Review of Civil Aviation Noise Policy in the United States

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ABSTRACT

Although the number of people exposed to significant civil aviation noise in the United States (U.S.) decreased by 95 percent between 1975 and 2012, noise remains one of the largest constraints on aviation growth in the U.S. In addition, there is significant interest in advancing our knowledge of the impact of aviation noise on human health and welfare. The Federal Aviation Administration (FAA) has launched a series of noise research projects to update the scientific foundation for U.S. civil aviation noise policy. This research includes areas such as annoyance, children's learning, cardiovascular disease impacts, and sleep disturbance. The goals of the research are to improve understanding of the effects of civil aviation noise in these areas and to ensure that U.S. civil aviation noise policy continues to be based on the best available scientific information. The FAA will use the results of these research efforts to revisit and update policy and guidance on addressing civil aviation noise. This paper will discuss the ongoing research and the U.S. policy and guidance associated with the research.

INTRODUCTION

Although the number of people exposed to significant civil aviation noise in the United States decreased by 95 percent between 1975 and 2012, noise remains one of the largest constraints on aviation growth in the U.S. In addition, there is interest in the potential impact of aviation noise on human health and welfare. The Federal Aviation Administration (FAA) conducts noise research to provide the scientific foundation for U.S. civil aviation noise policy. The FAA's 1976 noise policy has evolved to reflect changes in aircraft technology and the balanced approach to dealing with aviation noise. Most recently, the FAA published the Aviation Environmental and Energy Policy Statement (Department of Transportation 2012), which identifies a noise goal of reducing the number of people exposed to significant noise around U.S. airports in absolute terms, notwithstanding aviation growth, and providing additional measures to protect public health and welfare and our national resources.

The FAA has developed a goals-oriented research program based on a five-pillar approach for environmental protection that allows sustained aviation growth. The

pillars are: improved scientific knowledge and integrated modeling; new aircraft technologies; sustainable alternative fuels; air traffic management modernization and operational improvements; and policies, environmental standards and market based measures. The FAA's goals for noise research are to resolve key questions relating to the impacts of civil aircraft noise and provide sound scientific data to inform policy decisions.

Within this framework, the FAA has launched a series of noise research projects. This research includes areas such as annoyance, children's learning, cardiovascular disease impacts, and sleep disturbance. The goals of the research are to improve understanding of the effects of civil aviation noise in these areas and to ensure that U.S. civil aviation noise policy continues to be based on the best available scientific information.

DISCUSSION

The FAA uses an environmental management system (EMS) framework to guide its research (See **Error! Reference source not found.**). First, work is conducted to improve scientific knowledge. This work includes characterizing source noise, evaluating noise propagation and modeling methodologies, and understanding health and welfare impacts of civil aviation noise. That knowledge is used where applicable to update FAA's set of environmental modeling tools, which provides for modeling the environmental impacts of noise, fuel burn and emissions, along with other modeling capabilities. Modeling provides an understanding of how future conditions might compare with FAA environmental goals (such as the reduction of people exposed to significant noise). The FAA uses that understanding to explore and develop mitigation measures, which can be factored in to analysis for future scenarios to assess potential progress towards meeting environmental goals. The information gained from the analysis is folded back into the process to help inform research to improve scientific knowledge. The majority of the FAA's work on aviation noise research is directed at improving scientific knowledge. The improved scientific knowledge then leads to an evolution of FAA's policy, when warranted.

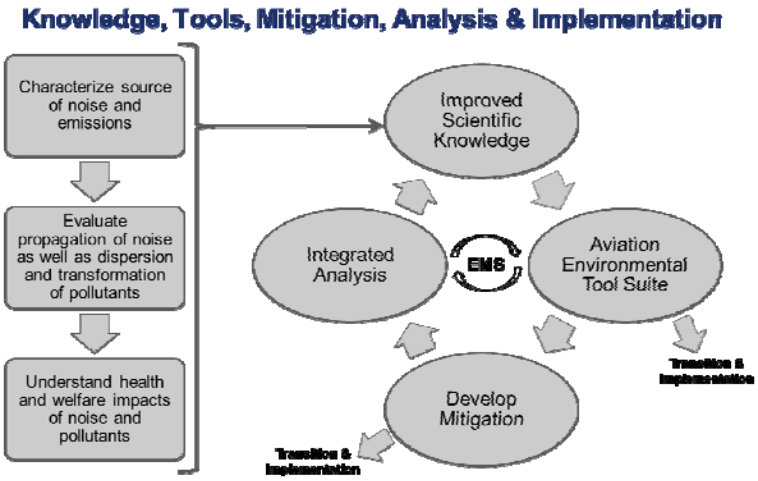
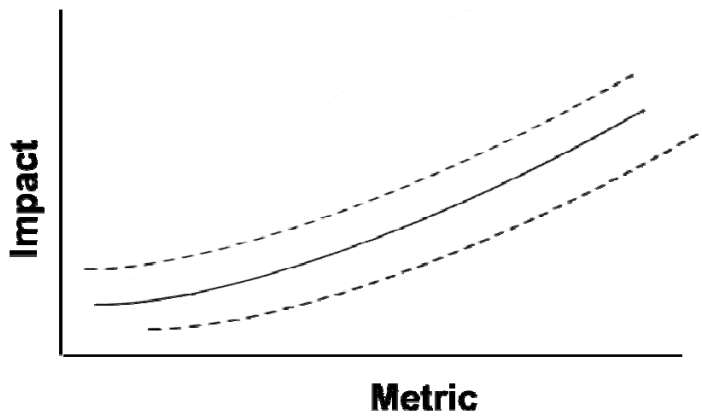


