disciplines and around the world, as well as with the broad community of aviation stakeholders including the public. Such a roadmap will enable FAA and interested parties to define systematic, focused, and complementary research programs, in which limited resources could be pooled to advance the scientific knowledge on how best to address the impacts of aviation noise on society.

To ensure that airport and aviation interests had an opportunity to review and comment on the roadmap, FAA held a one day workshop in San Diego following the annual UC Davis conference on aviation and the environment.<sup>1</sup> Some 59 aviation, government and interested individuals attended (see Attachment 1<sup>2</sup>). The FAA presented the need for the research roadmap, outlined its development process, and then described the roadmap. Throughout, attendees provided comments on the roadmap components and identified areas of interest or concern. This report summarizes both the presentation and attendee comments and observations.

This memorandum also begins the process of relating the roadmap research components to the concerns and issues voiced at the workshop. Many of these relationships have been refined after the conference. The goal of the conference was to focus on presenting the basic research roadmap and soliciting comments and concerns, but not to use conference time to respond to all the comments. In what follows, material that has been added since the workshop is presented in this font.

**THE NEED FOR AVIATION NOISE RESEARCH<sup>3</sup>**

The purpose of the NextGen initiative is to increase the capacity and efficiency of the U.S. air transport system. Examples include increasing the arrivals and departures at high-density airports, airspace redesign, and identifying airports that will need to expand in the next decade, see “Capacity Needs in the National Airspace System, 2007 – 2025 (FACT 2).”<sup>4</sup> These actions will all have the potential to alter, perhaps significantly, the aircraft noise exposures in the vicinity of the changes.

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<sup>1</sup> Meeting agenda is available: [http://www.fican.org/pdf/faa/2010-03FAA\\_WorkshopAgenda.pdf](http://www.fican.org/pdf/faa/2010-03FAA_WorkshopAgenda.pdf)

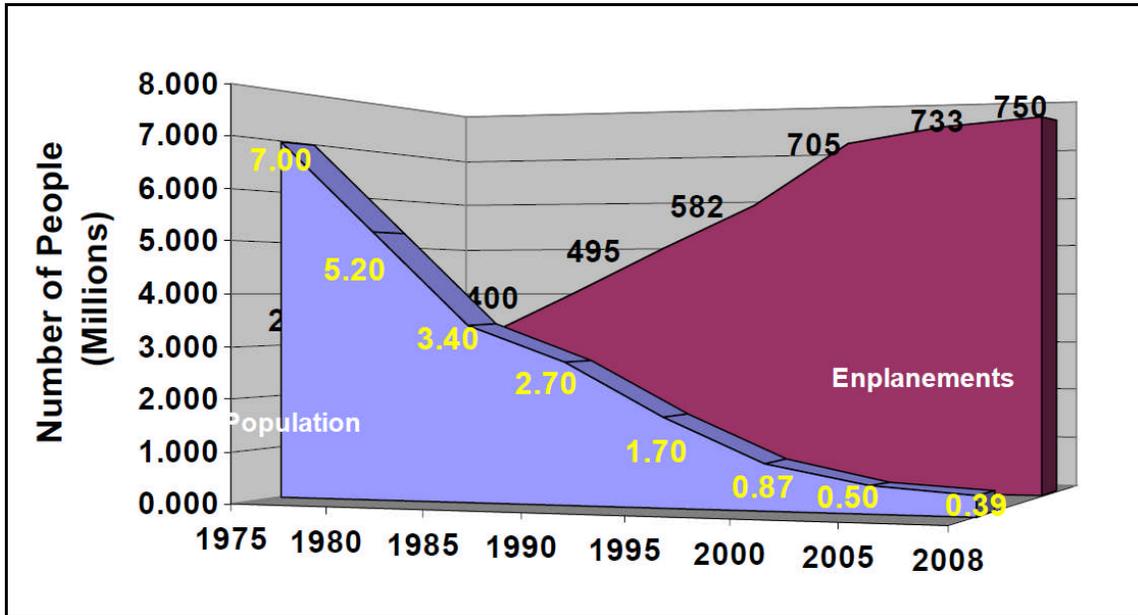
<sup>2</sup> Any attendees not included in the list are encouraged to contact FAA ([Patricia.friesenhahn@faa.gov](mailto:Patricia.friesenhahn@faa.gov)) so that their name can be added.

<sup>3</sup> The presentation of this and the following information may be found at [http://www.fican.org/pdf/faa/2010-03\\_FAANoiseworkshop.pdf](http://www.fican.org/pdf/faa/2010-03_FAANoiseworkshop.pdf)

<sup>4</sup> [http://www.faa.gov/airports/resources/publications/reports/media/fact\\_2\\_main.pdf](http://www.faa.gov/airports/resources/publications/reports/media/fact_2_main.pdf)

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Though it is clear that aircraft noise has been reduced for millions of people over the past 30 years despite increasing air traffic, Figure 1, noise issues continue to generate community reactions that can slow efforts to increase capacity. If air transport capacity is to increase to meet coming demand, our understanding of aircraft noise and its effects on people needs to be improved and FAA policy reviewed in light of this better understanding.



**Figure 1 US Trends: decline in population exposed to levels exceeding 65 DNL**

The technical bases for FAA’s noise policies were last reviewed in 1992.<sup>5</sup> Currently, this policy identifies a value of 65 dB Day-Night Average Sound Level (DNL) as the threshold of significant impact for purposes of the National Environmental Policy Act (NEPA) analyses of FAA major actions. This threshold corresponds to about 13% of the population which will report high annoyance (the “Schultz” curve). The policy is to be based on the best available scientific evidence on the effects of aircraft noise and should this relationship be outdated, a policy review / update would be appropriate.

**THE GOALS FOR AVIATION NOISE RESEARCH**

Research would provide the needed scientific basis for examining or updating FAA noise policy and insure that decisions about major FAA actions and any FAA sponsored airport noise studies would be informed by the best available information. Three goals have been identified. First, *with the proper technical evidence, FAA could update land use compatibility guidelines, the NEPA significance thresholds, and criteria for judging / targeting mitigation measures.*

<sup>5</sup> FICON: “Federal Agency Review of Selected Airport Noise Analysis Issues,” August 1992.

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Second, *application of up-to-date research results would help build public trust in noise analyses* and, through better communication, increase understanding about aircraft noise, its effects and the likely changes that can be expected from airport / airspace projects.

Third, *updated research results can focus noise abatement or airport / airspace design efforts for efficiency and help to balance noise with other environmental considerations.*

## **THE PATH TO THE RESEARCH ROADMAP**

This research effort is directed at the first of four research areas identified by FAA:

- 1. Noise effects on health and welfare**
2. Noise in National Parks and wilderness
3. NextGen noise modeling enhancements: other operational regimes and unconventional aircraft
4. Overall costs of aircraft noise on society

The research effort in this first area is in turn to focus on two effects of aircraft noise on public health and welfare: annoyance and sleep disturbance.

Three public meetings have been held: the first to identify the major questions and issues in these two aspects of noise effects; the second to critique a draft roadmap; and the third to review the revised roadmap with stakeholders most likely to be directly affected by results - airports, communities and aircraft operators. The first two meetings (the Forum in Ottawa, and the workshop in Washington, D.C)<sup>6</sup> were dominated, as planned, by discussion of researcher ideas and concerns, while the third focused on questions of airports, communities and the aviation industry.

