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Concerns and Mitigating Strategies for Aircraft Noise Pollution on Airport Communities

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Where there are airports, there are noise complaints from residents in the community. Aircraft produce a unique sound that interrupt an existing environment as they traverse a particular point. Noise disturbances from aircraft appear to distract residents near airports more than other types of vehicles such as cars or trains [1]. For example, San Jose International Airport, located in San Jose, California, is a large commercial airport and carried over 10 million passengers through its gates annually [2]. Seven miles south of the airport is a residential community on hill several hundred feet above the surrounding town and nearly directly under the departure and approach corridor for one of the runways at the San Jose airport. The airport began receiving complaints about aircraft noise even prior to the completion of the residential community on top of the hill [3].

Around airport communities, the Maximum Sound Level method and the Sound Exposure Level method are two measures commonly used to monitor noise form single takeoff or landing [4]. The Maximum Sound Level method identifies the peak decibel (dBA) produced from a takeoff or landing event but does not consider the duration or total sound energy produced. The Sound Exposure Level method considers the duration of the sound as well as the intensity, and therefore two measures of the same intensity could have different noise levels depending on the duration of exposure to the sound [4].

Regulatory guidance on aircraft noise pollution in the US comes from the Federal Aviation Administration (FAA) and a specialized agency of the United Nations, the International Civil Aviation Organization (ICAO). The ICAO initially began discussing concerns over aircraft noise in the late 1960s and early 1970s and the United States adopted its first aircraft noise regulations in 1969 [5]. Since then, noise concerns have received intense scrutiny at the international level, resulting in the first set of international protocols, known as Standards and Recommended Practices (SARPs), in 1971, through adoption of the 16th Annex (Annex 16) to the Convention on International Civil Aviation of 1944 [6]. Expanding the scope of Annex 16 to incorporate the broad category of environmental protection, aircraft noise issues and standards became Volume I of Annex 16, passed by the ICAO Council in 1981 [6].

Despite continuous noise monitoring at many of the busiest airports and improvements in aircraft technology, noise complaints are increasing around many airports every year as the numbers of passengers and aircraft increase [7].

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It is possible noise complaints may be an indicator of overall aircraft noise affecting a community; however, attempting to evaluate the impact of noise and the associated consequences to the surrounding environment is challenging because of the subjective scale individuals use to evaluate a disturbance by a particular noise. It is also challenging to determine unequivocally if the noise that disturbed a particular individual that resulted in their complaint was actually an aircraft, or if it was noise from something other than an aircraft flying overhead [8].

This brief discusses several of the concerns and implications of the impacts of aircraft noise pollution on communities. It highlights the regulatory framework guiding noise policy mitigation at commercial airports in the United States and provides a landscape describing how noise policies have developed at airports across the country. This brief also provides a few recent discoveries from current research about aircraft noise pollution policies in the US.

Typical Airport Policies Target Noise Mitigation

Airports currently use a variety of strategies and policies to mitigate the effects of noise pollution on a community. Research has examined noise technologies extensively, but only relatively recently have particular policies been under scrutiny [7, 9]. Early aviation policies targeting potential noise pollution mitigation almost exclusively focused on the reduction of noise through technological improvements of aircraft [9]; however, aviation industry officials and policymakers understand a more holistic and interdisciplinary approach is necessary to understand and reduce the impacts of aircraft noise on the environment and surrounding communities. This came to fruition through international agreement by the introduction of the Balanced Approach to Noise Management by the ICAO [10]. Through careful examination of the Boeing database of world airports on noise and emissions, a study detailed the various noise mitigation policies airports choose to implement study leading to the Identification of 18 different policy measures aimed at reducing noise [7]. The policy measures identified were: noise abatement procedures; engine run-up restrictions; preferential runways; airport curfews; noise charges; APU operating restrictions; noise level limits; ICAO 16 Chapter 3/Chapter 2 restrictions; operating quotas, noise budget restrictions (i.e. slot allocation); sound insulation, purchase assurance for homeowners; avigation (overflight) easements; zoning laws; real estate/property disclosure laws; land acquisition for noise compatibility; population within each noise contour relative to aircraft operations; and, airport noise contour overlay maps [7]. These 18 categories directly relate to the four guidelines for targeting noise reduction as established in the balanced approach model and discussed in Part 5 of Annex 16, Volume 1: source of the problem, managing land-use programs, operational procedures that focus on noise abatement, and aircraft operating restrictions [11]. Netjasov (2012) found that the most common measures implemented were noise abatement procedures, engine run-up restrictions, preferential runways, and airport curfews. In North America 147 out of the 294 airports used between one and four strategies; 116 airports used between five and nine different strategies; and, two airports used 14 of the 18 indicated strategies [7].

