

# Evaluation of ATC Working practice from a Safety and Human Factor perspective

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# Plan

- Quick Introduction
- The IJAMAN (IIssage de traJectoires avec extrAction et identification de MANœuvres) toolkit
- The BISCOT (human BBased risk and deciSion taking CComplexity integrated tOolkiT) toolkit
- Application of IJAMAN and BISCOT to ATC evaluation
- Case Study : the ERASMUS project

# Quick Introduction

# Human factors in a safety perspective



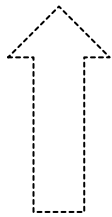
## Hidden causes:

- Physical equipment
- Procedures
- **Human**

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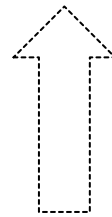
# Means for mitigating hidden causes

**Physical  
Equipment**



**Industrial  
Requirements**

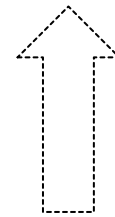
**Rules &  
Procedures**



**Airspace Planning**

- Separation minima
- Letters of agreement

**Human**

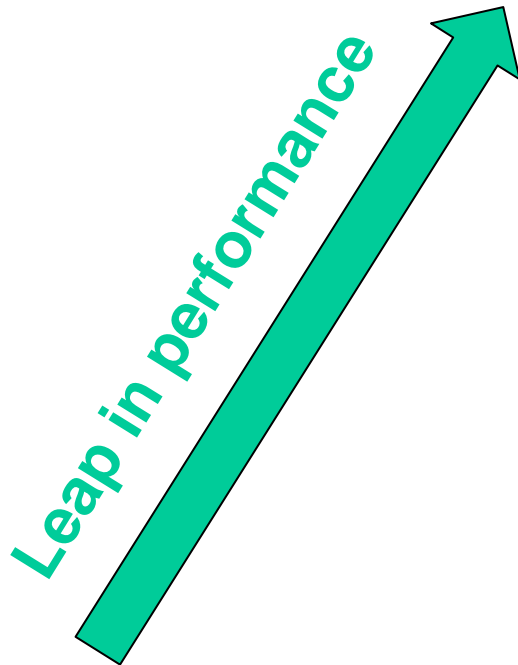


▪ **Sectorization**

▪ **Human factors**

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# Evolution from past to current



**Rules &  
Procedures**

**Human**

**Physical  
Equipment**

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# Major changes in SESAR ConOps

**Rules &  
Procedures**

**+**

**Human**

**Aircraft Trajectory**

**Physical  
Equipment**

**Will allow for a safe implementation**

**provided**

**Industrial  
Requirements**

**are defined accordingly**

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# Safety implications in SESAR



**Human  
Procedures  
Physical Equipment**



How can we validate the  
human&procedures components  
of the safety argument ?

