ERASMUS

Strategic deconfliction to benefit SESAR

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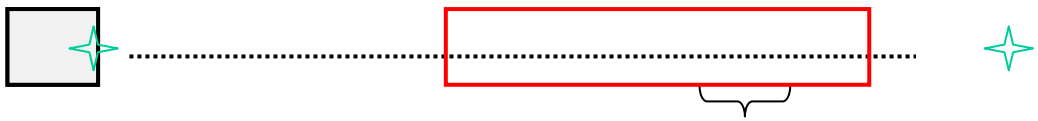
Concept presentation

ERASMUS: En Route Air Traffic Soft Management Ultimate System

TP in Strategic deconfliction

Future 4D position in 20 min ?



5 sec TP ACCURACY

Airborne Trajectory Prediction with RELIABILITY level

CTA/CTO constraint

Minor speed adjustment [-5%,+3%]
Longitudinal deviation : ± 1 min

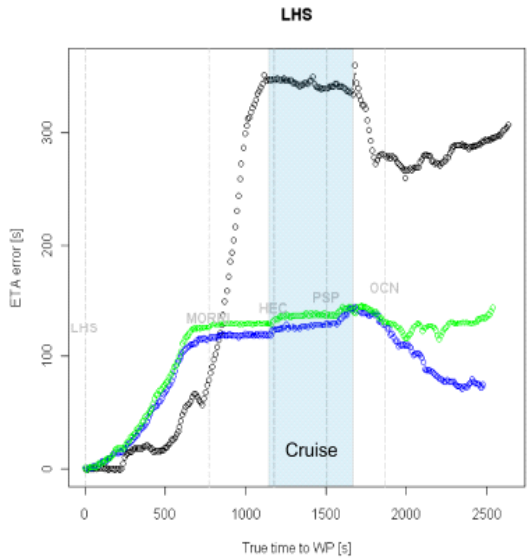
ERASMUS computes
Conflict-free segment for the next 20 min

Inside the RBT Tolerance

Multi-Sector Planner (MSP)

TP Accuracy

Results for 20 minutes time horizon and worst case (extreme weather)



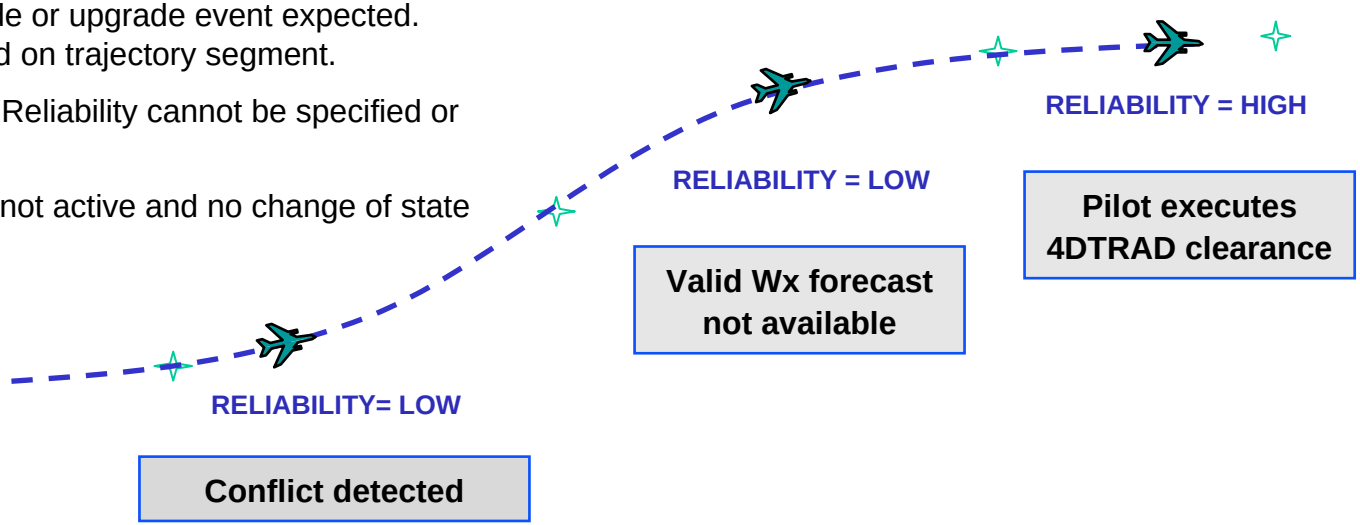
- ***Cruise (level flight)***
  - **Cross-track error – typically less than 0.05 NM,**
  - **Time error – tens of seconds -- worst case**
  - **Not sensitive to wind forecast availability**

