Applied Acoustics 92 (2015) 115–123

Contents lists available at ScienceDirect

Applied Acoustics

journal homepage: www.elsevier.com/locate/apacoust

Analysis of noise abatement measures on European airports

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ARTICLE INFO

Article history:
Received 16 September 2014
Received in revised form 29 December 2014
Accepted 13 January 2015
Available online 3 February 2015

Keywords:
Airport
Noise abatement measure
Noise control
Noise management

ABSTRACT

Air traffic noise is one of the major constraints of airport development. Many airports recognized noise problem long ago and have introduced a variety of measures to reduce its impact. The number and types of the introduced measures differ between airports. In order to determine the most influential factors for the introduction of noise abatement measures in airport surroundings, the research presented in this paper examined 248 European airports. By analyzing the correlation of specific characteristics related to airports (number of runways and aircraft operations, distance from the city and the population of the city that it serves, gross domestic product (GDP) per capita) and the number of introduced noise abatement measures, five hypothesis were examined: the higher number of aircraft operations causes the introduction of a higher number of noise abatement measures (NAMs); the higher number of runways will affect the introduction of a higher number of NAMs; airports that are closer to the settlement will introduce a higher number of NAMs; the higher population in the vicinity of the airport will affect the introduction of higher number of NAMs; the higher GDP per capita will affect the introduction of a higher number of NAMs. The results of analysis have shown that number of NAMs introduced does not have significant functional relationship with observed factors, except in some certain cases.

1. Introduction

Aircraft noise is considered as one of the most influencing limiting factors of air traffic development, especially airports. Due to increase of population in cities and their territorial expansion, cities become more closer to airports, which parallel with air traffic growth, results in increase of number of people affected by negative noise effect.

Various organizations at the global level discuss possible solutions to the problem of air traffic noise. In September 2001, within the Resolution A33-7 [1], International Civil Aviation Organization (ICAO) has presented the policies and programs based on the so-called "Balanced approach" of aircraft noise management. This approach to noise management considers four elements: reduction of noise at source, land use planning and management, noise abatement operational procedures, and operating restrictions on aircraft. In the guidelines for the application of a "Balanced approach", ICAO has recognized the need that the solution for noise problem should be discussed separately at each airport in accordance with the specific characteristics of the observed airport [2]. The guidelines are general and do not require an accurate and uniform application for all airports. However, the same solution can be applied if similar noise problems are identified at airports [2]. The Balanced Approach recommends that noise policy should not target single solutions but use any combination of solutions as the most appropriate option to solve the causes of problems [3,4].

Many airports recognized noise problem long ago and have introduced a variety of measures to reduce its impact. Since 1992, Boeing has maintained a database of airports around the world that implemented measures to reduce noise impacts [5]. Until 2010, Boeing has anually updated database in cooperation with airports, and this data verification increased the quality of the data. The database contains basic information about airports and description of noise abatement measures implemented on specific airport.

This paper presents a continuation of the research of Netjasov [3]. Based on data from Boeing's database, Netjasov [3] provided an overview of the measures implemented at airports around the world showing their frequency and diversity. In addition, Netjasov [3] presented directions of the development of new noise abatement measures, generated as a response to ICAO recommendations. Analysis of many international airports has shown that numerous measures for solving the noise problem at airports and in their surroundings have been developed and implemented and thus respond to requests of "Balanced Approach" [3]. Due to

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http://dx.doi.org/10.1016/j.apacoust.2015.01.010
0003-682X/

ever-increasing volume of air traffic in the world, it was shown that the number of airports that are facing the problem of noise is increasing and that the number of airports that are introducing some measures to manage noise is increasing [3].

Although there are similarities between airports that are introducing some of the noise abatement measures, the number and type of applied measures are very different among them. In addition to all the previous knowledge of the subject, the question set up in Netjasov [3] that remains open is: what are the most influential factors for introduction of certain measures? The aim and main contribution of the research presented in this paper compared to Netjasov [3] is to find the answer to the above open question, i.e. to analyze and show if the significant correlation between number of noise abatement measures introduced and specific characteristics related to airports (factors) exists or not.

This paper is organized as follows. Section 2 describes types of measures that airports are introduced in order to reduce noise impacts. Particular emphasis was placed on noise abatement measures applied by the airports in Europe. Section 3 explains the research methodology, the main questions that motivated the study, the starting point for research, as well as a database based on which the survey was conducted. By analyzing the correlation of specific characteristics related to airports and the number of introduced noise abatement measures (NAMs), based on data collected for European airports, Section 4 provides the discussion of results obtained. Section 5 contains conclusions and future research directions.