Before and between meetings, two expert panels, one for sleep and one for annoyance developed and refined the roadmap through teleconferences, using the comments and discussions of the public meetings.<sup>7</sup> Additionally, some of these experts as well as some who attended the meetings provided additional background in “Information Briefs.”<sup>8</sup>

The remainder of this report summarizes the information presented about annoyance and sleep at the last workshop, presents the comments and concerns raised by workshop attendees, outlines the final proposed research projects contained in the roadmap, and provides connections between the research projects and the comments and concerns.

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<sup>6</sup> Additional information about all three meetings can be found at <http://www.fican.org/faaworkshop.html>

<sup>7</sup> Participants in the expert panels are given in Attachment 2.

<sup>8</sup> [http://www.fican.org/pdf/faa/InfoBriefs-Research\\_Roadmap\\_Workshop.pdf](http://www.fican.org/pdf/faa/InfoBriefs-Research_Roadmap_Workshop.pdf)

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**ANNOYANCE INFORMATION AND ROADMAP PROJECTS**

<<< **FIRST PRESENTATION**>>>

Annoyance should be thought of as two distinct types:

- *Private annoyance* or reaction or attitude – ascertained only from social surveys
- *Public action* or behavior – comprising complaints, organized opposition, legal action

**What we know about private annoyance**

- Determined by asking residents to rate their annoyance with aircraft noise on a scale ranging from not at all to extremely annoyed
- This method does not introduce significant bias in the responses
- Reported annoyance increases with increased noise
- There may be no lower limit of noise with no reported annoyance
- Annoyance reports are influenced by multiple non-acoustic factors
- Annoyance is different for different sources of noise (e.g., aircraft, rail, highway)
- Demographic factors such as age, gender, social status, income, education, appear to have no reliable effect on reports of annoyance<sup>9</sup>
- There is no clear “break point” in the data where annoyance transitions from gradual to rapid increase with noise level; “significance” must be determined as a matter of policy
- There is a lack of recent annoyance data for U.S. populations
- ISO is in the process of developing an updated relationship between aircraft noise and reported annoyance

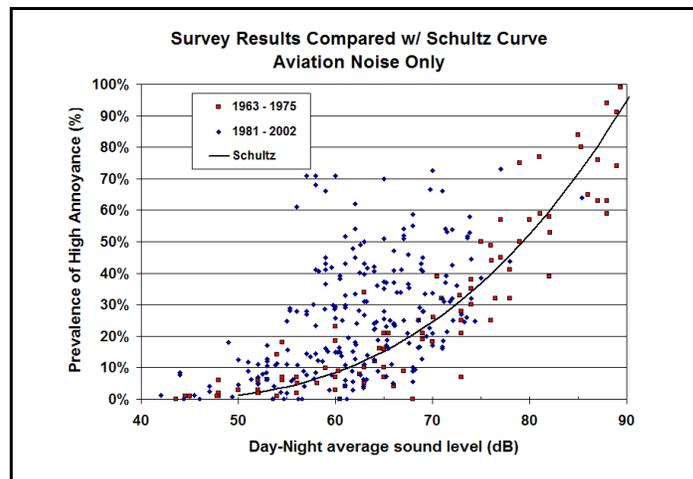
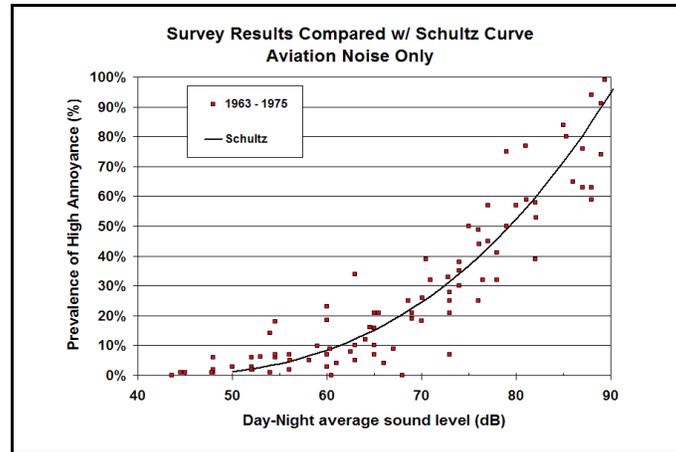
**Key issues: What factors affect *private* annoyance?**

- Has annoyance increased with time? A simple comparison of percent highly annoyed *versus* DNL from surveys taken in different years suggests there may have been an increase:

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<sup>9</sup> Although there may be developing some alternative analyses: see Maarten Kroesen, *et al*, “Estimation of the effects of aircraft noise on residential satisfaction,” Transportation Research Part D 15 (2010) 144-153

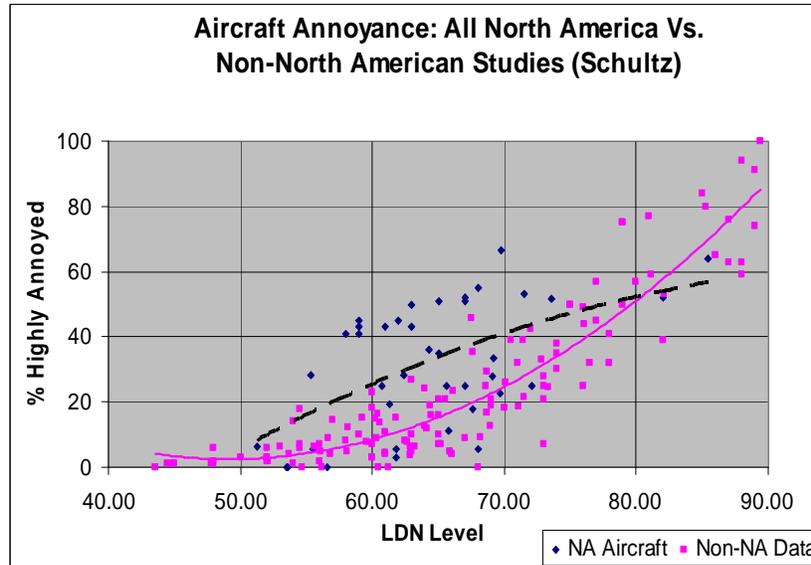
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A presentation by Vincent Mestre, prepared by him and Jon Woodward, provided additional observations about this annoyance curve and the data supporting it:

- The data collected before 1975 were prior to the phase out of the older, louder aircraft
- Less than 10% of the original data points were collected around U.S. airports
- There may be a significant difference between responses collected in North America and those collected elsewhere:

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- Studies since Schultz have been conducted under different circumstances – more operations by quieter aircraft; more public opposition to airports and litigation

**<<<FIRST ANNOYANCE DISCUSSION>>>**

At this point in the workshop, attendees were given an opportunity to raise questions, issues, concerns and ideas. The following paragraphs summarize these comments and respond to them in the context of the research roadmap. Some liberty has been taken in clarifying the discussions. Some of the meeting member's comments / questions have been parsed in order to separately address the individual questions in an orderly manner. The connections made with the roadmap projects were not all provided at the workshop since the primary intent of the workshop was to offer the maximum opportunity for participant discussion. **These connections that were not provided are shown with this type font.**

The discussions are summarized in terms of Q(uestion), C(omment) and A(nswer), to signify that some attendee in the group has raised an issue (Q or C), and another person or several people –in some cases the FAA, but in other cases other attendees – have responded.