- ***Climb/Descent***
  - **Cross-track error – similar to cruise**
  - **Time error – very sensitive to missing wind forecast**
    - **As high as 2 min for 10 minutes look-ahead time,**
    - **Wind forecast can reduce error by more than 50%.**
  - **Altitude error – very sensitive to missing wind forecast**
    - **Largest errors in climb with missing forecast**
    - **E.g., thousands of feet for 10min look-ahead time**
  - **Accurate Wind forecasts reduce Time and Altitude deviations dramatically.**

TP Reliability

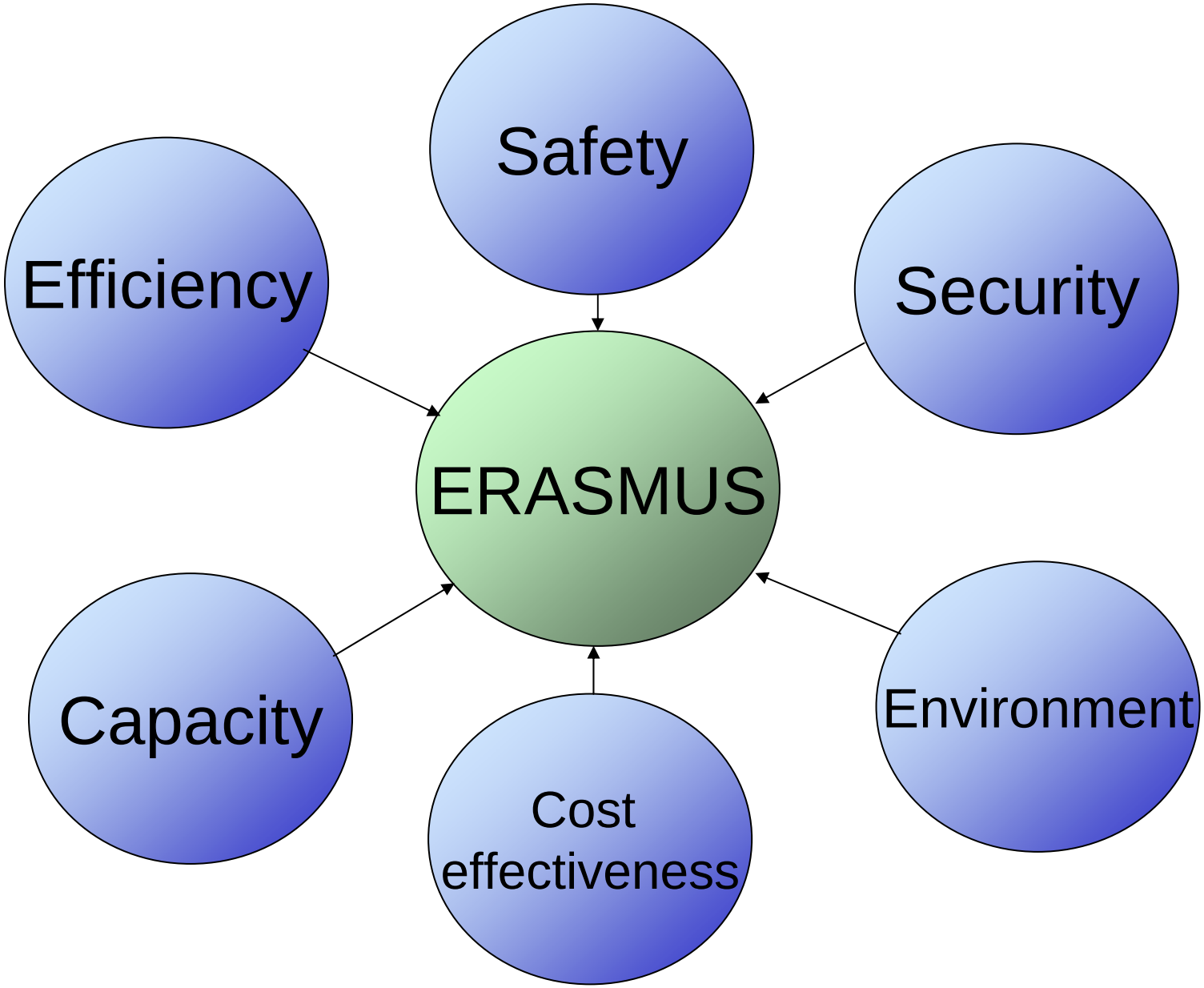
- TP Reliability affects CD&R strategy
- Reliability influenced by pilot and ATC actions, aircraft states, operational environment, Wx…
- TP Reliability levels (Lateral, Vertical, Longitudal):
  - **HIGH** – Trajectory actively controlled, no event expected.
  - **MEDIUM** – Downgrade event not expected. Upgrade event or reliability-neutral event expected. E.g., 4DTRAD mod negotiated, not yet FMS activated.
  - **LOW** – TP Downgrade or upgrade event expected. E.g., Conflict detected on trajectory segment.
  - **NOT DEFINED** – TP Reliability cannot be specified or determined.
  - **NONE** –TP segment not active and no change of state expected.