2. Noise abatement measures

According to Boeing database, airports around the world have introduced 18 different noise abatement measures so far [3,5]:

1. *Noise Abatement Procedures* – referring to the procedures, i.e. on the arrival and departure trajectories, as well as recommended flying techniques.
2. *Engine Run-Up Restrictions* – referring to the restrictions on the engine testing (usually the specific facilities and location at the airports are intended for that) and the use of "reverse thrust" in landing.
3. *Preferential Runways* – referring to the runways predefined for arrivals and departures in case of airports with multiple runways (if traffic, weather and safety conditions permit).
4. *Airport Curfews* – referring to the time intervals in which takeoff or landing are not allowed for some or all types of aircraft (usually time intervals during the night or weekend) and they can be changed seasonally (summer, winter).
5. *Noise Charges* – referring to the additional charge to airlines whose aircraft exceed the allowable values of noise as well as additional charge to companies using older types of aircraft (louder), where the amount of charge can vary with the time of the day (e.g. more expensive during the peak period) and the weight of the aircraft (e.g. more expensive for the heavier aircraft).
6. *APU Operating Restrictions* – referring to the prohibition of the APU (Auxiliary Power Unit) use while the aircraft is on the ground and recommends the use of fixed or mobile GPU (Ground Power Units).
7. *Noise Level Limits* – refers to the allowed noise values in certain points of the noise monitoring system (usually per operation), the excess which leads to additional charges (or fines) applied to airlines.
8. ICAO Annex 16 Chapter 3/Chapter 2 Restrictions– refers to the prohibition of flying for the aircraft that are certified in accordance with Chapters 2 and 3 of ICAO Annex 16, Volume 1.
9. *Operating Quotas* – refers to the limit of the number of commercial operations at the annual or seasonal (summer, winter) level as well as the limited number of actual arrivals and departures during peak hours.
10. *Noise Budget Restrictions* – refers to the process of giving the time interval for the landing and taking off (slot allocation) in order to meet the defined criteria (e.g. the annual number of operations) and approved overall noise level (noise total volume).
11. *Sound Insulation (Residences and Public Buildings)* – refers to technique which provides the addition of insulation, noise attenuation baffles, solid core doors, double paned windows, and possibly air conditioning units to incompatible buildings located within the specific noise contour at airports.
12. *Purchase Assurance for Homeowners Located within the Airport Noise Contours* – refers to assistance programs intended to provide homeowners in noise-impacted areas assurance they are going to be able to sell their property for fair market value. Under purchase assurance the airport proprietor agrees to acquire the property as a purchaser of last resort if the homeowner was unable to sell in the open market.
13. *Avigation (Overflight) Easements* – refers to agreement that grants the right to fly airplanes over property, even if the practice causes damage, inconvenience, or loss of property value. Such agreement usually prevents the property owner from building or growing anything over a specified height.
14. *Zoning Laws* – refers to development regulations that discourage or prohibit the placement of incompatible uses in areas within contours of significant noise exposure adjacent to an airport.
15. *Real Estate/Property Disclosure Laws* – refers to disclosure of hazardous or defective conditions on real estate which is regulated by the state law. The law usually requires that potential buyers be told all material facts about the condition of a property for sale.
16. *Acquire Land for Noise Compatibility* – refers to acquisition of property by an airport and relocation of any occupants who reside within contours of significant noise.
17. *Population within Each Noise Contour Level Relative to Aircraft Operations* – refers to determining the number of people residing in areas within specific noise contour around airport.
18. *Airport Noise Contour Overlay Maps* – refers to determining the noise contours around airport which purpose is to alert existing and future property owners to the possible noise impacts from a nearby airport. These contours also prevent or discourage incompatible development of property within the contour without the proper notice and documentation.

In this research, only the first ten previously described measures were analyzed, because data for other measures have not been available for larger sample of airports needed for quantitative research.

Analyzing Boeing's database it was found that 603 airports applied some of the NAMs in the year 2009. In 2010, the number of airports increased to 630.

In this paper, a special emphasis was given on NAMs that European airports applied. According to Boeing's database, the number of European airports that applied some of the NAMs was 231 in 2009 and 246 in 2010.

Distribution of number of NAMs introduced per airport in Europe for years 2009 and 2010 is shown on Fig. 1.

From the Fig. 1 it can be seen that in both years, roughly 60% of airports are introducing one to four NAMs and 25% five to six NAMs. Only 1% of the observed airports have implemented all ten analyzed measures.