**Q:** Does the Schultz curve address frequency of operations? Experience shows that the greater the frequency of loud events, the more likelihood of annoyance.

**A:** In some ways, DNL and percent highly annoyed (%HA) are intended to address this issue since more loud events mean a higher value of DNL. **However, the research would examine previous surveys (Roadmap Project A1, below) to determine if any of these surveys contain enough information about numbers of operations to learn whether numbers (frequency) should be included in an additional manner into the determination of the noise exposure metric. Possibly, if Project A1 shows a**

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significance of number of operations, new surveys, Project A2, may include number of operations as one of the variables collected during the survey(s).

Q: Any results of the research used for policy decisions should be based on the best scientific evidence. When the effort first began to reduce noise, supposedly the policy was based on scientific evidence, but we still have noise problems. Why should this effort be better; what happens if, after the research is completed and implemented, we still have a noise problem?

A: As far as past policy is concerned, much progress has been made in reducing aircraft noise, largely through the phase-out of the older, noisier aircraft, and the introduction of the much quieter high-bypass ratio jet engines. On the other hand, the compatibility policy of 65 dB DNL was originally established as a compromise based on feasibility and the large land areas encompassed by 65 dB DNL. If the research results in an altered noise and land use compatibility policy, say 60 dB DNL, then, to the extent that jurisdictions restrict noise sensitive development at or above that threshold, the problem should be reduced. However, there are many situations in city airports where people will always live in high noise areas, and for those, only quieter aircraft and possibly sound insulation will reduce the noise problems. It is unlikely that the “problem” from the annoyance perspective will ever be eliminated unless aircraft become essentially inaudible around airports.

Q: We have heard that noise levels explain only a part of the annoyance so that there are unscientific factors that play a role. How can noise be held responsible for these non-acoustic factors and how can the roadmap take this into account?

A: The understanding is that some things, such as attitudes toward the airport, toward the FAA, toward pilots can affect the extent and intensity of annoyance. All of the annoyance Roadmap Projects contain possibilities for identifying non-acoustic factors that might be important. Project A1 would look at previous studies to learn if any other variables, such as anticipation of changing noise exposures, limited interactions at the time of the survey between airport and community, previous experiences that could have led to loss of community confidence in the airport, could be analyzed. Project A2 would include such variables in the design of the surveys. Project A3 would look for similar variables in examining community reactions. Projects A4 and A5 are both directed at improving the non-acoustic factors of community / airport relationships concerning noise and communicating about it.

It is important to be clear, however, that annoyance is a result of both acoustic and non-acoustic factors. That some of these motivators are “non-acoustic” should not be taken to mean they are unscientific; it is just that we can not always fully identify these non-acoustic factors.

Q: Communities and local jurisdictions would benefit if research and policy could address all “cumulative” noise, not just aircraft noise. Communities need a good basis

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for limiting non-compatible developments, and that basis would be more defensible if it addressed all sources of noise. It would be helpful if this research could also identify that other sources of noise need to ultimately be considered in determining land use compatibility.

A: There currently is no federal level noise policy, though the National Academy of Engineering is drawing up such a draft policy. However, this present FAA work will be directed at only aircraft noise as it is experienced by communities around airports.

C: Two surveys were conducted in Tempe Arizona before and after opening of a new runway at Phoenix International Airport. No reference was made to aircraft noise, but people identified aircraft noise as an issue, and at distances further from the airport than anticipated. So it seems it may be possible for people to identify the sources of noise that affect them, even when not directed to consider a specific source and that aircraft noise can be separated in people's minds from other sources of noise.

Q: Is there a relationship between the Schultz curve, 65 DNL, background noise and annoyance from noise sources?

A: Most surveys that examined reactions to road and aircraft noise found people were able to separately judge aircraft noise; people seemed to have a compartmental judgment of those different noise sources.

Q: To clarify, does the level of background noise affect people's annoyance? For example, people living just outside 65 DNL in East Boston would reply differently from people living just outside 65 DNL in Jackson Wyoming.

A: We don't have many surveys in areas like Jackson, Wyoming. But where researchers have tried surveys in suburban and urban areas, this does seem to be true. For a few done in more rural areas, the results seem pretty mixed. You have to be careful because these studies have inconsistent levels of detail and results.

From an airport's perspective, the research should focus on determining the "Schultz" curve for aircraft only, and for only the U.S., and whether this curve has moved and whether the level of significance should be changed.

<<<End First Annoyance Discussion>>>

**Key issues (Continued): What factors affect *private* annoyance?**

- Is annoyance different for different aircraft types, e.g., commercial jet airports compared with general aviation, propeller only airports?
  - Experience suggests general aviation airports seem to have community raised noise issues despite lower levels of aircraft noise
- Does annoyance depend on location relative to the airport, e.g., do people living adjacent to a runway, exposed primarily to start-of-takeoff noise with its low frequency content react differently from people living under flight tracks?

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- Is annoyance different after a “step change” in exposure than the annoyance that results from long-term unchanging noise exposure?
  - Some research suggests step change reactions are different. If so, how should this type of annoyance reaction be treated in an environmental analysis of a project that will produce a step change?

**Roadmap Project A1**

**Review Available Studies / Data** - There are some 628 surveys cataloged.<sup>10</sup> These should be reviewed with respect to the key issues. Are secondary analyses possible for some of the studies, singly or in combination? Identify gaps and design additional studies. It should be noted that ISO is currently reviewing existing survey data for a possible update of the percent Highly Annoyed relationship (“Schultz” curve), as mentioned under “What we Know about Private Annoyance, above.

**Roadmap Project A2**

**Conduct New Surveys in U.S.\*<sup>11</sup>** This is intended to be a comprehensive set of telephone interviews around multiple airports. Data to update noise contours, to document non-acoustic measures taken by airports and noise abatement procedures implemented would be collected in addition. The intent of this study would be to document changes, if any, between the multiple sources of transportation noise used by Schultz to develop the annoyance curve in his 1978 paper, while during the same evaluation, to assess whether there has been a substantive shift in the degree of high annoyance in communities exposed to aircraft noise since the phase out of Stage 1 (and Stage 2) aircraft in the early to mid-80’s and in 1999. The study would also shed light on research topics such as difference in responses due to step change versus gradual change in noise exposure, type/number of aircraft operations, alternative noise metrics, and non-acoustic factors.

<<<SECOND ANNOYANCE DISCUSSION>>>

Q: Communities at one Southern CA airport were very upset about a change from one aircraft type from King Air to Embraer: people identified the “vibrational (sic) level” that “drove them crazy.” The issue was one of 15 or 20 turboprops [per day?] overflying a community. Reactions were not an issue of traditional noise exposure, which was measured at approximately 45 dB CNEL. This continues to be a matter under investigation.<sup>12</sup>

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<sup>10</sup> Bassarab, R., *et al*, “An Updated Catalog of 628 Social Surveys of Residents’ Reaction to Environmental Noise (1943 – 2008)” WR 09-18, November 2009, [http://www.faa.gov/about/office\\_org/headquarters\\_offices/aep/research/science\\_integrated\\_modeling/media/An%20Updated%20Catalog%20of%20628%20Social%20Surveys.pdf](http://www.faa.gov/about/office_org/headquarters_offices/aep/research/science_integrated_modeling/media/An%20Updated%20Catalog%20of%20628%20Social%20Surveys.pdf)

<sup>11</sup> Projects with an asterisk (\*) are being submitted for possible funding by the Transportation Research Board, Airport Cooperative Research Program, <http://www.trb.org/ACRP/Public/ACRP.aspx>

<sup>12</sup> Later research showed that at several locations around the airport, the C-weighted maximum minus the A-weighted maximum was higher for the Embraer 120 than for most other aircraft using the airport, suggesting a non-typical presence of low-frequency versus high-frequency sound energy.

