

Executive Summary



Enhancing Compatibility of European Financial and Environmental Modelling Tools for Aviation

EFEMTA

Results of a Short Study funded under the AERONET III Project



Summary for policy makers

Background

Aviation has made substantial reductions in noise, emissions and costs since the introduction of the jet airliner. As some level of technological maturity is reached, these former win-win situations regarding noise, emission and cost reductions are becoming rare, resulting in further aviation system development now requiring trade-off between these factors. The recent growth in interest in interdependency modelling springs from a realisation that not only do we need to understand the interrelationships between all the different technical environmental and economic factors that affect aviation, but also that we now have the technical know-how and computing power to integrate all the major influencing variables in aviation into a single model or modelling system.

A major US initiative to develop an integrated capability to model aviation interdependencies is ongoing. However, in Europe similar activities are currently fragmented and limited to organisational efforts. Therefore, a European approach to unifying existing European tools for modelling aviation's environmental impact and its interdependencies has been suggested. Europe on its own should have an ICAO/CAEP-accepted capability, i.e., a set of compatible models or a working system for CAEP/8 (2007-2010). This would give Europe the capability to do integrated assessments, which meet European requirements, e.g., regarding input data, assumptions, availability, transparency, and, moreover to investigate Europe's own policy initiatives and alternate options in the field of aviation and the environment.

AERONET short study and objectives

Against this background and triggered by European policy makers, the European network AERONET funded a short study on needs and requirements, existing capabilities and gaps, feasibility and future work to establish a European modelling system(s) to support European policy decision-making in the field of aviation and the environment. The study approach, results and recommendations are reported in detail in this document.

The study was named EFEMTA (European Financial and Environmental Modelling Tools for Aviation), was led by NLR, assisted by QinetiQ plc, and received many contributions from the European modellers and policy makers communities. The study took place in the first half of 2006. More specifically, the aims of the AERONET short study were:

1. To define a European view of the analytical requirements for CAEP policy considerations for CAEP8 and thereafter and to set out the likely requirements for Europe-based *econo-environmental modelling* of aviation in the medium term.
2. To establish an inventory of potentially useful existing and emerging models together with a gap analysis.
3. To report on the technical feasibility, approximate costs and timescales to establish the capability needed from a modelling system.

“Econo-environmental modelling” includes the effects of policy measures on the environment, evaluated by assessing changes in emissions and noise and their environmental impact set against changes in costs within the aviation system.

European policies, needs and priorities

In summary, the list of identified – national and international – policies and needs in the EC States, as they relate to emissions and noise from commercial aircraft, includes:

- Source emissions and noise regulations
- International agreements (e.g., Kyoto)
- Operational measures
- Air quality standards
- Technology insertion
- Economic measures such as taxation, charging and trading
- Land use planning
- Other policy-related modelling.

In the international context, NO_x and noise regulatory stringency increases are expected to be considered by CAEP/8 in 2010. CAEP requires interdependency modelling of the effects on population exposed to noise and mass of local airport and global/GHG-related emissions. Further consideration of emissions impacts has moved to CAEP/8 and beyond. With the existence and benefits of a CAEP-endorsed European modelling input, the European CAEP delegates would be in a significantly stronger position to negotiate policies, which more directly address European and global needs than those CAEP policies agreed to date.

In addition Europe’s own policies will require assessment – this will likely cover all summarised policies except source emissions and noise regulations. Tools to carry out the necessary analysis are essentially no different to those required for global analysis.

Europe’s policy priorities were seen to be the development of a capability to model stringency for CAEP/8 and beyond, a capability to model changes in air quality around airports, a capability to assess future aviation noise and emissions as a result of technology changes and, finally, a capability to model the impacts of economic measures.

Modelling system capabilities

Five basic types of modelling systems are identified and defined. These should provide the European modelling capability on aviation and environment assessments necessary to meet the policy analysis requirements. It was found that:

- The basic modelling system is a modelling requirement to meet high priority CAEP and European policy requirements.
- The responsive modelling system is a modelling requirement to meet high priority European-only policy requirements.
- The aircraft type modelling system is a modelling requirement limited to provide additional information – for European needs – regarding high priority European-only policy requirements.

