AVIATION AND THE ENVIRONMENTAL NOISE DIRECTIVE: AN ANALYSIS OF DIFFICULTIES AND GAPS IN THE IMPLEMENTATION*

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Following various studies and consultation exercises, the enforcement of the 2002/49/EC Directive brings some additional technical work for the aviation sector. Some EU countries consider it a relatively minor adaptation of the noise mapping already made for the major airports, while other have problems in finding the right methodology. The current debate amongst aviation noise experts is more on how aircraft noise should be assessed rather than how to predict it. The paper will focus on aviation and END relation, as:

– benchmark of aircraft noise mapping methods;
– aircraft noise and performance database;
– data collection;
– implication of Doc 29, and
– the use of measurements in noise mapping.

An airport case-study will be illustrated, the implication of the competent authorities in process of making action plans, involving aviation, will also be mentioned.
The paper concludes with identifying gaps and lesson learnt from this expert judgment exercise.

1. INTRODUCTION

This paper presents an analysis of an expert judgment exercise on the implication of the Environmental Noise Directive (2002/49/EC) to aviation sector. The author presents an analysis of difficulties and gaps of END implementation in aviation sector and also examines some additional work for aviation, identifying difficulties in implementing the mitigation measures and assessing the gaps in knowledge.

2. AVIATION AND THE ENVIRONMENTAL NOISE DIRECTIVE

The European Noise Directive – END. The European Directive 2002/49 requires Member States to produce noise maps to assess the environmental noise,

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to make information on noise exposure and its effects available to the public. Local administration is asked to prepare action plans to reduce noise where necessary, and to maintain environmental noise quality where it is good.

While the previous EC Directives on noise have reduced noise emissions from sources, the END addresses noise exposure [3]. In the first stage, there is need to:

- harmonise methods of assessment;
- prepare noise maps;
- provide information to the public and to the EC.

The next stage will require setting target values and action plans. However, the END deals with integrated policy and shared responsibility, involving a wide public consultation. Therefore, the aviation sector has to tackle the issue of noise for the first time outside agglomerations, together with noise from road, rail and industry.

Thus, the Commission will be involved in setting the indicators, common methods, establishing noise data at EU level and assessing the community actions. The Member States are responsible to establish the limit values, perform the national mapping, design the action planning and inform the public.

Work on aviation and noise within the EU. The implementation of END will for the first time ever, at the scale of the EU, provides a link between sources of environmental noise and exposure to noise, allowing citizens to deal with noise problems at an integrated common European level. Thus, preparing noise maps are essential to determine noise exposure, while through action plans, the harmful exposure to the environmental noise may be reduced and public informed. Strategic Noise Maps should be prepared for 2007 by all the airports registering movements over 50,000 per year, take-offs and landings.

3. AVIATION APPROACH TO NOISE

The objectives of the presented paper are to support the development of a detailed research strategy for Aircraft Community Noise Assessment Tools within the frame of the ACARE 2020 Strategic Research Agenda, to identify research needs emerging from current noise mapping practices and implementation of 2002/49/EC (END) and build up 2020 roadmap for noise mapping techniques.

Modelling the aviation noise. Method for assessment of environmental noise levels near airports should be harmonised, accepted and reliable. Aviation noise source is complicated and it varies according to mode of flight, weight of aircraft and proportional to thrust involved. A large change during flight is registered due to fuel use, aircraft configuration gear up/down, flaps, slats etc. The airframe sources can contribute to up to 50% of total during approach. A good aviation model should consider all sources integrated into data. The current models are based on standard aircraft flight profiles, noise being correlated only to the power

settings. Some new research version produced for use in Sourdine II can prove the difference, but there is not much data – only 75 aircraft [2].

Noise experts will deal with the production of noise sensitivity maps and conflict maps. Noise measurements will help to update/validate predicted noise maps, evaluate effectiveness of noise abatement measures and emphasise unpredicted situations. Calculation of noise maps is related to the existing noise situation and to the future developments.

