PROJECT

ATC-WAKE

Integrated Air Traffic Control Wake Vortex Safety and Capacity System

**Funding:** European (5th RTD Framework Programme)

**Duration:** Jul 2002 - Jun 2005

**Status:** Complete with results

**Background & policy context:**

With the steady increase in air traffic, civil aviation authorities are under continuous pressure to increase aircraft handling capacity. One potential approach is to reduce the separation distance between aircraft at take-off and landing without compromising safety. One major limiting factor is that aircraft always give each other a wide berth to avoid each other's wake turbulence (aircrafts create wake vortices when taking off and landing). With the aid of smart planning techniques, however these distances can be safely reduced, significantly increasing airport capacity.

The ATC-WAKE project aimed to develop and build an integrated system for ATC (Air Traffic Control) that would allow variable aircraft separation distances, as opposed to the fixed distances presently applied at airports. When used with new European Wake Vortex Safety Regulation, ATC-WAKE is able to provide airports and aircraft handling organisations a significant increase in punctuality and capacity, while maintaining safety.

This project was undertaken in the context of the EUROCONTROL Safety Regulatory Requirements (ESARRs) and the ICAO wake vortex induced separation criteria.

**Objectives:**

The main objective of ATC-WAKE was to develop and build an integrated ATC Wake Vortex Safety and Capacity platform. A variety of existing subsystems is integrated such that this platform is used within a test bed environment role:

- To evaluate the interoperability of the ATC-WAKE system with existing ATC systems currently used at various European airports;
- To assess the safety and capacity improvements that can be obtained by local installation of the ATC-WAKE system at various European airports;
- To evaluate operational usability and acceptability of the ATC-WAKE system;
- To make a plan and to assess the costs for further implementation and exploitation of the ATC-WAKE IP platform into the system that can be installed at European airports).

A further aim was to analyse both tactical and strategic benefits of using this integrated system at various European airports. This project provides both:

1. Tactical benefits, in terms of temporary capacity increases, and improving the management of arrival flows while reducing holding.
2. Strategic benefits, in terms of long-term runway capacity for airline schedule planning.

The proposed time frame for local installation of the integrated system at European airports was 2010, which implies that the project's baseline was the airport environment with infrastructure systems at that time.

The integrated platform will be extendable, such that evaluation of future systems and concepts will be feasible after completion of ATC-WAKE.
Methodology:
The main scope of ATC-WAKE was to develop and build an integrated ATC Wake Vortex Safety and capacity platform. The project followed five steps:

**Step 1: System Requirements** - Defining the requirements of the system included the operational requirements, the operational concepts and procedures, the users' requirements, and the system requirements themselves.

**Step 2: Integrated System Design and Evaluation** - This step involved the building of the platform, integrating all subsystems. These subsystems included Wake vortex prediction and monitoring system, weather forecasting and monitoring systems, aircraft spacing predictor, and human machine interface for air traffic controllers. Evaluation of the technical feasibility of the system was also carried out.

**Step 3: Safety and Capacity Analysis** - This step focused on a thorough assessment of safety and capacity improvements (tactical and strategic benefits) owed to the system's use. Safe and appropriate separation distances were determined for single runways (arrivals and departures) and closely spaced parallel runway arrivals.

**Step 4: Evaluation of Operational Feasibility** - The evaluation of the operational feasibility of the system included: analysis of the interoperability with existing ATC systems, and the usability and acceptability by air traffic controllers.

**Step 5: Technological Implementation Plan (TIP)** - The Technological Implementation Plan was set up in accordance with the guidelines from the EC. This was carried out in co-ordination with a User Group members and representatives of the aerospace and ATM community.

Related Projects:
- I-Wake (detection of Wake vortices from the aircraft to avoid encounters)
- MFLAME (forerunner project to I-Wake, where lidar ground-based detection was tested)
- S-Wake (development and application of tools for assessing appropriate [safe] wake vortex separation distances)
- AVOSS (Aircraft Vortex Spacing System developed by NASA)
- Canadian Wake Vortex project, in particular the VFS (Vortex Forecast System)
- German Wake Vortex project 'WIRBELSCHLEPPE';
- Wake Vortex Warning System (WVWS) developed for DFS at Frankfurt airport
- High Altitude Landing System (HALS) / Dual Threshold Operations (DTOP) from DFS/Fraport for Frankfurt Airport
- SOIA (Simultaneous Offset Instrumented Approach) by FAA for San Francisco International Airport
- SYAGE (SYsteme Anticipatif de Gestion des Espacements) developed in France for Toulouse Blagnac Airport

Parent Programmes:
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Partners:
**Belgium**
European Organisation for The Safety of Air Navigation; Universite Catholique de Louvain

**France**
Thales Air Defence S.A.; Thales Avionics S.A.

**Germany**
Deutsches Zentrum für Luft- und Raumfahrt E.V.
The ATC-WAKE project developed an integrated platform for ATC (Air Traffic Control) that will allow variable aircraft separation distances, as opposed to the fixed distances presently applied at airports. A variety of existing subsystems were integrated within the ATC-WAKE Integrated Platform, which was used to:

- Evaluate the interoperability of the ATC-WAKE system with existing ATC systems currently used at various European airports;
- Assess the safety and capacity improvements that can be obtained by local installation of the integrated system at various European airports;
- Evaluate operational usability and acceptability of the ATC-WAKE system;
- Make a plan and to assess cost elements for further development, implementation and exploitation of the ATC-Wake Integrated Platform (and other results).

This platform is an essential step that will lead to installation of an integrated ATC decision support system at airports, enabling air traffic controllers to apply new optimised weather based aircraft separation.

Technical Implications

As a first step towards use of an ATC-Wake system at airports, the operational concept and requirements for the application of reduced aircraft separation under favourable weather conditions were established.

The ATC-Wake Operational System comprises four components, which interface with several existing and/or enhanced ATC systems. Relevant ATC-Wake components, together constituting the Separation Advisory System (SAS), are:

- ATC-Wake Separation Mode Planner
- ATC-Wake Predictor
- ATC-Wake Monitoring and Alerting
- ATC-Wake Detector.

These components have been integrated successfully in the Integrated Platform, and it has been shown that the functional data flow defined the System Requirements for all ATC-Wake Use Cases can be realised in an Operational ATC System. The technical feasibility of the ATC-Wake system has been evaluated by experimental simulations with the Integrated Platform. It has been shown that the functional integration of the components is successful and it will be technically feasible to integrate Wake vortex prediction/detection information into existing ATC systems.

Moreover, Air Traffic Controller Human Machine Interfaces have been designed, specified, and tested successfully through two real-time simulation experiments with nine active controllers from five European countries. It has been shown that these HMIs are compliant with the HMIs currently used at key European airports (Paris Charles de Gaulle and Amsterdam Schiphol).

Policy implications
As the project validated technical and operational issues, various activities were performed to validate the safety assessment. Nevertheless, it has become clear that the Wake vortex phenomena during departures is still not fully understood, and further research is needed before the outcome of the departure safety assessment will be ready for approval by regulatory authorities.

The next step will therefore be to complete the validation through production of a Safety Case, Human Factors Case, Benefits Case, and a Technology Case towards installation of the ATC-Wake at one or more European airports. This could be carried out with airport shadow mode field trials, i.e. with direct involvement of airports and air traffic control centres.

Documents:

- ATC-Wake project - Final Report (12/2005) (Final report)

**STRIA Roadmaps:** Network and traffic management systems
**Transport mode:** Air transport
**Transport sectors:** Passenger transport, Freight transport
**Transport policies:** Safety/Security, Digitalisation
**Geo-spatial type:** Infrastructure Node