- The impacts add-on and the monetisation add-on are modelling requirements to provide additional information – for European needs – regarding high priority CAEP and European policy requirements.

Moreover, the study made available a preliminary inventory of key existing European capabilities – models and tools. These can be harnessed to provide the basis of the modelling systems.

A further analysis of the defined modelling systems identified initial interface issues and potential gaps. Moreover, future needs on modelling work including costs and timescales were estimated. The recommendations for future work consist of a first setup of three stand-alone proposals for different time periods: a short term one for the second half of 2006, a medium term one for the 2007 period and finally a long term one for 2008 and beyond. It calls for funding from European organisations, governments and the European Commission (FP7).

Recommendations for the Short Term

The Short Term Study Proposal focuses on the realisation of the basic modelling system to meet the urgent European CAEP modelling needs. Recommended activities involve:

- Finalise the inventory of European emissions/noise assessment models
- Identify data flows and needs
- Setup the basic modelling system with available models
- Identify interfaces and develop data exchange protocol
- Demonstration run of the initial modelling system
- Provide recommendations for the management of a European modelling system

Approximated costs are 100.000 Euro and estimated duration of half a year.

Major work items for the basic modelling system will be the development of a publicly available tool or process to model – especially future and non-conventional – aircraft technology and performance and to get a publicly available comprehensive database to match tail-number / aircraft / engine. Other uncertainties are the noise contour calculator and the economics calculator for which a further dialogue is recommended with noise modellers and Euro-FESG members respectively. The costs to fill all gaps and to make adjustments are much more than the above-mentioned 100.000 Euro; it is roughly estimated to be in the range of 0.5 to 0.75 million Euros and the development work will last at least one year.

Recommendations for the Medium Term

In general, the medium term recommendations and activities are focused on the realisation of all five modelling systems to meet the high priority CAEP and European policy requirements. Approximated costs are 1.5 million Euro and estimated duration of one year.

Concerning the overarching interface issue in all modelling systems, it was concluded that this issue boils down to a choice between the application of one overall standard data structure and format, or a model-to-model specific data transformation, or to a hybrid of the two systems. Both options have their pros and cons. Considering ongoing developments and uncertainties regarding requirements, tools and input data, it is proposed that a rigid common data structure is not used as the basis for the European modelling system. Instead, the data requirements of individual candidate tools need to be established, in detail, together with a set of additional data sources and assumptions needed to transfer data from one tool to another. From this data, a small set of common data formats may emerge. These would form the basis of data transfer protocol, limited in scope, but aimed at reducing the overall work in transferring data from one tool to another. All other issues involving data transfer would be dealt with by the receiving tool, requiring identification of the output from the input databases and tools, the “transfer functions” required to translate the data into the format required by the receiving tool and the additional data sources needed, if any, to complete the dataset.

Once the main candidate models are identified, a work package is required to set out any common data and to describe the remaining requirement for “tool wrappers”.

Due to many overlaps – e.g., in development and use of models, tools, databases, interfaces and data exchange protocols – the work for multiple system purposes should be integrated. In addition, the following paragraphs address each modelling system more specifically.

Responsive modelling system

The AERO Modelling System (AERO-MS) is probably the only existing example in Europe of a comprehensive responsive modelling system. AERO-MS has been developed in the previous decade and needs an overall update. Due to its modular character, sub-models in AERO-MS can be replaced with similar, but more recent (sub-) models. The feasibility and cost-effectiveness of this should be assessed in more detail. Moreover, further detailed discussion with Euro-FESG members are recommended whether economic assumptions and economic calculations in AERO-MS added with suggested features would fulfil the needs for economic assessments in CAEP in the future.

The costs to fill gaps and to make adjustments are estimated to be more than 250.000 Euro and the development work will last at least one year. This includes the overall data and system update of AERO-MS and interface issues. However, it excludes the development of an enhanced aircraft technology/performance model and the noise calculator, which is already included in the cost estimation of the basic modelling system.

