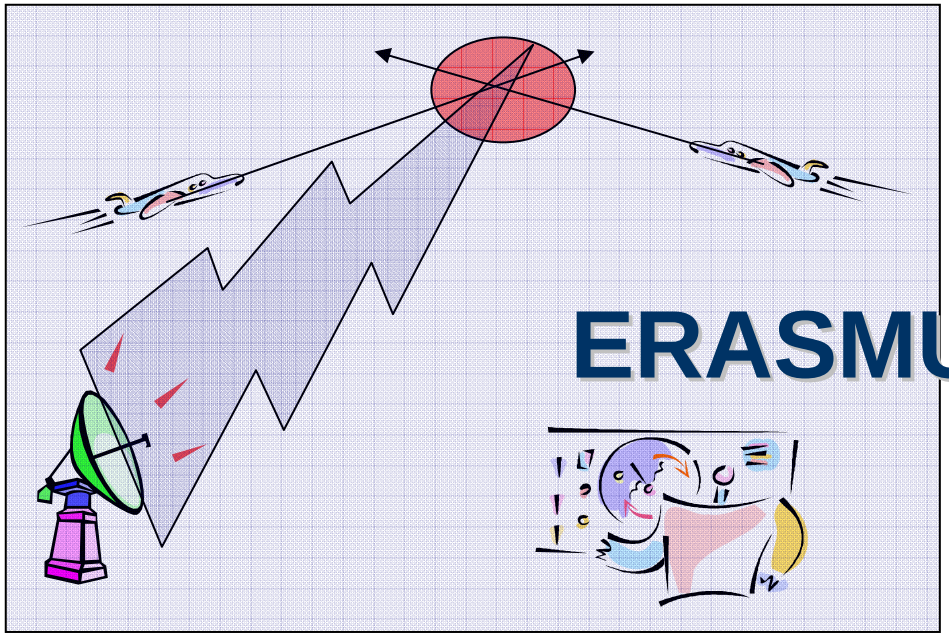


Welcome to the 2sd ERASMUS User Forum

Toulouse
Cite de l'Espace
January 2008, the 22sd

Marc Brochard EUROCONTROL – Project Coordinator

Honeywell (CZ & US) – DSNA/DTI(FR) – Linkoping University (SW) - Zurick Technical University (CH), SICTA (IT)

Directorate-General for Energy and Transport

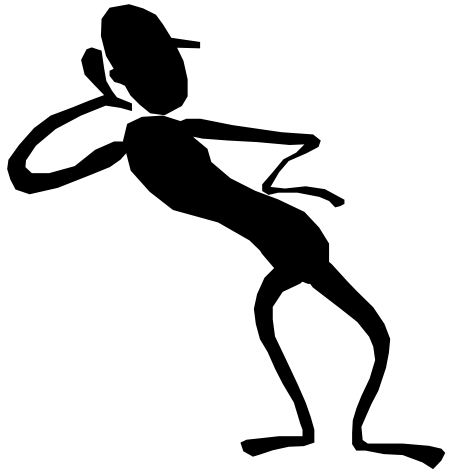
EUROPEAN COMMISSION

ERASMUS User Forum - Objectives

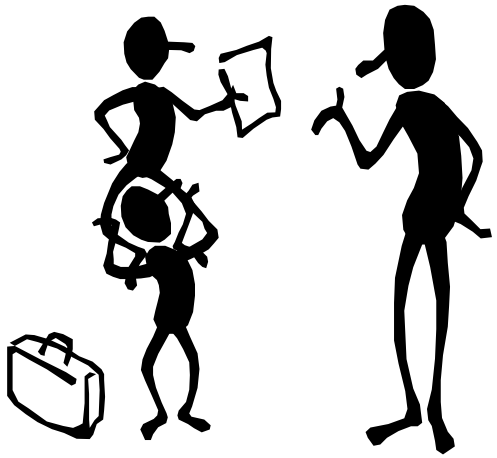
One of the major dissemination activities (ERASMUS Project WP0).

To **listen**

capturing & reviewing user needs



but also



To **inform**

providing feedback about the project progress.