The analysis of the noise situation will take into account noise levels and the number of people annoyed. The development and proposal of noise abatement measures and evaluation of their effectiveness are the end result of the noise mapping exercise. The quality of calculated noise maps depends on many parameters: input data (geometry, buildings, traffic data, etc.) and ground properties. The present calculation methods do not consider acoustically relevant parameters. Estimation of future developments (increase of traffic flow, new infrastructures, and noise abatement measures) should also be considered.

The existing modeling knowledge. Existing national computer models fall into two categories:

- those based on international guidance, including INM and derivatives; and
- those built on methodology specially developed and validated for specific airports.

Integrated models are based on EPNL or LAeq and source and propagation are combined. Well established noise and performance databases should be available. These models use segmentation of flight tracks and they are suitable for long term average, less for single events. Examples of these models are INM, ECAC Doc29rev, SONDEO, etc.

The spectral models take into account the directivity and spectral content, considering a *s*eparation of source from propagation. They are suitable for long term average and for single events, but require more calculation time and much more detailed information. Examples of these models are: FLULA, SOPRANO, IMAGINE.

Since the harmonized calculation model HARMONOISE is not ready for use at the time, two other opportunities are given in the Directive:

- the use of the interim methods;
- the use of the present national methods if they give equivalent results.

Present national methods. The directive 2002/49/EC states that present national methods shall give equivalent results as the interim methods – therefore this had to be evaluated. The evaluation for the land related sources (railway, road traffic and industry) was done by a comparison of the calculation terms.

The methods discussed by the aviation experts were:

– *Civil Airports* : hybrid;

– Integrated: ARP 1845; ICAO 205; ANCAT 29; ANCAT 29R; National: INM; SONDEO; MAGENTA.
– Spectral: FLULA, SOPRANO, IMAGINE Engineering, IMAGINE.

New common methods are being developed at the European level. Harmonoise, a project for road and rail traffic noise is followed by IMAGINE (2004-07). While *Harmonoise* provides the scientific basis, IMAGINE supports the application of noise mapping and action planning under Directive 2002/49/EC. To prepare Strategic Noise Maps for 2012, IMAGINE will be ready, but probably not with full source data. At present (2006), there is need for financing and political will for full source data, either from flight trials or from manufacturers. The advantages of using Harmonoise/IMAGINE consists in harmonization of different sources, using the same propagation model.

Interim noise computation method for aviation. The interim noise computation method is indicated the methodology from ECAC/CEAC doc. 29, 1997. Thus, the European civil airports are using as methodology for computing noise contours as provided by the ECAC Document 29, guidance produced by the ANCAT/AIRMOD working group. The new method, Doc 29 R (revised) includes major updates, such as: the introduction of a segmentation process, and an improved lateral attenuation model.

The Aircraft Noise and Performance database is a data resource accompanying the updated ECAC Document 29. This on-line facility enables the practical and full implementation of the methodology described in the updated guidance in a real modelling system. This database provides noise and performance data for segmentation-based models, for a wide range of civil aircraft models & variants. This is an industry-backed database, which includes *spectral class data* in a readable format (unlike INM).

4. VILNIUS AIRPORT – CASE STUDY

Vilnius Airport represents 70% of the total air traffic in Lithuania. According to local legislation, Vilnius airport is required to produce noise maps in conformance with END, providing it achieves 50.000 movements/year. However, the airport is increasingly constrained because of noise due to traffic growth, therefore, noise contours are required as part of the noise management issues.

The case study [4] tackles the aircraft operations in 2005 and 2012, based on forecast data and a theoretical new runway. Based on the present data (one runway), maps can be produced for today's operations:

– using radar data + noise monitors,
– using radar data + noise models (*e.g.* INM) or,
– *using simulated radar data + noise models*.

Simulation models were presented by Ian Crook [1]. They developed two scenarios: a Baseline (2005) and a future one for (2012). Both simulated with

RAMS Plus, an Airspace & Airport simulator developed by Isa experts. Two sets of simulation data were required for the simulator modeling as below described.