- Recent* 4DTRAD Nav support workshop recommendation: *"ETA accuracy states"*
  - **NOT DEGRADED** (wind/ temperature data uplinked less than 3 hours ago.
  - **PARTIALLY DEGRADED** (meteo data uplinked more than 3 hours ago
  - **DEGRADED** (no meteo data entered by the pilot)



* April 23rd and 24th 2009

Erasmus Key Performance Areas

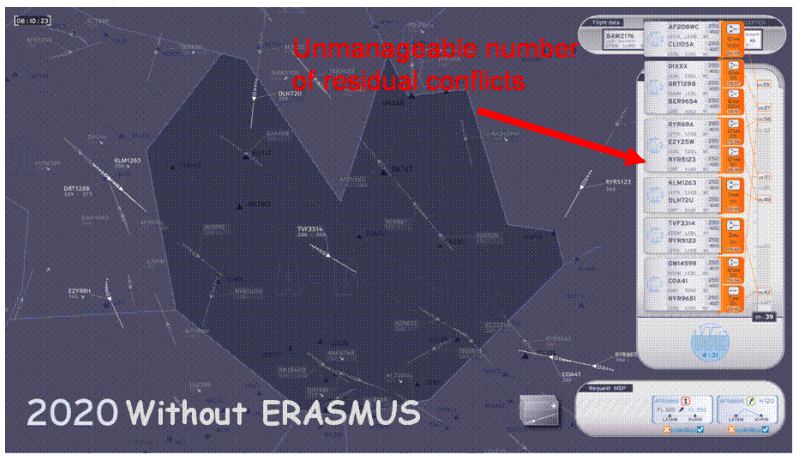


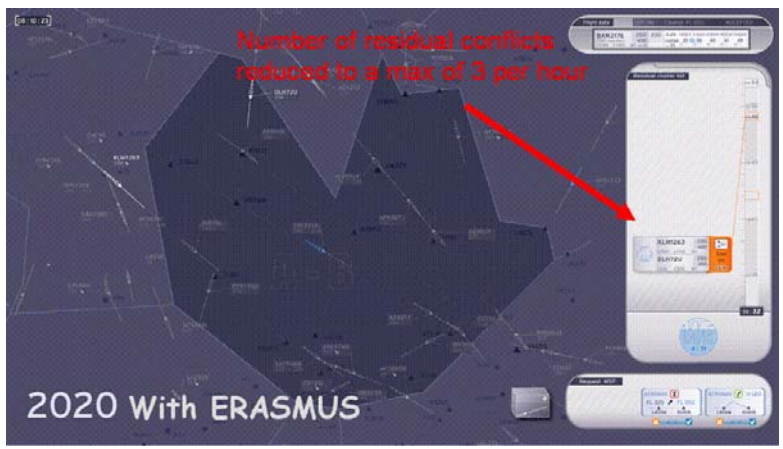
KPA : Efficiency and Capacity

- The assessment done demonstrated that without aids the controllers will not be able to handle the 2020 traffic (1.7 times higher than today)

