En Route Air Traffic Soft Management Ultimate System

Sixth Framework Programme

Call Identifier : FP6-2004-TREN-3
Thematic Priority 1.4 Aeronautics and Space

ERASMUS project
Project overview

Aeronautical Days - Vienna
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Eurocontrol – ERASMUS Project Coordinator - Marc Brochard
DSNA (FR) - ETHZ (CH) - Honeywell (US/CZ) – Linkoping univertisy (SW) - SICTA (IT)

EUROCONTROL

Rational I

- The ACARE Strategic Research Agenda (SRA 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**.

- This group stresses that ATM system will not be able to cope with this increase if no **radical changes** are performed. Several fields of improvement require urgent investigations:
  - **more automation** for the ATM;
  - **shifting responsibilities** from ground to the air.

Rational II

- Automation for ATM is reaching a strong barrier for many reasons:
  - existing **legacy** system and **difficulties for change**;
  - **uncertainty** and **poor accuracy** of data;
  - **ATCo cognitive process** badly known;
  - so far aiming at **replacing the human being** by the machine;
  - **poor common use of proven technologies** such as Precision Area Navigation (P-RNAV), air/ground communication facilities, airborne flight management system (FMS) already widely used by airlines.

- We could imagine automation in a way of:
  - improving air ground cooperation;
  - reducing uncertainty (and not removing it);
  - seeking for human being and machine cooperation.

Objectives

- ERASMUS[1] project proposes an **air-ground cooperative work** aiming at defining and validating **innovative automation** and **concepts of operations** for the En-route phase. The goal is to propose an advanced automation while maintaining the controllers in the decision loop.

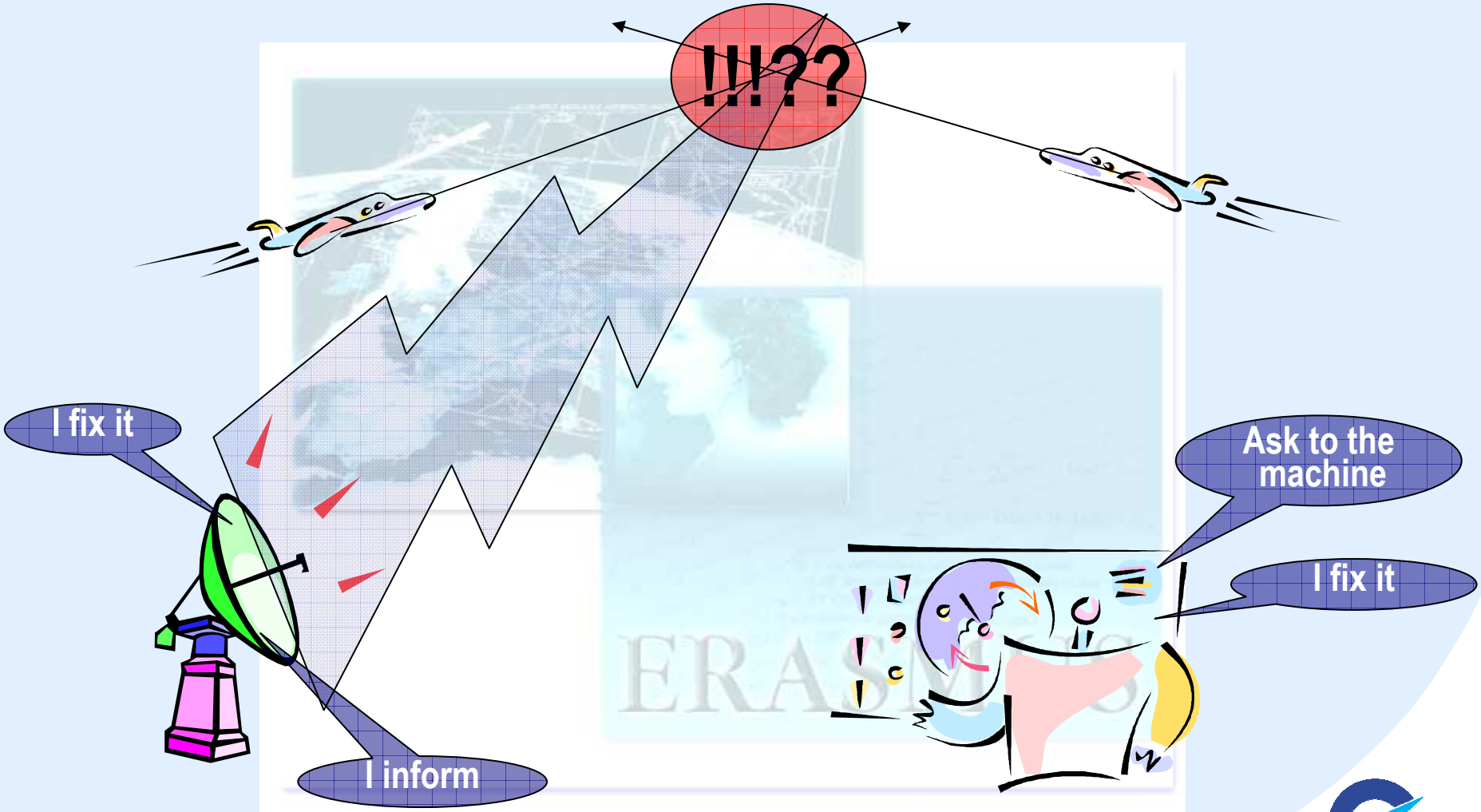
- Three majors applications are proposed to be investigated:
  - **subliminal control;**
  - **"ATC autopilot";**
  - **Enhanced Medium Term Conflict Detection (MTCD).**