Airports have a variety of policies that include noise limits that can involve fines for excessive noise as high as $500,000 and taxes for aircraft operation in the form of passenger facility charges [9]. Curfews for operations and other operational restrictions are a direct form of noise restrictions by not allowing any operations at an airport during a specific time-period. Various forms of noise reduction techniques that do not impact how an aircraft operator uses aircraft include certain restrictions such as preferential runways where air traffic controllers only allow operations at certain runways, and land use planning where airport managers can control the impact aircraft have on land in the airport environment [9].

Societal Impacts of Aircraft Noise

As the research concerning noise pollution surrounding airports grows, concerns increase from academic communities about the consequences of the impacts of aircraft noise on a community and the surrounding environment. The effects of noise pollution can disrupt environments of humans and animals. Health effects, physical and mental, attributed to aircraft noise are continuously evaluated, and research shows that disruptive noise levels may harm human health. Researchers

discovered links between the disturbance on an individual by aircraft noise and negative health consequences suffered. While it has not yet been determined the extent to which aircraft noise specifically contributes to a health consequence such as high blood pressure, the following studies highlight some of these specific discoveries.

In one study, researchers examined test scores of students who attended schools near the London Heathrow Airport and they found that students subjected to more aircraft noise had poorer reading performance scores than students not subjected to aircraft noise [12]. The researchers concluded that chronic noise exposure appeared to influence mathematics and reading exam performance. Socioeconomic factors (i.e. class, defined by students eligible for free school meals) confounded the results suggesting that further research was necessary to understand the relationships between social class and aircraft approach and departure paths [12].

In addition to academic performance, aircraft noise also affected the physical health of those exposed. A review of literature pertaining to health effects of aircraft noise concluded that serious adverse health consequences have been linked to aircraft noise, particularly at night. Two major health issues, hypertension and heart disease, were cited in several studies as potential health risks attributed to lack of sleep resulting from aircraft noise. Lack of sleep due to aircraft noise appeared to correlate with obesity and diabetes. Although many of these health issues may be attributed to noise in general, noise produced by aircraft is a contributing source [13].

Noise pollution is harmful to communities. Noise affects people and animals by filling what would otherwise be a quiet environment with unnatural, manmade noise at high intensity levels. Pepper, Nascarella, and Kendall (2003) stated, “The two most important elements of noise exposure in wildlife are the proximity to the airport and the frequency of overflight” (p. 425) [14]. Animals rely heavily on their hearing to obtain food, evade predators, and reproduce. Loud aircraft noise may change their behavior patterns, potentially causing a lifelong change in behavior. Studies have shown that animals exposed to excessive noise typically exhibit a fright response, resulting in the animal attempting to escape the source of the noise. The habitat where the animal resides may affect its response to aircraft noise [14]. Animals may respond more aggressively around airports that have large open fields in the surrounding area, compared to airports that are located in busy urban environments. This is a result of the increased noise in open environments due to the lack of natural sound barriers in forests or urban areas [14]. Many airports have implemented environmental components to their noise reduction programs that describe airport procedures such as how to clear hazardous wildlife from the airport boundaries in an attempt to mitigate effects on natural animal habitats. It is important to understand the impact on animals because airports typically include large areas of undeveloped property that are home to many species of animals, including ground-based deer and foxes as well as many varieties of birds. If these animals become confused or aggressive they may wander onto airport surfaces impeding or colliding with aircraft, and endangering ground personnel [14]. Cleary and Dolbeer (2005) reported that wildlife strikes to aircraft resulted in deaths to over 100 people and caused a yearly $500 million in damage, with 74 percent of wildlife strikes occurring on airport grounds or within the immediate vicinity. Between 1960 and 2004, 18 of 19 large transport category aircraft severely damaged by wildlife occurred on airport grounds [15].