ERASMUS User Forum - Objectives

September 06: to capture requirements from the stakeholders focussing on:

- the project objectives and scope;
- the validation objectives and process;
- the Operational Concept (OC) and its applications (high-level principles);
- the envisaged enablers.

January 08: to capture requirements from the stakeholders and to present intermediate results focussing on:

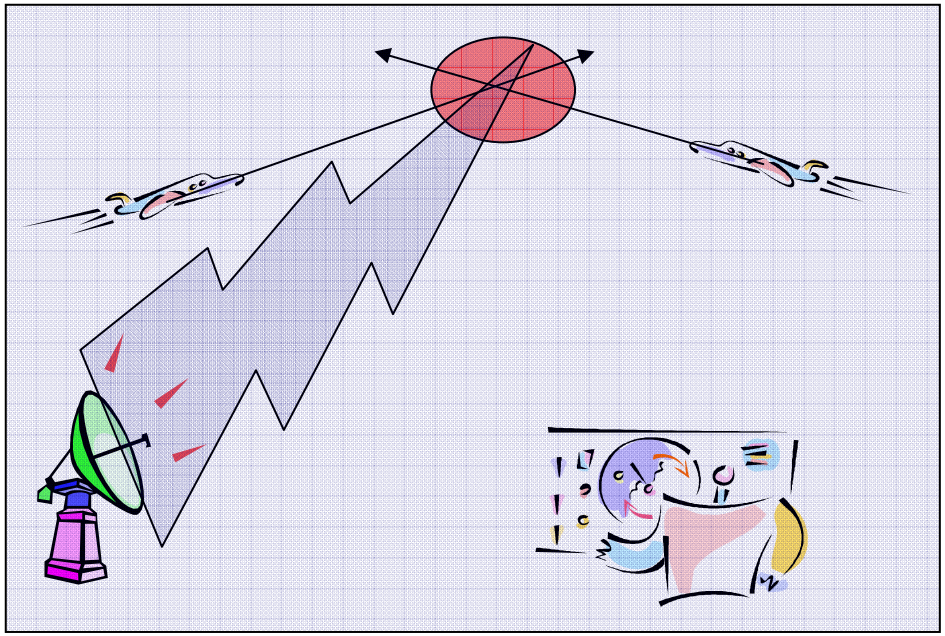
- Validation/experimental plan and intermediate results;
- Modus Operandi of ERASMUS application;
- Detailed view of enablers.

January 09: to present the project results focussing on:

- Experiments results and analysis;
- Concept and OC refinement;
- Results dissemination.

ERASMUS User Forum - Agenda

09:30 – 10:00	Welcome to the Second ERASMUS User Forum •Agenda & Objectives •ERASMUS in short	M. Brochard (EURO)
10:00 - 10:30	ERASMUS Operational Concept: •from initial assumptions to SESAR frame	G Gawinowski (EURO) & JL. Garcia (DSNA)
10:30 – 11:00	Coffee Break	
ERASMUS - a way for Improving Trajectory Prediction Accuracy		
11:00 – 11:45	ERASMUS Server *(including A/G demonstration)*	R. Weber (Honeywell) & JL. Garcia (DSNA)
11:45 – 12:30	First Round Table *Subject : Improving Trajectory Management*	*Moderator* JM. Bara
12:30 – 14:00	Lunch	
ERASMUS - proposing New Separation Modes		
14:00 – 14:30	ERASMUS experimentations - Performance results	R. Woltjer (LIU) & S. Carotenuto (SICTA) F. Drogoul (EURO)
14:30 – 15:00	Second Round Table *Subject : Human in a Closed-loop Control*	*Moderator* D. Figarol
15:00 – 15:30	Coffee Break	
ERASMUS dissemination		
15:30 – 16:00	Transition Issues	R. Guerreau (EURO)
16:00 – 16:30	ERASMUS findings considered in Episode III	R. Graham (EURO)
16:30 – 17:00	End of the Second ERASMUS User Forum	M. Brochard (EURO)



ERASMUS in short

Toulouse

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ERASMUS – 2004 - the Initial idea

AIR TRAFFIC CONTROL AUTOMATION

"ERASMUS" A friendly way for "breaking the capacity barrier"