Baseline data scenario involved: 24-Hours traffic (Mon 23/5/05), standard SID/STAR (AIP) operation, using runway 20 (south-bound Arr/Dep), full ground movement and operational support from Lithuanian CAA.

Future scenario took into account forecast traffic growth [*14% in 5yr, 25% in 8yr*], theoretical SID/STAR operation, new runway [details provided by Lithuania CAA]. It is expected that 80% of future traffic will use the new runway.

Noise assessment scenarios used in Vilnius study were:

- Noise contours of interest (55 dBA, 65 dBA) were calculated for each scenario; two scenarios – Baseline (05) + 2012
- Both simulated with RAMS Plus [*Airspace & Airport simulator*]
- Baseline: 24-Hours traffic (Mon 23/5/05), Standard SID/STAR (AIP) operation, using runway 20 (south-bound Arr/Dep), full ground movement.

The methodology and date involved pair used for Vilnius case-study was diversified: RAMS – Route design and flight simulation, ENHANCE – Thrust, INM – Noise maps and surface of contours, and finally Census data – Number and type of households avoided

Noise contours of interest (55 dBA, 65 dBA) were calculated for each scenario, as illustrated in Fig. 1.

The development of a noise assessment methodology should be based on valid tools to help decision makers to assess their scenarios. It can vary with geographic attributes (e.g. socio-economic aspects, land-use etc.).

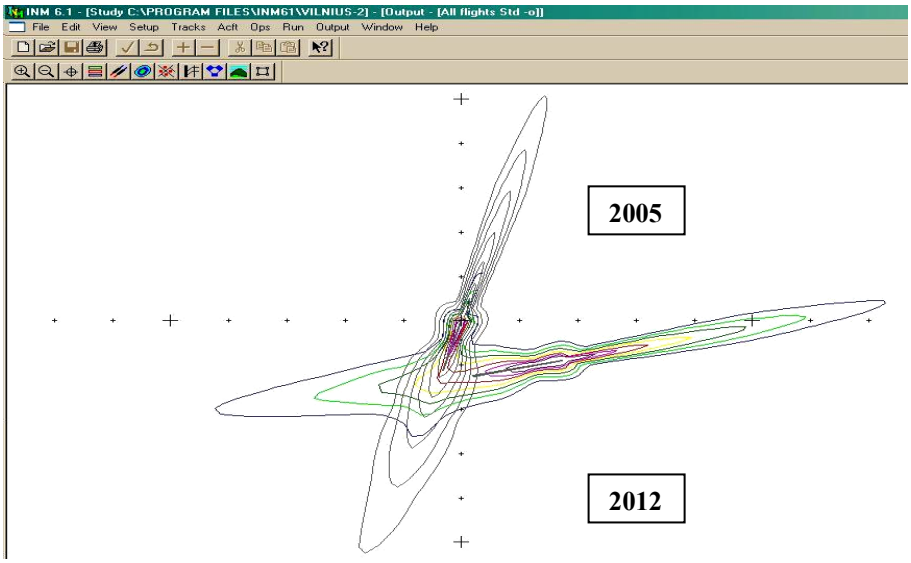

Fig. 1 – Noise assessment for each scenario.

5. CONCLUSIONS

There appears to be a need for clear guidance on how to interpret the END commonality with rail and road. The future role of IMAGINE has to be considered, as well as centrally managed databases.

The traffic data should be an aircraft-engine combination, weight/range, track used, etc. Noise mapping can vary with geographic attributes (*e.g.* socio-economic aspects, land-use etc.).

For noise and performance database, ANP with extensions to future aircraft and substitutes remains important, while use of simulation in noise analysis is an important tool. Simulation can also be an efficient tool to perform tradeoffs between candidate future scenarios by directly feeding both noise and emission models. There is a great need for development of an assessment methodology based on valid tools to help decision makers to assess their scenarios.

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