Aircraft type modelling system

The Airbus Technology Evaluator tool or process seems to be the overall best candidate for the development of new aircraft performance and noise/emissions characteristics. However, it is yet to be developed. Considering availability, costs and timeframe, a more publicly available, simpler and less-costly version of the technology evaluator might be required. The actual flight simulation of existing and new aircraft then requires selection of appropriate tools from the wide range of tools available in the various aviation establishments around Europe. For now, the costs for a first simple version of the technology evaluator are estimated to be approximately 100.000 Euro and the development work will last at least one year.

Impacts add-on

The Impacts Add-on covers a Climate Impact Calculator, a Local Air Quality (LAQ) Impact Calculator and a Noise Impact Calculator.

The main issue for the Climate Impact Calculator is that there are several climate impact metrics, but no agreement yet on what might be the most representative one. There is a need to identify one or more metrics, which can appropriately represent the impact of aviation. This will need further dialogue with the scientific modelling community. The costs to close the gaps and to make adjustments are estimated to be approximately 100.000 Euro for the Climate Impact Calculator and the development work will last at least one half year.

With a number of LAQ models available, the main open issue here is the lack of a simple and single LAQ parameter, which should be easy to calculate and covers the LAQ impact in an overall sense – something similar to “population affected by noise” parameter in MAGENTA/INM. In dialogue with the LAQ modelling community, this needs further investigation. The costs to close the gaps and to make adjustments are estimated to be approximately 75.000 Euro for the LAQ Impact Calculator and development work will last at least half a year.

An additional Noise Impact Calculator – in addition to the “population affected by noise” parameter in MAGENTA/INM – is not envisaged at this stage. This may need further dialogue with the policy and scientific modelling communities.

Monetisation add-on

Despite the fact that there are recent proposals from the US for CAEP to take up challenges in the area of the Monetisation add-on – and the US modelling effort is in the early stages of developing its methodology – it is proposed that at this stage no further work is undertaken and further activity on this area is undertaken in dialogue with the European policy community.

Recommendations for the Long Term

The proposed activities for the longer term involve:

- Part 1: Use of modelling systems and performance of modelling studies in support of EC and European States for discussion and policymaking in CAEP/8 or in the European environmental debate. If needed, work could include outstanding work from the proposed medium term study in 2007.
- Part 2: Study and work equivalent to the medium term study proposal but now including lower-priority policy requirements.
- Part 3: Setup a network of policy makers and model makers in order to maintain a certain level of expertise and work on aviation noise and emissions interdependency modelling in Europe. The network could act as a “quick-reaction-force” advisory panel to support the EC and European States. It should be able to set out short studies to maintain or update the European modelling capabilities including required databases.

Estimated costs / duration: 1 million Euro / 2008-2010 for Part 1; 250.000 Euro / 2008 for Part 2; 2 million Euro / 2010-2013 for Part 3.

Other recommendations and final remarks

System management aspects or the management of a toolset emerged as an additional system related issue. It will in all likelihood consist of component parts and expertise residing in a number of European States and establishments. It is recommended that in parallel with the other recommendations, work is undertaken between the main participating States to establish a set of umbrella principles for organisation of the work and to undertake a work package to set up and run the management system.

The AERONET EFEMTA study has addressed the complex topic of aviation environmental interdependency modelling from a European policy perspective. The focus has been on establishing the requirement for such policy modelling, establishing the required timescales and identifying the gaps in the existing European capability. The outcome is described in detail in this report, including proposals for further work and some rough cost estimates. It should be emphasised that whilst focussing on the policy level, only a limited amount of technical model assessment has been possible within the resources available for this short study. As a consequence, the cost estimates must be regarded as an indication only and, importantly, it should be recognised that these indicative costs do not contain any allowance for contingency, additional requirements or inflation. They are therefore best regarded as absolute minimum figures.

Europe has a significant and unique existing capability in each individual aspect of aviation modelling. The gaps identified are primarily in the interchange of data and in the European management of the capability. Both of these will require considerable and effective European collaboration in order to realise their full potential for the benefit of European policymakers. If realised through the recommended Study Proposals, the modelling capability has enormous potential to guide European aviation policy in the best direction for Europe.