- CAPACITY: Management of 50-70% traffic increase through reduction of complexity by ERASMUS TCSA

  complexity= nb of situations delivered to the controller + form of problems to be solved tactically



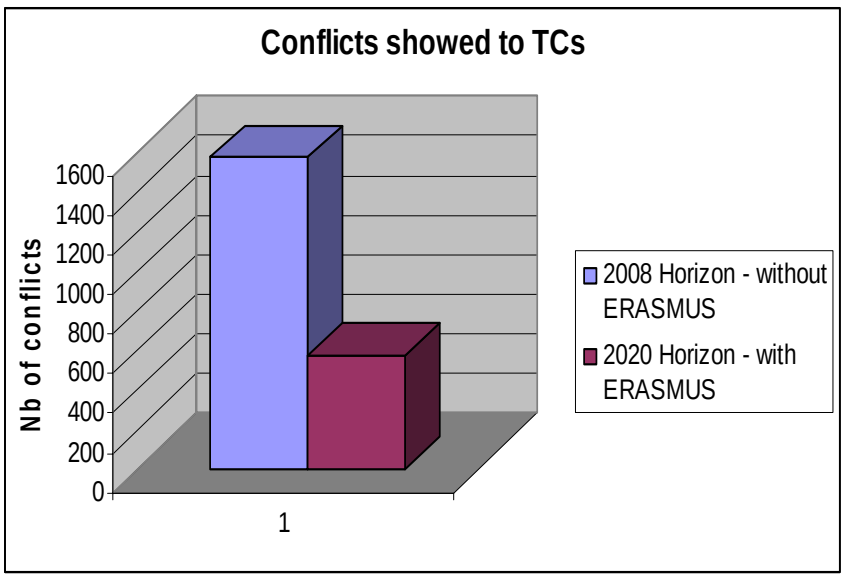


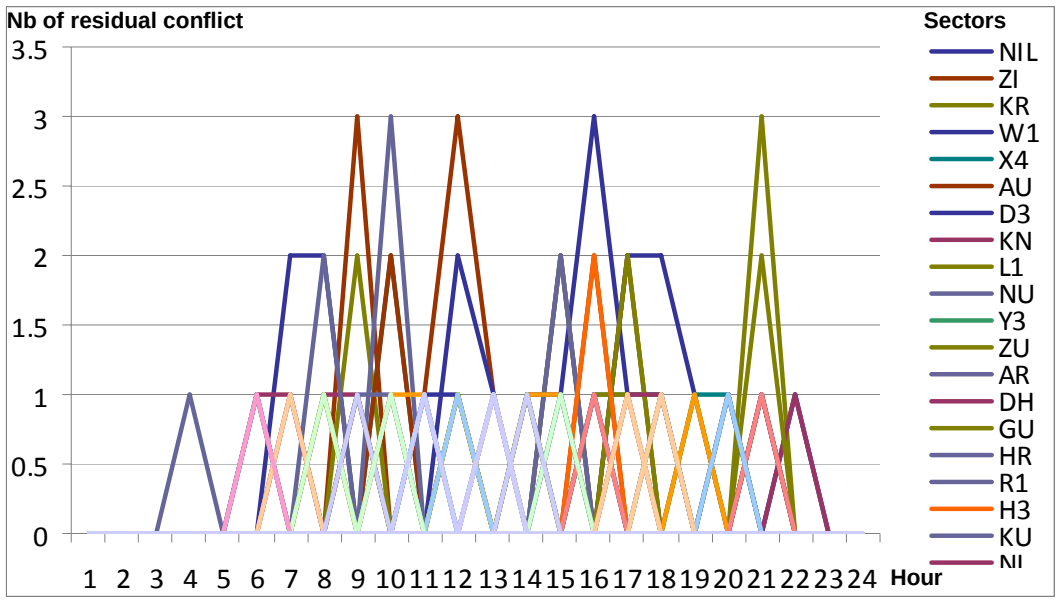
KPA : Efficiency and Capacity

- The experimentations demonstrated ERASMUS services are able to detect and reduce drastically the number of conflicts (~ 80%)