Airports Cluster by Noise Mitigation Strategy

This section briefly discusses the current research discoveries about noise mitigation strategies at US Commercial airports. After examining noise policies at 132 airports, six distinct groups of airports appeared with each group of airports implementing a different overall strategy to combat aircraft noise pollution. These six groups were determined from a latent class analysis that determined the results based on identification of the 18 different policy options discussed above. The groups were distinct groups in that each group of airports was likely to implement a different set of noise mitigation policies. These groups and their potential policy implementation definitions are presented in Table 1. Community policies consisted of strategies like sound insulation for homes and schools, homeowner purchase assurance, zoning laws, avigation, real estate disclosure laws, and the ability for airports to acquire land. These policies

required funds or legislation that directly affected community residents.

Certain policies targeted procedures for aircraft, such as noise abatement procedures, engine run-up procedures, and preferential runways. Several policies directly affected the aircraft operation and required awareness of the aircraft operator. These included airport curfews, noise charges, auxiliary power unit restrictions, noise level limits, and operating quotas. This set of policies were only implemented consistently in Group 6 because they potentially impacted the ability for aircraft to operate, possibly changing procedures that operator would typically prefer to implement without those policies in place. Many of the airports may not feel comfortable forcing airlines that supply revenue to the airport to comply with restrictive policies that add repercussions to their operations.

Table 1. *Potential Airport Noise Policy Groupings*

Group Classification	***Policy Status***
Group 1	Implementation Unlikely
Group 2	Implementation of some community policies somewhat likely (e.g., sound insulation)
Group 3	Implementation of noise abatement procedures and noise monitoring likely
Group 4	Implementation of noise abatement procedures and noise monitoring likely, implementation of community policies somewhat likely
Group 5	Implementation of everything likely except for airport noise level restrictions
Group 6	Implementation of nearly all policies likely

Despite there being a wide range of policies airports implement to combat noise pollution, there are common policies used throughout the country. The region appears to be important in determining the types of policies that airports choose to implement so policy makers can use the classifications to help make broad policies that improve general areas. The airports in the southern portion of the United States east of the Mississippi are generally the most lenient toward aircraft noise and it may be difficult to make more stringent noise limitations there. However, many airports in the western portion of the United States are very concerned about total noise production from aircraft and invest in noise monitoring and flight tracking systems.

Summary and Future Studies

Many airports in the western portion of the United States are very concerned about total noise production from aircraft and invest in noise monitoring and flight tracking systems. Further restrictions limiting noise that affects an airport community may be seen more favorably in these areas than in airports in other parts of the country. It is possible that political beliefs and beliefs about the role of government interference in industry play a role in the types of policies an airport will implement in a certain location. The evidence suggests that a single approach that attempts to limit noise and accommodate all airport communities may not be as successful as a flexible approach that allows different policies in different parts of the county.

Aviation will be the primary transportation method for people to travel around the world. To accommodate the growing demand, aircraft will have to continue to become larger and heavier, creating more noise during phases of flight that are close to the ground. Policies only targeting noise from engine production may not have the most impact on noise reduction in the future, particularly and specifically on communities that live near airports.

It is important for airport leaders and policy makers concerned with the noise pollution around airport communities take steps to understand the landscapes and environments in which they are working. This research has provided a foundation of the overall airport noise mitigation policy landscape around the Class B and Class C airports in the United States. The most important consideration is that noise production concerns are not 100 percent solved and, if all predictions remain correct, will become a more serious problem in the future. Before policymakers can target the legislation of specific policies there needs to be an understanding among the aviation community of what is already in place and what airports are already doing to combat noise pollution disturbances in a local airport community.

The next steps required for researchers is providing specific directions airports may take regarding the implementation of noise mitigation policies. A few areas that may be addressed through future research are suggested below.

1. Many non-commercial airports are becoming busier to general aviation jets. Long Beach airport in Los Angeles, for example, is a Class D airport that has a noise monitoring program and fines aircraft for excessive noise production. Are airports generally associated with General Aviation able to be classified into certain noise policy strategy clusters?

2. There have been some federal regulations that have targeted noise production in an effort to minimize the effect of noise on communities. How has the United States Congress reacted to community concerns about aviation noise pollution and to what extent have federal agencies engaged with Congress to set federal noise mitigation policies?

3. Are there certain noise policies believed by the aviation community to be more beneficial to aircraft operators and community residents, and have a greater impact on reducing noise than other policies? Do airport leaders and community citizens have different opinions about noise concerns?

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