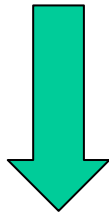
# The IJAMAN and BISCOT toolkits

# The IJAMAN toolkit

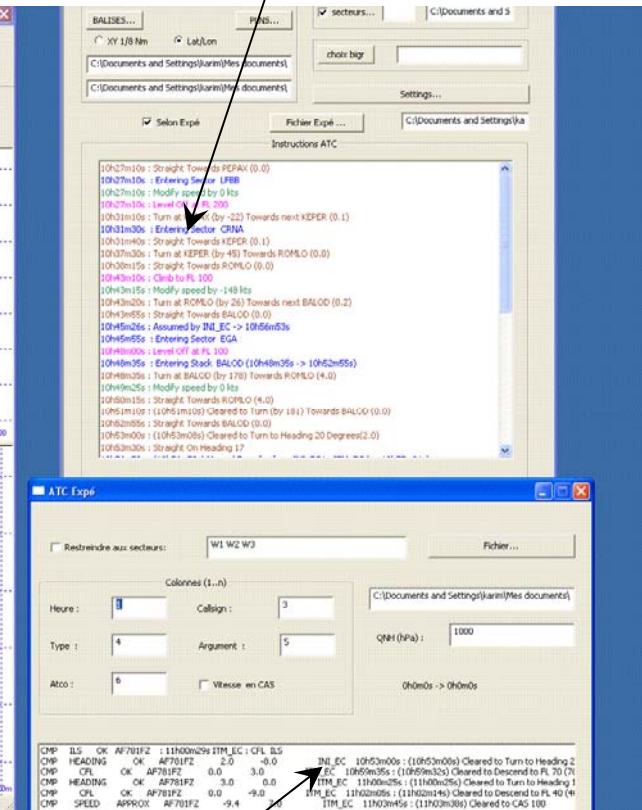
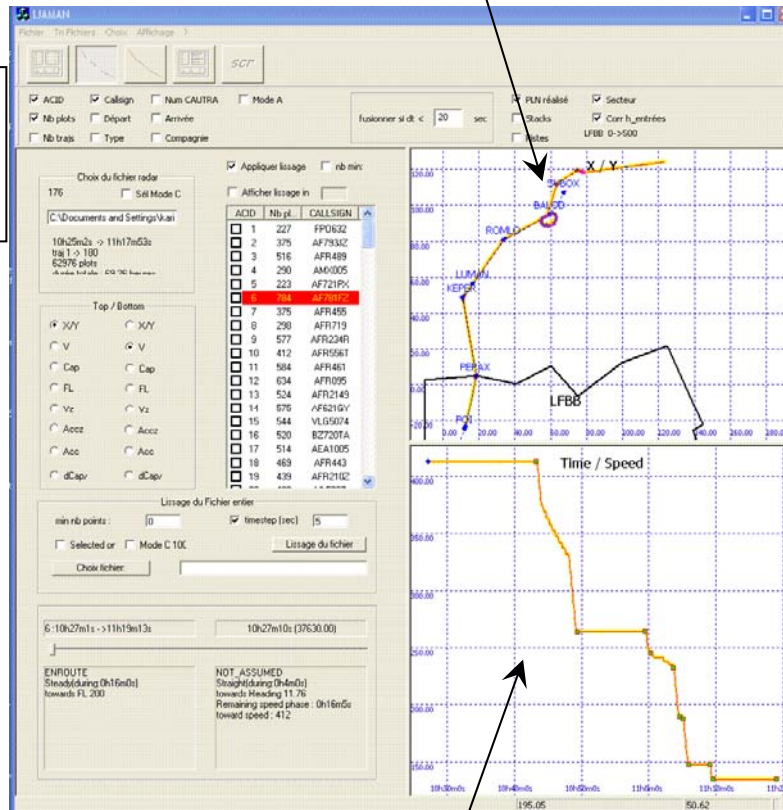
## Identification of horizontal maneuvers

## Interpretation of maneuvers

- Radar data
- Flight Plans
- ATC instructions



**Trajectories of reference**  
+  
**ATC instructions errors**



## Identification of speed maneuvers

## Comparison maneuvers ↔ ATC instructions

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# The BISCOT toolkit

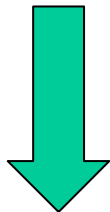
Conflicts solved by ATC

Traffic display

ATC clearances

Failures in ATC decision taking process  
(conflict resolution?)

Failure in the "no decision" case  
(proximate events)



« ATC oriented » traffic display

The screenshot displays the BISCOT toolkit interface, which is used for traffic display and conflict resolution. It includes several key components:

- Traffic display:** A top-left window showing a 2D map of the EGA (Enschede) area with various flight paths and aircraft positions. A red circle highlights a specific area of interest.
- ATC clearances:** A top-right window titled "Objet ATC" showing a list of ATC clearances and parameters for a specific flight.
- Panorama de trierecture des conflits:** A bottom-left window showing a table of conflict types and their associated parameters. The table includes columns for "Type de Conflit", "FL", "T alt col", "Cu/P Dist min", and "Clearance".
- Vertical/Horizontal plots:** A bottom-right window showing two plots: "Horizontal" and "Vertical". The horizontal plot shows the relative positions of aircraft over time, while the vertical plot shows their vertical profiles.

fields associated to encounters

# Application of IJAMAN and BISCOT to ATC evaluation

# Applications to safety

## Hazards:

- 1) Initiators
- 2) Consequences

- Proximate events : context and possible consequences?
- ATC instruction errors : context and possible consequences?
- Abnormally long TRANSFER/ASSUME: consequences?
- Failure in conflict resolution : context and possible consequences?
- Etc...

