ERASMUS

En Route Air Traffic Soft Management Ultimate System

Funding: European (6th RTD Framework Programme)
Duration: May 2006 - Mar 2009
Status: Complete with results

Background & policy context:

Within the SESAR ATM Target Concept that proposes a service-oriented approach based on a performance partnership amongst stakeholders, each single flight shall be performed according to the owner's request. This is the main driving principle for the ATM Target Concept, which is centred on the reality of the 'business trajectory' representing the airspace users' intention with respect to a given flight. Business trajectories will be expressed in all four Dimensions (position and time) and flown with much higher precision than today, reducing uncertainty and allowing an increased reliance of airborne and ground based automation. This will open innovative ways to envisage new separation modes to allow for increased capacity. SESAR has identified new separation modes as TC-SA (Trajectory Control by Speed Adjustment) that will use trajectory control and airborne separation systems to minimise potential conflicts and hence reduce controllers' interventions and workload.

Objectives:

ERASMUS is considered an important contribution to the validation and implementation of the SESAR WP4. The main aims of the validation process were the following:

- To demonstrate the feasibility and potential benefits of a future air/ground integrated air traffic management system focusing on strategic de-conflicting and separation management functions in the en-route phases of a flight;
- To provide input to the definition of the SESAR concept implementation phase.

The ERASMUS Strategic De-Conflicting function aimed at adjusting the 4D Business Trajectory in order to optimise the separation management with the provision of conflict free trajectory on short segment of 15 minutes, reducing controller's workload associated with routine monitoring and conflict detection as well as reducing the interventions of ATC in changing flight profiles to resolve potential conflicts.

Methodology:

Project objectives were achieved by:

- Definition of concepts of operations for the air and ground sides;
- Definition of the operational scenarios (advanced tools, working methods);
- Detailed specification and design of the prototype (advanced tools, working methods);
- Definition of the validation plan and experimental plan (E-OCVM applied);
- Assessment and refinement of the hypothesis and proof of concept in term of safety, efficiency, capacity, security and economy;
- Clearly identified quantified benefits in safety, efficiency, capacity, security, economy;
- Identification of the transition issues and implementation plan.

The project was broken-down into five main work packages:

- Project Management & Dissemination (WP0) to manage the consortium and ensure the reporting to the Commission and the technical coordination with the partners. In addition this work package will also ensure the dissemination activities. WP0 will be led by Eurocontrol.
- Air and Ground Trajectory Prediction (WP1) to have a better knowledge of the aircraft position forecast (air and ground data availability, accuracy and integrity) in order to assessing the feasibility and efficiency of any future automation project. The second objective is: from the results of the air and ground trajectory prediction model, an ATC mathematical model will evaluate the
ability to a priori estimate in each case the probability of success of the trajectory prediction and the proportion of successful subliminal action as well as minor adjustments. WP1 will be led by Honeywell.

- Definition of Concept of Operation (WP2) to elaborate the concept of operations from the C-ATM baseline, so that target objectives in terms of capacity, safety and efficiency are met in the 2011 - 2020 timeframe. At this stage confidence shall be gained in the fact that the ERASMUS operations will provide qualitative benefits and well detailed transition process. WP2 will be led by DSNA.
- Prototype Development (WP3) to produce detailed specifications of the selected operational scenarios, in particular on the HMI/traffic information representation and to develop the prototype both for the controller and the pilot sides. WP3 will be led by DSNA.
- Validation & Conclusion (WP4) to conduct validation processes in term of 'proof of concept' assessment aiming at providing quantifiable benefits.

**Parent Programmes:**

**FP6-AERO-1.4 - Increasing Operational Capacity and Safety of the Air Transport System**

**Institute type:** Public institution

**Institute name:** European Commission

**Funding type:** Public (EU)

**Partners:**

- Belgium
- EUROCONTROL,
- USA
- HONEYWELL,
- Czech Republic
- HONEYWELL
- France
- DSNA/DTI/SDER,
- Italy
- SICTA,
- Sweden
- University of Linköping,
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**Key Results:**

The 'TC-SA based Strategic De-conflicting' design and validation represents the major achievement of the ERASMUS project. Feasibility and benefits assessment clearly demonstrated the high added-value of this approach. During the Project Management Committee in Linköping (September 2007), it was decided to focus on the algorithms Solver and the services provided to the strategic de-confliction activity of the controller. This ERASMUS project re-scoping also aimed at making ERASMUS SESAR-compliant. Therefore, ERASMUS can be seen as a strategic and political success.

The ERASMUS strategic de-conflicting service aims at adjusting the 4D Business Trajectory in order to reduce separation management activity. This service provides conflict free trajectory on a short segment of 15 minutes, reducing controllers' workload associated with routine monitoring and conflict detection. Furthermore, the number of ATC interventions to change flight profiles in order to resolve potential conflicts is reduced.
To adjust the 4D Business Trajectory, the ERASMUS project validated:

- A high-precision Trajectory Prediction (TP) for both Ground and Air segments performance assessment, which will deliver more accurate and reliable trajectory prediction information;
- Conflict detection and resolution - the Solver - via Trajectory Modification performed through minor speed adjustments, with the aim of not being perceived by the controller in order to minimise interference with their actions and cognitive process (notion of subliminal action).

ERASMUS addressed two scenarios (defined by SESAR) regards to the separation management function:

- Baseline scenario (current ATC system);
- SESAR 2020 scenario aiming at demonstrating the feasibility and efficiency of ERASMUS in 2020. To define this scenario we need to take into account the SESAR 2020 ATM Capability Level, e.g. the ATM capability level 3.

On the basis of fast-time simulations (FTS), it was estimated that with TC-SA the number of potential conflicts to be considered by controllers can be significantly reduced (i.e. up to 80%). With a time horizon of 15 minutes, this corresponds to a small speed change applied to pair of aircraft so as to increase their separation to above the established minimum of separation threshold (e.g. 7 Nm with a reference speed of 560kts). The resulting traffic to be managed by the tactical controller was characterised by fewer conflicts (e.g. 3 conflicts).

**Technical Implications**

Even with promising results already demonstrated, ERASMUS is nevertheless calling for further investigations as the current results are based on specific hypothesis with a wide range of open issues still to be addressed, in order to refine and assess the concept especially in the frame of SESAR. Possible follow-up of ERASMUS could cover operational concept development and assessment activities such as:

- Investigation of further manoeuvres than speed adjustments under the general goal to develop a concept for automated Conflict Detection and Resolution via data link exchange between air and ground.
- Introduction of automated systems for Conflict Detection and Resolution opens issues related to Transfer of Legal responsibility which will be addressed in connection with Operational aspects (Safety & Security).
- Further development of automated Conflict Detection and Resolution tools under Legal limitation will be addressed together with new methods of Conflict Detection and Resolution.
- Definition of the modus operandi proposing solutions to issues related to Transfer of Legal responsibility which will be addressed in connection with Operational aspects.

Also, in order to properly enable advanced concept such as ERASMUS strategic de-conflicting services, it is of prime interest to assess the technical enablers of such advanced concept, such as:

- Air and ground trajectory prediction accuracy including the definition of the ground trajectory prediction as well as the air trajectory prediction required.
- FMS capabilities in order to achieve an efficient conflict detection and resolution (i.e. conflict dilution).
- Definition of the required accuracy of Wind prediction and wind modelling.

**Documents:**

- [ERASMUS Final Report (Final report)]

**STRIA Roadmaps:**

- Cooperative, connected and automated transport
- Network and traffic management systems

**Transport mode:** Air transport

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

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

**Geo-spatial type:** Infrastructure Node