[1] Jacques Villiers, ERASMUS, a friendly way for breaking the capacity barrier, IT, volume 58, June 2004.

Objectives

- Foundations of the three proposed applications:
  - Slight variation in aircraft speed or rate of climb can be sufficient to prevent a latent conflict (15' in advance a difference of some 2%, less than 10 knots, in speeds could change a "conflict" into a "non conflict").
  - Such accuracies are far out of reach of the controller (perception) sensorial picking and mental computing.
  - Derived current cockpit autopilot enabling aircraft attitude, trajectory and level control to be delegated to the FMS (minor automatic trajectory adjustment not always perceivable by the pilot), in the ATC domain.
  - Derived from ERATO, in addition with the integration of more accurate data (sharing air and ground trajectories via FMS application), ATCo cognitive processes to be considered for providing better and more accurate aircraft conflict/problem information.

Objectives – the 3 applications



Objectives – subliminal control

The subliminal control could automatically "remove" conflict by minor alterations of the speeds or rate of climb with no human being intervention

- The innovation is:
  - to use the machine not to solve conflict but to de-conflict the air situation (advanced MSP function with automatic and minor adjustments);
  - to apply changes not directly perceivable by the human being;
  - to be able to overwrite any subliminal changes at any time: keep ultimate control;
  - not to conflict with ATCo and pilot own actions and responsibilities;
  - to use existing and proven air/ground data-link facilities (sharing air and ground trajectories via FMS application) and to transform the current "open loop" into a "closed loop" ATC - computer-to-computer clearances delivery.