Figure 1: FAA's Research Framework

The FAA research projects for civil aviation noise can be grouped into distinct areas related to improving scientific knowledge, including noise technology, sound

propagation, source measurements, impact of civil aviation noise on human health and welfare, and sound transmission and land use planning. Work is being planned to apply the results of this research to enhance modeling capabilities, strengthen noise policy and reduce the impact of aviation noise. This research is linked to an overall effort to determine the most appropriate way to capture the human response to civil aviation noise in a dose-response relationship. As seen in Figure , currently, the FAA captures human response to civil aviation noise using the Day-Night Average Sound Level (DNL) with percent highly annoyed at a level of DNL 65 dB. In the mid-term, the FAA is keeping the DNL and percent highly annoyed framework, but is reexamining whether DNL 65 dB remains the appropriate level. The longer-term research is exploring whether there is an alternative metric and/or type of impact that the FAA should consider.



Timeframe	Metric	Level	Impact
Current	DNL	65 dB	% Highly Annoyed
Mid-Term	DNL	?	% Highly Annoyed
Far-Term	?	?	?

Figure 2: FAA Dose Response Goal

To ensure that research is providing the appropriate evidence to inform policy, the FAA developed a research roadmap. The roadmap covers four different types of impacts (annoyance, sleep disturbance, health, and children's learning), source characterization of noise from helicopters and supersonic aircraft, and noise propagation.These research areas correspond with the inputs to improved scientific knowledge in the EMS framework shown in Figure 1.

In each area, the FAA has determined what research is needed to resolve key scientific and policy questions. A high-level graphic of the roadmap is shown in Figure . The graphic also illustrates how the research applies to three areas as it matures: modeling tools, policy and guidance, or international work. Because the different projects are intertwined,work needs to progress in all areas to fully understand some of the policy implications of the results.

