PROJECT

WAKENET2-EUROPE

A European thematic network for aircraft wake turbulence

Funding: European (5th RTD Framework Programme)
Duration: Jan 2003 - Feb 2006
Status: Complete with results

Background & policy context:

Over a much longer period, research in the area of wake vortices has been stimulated by the European Commission by co-financing many European research programs. The interest in wake vortices stems from the fact that airport capacity is becoming increasingly a bottle neck for the air transportation system. Also the introduction of the A380 has stimulated research as the adequacy of separation standards for new and larger aircraft has to be demonstrated.

Wake vortex research is presently at interesting cross-roads. EUROCONTROL is of the opinion that we are at the transition phase to introduce changes to the present system within the next 5 years, e.g. by introducing time based arrivals and weather based departures. This is partly based on (high level) studies that indicate substantial capacity benefits for e.g. time based separations. Similar cost / benefit studies in the US also show large benefits. Yet at Frankfurt Airport the original expectations that the proposed procedural changes with a weather dependent Wake Vortex Advisory System (WSWS) will increase capacity while still maintaining safety, have not been realised so far in spite of a considerable effort. It might be the right time to step back a bit to see if knowledge is sufficient to implement real changes.

Wake turbulence separations, which are in many cases in excess of the radar separation, are a major factor limiting the capacity at many European airports. Several additional movements per hour and per airport seem possible, if the behaviour of the trailing vortices could be predicted accurately enough. Separation distances and flight paths tailored according to the ambient meteorological conditions can be employed to safely avoid potential wake encounters and therefore maintaining the current level of operational safety of the air transport system.

The expected capacity benefits seem achievable at comparably low cost; however no-one so far has succeeded to develop, implement and operate such a system or procedure on a routine basis. Several concepts of operation, CONOPS, are currently investigated. Some successful attempts corroborate the overall feasibility of novel wake turbulence avoidance procedures, but they also reveal that there are still remaining issues that need to be solved prior to a much broader and more frequent application.

Among other aspects, the successful proof that the safety requirements can be met constitutes a major chal

Objectives:

WAKENET2-EUROPE will:

- promote multidisciplinary contacts and information exchange between specialists active in the field of wake turbulence and end-users of this knowledge in the operational airport environment
- enable the development of a shared view on research needed to address the existing and forseeable safety and capacity related problems caused by wake turbulence

Methodology:

The Thematic Network WakeNet2-Europe (WN2E) has brought together many parties that are interested in wake vortices, both from the operational and from the research side. At the mid-term review meeting (November 2004), the two reviewers and the scientific officer of the European Commission urged to document the research needs. This has been picked-up by the various Working Groups of WN2E and resulted finally in a document that should also be regarded as the final deliverable of this network.
Key Results:

- Various operational scenarios (CONOPS) are proposed to increase airport capacity without loss of safety. High level studies have generally indicated substantial capacity gains. It is important to extend these studies into a more detailed analysis taking into account specific (site-dependent) details to quantify potential benefits.

- Continuing efforts in model validation; the collection of data for model validation is still required; this is needed to strengthen the arguments for safety assessments

- Inter-comparisons between probability based safety assessment methods to build confidence in these methods

- Efforts to improve the capabilities for all-weather wake vortex measurement

- To support operational changes, the collection of incident and encounter statistics is needed; hence particular attention has to be given to more objective, partly automated methods using Flight Data Recordings

- An evaluation of the prospects of on-board wake vortex detection, as integrated within wake avoidance procedures.

Technical Implications

Some of this research might have approached its limits. The physics of wake vortices is very complicated and the interaction with a large variation in weather conditions that have a direct effect on the vortex life time, introduces an essentially stochastic element. The question can be put forward if more refinements of the models still ‘pay off’ or that one has to concentrate on the implementation now. One of the key issues is to quantify the potential capacity increase, when all boundary conditions
(uncertainties in weather and wake prediction, system complexity, operational aspects, proof of safety) are properly dealt with.

To make further steps forward it might very well be essential to consider research predominantly in relation with questions that evolve from the process to implement new wake vortex separation procedures. So far, the European research programs on wake vortices have set their own goals that resulted to a large extend from the combined interest of the individual partners. To improve the coordination between the various projects the European Commission introduced the mechanism of the ‘Thematic Networks’ like WakeNet2-Europe. But such a (still rather loose) co-ordination might not be enough to make real progress. A ‘proof of concept’ as the main theme of an ‘integrated project’ will be required to find out where the weak points are and how large the real benefits really are. The implementation of new systems requires the approval of the authorities and this very well might proof to be the hardest part, necessitating additional validation efforts. But this can only be assessed for a fully defined concept.

**Policy implications**

The introduction of new wake vortex separation procedures can be viewed as a multidisciplinary activity. The disciplines should not work for themselves and a ‘smart integrator’ is needed to bring the implementation closer. The role of the ‘smart integrator’ is to define the particular project goals (clearly aimed at a specific implementation and not in generic terms), to interface with the ‘end users’ and to orchestrate the required specific research actions. This requires a high level of technical competence of the integrator, one or more interested stakeholders and the funds for the research and the implementation of new systems and measures.

Documents:
- [WAKENET2-EUROPE 2006-171-PT-1-cr.pdf (Final report)]

**STRIA Roadmaps:** Network and traffic management systems

**Transport mode:** Air transport

**Transport sectors:** Passenger transport, Freight transport

**Transport policies:** Decarbonisation, Societal/Economic issues

**Geo-spatial type:** Network corridors