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A: There is no roadmap project focused specifically on low frequency noise at this time. The Center of Excellence, the Partnership for AiR Transportation Noise and Emissions Reduction (PARTNER) has studied and continues to study in some detail, human reaction to low frequency aircraft noise and appropriate methods for quantifying and assessing noise with significant low frequency energy.<sup>13</sup> However, Projects A1 and A2 might reveal whether different aircraft types produce different degrees of reported annoyance.

Q: What obligation does FAA have to deal with reactions to change when noise levels are well below any concerns about health and welfare? Certainly, an airport will have to deal with a change that generates complaints, but what role does FAA play?

A: Part of the purpose of the research is to help guide FAA in identifying when federal action is appropriate. There is no expectation that everyone's issues with aircraft noise will be addressed and all problems eliminated. The research does address public reactions or behaviors from the perspective of whether these reactions can be predicted (Project A3, below), whether there are better ways to communicate with the public (Project A5) about expected changes, and whether or not health and welfare are at issue. Thus, if research identifies how to better predict reactions, better collect and respond to complaints, and how better to communicate, FAA could, for example, offer guidance for managing these aspects of community / airport interactions.

Q: How can the research distinguish between community reaction caused by a change at levels well below any compatibility threshold, and changed annoyance / behavior due to a change related to health impact, and what is FAA's responsibility for dealing with either?

A: The research will consider whether some of the studies contributing to the annoyance curve were conducted around airports with "hot button" issues. We need to distinguish between these types of behaviors. However, if attitudes (private annoyance – survey based) does increase, all the details, acoustic or not, may not really matter – annoyance is annoyance, and it was a result of some sort of noise.

Again, the distinction needs to be made between attitude and behavior (private and public expressions of annoyance). The changes in attitude due to step changes in noise exposure can be addressed in Projects A1 and A2 though currently, there is no project directed specifically at doing before and after surveys around airports that experience such a step change. As to change in behavior, [Project A3] is directed specifically at whether, within the context of FAA responsibilities, it is possible to correctly anticipate when and where a change will result in community reactions. For changes outside of this responsibility, such as the one mentioned earlier caused by a change in aircraft type, it is possible that results [from Projects A4 and A5] will aid this type of ad hoc response that airports need to make to these types of complaints. Project

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<sup>13</sup> <http://web.mit.edu/aeroastro/partner/projects/project1.html>

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A4 could assist in developing universal causes of complaint - i.e., one type of turbo-prop seems not to bother people, while another type does - and Project 5 could help in communication with the public as well as add to understanding the underlying causes of the complaints.

<<<End Second Annoyance Discussion>>>

**Key issues: What factors lead to *public* annoyance?**

Public actions reflecting annoyance take many forms, from complaints to the airport, to groups (organized or not) that attend public meetings related to aircraft noise or potential changes at an airport that could alter noise exposures, to lawsuits in response to anticipated or implemented actions that alter aircraft operations or noise. Key questions include

- Can these public actions be anticipated or predicted?
- Are the available tools and current understanding of reactions to aircraft noise sufficient to predict public actions?
- Are there additional tools that would help?

An assumption is that there is sufficient general knowledge about most circumstances that produce public actions to predict when and where these actions are likely. People act when:

- A prospective change is publicized
- Unusual noise producing operations occur (unusual time or type of operation)
- A change in exposure occurs

**Roadmap Project A3**

**Retrospective Study of Community Reactions\*** The objective of this research is to develop analysis methods to help identify communities that may react negatively and strongly to the noise environment resulting from airport/airspace projects. Such knowledge could:

- Improve the effectiveness of public outreach during the NEPA process;
- Ensure that study assumptions and analyses address critical community concerns;
- Provide an opportunity during the NEPA process to explore reasonable alternatives that would lower the likelihood of adverse community action
- Yield information that may be useful to help manage public expectations
- Help airports and communities investigate abatement alternatives that are raised in such forums as round-tables or during general community outreach processes

The results of this research are not intended to alter the basic NEPA requirements and procedures – only to assist the proponent to better understand the likely effects on surrounding communities and plan for them, either by modifying the project alternatives, providing supplemental metrics or by identifying and reporting additional analysis deemed important to surrounding communities.

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**Key issues: What factors lead to noise complaints?**

There is a wealth of complaint data, collected over the years at many airports, but these data have never been scientifically assembled and analyzed. Key questions such investigation could answer are:

- Can noise complaint data be used as an aid to airport management?
- Can we develop an easy-to-use tool for tracking complaints?
- Can complaint data help estimate non-acoustic components of annoyance?
- Can complaint data help us quantify the rise and decay times of community actions related to operational changes?

Our discussions here and in previous meetings with researchers have shown general support for the notion that annoyance, of the type surveys reveal, is to some extent connected with both the generation of complaints and with the ability of people to understand and to trust, the information they are provided about noise. People are unlikely to complain if they are not at all annoyed by the aircraft noise, and people's annoyance is likely to be less if communications have been understandable and reliable.

**Roadmap Project A4**

**Develop Standardized Noise Complaint Handling System\*** In the United States and other developed nations, many thousands of formal complaints are generated every year about noise due to transportation systems, particularly aircraft noise, but there is no standardized method available to capture and evaluate this freely provided data stream in order to understand what issues may be generalized across airports versus those that are truly airport-specific, and what common approaches may be used to reduce and/or address complaints. This proposed research project sets out to answer two main questions:

- What can complaints usefully tell us and how could we use them to improve airport operations?
- What is the best way of handling complaints in a standardized format utilizing modern technology to improve communication and transparency across the aviation industry and with the residents in communities near airports?

The project would include interviewing airport staff, residents, airlines and aviation agencies to understand current complaint management and value of a standardized complaint handling system. Current complaint handling would be investigated. Complaints from selected airports would be analyzed.

**Roadmap Project A5**

**Test Methods for Communicating about Aircraft Noise with the Public** The approach would be to work with panels to test various ways of talking about what changes would occur and where, using such measures as changes in numbers of operations and distributions of aircraft sound levels by location. There has been at least one pilot test in

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the U.K. to explore how best to communicate these technical issues with the public.<sup>14</sup> The study used a group of citizens, both living near airports and distant from airports, to test different methods for presenting information. The study identified some useful findings that should be further explored in the U.S. One of the clearest findings was:

“Universal acknowledgement that bar charts, for specific locations illustrating the numbers of events within ranges of maximum sound levels for given periods of the day, were the most informative and easiest to interpret of all the metrics viewed.”

<<<THIRD ANNOYANCE DISCUSSION>>>

C: There are many causes for complaints other than noise or even changes in noise. A newspaper article about the airport can raise complaints. These causes need to be noted in the complaint data if they are to be understood. Wide distribution of the noise complaint phone number for example can generate an increase in complaints.

C: Some airports maintain sufficient information to associate complaints with specific non-noise events. Misperceptions about changes or expected changes in operations can lead to increased complaints.