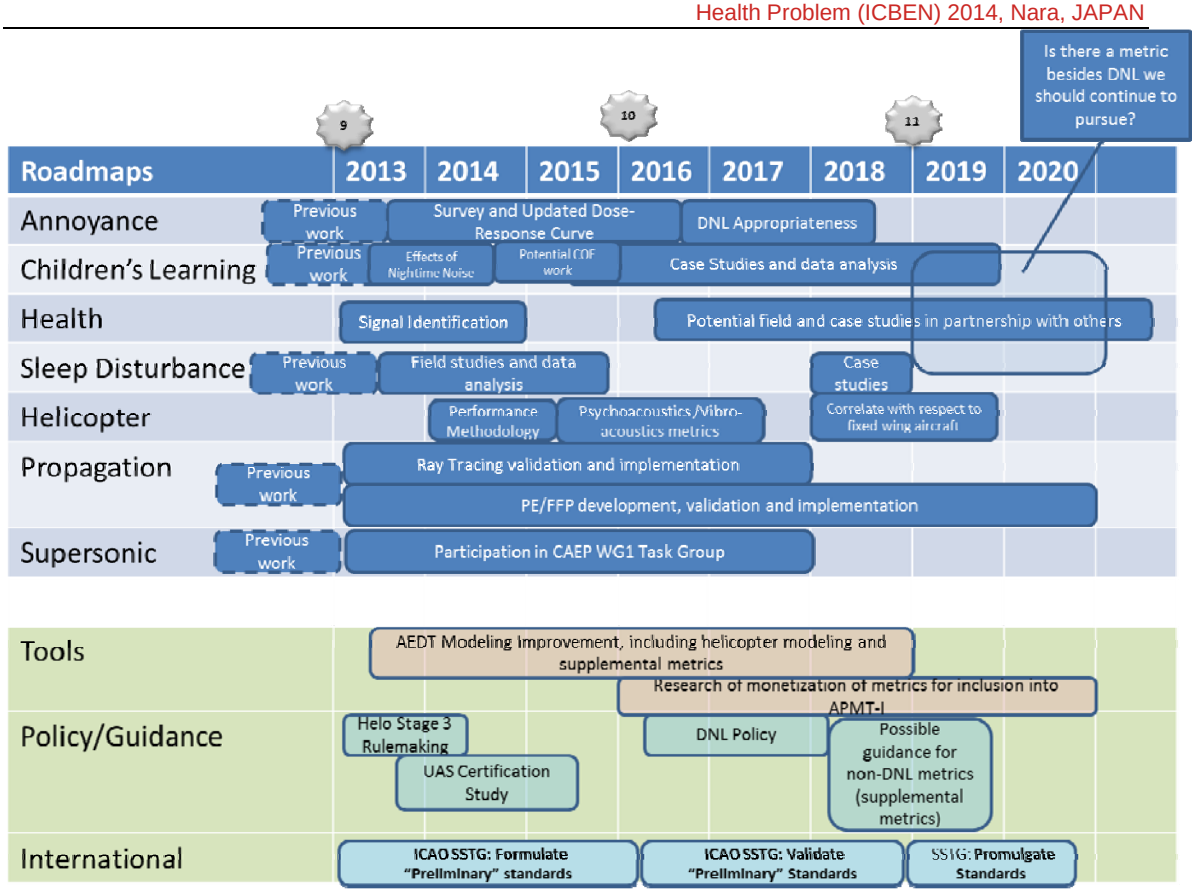


Figure 3: FAA Noise Research Roadmap

The FAA's work on annoyance centers on a new social survey that will produce data on community response to civil aviation noise (Aircraft Annoyance, 2014). That work, along with an exploration of the appropriateness of the DNL metric to capture cumulative noise exposure, will provide a basis for updating the FAA's policy guidance on assessing noise impacts.

The FAA's research on children's learning and civil aviation noise has concentrated on the benefits of sound insulation. Current research is exploring the possible linkage between exposure of aircraft noise at home and children's learning (Sharp et al 2014). In addition, the FAA is undertaking cases studies of how those in the classroom react when aircraft overfly the classroom, and exploring the use of different metrics and different eligibility criteria for sound-insulating schools.

The FAA's current work on aviation noise and health is focused on cardiovascular health. (Although many people include sleep disturbance and annoyance under the category of health, the FAA has separate research work in these two areas.) Recent research suggested a link between aviation noise and cardiovasuclar disease in the elderly, but limitations with the study require follow-on research to explore that linkage (Levy & Dominici).

Work has been completed on the impact of noise from different modes of transportation on sleep. The FAA, in collaboration with the German Aerospace Center, DLR, has been developing methods for conducting field studies to study the impact of aviation noise on sleep. The FAA is designing a field study on the effects of aircraft noise on sleep and recuperation based on current scientific knowledge in

both the noise effects and the sleep research areas (Davies & Basner). A small field study is currently being planned and will be executed in the next year.

As research progresses, the FAA's policy will evolve to reflect improvement in scientific knowledge. The FAA will issue policy updates if warranted by research results and other considerations, and anticipates being in a position to deliver an updated comprehensive policy document based on the findings of this research by the end of the decade. The FAA's policy will continue to build upon the goal outlined in the 2012 Aviation Environmental and Energy Policy Statement.

To support the research on impacts FAA needs to ensure that the environmental models used to calculate noise exposure use the latest methodologies and source data. To that end, there is dedicated on-going work to improve the propagation methods within the models and to ensure the noise-power-distance curves are expanded to the distances needed to support the necessary environmental analyses. Additional noise modeling methods will also be explored.

As new aircraft types are introduced, it is important that the right regulatory framework is in place to support certification of those aircraft. The FAA is working with the International Civil Aviation Organization's Committee on Aviation Environmental Protection (ICAO CAEP) to establish an internationally recognized certification process for supersonic aircraft that will fly over land. In conjunction with this work, the FAA is conducting research to explore the possibility of reducing the impact of sonic booms. This research includes such work as acceptance, annoyance, modeling, and metric exploration.

Finally, community response to the use of helicopters in urban areas has led to a resurgence of work in this area. FAA is exploring the correlation of human response to civil jet operations and helicopter operations. In addition, FAA is endeavoring to improve modelling for helicopters and explore potential updated noise abatement procedures for helicopters.

FAA is also beginning to explore the noise research needs for unmanned aircraft systems (UAS). Current work consists of understanding how the vehicles may be used in the national airspace system, how they may need to be considered in environmental analysis, and how FAA environmental modeling tools can best model the environmental impacts of UAS. In addition, ongoing work with respect to commercial space is concentrated on determining the most appropriate noise modeling methodology for the vehicles and ensuring appropriate noise policy for commercial space operations within the U.S.

Using an EMS framework, these individual areas of research come together in a goals-oriented research portfolio that will provide a stronger, more comprehensive basis for an updated FAA noise policy.

CONCLUSIONS

The FAA uses an EMS framework to guide its civil aviation noise research. The goals of the research are to improve our understanding of the effects of civil aviation noise in these areas and to ensure that U.S. civil aviation noise policy continues to be based on the best available scientific information. To reach that goal, the FAA has launched a series of noise research projects to update the scientific foundation for U.S. civil aviation noise policy. When warranted, the improved scientific knowledge leads to an evolution of FAA's policy.

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