Jacques Villiers - June 2004 - Volume 58 -

ERASMUS Patented in France (2003), EU and US patents pending

ERASMUS – 2004 - the initiation

ERASMUS EC FP6 Project

Title:	*En Route Air Traffic Soft Management Ultimate System*
Acronym:	***ERASMUS***
Contract Nr.:	***518276***
Total Cost:	***5 635 326 €***
EU Contrib:	***3 150 101 €***
Starting Date:	***11 May 2006***
Duration:	***30 months (November 2008)***
Web-site:	***http://www.atm-erasmus.com/***

Coordinator: ***Mr Marc Brochard***
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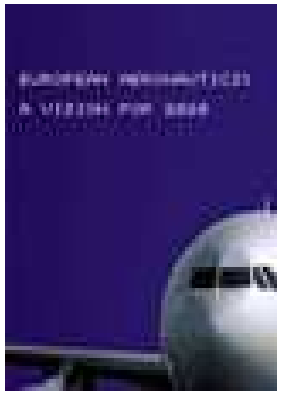
ERASMUS objectives



The **ACARE**[1] **SRA**[2] **II** and its **Vision 2020** foresees a **doubling, if not a tripling of traffic** in the 15 years to come. There is clear need for:

- **more capacity**;
- **more efficiency**;
- **more safety**.

- The strategic objectives addressed through ERASMUS[3] are to propose an innovative ATM solution able **to respond to the challenge of traffic growth** (more capacity), while **improving the efficiency and safety** level of the European Air Transport System as stated in the ACARE SRA II**.**
- ERASMUS proposes innovative ways to re-synchronise **automation (subliminal control – closed loop control)** between the air and ground segments seeking **to develop high cooperation between the human being and the machine** and aiming at **better using current potentials (FMS and 4D Trajectory Prediction) offered by the air segment**.

(1) ACARE – Advisory Council for Aeronautics Research in Europe

(2) SRA - Strategic Research Agenda

ERASMUS (aligned with SESAR) Scope

4D Trajectory Management

- Airport
- TMA
- En-route

- Density mngt
- Strategic de-conflicting mngt
- Separation mngt

4D Trajectory Based Operations are expected to enhance the capacity with the notions of:

- Maximising flight efficiency
- Minimising Trajectory changes during flight
- Minimising Controller task load per flight

Improving strategic de-conflicting for increasing sector productivity

Improving strategic de-conflicting aiming at **in-flight adjustment of the 4D Business Trajectory** to reduce the number of potential conflicts.

Improving separation management to increase sector capacity with **High-precision 4D Business Trajectory** and conflict-free segment.

To address these issues, ERASMUS will investigate a new separation mode :

TC-SA (Trajectory Control by minor Speed Adjustment)

An Innovative Solution : TC-SA

Trajectory Control by minor Speed Adjustment (TC-SA) in order to generate conflict-free segment (15 min), ERASMUS proposed **real-time 4D Business Trajectory based on minor speed adjustment**.

Former Subliminal control & Enhanced MTCD

With a key enabler a progressive **improvement in the accuracy of trajectory prediction** through reduced uncertainty will lead to improved performance of controller support tools

ERASMUS Project Objectives

The ERASMUS project objectives are:

- To define the TC-SA concept of operation & modus operandi;
- To investigate the feasibility & performance of the TC-SA mode (proof of concept – E-OCVM V2 maturity model);
- To deliver information on the system description;
- Using a rigorous and consistent methodological approach (E-OCVM);
- To deliver advanced contributions to SESAR:
  - To validate part of the SESAR Operational Improvements;
  - To respond to SESAR R&D identified needs.