C: Absence of complaints does not mean there are no noise issues. Perhaps very good outreach, including resources to track airport activities, limits complaints. Complaints need to be treated very cautiously. They may be “preventive” in the sense of trying to prevent an anticipated action.

C: FAA also receives complaints, especially for small airports with no noise office. It would be useful if any organization that receives complaints had the same tools - the same complaint handling process available so that all complaints are to be treated uniformly and in a scientific manner. The FAA keeps track of complaints, and asks for written versions. If contours are available for the subject airport, the FAA will route complaints to FAA Airports Office if the complainant is inside the 65 DNL contour, and to FAA Airspace Office if the complaint is located outside of 65 DNL.

C: The closing of El Toro might be useful for the retrospective study. Communities were apparently unaware of John Wayne overflights while El Toro was in operation creating noise, but after it closed, communities apparently became aware of John Wayne operations and complained that FAA had changed the airspace. John Leyerle collected considerable data that may be useful for such a study.

C: It might be useful to relate noise levels to health effects (from stress perhaps) so that changing procedures to limit or move noise in quieter areas (outside the 65 DNL contour) could be better justified, rather than relying on annoyance. The point is the easy things

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<sup>14</sup> Hooper, P. *et al*, “OMEGA Community Noise Study, Indices to enhance understanding & management of community responses to aircraft noise exposure,” Manchester Metropolitan University / University of Southampton January 2009

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have been done, and if making small changes could be shown to be of a benefit to health, then the complexities of moving flight tracks would be easier to justify - especially if the need for these changes could be linked to NextGen.

A: FAA is trying to link health and welfare<sup>15</sup> effects to noise as part of the NextGen efforts. The health and welfare effects are also being examined as part of the analysis of emissions. It is expected that noise and emissions will need to be balanced in terms of their health and welfare effects.

C: Awakenings due to nighttime operations need to be included, even if these awakenings do not appear in the complaint data. People will awaken but do not get up to complain, and may not remember or bother to the next day.

A: Sleep disturbance is an important part of the research.

C: In anticipation of a possible temporary change in departure procedures at San Diego, due to taxiway construction, the airport sent out some 6,000 mailers alerting residents likely to be affected (to the south of standard departures). The taxiway project was to begin 5 August and on that day the airport received 10 complaints about the changed departure procedures. Additionally, residents to the north who would be unaffected whether or not the projected changes in departures occurred started complaining as well. In fact, no changed departures were ever required. So by “trying to do the right thing” the airport produced more complaints.

C: Montreal continues to keep communities informed even though such information can provoke additional problems. Montreal tries to keep a dialog active.

C: David Southgate’s method (for showing community useful aircraft flight and noise information)<sup>16</sup> was developed by responding to what communities wanted. Communities thought of DNL as hiding information. Now the most popular approach is the flight path movement chart which shows where the flight paths are located and the numbers of operations on those paths by time of day or year, which is similar to Ken Hume’s histogram method (described in reference of footnote 14). Australia hardly uses contours; the flight path approach gives much greater geographic spread – out to even 50 kilometers.

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<sup>15</sup> It should be noted that in the EPA Report “Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety,” NTIS PB-239 429, 1974, available at <http://www.nonoise.org/epa.htm> “health and welfare” is described as follows on page 7:

“The phrase ‘health and welfare’ us used herein is defined as ‘complete physical, mental and social well-being and not merely the absence of disease and infirmity’. This definition would take into account sub-clinical and subjective responses (e.g., annoyance or other adverse psychological reactions) of the individual and the public. As will be discussed below, the available data demonstrate that the most serious clinical health and welfare effect caused by noise is interference with the ability to hear. Thus, as used in this document, the phrase ‘health and welfare’ will necessarily apply to those levels of noise that have been shown to interfere with the ability to bear.”

<sup>16</sup> For a complete description and examples, see [http://www.infrastructure.gov.au/aviation/environmental/transparent\\_noise/](http://www.infrastructure.gov.au/aviation/environmental/transparent_noise/) particularly “Guidance Material for Selecting and Providing Aircraft Noise Information.”

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C: San Diego is so consistent with its operations that regardless of which metric is used to communicate noise exposure, DNL, N70, SEL the results always come out looking the same.

C: Primary need of the public is to know how many, how loud and how those interact with time of day. It is impossible to explain decibels. Time-weighted averages are interpreted as hiding information. Any policy that relies on complex noise metrics as a basis will not be well understood by the public.

A: FAA will ultimately need to base policy on metrics that use logarithms and that is why supplemental metrics are important. Nevertheless, it will be important to make sure that the public be given the full story. It is very unlikely that any overall metric other than DNL will be used, but much of the research is targeted at providing more, understandable information. Research Projects A3, A4 and A5 all are intended to explore and identify the aircraft noise related factors to which the public responds. While land use compatibility will likely depend more on the findings of the survey projects (A1 and A2), understanding what factors can cause public actions and how to communicate meaningful information will derive from Projects A3, A4, and A5. Work in both the U.K. (see footnote 14) and in Australia (footnote 16) strongly suggests there are valuable methods of communicating with the public that rely very little on decibels.

Q: Would FAA be willing to accept changes of effects well outside the 65 DNL as a tool for examining beneficial changes such as CDA's and do this as part of Part 150 policy?

C: Public wants the policy to be based on the same metrics that are used to explain the noise.

<<<End Third Annoyance Discussion>>>

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## **SLEEP DISTURBANCE INFORMATION AND ROADMAP PROJECTS**

### **What we know about noise and sleep disturbance**

- Noises can awaken people
- People are awakened more readily in a laboratory setting than in their home
- There is considerable variation in awakening responses from person to person
- For most people, the chance of awakening from one event is quite small -<10% for events less than ~75 dB(A) at the ear
- Subjective judgments of sleep quality are generally uncorrelated with objective measures
- Few people will awaken from events less than ~30 –40 dB(A)
- People normally awaken “spontaneously” several times a night, depending on how “awakening” is determined
- There is no consensus on the “best” method for studying noise induced awakenings

### **KEY ISSUES: Usefulness of Previous Noise and Sleep Disturbance Studies**

(This Meta study was not discussed at the workshop.) A moderate number of sleep disturbance studies have been conducted in people's homes, researchers having determined in the 1990's that laboratory studies significantly overestimated the probability of awakening from a noise event heard in the sleeping room.<sup>17</sup> Can these studies provide useful information about the following key issues?

#### **Roadmap Project S1**

**Meta study of reports of sleep disturbance** This initial project is needed to determine what previous studies, data, and results might be useful to address the key issues. A first step would be to clearly identify the important variables associated with each of the issues identified below. The previous studies would be reviewed to identify those issues that have been included or addressed. Needed information that is not available will represent a gap in knowledge that will be used to formulate follow-on studies.

### **KEY ISSUES: Sleep Disturbance in U.S. and Other Populations**

Most of the previous studies have been of non-U.S. populations. Hence, for useful and defensible application around U.S. airports, the first issue is to determine, as well as current data permit, the relationship between U.S. populations around airports and the populations studied at non-U.S. airports.