Objectives – ATC autopilot

To delegate "subliminal" problem resolution actions to the machine on case by case basis (under the control of the human being)

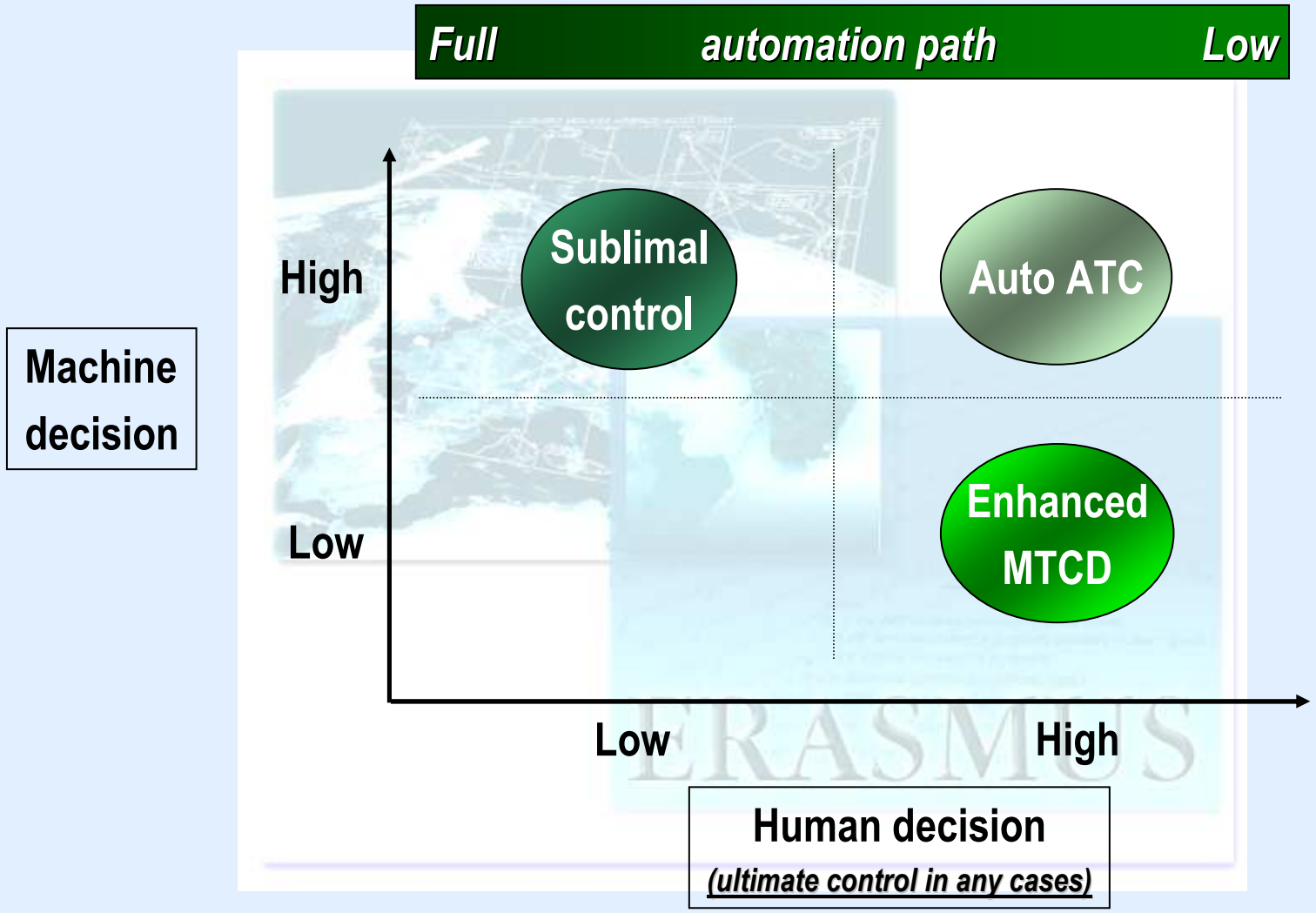
- The innovation is:
  - to use the machine to solve conflict;
  - to be able to overwrite any subliminal changes at any time: keep ultimate control;
  - not to conflict with ATCo and pilot own actions and responsibilities;
  - to use existing and proven air/ground data-link facilities (sharing air and ground trajectories via FMS application) and to transform the current "open loop" into a "closed loop" ATC - computer-to-computer clearances delivery.