  The comparison of remaining conflicts in different traffic contexts can be used to assess the saving of controllers resources

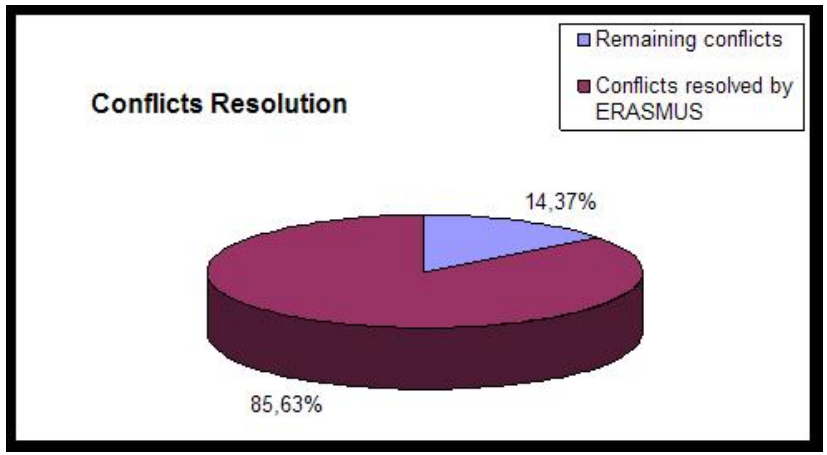
- CAPACITY:ATCO pulled out of the global management – work tactically on specific situations filtered and delegated at the MSP level





KPA: Safety

2020 traffic



	No. of conflicts Without ERASMUS	No. of conflicts with ERASMUS
aircraft with separation < 4	1891	171 conflicts remained_9%
aircraft with separation < 8	4031	576 conflicts remained_14%

- Safety margin is improved

KPA: Flight Efficiency

- A trade-off between time delay and fuel burn
- An appropriate selection of manoeuvre for ERASMUS Conflict Resolution has direct impact on flight efficiency and potential delays
- Any manoeuvre not planned in Flight plan effectively degrades airline preferences represented by Cost Index.

Example (depending on Cost Index, Weight of Aircraft, Flight Level, Speed, etc..)**:**

	Estimated savings		Estimated time delay
In Operation Costs	Per manoeuvre	Per airlines/year	Per manoeuvre
Cost of Manoeuvres	40,25€	19223€	31s

- To insert advanced Cost estimator into ERASMUS Solver

KPA: Cost - Effectiveness

- Cost related to supporting infrastructures or system enablers may be part of the operational changes planned in SESAR IP2

ANSP

Benefit type	Cost type
En-route Capacity increase	Installation of ERASMUS Server
Workload decrease	HMI upgrade
ATCO productivity increase	ATCO training
Safety improvement	CPDLC upgrade & ADS Ground station (SESAR)

Airline

Benefit type	Cost type
Fuel consumption reduction	Avionics upgrade (CPDLC/ADS) (SESAR)
Flight time reduction	FMS upgrade (SESAR)
Delay reduction	

KPA: Environment

- ERASMUS would reduce the number of trajectory modifications
- *Speed reduction* and *altitude increase* are the most fuel efficient manoeuvres

	Estimated CO_2 Reduction (tons)
Costs	All environments
In Operation Costs per year	
Cost of Manoeuvres (2020 figures)	69,800
Total Airline benefit per year	**69,800**

Conclusions

It has been more complex than initially envisioned:

- TP/CTO accuracy and reliability issues
- Controllers modus operandi & tools:
  - How to maintain sufficient level of SA to be able to act strategically?
  - ATCOs will handle exceptions – loss of practical skills Vs in charge of the most difficult problems
  - Issue of responsibility: Window of opportunity close to 0?
  - Today, ATCo's infer information – with Advanced TP precision → less doubt than less support from ERASMUS concept?

What’s next?

- SESAR WP 4.7.2 – “ERASMUS II”
  - Concept assessment, extension and refinement via further investigations into wide range of open issues (Current results are based on specific hypothesis).

Questions?