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<sup>17</sup> Ollerhead, J.B., *et al*, “Report of a Field Study of Aircraft Noise and Sleep Disturbance” London: Department of Safety, Environment and Engineering (1992)

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**Roadmap Project S2**

**Compare Sleep Disturbance Studies of U.S. Populations with Results of Studies of Other Populations\***<sup>18</sup>

The most recent U.S. sleep disturbance studies are those of S. Fidell.<sup>19</sup> These studies used behavioral awakenings (the subject was instructed to press a button when awakened) and hence need to be compared with other studies that used the same technique, of which there is at least one.<sup>20</sup> A statistical comparison should reveal similarity or differences of the populations studied. Reasonable similarity could be used to justify application of other European or other country study results to the U.S. Cultural differences should be documented if possible. Additional differences include different house construction techniques and window-opening practices. Weakness of the correlations would suggest need for additional U.S. studies - probably modeled on an accepted EU approach.

**KEY ISSUES: Sleep Disturbance Prediction Models for Practical Application**

Several researchers have developed models to predict sleep disturbance or awakening as a function of single event noise levels. These need to be extended to predict the awakening effect of a full night of aircraft operations.

**Roadmap Project S3**

**Compare Sleep Disturbance Models and Prediction Results for Realistic Scenarios of an Entire Night of Operations**

One standardized method is available,<sup>21</sup> but other approaches should be developed and compared for a given set of realistic nighttime aircraft noise events and incorporate the populations affected. Time of night should be included.

**KEY ISSUES: Sleep Disturbance and Next-Day Effects**

It is certain that with sufficient sleep disturbance, a person's performance the next day can be diminished. Specific questions of interest are:

- Is there a threshold of sleep disturbance that can affect next-day performance / sleepiness?
- At what point does noise-induced sleep disturbance become significant compared to disturbances from other causes?

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<sup>18</sup> Included as one part of a submitted problem statement to ACRP; also being examined as part of a FICAN supported analysis

<sup>19</sup> S. Fidell et al., "Field study of noise-induced sleep disturbance," *J. Acoust. Soc. Am.* 98(2) (1995)  
S. Fidell et al., "Effects on sleep disturbance of changes in aircraft noise near three airports," *J. Acoust. Soc. Am.* 107(5) (2000)

<sup>20</sup> Passchier-Vermeer, W., *et al.*, "Sleep disturbance and aircraft noise exposure: Exposure-effect relationships," TNO report 2002.027, 30 June 2002

<sup>21</sup> American National Standard, ANSI S12.9-2008, Part 6: "Methods for Estimation of Awakenings Associated with Outdoor Noise Events Heard in Homes," July 3, 2008.

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**Roadmap Project S4**

**Review and Examine Available Studies of Next-Day Effects for Sufficiency and Determine whether Additional Studies are Warranted** Next day self-reports are generally regarded as unreliable. Studies, both of noise-induced sleep disturbance and other sleep disturbance studies should be reviewed for objective measures of next-day effects such as reaction times. If non-noise studies indicate thresholds of disturbance that produce next-day effects, then the task is to determine, possibly from Project S3, under what conditions such disturbance thresholds would be reached due to noise.

**KEY ISSUES: Variable Nighttime Noise and Sleep Disturbance**

Most sleep studies accumulate all awakening and noise event data across all nights by subject. Can reanalysis evaluate nights separately by subject so that the disturbance can be correlated with nights having significantly different levels of noise? For example, changed runway use night-to-night would result in some areas receiving very different noise exposures, night-to-night.

**Roadmap Project S5**

**Review and Examine Available Studies to Identify Populations that Experienced Variable Nighttime Exposures and Attempt Separating Effects by Exposure** At some airports, runway use or operations can vary from night to night. If such an airport has been a site for a sleep disturbance study, it may be possible to separately examine subject nights, segregated by noise exposure. Such a study could provide insight into how changing nighttime noise affects a single population. Application of results would permit evaluation of the benefits of altering nighttime operations, such as changed flight operations or runway use, or by providing additional sound insulation.

**KEY ISSUES: Relationship of  $L_{\text{night}}$  to Sleep Disturbance**

The World Health Organization has proposed night noise guidelines for Europe using  $L_{\text{night, outside}}$  as the metric of noise. Some studies have found that, though sleep disturbance increases with increasing  $L_{\text{night, outside}}$ , better agreement between nighttime noise and disturbance is achieved by including number of operations. This project is to examine using different available models of awakening (e.g., Project S.3) to examine the relationship between  $L_{\text{night, outside}}$  and predicted awakenings.

**Roadmap Project S6**

**Use Available Sleep Disturbance Models and Compare Nightly Awakenings with Corresponding Values of  $L_{\text{night}}$**  Most sleep disturbance studies include for each subject, for each night, the levels of the individual aircraft noise events as heard in the sleeping room. If these levels are, or can be converted to, Sound Exposure Levels, then it is a simple matter to compute  $L_{\text{night, inside}}$  for each subject night. Models that predict sleep disturbance can also be applied to each night of operations to determine the associated probability of disturbance / awakening. Plotting of probability of disturbance *versus*  $L_{\text{night, inside}}$  will show whether there is any correlation between the two variables.

**KEY ISSUES: Relevance of Non-noise Studies of Sleep Disturbance**

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Considerable research has been conducted examining the health effects of sleep disturbance. Results from these studies may help relate noise-induced sleep disturbance to health effects.

**Roadmap Project S7**

**Review and Examine Available Non-Noise Sleep Disturbance Studies of Health Effects for Applicability to Disturbances Produced by Noise** Assistance from sleep disturbance researchers will be required to identify applicable studies and to properly interpret study results for application to noise-induced disturbance.

**KEY ISSUES: Pursue Linkages with On-going or Future NIH Health Studies**

There may be NIH sponsored major studies which have included or which could include issues of sleep disturbance and associated health effects.

**Roadmap Project S8**

**Work with the National Institutes of Health to Determine whether Previous or Pending Reach has or could Include Noise and Sleep**

**<<<SLEEP DISTURBANCE DISCUSSION>>>**

Q: Have any studies correlated awakenings with other noise metrics that we use?

A: This comparison could easily be made using the single event levels in existing studies to compute  $L_{night}$  indoors and then use either empirical associated awakenings or one of the models of awakening to compare with  $L_{night}$ .

Q: Are current studies over-predicting awakenings?

A: The laboratory studies do, but not the field studies.

C: If we have studies considered worst case, perhaps they could be correlated with noise levels and help identify the relationship of the common noise metrics or levels with actual awakenings.

C: The relation of remembered awakenings has been related to integrated metrics, but remembered awakenings are quite different from actual awakening. Actual awakenings have not been related to integrated metrics.

Q: Use of higher background levels, a fan for example, increases our sleep. Has this ever been investigated in the studies?

A: Yes there have been some field studies in the U.S., and it is true that fans can reduce awakenings. But these studies used actimeter readings for body movement, which are not as reliable for determining sleep disturbance as polysomnograms.

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Q: What is the usual period of sleep?

A: In the laboratory, eight hours are available, while in the real situation, people generally have somewhat more than seven hours.

C: As far as the models go, at least ones based on the Castle Air Force Base, Denver airport data, the models are unaffected by rearranging the times of the events that awoke and the ones that didn't (soon to be published in *Noise & Health*<sup>22</sup>). At best, the models account for three or four percent of the variance. As shown in the information brief,<sup>23</sup> in principle, any sound event can awaken someone. So when you try to generate real-world predictions, you discover that it's not really operating [on level] but on time of night, which is highly airport dependent.

C: Everything we've heard today says that there has to be more research done in the U.S.

