ATC-Wake: Integrated Air Traffic Control
Wake Vortex Safety and Capacity System

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http://www.nlr.nl/public/hosted-sites/atc-wake
Why developing integrated wake vortex safety and capacity platform in ATC-Wake?

- Increasing airport capacity problems, partly due to the current (often over-conservative) wake vortex separation regulations

- Introduction of new high capacity aircraft

- Weather/wind conditions have the greatest influence on wake vortex, and thus safety/capacity and wake avoidance strategies should investigate possible solutions accordingly
Airport operations influenced by wake vortex

**Arrival**
- 4-6 NM
- IFR only
- Applied behind Heavy, Medium aircraft

**Departure**
- 4-6 NM or 2-3 minutes
- All times
- Applied behind Heavy or Medium aircraft

**Parallel Runway**
- 4-6 NM
- Treated as a single runway when runways are separated by < 2,500 ft.

**Single runway approach**

**Single runway departures**

**Closely spaced parallel runways**

Thus wake vortex problem is restricting airport capacity
Main objectives

- To develop and build an *integrated Air Traffic Control wake vortex safety and capacity platform*, and to use this platform:
  - To assess the interoperability of the ATC-Wake system with existing ATC systems currently used at European airports
  - To assess the safety and capacity improvements that can be obtained by local installation of ATC-Wake at European airports
  - To evaluate the operational usability & acceptability of ATC-Wake
  - To draft a Technology Implementation Plan (TIP) to guide the local installation of the ATC-Wake system which facilitates *dynamic and weather dependent aircraft separation at European airports*
Current ATC Operational Environment

- Current Practices for Take-Off and Landing
  - ICAO Standard Separation
  - Approach and Landing:
    • Initial / Intermediate / Final Approach
    • Planning and sequencing (AMAN)
  - Take-Off:
    • time-based separation (2-3 min)
    • Noise Abatement Procedure
    • No sequencing tool is operational (DMAN)

- No system integrating all sources of WV information exist
ATC-WAKE Operational Concept

- Considers Planning and Tactical Operations
- Two aircraft separation modes: **ICAO Mode** and **ATC-Wake Mode**
- Application of reduced wake separation is dependent on:
  - Meteorological conditions
  - Airport Layout and Runway Occupancy Time
  - ATC Controller working methods: planning of arrivals/departures
  - ATC Equipment: approach radars
- Notification in case of discrepancy between prediction & detection info
ATC-Wake Human Machine Interfaces

(established with active air traffic controllers and pilots)

- Advise to ATC supervisor:
  - Separation mode
  - Time for transition
  - Separation time / distance

- Alerting of the ATCo’s in case of:
  - Failure of the ATC-Wake system
  - Discrepancy between ATC-Wake Prediction & Detection information
The system components have been replaced by tools, data bases or emulators provided by the partners.

The Working Environment is realised using the SPINEware middleware which provides and combines the notions of metacomputing, tool wrapping and workflow to facilitate the required integrated and
Capacity aims (with the EEC System Model)

Predicted delay in 2015 (without ATC-Wake): 6 minutes per flight
With ATC-Wake, this delay is reduced by:
• 11% (with a capacity increase of 5%)
• 22% (with a capacity increase of 10%)
WAVIR: Wake Vortex Induced Risk Assessment

Flight Path data

FLIGHT PATH

VORTICES

ENCOUNTER

RISK

Vortex positions and strength in gates along flight path

Weather

Flight Path data

Vortex positions and strength in gates along flight path

Encounter severity classification

Risk versus separation distance

Instantaneous risk along flight path

WEATHER

FLIGHT PATH DATA

VORTEX SEVERITY

PILOT RESPONSE / AERODYNAMICS

ENCOUNTER SEVERITY

SAFE SEPARATION

Instantaneous risk along flight path

Major Incident

Hazardous Accident

Catastrophic Accident

Target Level of Safety

Safe Separation Distance

Risk per encounter (Non-Linear)

FLIGHT PATH DATA

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### Indicative Aircraft Separation per crosswind interval

<table>
<thead>
<tr>
<th>Crosswind Interval</th>
<th>Single Runway Departures (SRD)</th>
<th>Single Runway Arrivals (SRA)</th>
<th>CSPRA (non-segregated)</th>
<th>CSPRA (segregated)</th>
<th>CSPRA (semi-segregated)</th>
<th>Crosswind Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 ≤ u_c ≤ 1m/s</td>
<td>ICAO</td>
<td>ICAO</td>
<td>2.5NM</td>
<td>2.5NM</td>
<td>2.5NM</td>
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<td>2 ≤ u_c ≤ 3m/s</td>
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<td>2.5NM</td>
<td>2.5NM</td>
<td>2.5NM</td>
<td>0.090</td>
</tr>
</tbody>
</table>
Three trials with air traffic controllers (from France, Netherlands, Belgium, UK, Sweden) at NLR Amsterdam:

- 24 - 26 May 2004
- 29 - 30 March 2005
- 10 - 12 December 2005
Conclusions and recommendations

- ATC-Wake technical and operational feasibility analyses and the safety and capacity studies have build sufficient confidence in the operational concept and system design for the application of reduced separations.

- The reduced Wake Vortex separation, targeted with crosswind, is:
  - 2.5 Nm separation between aircraft on same final approach path
  - 90 seconds between all aircraft departing on the same runway

- Runway throughput (and delay) improves when ATC-Wake is used.

- Next step will be to complete the validation through production of a Safety Case, Human Factors Case, Benefits Case, Technology Case. The best would be to continue with airport shadow mode field trials.
The ATC-Wake Team