Objectives – enhanced MTCD

To provide aircraft conflicts/problems information taking into account the most accurate data, and the controller cognitive processes.

- The innovation is:
  - to enrich MTCD information with ATCo cognitive logic and more accurate trajectory prediction (sharing air and ground trajectories via FMS application);
  - to use existing and proven air/ground data-link facilities.

Objectives – an automation path?



Objectives – deliverables

- Project objectives will be materialised 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.

Potential impacts

- A **better knowledge of the air and ground trajectory prediction**: assessing if the spectacular accuracy of GPS and CNS capabilities would increase the accuracy of the knowledge of the past/present positions and speeds of an aircraft; knowing the statistical distribution of the position forecasts and defining the required accuracy and integrity of the positions prediction.
- An **ATC Modelling assessment**: using the air and ground data accuracy results, an ATC mathematical model should evaluate the ability to a priori estimate for each case the probability of success of the trajectory prediction and the proportion of successful subliminal action.
- **Safety**: assessing the "safety" of the automated processes themselves and of any subset, since it would be impossible to rely on any real time return back to the controller of any such transferred responsibility.
- **Working methods and modus operandi** (for subliminal control, ATC autopilot, and enhanced MTCD): considering cognitive needs and data accuracy capabilities, defining working methods and tools specifications.

Potential impacts

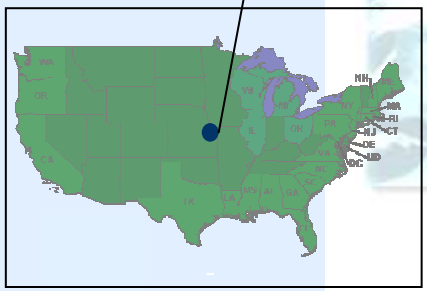
- What are the meteorological prediction capabilities?
- What are the aircraft speed margins of manoeuvre and constraints?
- What are the trajectory performance between the air and the ground?
- How to use a better FMS trajectory prediction capabilities in order to decrease the number of real conflicts and at which time horizon?
- How to use the controller cognitive model and technology capabilities to support different applications?
- How to present the relevant traffic situation information (conflict detection) in accordance with the controller cognitive model?
- How these new capabilities will allow to increase the ATC sector capacity?
- What is the safety impact of such applications in order to define nominal and degraded mode ? Which mode are acceptable to a controller and a pilot ?
- What are the other impacts (efficiency, cost-benefits)?

Consortium - Partners

1 EUROCONTROL - Paris
- Consortium leader -

4 University of Linköping

3 HONEYWELL - US



3 HONEYWELL - Brno

5 Swiss Federal Institute of Technology - Zurich

2 DSNA - Toulouse
(former DNA)

6 SICTA - Napoli

Project plan

- The project is broken-down into 5 main work packages:
  - **Project management & dissemination** (WP0): managing the consortium, reporting to the Commission, technical coordination with the partners. and also ensuring dissemination.
  - **Air and Ground Trajectory Prediction** (WP1): better knowing the aircraft position forecast in order to assess the feasibility and efficiency of any future automation project; and evaluating the ability to estimate "*a piori*" the probability of success of the trajectory prediction and the proportion of successful subliminal action as well as minor adjustments.
  - **Concept of Operation** (WP2): elaborating the concept of operations (with the objective of meeting capacity, safety and efficiency in the time frame 2011 – 2020).
  - **Prototype developments** (WP3): producing detailed specifications of the selected operational scenarios and developing the prototype (both controller and the pilot sides).
  - **Validation & Conclusion** (WP4) conducting validation processes in term of "proof of concept" assessment aiming at providing quantifiable benefit statements for the safety, efficiency, capacity, security and economy (validation process based on E-OCVM, ESARR4 as reference for safety requirement).

ERASMUS - to automate or not to automate?

Thanks for your attention

1St Users group In September 2006 At the EEC

contact

marc.brochard@eurocontrol.int