C: Sleep deprivation needs to be studied in relationship to next day increased somnolence, ability to work, increased risk of injury. These effects occurred in (medical) residency situations where program requirements caused sleep deprivation and resulted in errors in diagnoses. Also, hearing loss increases with age, drug use, injury, etc., and these effects need to be accounted for in the studies. Finally, the effects on children should be considered, including school performance and delayed reading ability.

Q: In field and lab studies are prior health / sleep problems identified?

A: Studies do not include people with these issues.

Q: What will be the practical application of the research results, especially in influencing land use decisions by municipalities?

A: Currently, 65 DNL is the criterion for compatibility. If research shows the increased effects on sleep, learning, etc. then we will need to update the compatibility criterion. If the Federal government changed its compatibility guidelines, it could make available Federal Grant-in-Aid funding for noise mitigation that is currently not available. Hypothetically, if a larger area should be declared non-compatible due to increased annoyance or sleep disturbance not previously recognized, FAA would expand Federally funded noise planning to the enlarged area and expand eligibility for Federally funded noise mitigation to the larger area, and might potentially, though not necessarily, identify the larger area as a significant impact under NEPA and the area would be part of an environmental review of proposed airport development, for example.

C: These are useful comments, but it is still unclear how new information could help municipalities make better informed, long-term decisions beyond funding and grant applications. Alternatively, from a land use point of view, the local municipality needs to understand the ultimate build-out of the airport. Generally, there are other connections that need to be made to benefit from the research, e.g., with International City Managers

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<sup>22</sup> <http://www.noiseandhealth.org/>

<sup>23</sup> See reference of Footnote 8

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Group, to harmonize the research with potential applications. There are additional benefits to be gained from the research.

C: FAA's role is to provide guidance on land use compatibility, and financial incentives for planning and mitigation, but FAA does not have control over land use.

C: For ICAO, encroachment is a world-wide problem – “chasing in contours.” Any information that airports can use to go to land use decision-makers will help.

C: Encroachment is a huge issue, and land use is controlled locally. One approach is to look for better ways to disclose information to home buyers.

C: FAA is open to many approaches. Whether FAA actions will be small steps or a giant leap has not been decided. In any case, the actions will be science driven.

C: Encroachment depends upon perspective. Communities feel encroached upon when a new runway is constructed. Any actions must be cooperative with communities and airports. In Chicago, for 2010, 40 to 50 community planners will be working with airport planners in an effort to avoid future issues. Communication between communities and airports is necessary.

C: Communities always look for examples. Federal compatibility guidelines can and do provide useful information for communities.

Q: Should the 10 dB penalty be changed?

A: Cumulative metrics have been found not to correlate with sleep disturbance. Sleep depends more on the level and number of single events. One possible perspective is as a matter of policy move away from limiting  $L_{\text{night}}$ , for example, to attempt to limit nighttime awakenings to, say, 15% of the population. Such an approach avoids specific noise metrics or weightings and is directed at the specific problem.

C: The ultimate remediation is to limit night flights. Also, consider using a dynamic metric that reflects how humans hear rather than using A- or C-weighting.

C: From a regional perspective, not every airport needs nighttime flights. Trucking to a central airport can serve to support overnight deliveries without having nighttime departures from every airport.

C: Without a change in the legislative framework, any restrictions, curfews, have to go through the Part 161 process which has a fairly high bar for limitation of operations. In other words, nothing here from the research would automatically change this framework.

C: Nothing prevents policy considering regional planning decisions.

C: Airports would have to agree to work together for that type of action and it would have to go through the Part 161 process.

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C: Trucking alternatives would include not only noise considerations, but emissions as well. The trade-offs would need to be considered.

Q: Is there any planning going on in a system-wide perspective? Each carrier – truck, airplane, train – makes its own decisions for market reasons. Does anyone care about system-wide transportation planning?

A: A GAO report recently encouraged FAA to do just that. State level efforts are made to put together state-wide plans. However, each airport is its own fiefdom, there being no one above them to say they have to coordinate their efforts.

C: Every airport wants to build out to its maximum capacity, even if it solves a capacity problem for only a few years. Such an approach can also result in underutilized airports like Cincinnati and others for lack of a regional perspective.

C: San Diego area was legislated in 2003 to have a regional plan that encompasses 16 airports within the area, and that plan is ongoing.

C: DHL made a decision to fly out of only specific airports and to truck cargo from other airports. So they did take a regional perspective.

C: There are also counter examples where time saving dictated short flights to deliver packages.

C: Phoenix did a regional plan, but it had to be approved by each metropolitan planning organization and consensus is required; each region with an airport wanted maximum expansion. Eventually the plan stalled due to lack of consensus. There are no regional airports in Arizona, just city airports, so only a consensus plan will work.

C: California has one highway authority state-wide which identifies state-wide requirements. Without that type of authority, nothing will change for the airports.

**<<<End Sleep Disturbance Discussion>>>**

There are several projects currently being funded by FAA with the Partnership for Air Transportation Noise and Emissions Reduction (PARTNER), planned projects, other on-going work, and future collaborations.

1. Health and welfare:

- PARTNER - Sleep disturbance model development – expanding on an existing model<sup>24</sup>
- PARTNER - Summary of literature on sleep disturbance due to aircraft noise – to make previous work more accessible

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<sup>24</sup> Basner, M., “Markov state transition models for the prediction of changes in sleep structure induced by aircraft noise,” German Aerospace Center (DLR), Institute of Aerospace Medicine, Cologne, Germany (2006)

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- PARTNER - Complete health effects literature survey - “A Review of the Literature Related to Potential Health Effects of Aircraft Noise”
- ACRP<sup>25</sup> - Student learning: identify and evaluate conditions under which aircraft noise may affect student learning and identify and evaluate one or more alternative noise metrics that best define those conditions. This initial work will help define a roadmap for further research on noise and student learning.
- Recent Procurement - Trends in response to noise exposure – an updated catalog of 628 social surveys,<sup>26</sup> to help identify which of these previous studies might aid in addressing the key annoyance issues listed above.
- PARTNER - Document the status of a public database of noise surveys and studies; identified problems of building such a database
- New solicitation – a meta-analysis to update exposure-response curve for annoyance to aircraft noise
- PARTNER – sound characteristics of aircraft noise other than loudness that influence annoyance; tonality is important
- PARTNER – how does meaning of the sound (type of source) affect annoyance;

2. Funding

- Funding for FY10 and FY11 is modest
- Planning is now for FY12 and developing needs and associated funding needed
  - Meta analyses not likely to be expensive
  - Expect not to get all important questions answered from these analyses
  - If current data from the U.S. are needed, then additional funding will be necessary

3. Next Steps

3.1. ACRP also has considerable funding, and FAA will try to access some of this, despite FAA having no control over what problem statements are funded; roadmap projects that are being submitted for ACRP consideration include:

- Systematic re-analysis of existing annoyance survey data
- Systematic review of complaint data collected by airports and FAA
- Retrospective study of community reactions to changes in exposure
- Sleep disturbance study

3.2. PARTNER – several small projects related to sleep, annoyance, other aircraft noise issues

3.3. FAA AEE- sponsored work – small scale near-term studies

4. Assistance from others

4.1. ACRP problem statement submissions reflecting roadmap projects

4.2. Airports and communities interested in participating in field studies; e.g., collected complaint data

4.3. Researchers - establish contacts with international and interdisciplinary noise effects research community and keep FAA informed of collaborative opportunities

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<sup>25</sup> Airport Cooperative Research Program, <http://www.trb.org/ACRP/Public/ACRP.aspx>

<sup>26</sup> Bassarab, R., *et al*, “An Updated Catalog of 628 social Surveys of Residents’ Reaction to Environmental Noise (1943-2008), November 2009, DOT-VNTSC-FAA-10-02

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FAA approaches these issues as carefully and as neutrally as possible, knowing that there can be major implications from policy changes. The goal is to build a logic / research trail to rationally support any changes. We expect, however, that new data from across the U.S. are necessary to support any decisions.