ERASMUS – Major research questions

1. How to assess the high-precision trajectory management ?

2. How to act on traffic to dissolve conflict with a minimum of constraint on the users' trajectory ?

3. How to design automation consistent and robust not disturbing the human activity (controller & pilot) ?

4. How to assess the system performance (KPA) ?

5. How to ensure the transition ?

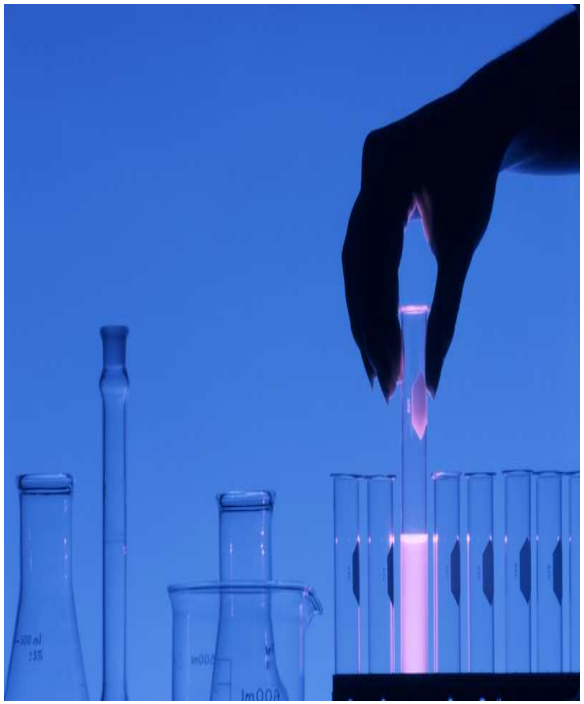
ERASMUS - Research Issues

Strategic de-confliction function

- Precise Trajectory Management performance?
- Conflict Resolution performance?
- Number of conflict dissolved?
- Number of conflict-free segment?

Separation Management function

- Human-machine consistency & acceptability?
- Human-machine robustness?
- Human-machine performance?



ERASMUS is identified in the IP2 SESAR Transition Phase (2013-2020)

Investigations with the **SESAR 2020 Scenario** & **SESAR Baseline Scenario:** Modelling and real time simulations.

The way forward - Strategic de-conflicting

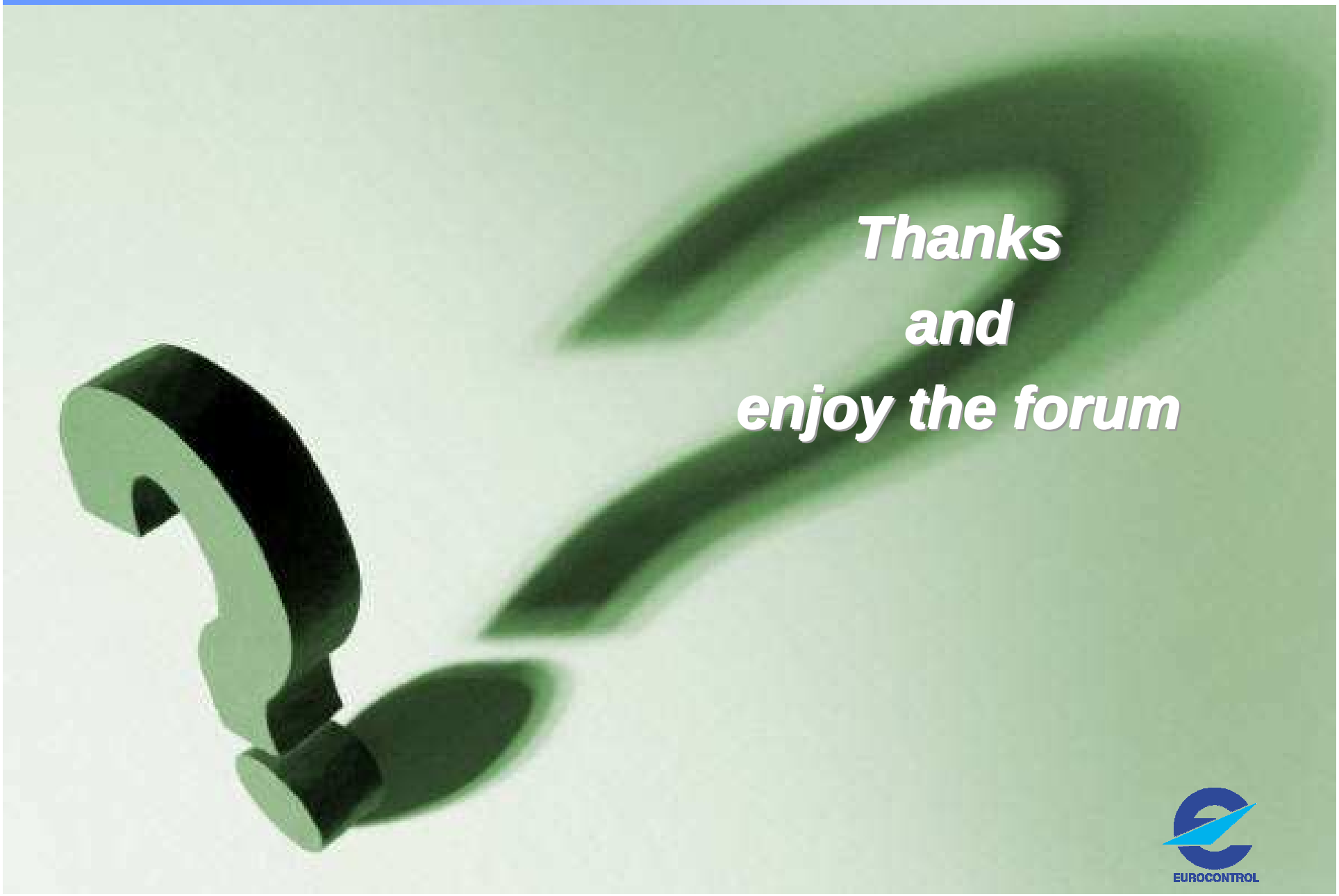
Real-Time Simulations (SESAR Baseline scenario) already performed:

- Nov'06 - Real-Time Simulation at Aix-en-Provence (50 ATCo)
- April'07 - Real-Time Simulation at Toulouse (10 ATCo)
- May'07 - Real-Time Simulation at Aix-en-Provence ACC (50 ATCo)

And also model based simulations for FMS and algorithm performances

For 2008

1. Trajectory Prediction
   - Accuracy & Reliability
2. Strategic de-confliction Performance
   - Algorithm optimisation
3. Strategic de-confliction Architecture
   - Proposing a generic plug-in applicable to any Controller tools
4. Human in the loop experimentation for SESAR Baseline and 2020.


Thanks
and
enjoy the forum
EUROCONTROL

Concrete Results about Strategic de-conflicting

Results for the strategic de-confliction function

1. Precise management of trajectories : HONEYWELL Math Modelling Simulator (A380/A340/B737)
   - FMS TP Performance (lateral*) : 0.5 Nm (5 sec) accuracy (15 min ahead)
   - CTA/CTO Performance (lateral*) : 0.5 Nm (5 sec) accuracy (15 min ahead)

2. Strategic de-confliction Performance : DSNA Math Modelling Simulator (lateral* & vertical** : 0.5 Nm accuracy; [-6%, +3%] a/c speed variation; 15 min ahead)
   - 80% conflict “removal”

**FMS lateral and longitudinal mode*

***FMS vertical mode*

Concrete Results about Separation Management

3 Real-Time Simulations (SESAR Baseline scenario)
- Nov'06 - Real-Time Simulation at Aix-en-Provence (50 ATCo)
- April'07 - Real-Time Simulation at Toulouse (10 ATCo)
- May'07 - Real-Time Simulation at Aix-en-Provence ACC (50 ATCo)

1. Consistency/Acceptability
   - Speed change [-6%, +3%] not perceived by the controllers
   - Good Human-machine cohabitation
   - High-acceptability : Minor speed concept accepted by ATCo
2. Robustness
   - 50% aircrafts under ERASMUS broken by ATCo's action (specific sector requiring direct route).
3. Performance
   - ATCo felt safer and more confortable
   - Increase in quality of service (flight plan adherence)
   - Cognitive resource saving – good trend but still under investigation
   - Link with capacity under investigation

ERASMUS - Validation Strategy

ERASMUS is identified in the IP2 SESAR Transition Phase (2013-2020)

Investigating ERASMUS principles with the **SESAR 2020 Scenario** & **SESAR Baseline Scenario:**

- Technical investigation
  - Performance : using modelling simulation approach;
  - Architecture : prototyping;
- Human/machine investigation using real-time simulations
  - SESAR KPA Targets (capacity, safety, …)