<<<**DISCUSSION OF FUNDING / SUPPORT POSSIBILITIES**>>>

Q: What are the top one or two projects – U.S. airport surveys?

A: The responses to annoyance and sleep disturbance are the most difficult, but would provide the most important data for future policy review.

C: The ACRP process has significant limitations. Each project has its own panel with its own interests. Projects need to provide practical results directly applicable to airports. Follow-on work is difficult, given the individual nature of the projects. The funding, at a maximum, is \$600k which is not much for this type of work. Perhaps ACRP should change to support this type of work.

C: Committees write the scopes, so the actual projects may not reflect the original problem statement.

C: It is important to think about what the direct benefit would be to airports. Also the panels look at the projects and ask whether FAA should be funding the research directly. The panels may not have relevant expertise because of the nature of how the panels are formed.

C: Kudos to the FAA for updating the exposure-response curve. Too much has changed since the Schultz curve. New data should be the primary focus, especially since DNL will not be changed for Part 150's and other noise studies. Maybe 16% highly annoyed is appropriate, but if with new data it drops [the compatibility guideline] to 55 [DNL] so be it.

C: Airports would like to be finished with the noise problem, so changing the criterion would have nightmare implications.

Q: What is the situation when we can say “we’re done with noise?”

A: California has state noise standards to eliminate people living within the noise zone (65 CNEL / DNL). The noise problem won't be over, but where airports could use FAA assistance is in implementing things that actually work, but that don't line up with any specific value of CNEL / DNL.

C: It is not likely San Diego will ever get 65 DNL on airport property; even with sound insulation, we will still have noise complaints. I believe 65 DNL is completely arbitrary. We do want to have FAA support going beyond 65 DNL for mitigation measures.

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A: FAA expects that this research will help airports. If we knew how to better describe aircraft noise that should help airports.

C: It is true, if we could better describe real annoyance that would be helpful. Also, if we had other metrics to help describe effects on schools and sleep, we could use them as a means to reduce noise problems. Especially for NEPA, good metrics are needed. What is the purpose of the research? If it is to help communicate, then the metrics used to determine impact and to describe noise should be the same.

C: It is possible to connect DNL to metrics of effects. There are other ways to describe the DNL components. People who are not familiar with the technical details are confused by numbers that are not related. FAA could do a better job of describing the supplemental metrics. A takeaway is – better guidance on what the metrics mean and how to relate them.

Q: The metrics we use to explain are not disconnected from DNL. The public can understand Lmax, fewer understand SEL, and most don't understand DNL. So their question is why don't we do mitigation based on Lmax or time above, which they can understand? What people care about is how loud the airplanes are and how frequent they fly over. Research could help, but it will involve some flexibility on the agency's part.

A: And those relationships are what the research is targeted to develop. We are currently tied to DNL and 65 and we need the data to disentangle us from these.

C: The public issue is how loud is the plane? For San Diego and Los Angeles, the only mitigation is either reducing noise at the source or massive sound insulation to mitigate to Title 21 standards. It would benefit everyone if FAA could use the sound insulation money to hush-kit the MD80 and eliminate the 727, and quiet the aircraft right at the source.

C: FAA is committed to reducing noise at the source. There is a program to assist manufacturers get the technology developed. But it won't go into the planes until the airlines are ready to buy the new technology.

C: That is the point - to not wait for installation by market forces, but have FAA provide incentives, since FAA will provide the funds no matter what.

C: That has been thought of, but the politicians want the AIP funds to go to their districts, not to FAA or the private sector.

C: The Supreme Court decided in 1962 that the airports have the liability for the noise damages. Airlines have perverse incentives not based on noise but on cost, which include getting the most mileage out of their equipment.

Next steps: Surveys seem to be required. Do any airports have the appetite to volunteer to fund surveys?

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<<<COMMENTS ON FUTURE SURVEYS>>>

C: Most of U.S. surveys since 1978 have been funded by airports. These were funded in the atmosphere of a highly contentious project. So a question is if one of these surveys were repeated, would we get the same result? Ultimately, it's up to the airports as to whether they want to support a survey.

C: Also, the exact nature of the controversy can change with time. So the issues may still be highly controversial, but for different reasons.

C: We wouldn't want to survey only stirred up communities or only airports with no issues. We want Federal decisions based on neither extreme.

C: There is a good amount of data already available for data mining. Also, any airport doing sound insulation does a follow-up survey to which appropriate questions could be added to help in the data mining.

C: This meeting has had a greater variety of ideas than previous meetings. Congress men and women are very parochial about airports. The PFC's should be increased to \$7 or \$7.50. It's better to pay for the PFC in a ticket than to pay for checking a bag. People who get sound insulation become advocates for the airport because they feel they've been paid for pain and suffering. MD80's and 727 were eliminated due to economics, rather than noise. Each stakeholder is trying to do their best. FAA has shown a new philosophy in the past 7 – 9 years; they are much more interested in communities. FAA is now participating in conferences, unlike past experiences. FAA is asking for opinions from everyone. On metrics, citizens hate DNL. It doesn't make any sense. At least we are now discussing metrics and noise effects and communicating. We all need to share our perspectives.

C: If we could do a pilot study in a truly non-controversial place, perhaps this could get us back into the system of collecting data. If we want to advance our understanding of noise and non-acoustic effects, we need new data.

C: San Diego has a good complaint data base for a study of complaints.

C: San Diego might be a good site for a survey since nothing has changed for years and years, except number of operations. Combined with decades of data, would be a good place to conduct a study.

C: Citizen discontent has also been documented well over 30 years; nothing changes – same complaints.

C: Looking at San Diego's complaints might be a good measure of what non-noise issues generate complaints. It could be very informative to examine the factors that gave rise to increases in complaints when noise exposures had not changed.

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C: An alternative means for funding could be to pool funds, in the way that state highway departments do.

C: There could be airports that have common concerns.

C: If user fees were raised; the funds could be used to support studies.

FAA would like to know if any of the attendees are preparing problem statements for ACRP. We could possibly add our support for the problem.

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**Attachment 1 - Attendees**

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**Summary Report of the FAA Workshop on Aircraft Noise Impacts Research**  
 San Diego, CA – March 4, 2010

**Attachment 1 - Attendees**

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**Attachment 2 – Expert Panels**

**Panelists for Sleep Disturbance:**

Mathias Basner	German Aerospace Center DLR
Patricia Davies	Purdue University
Jim Fields	Independent Consultant
Barbara Griefahn	Leibniz Research Center, TU Dortmund
Sarah McGuire	Purdue University
Nick Miller	HMMH

**Panelists for Annoyance:**

Kenneth Hume	Manchester Metropolitan University
Sandy Lancaster	Dallas-Ft Worth International Airport
Mayor Arlene Mulder	O'Hare Noise Compatibility Commission
Paul Schomer	Schomer and Associates, Inc
Catherine Stewart	U.S. Department of Army
Kevin Shepherd	NASA