No **“hidden independence”** assumption: by getting the  
“movie” representation of the traffic, possible to  
distinguish the **independent components:**

- 1) Geometry of the encounter (**time uncertainties**)
- 2) ATC workload/detection/intervention

# Qualitative estimation of ATC working practice

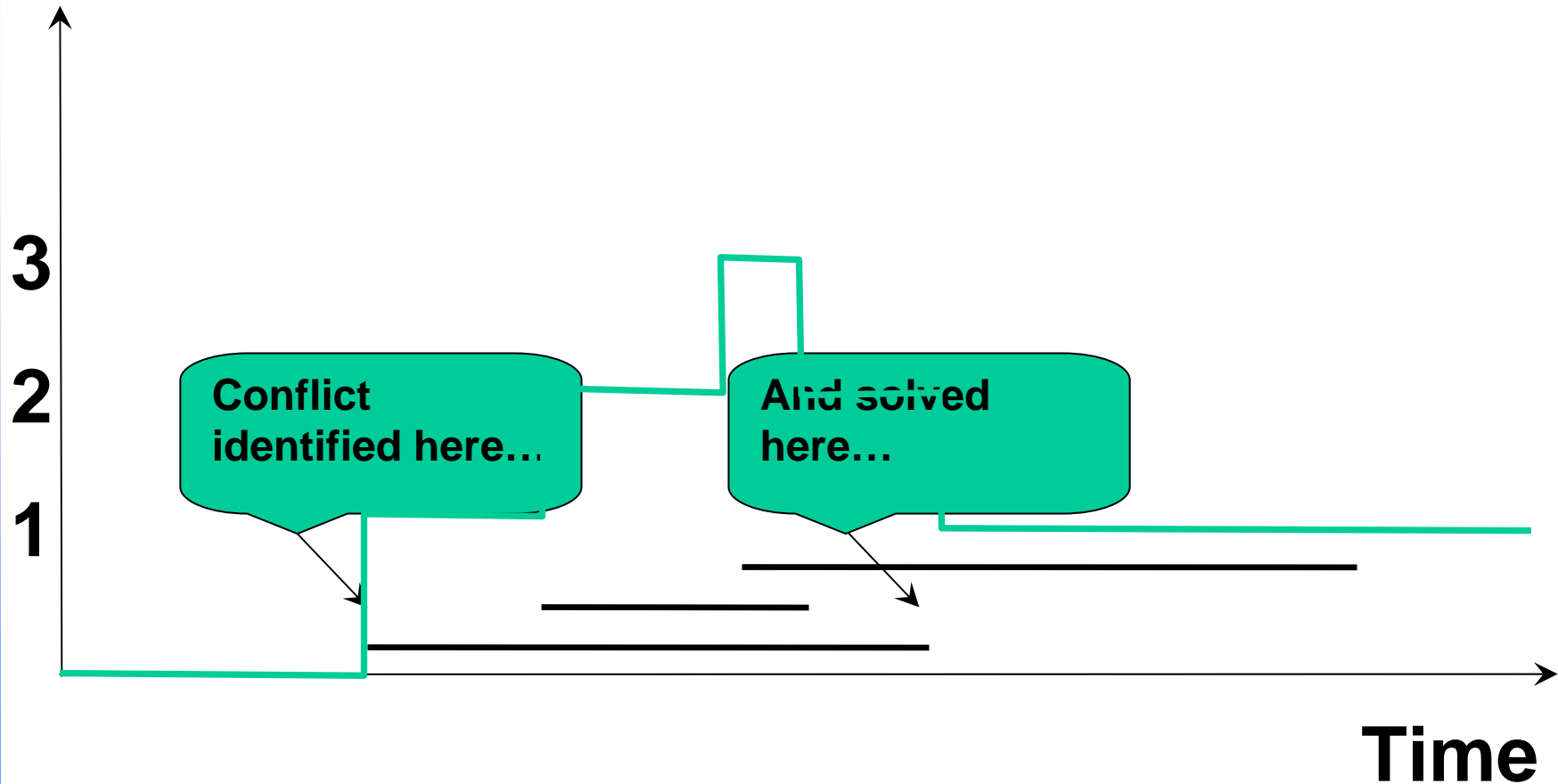
## Fields associated to conflicts:

- Min distance if no resolution: “ATC perceived” Gravity
- ATC intervention time in case of failed intervention : Risk of Collision
- Time of “Horizontal Closest Point of Approach without vertical separation” – Time of maneuver: ATC Anticipation/Urgency/Stress
- CWP for maneuver and at the time of the CPA (if any): collaborative working practice

**Underlying  
Cognitive model  
representation:**



# Cognitive resources in dynamic

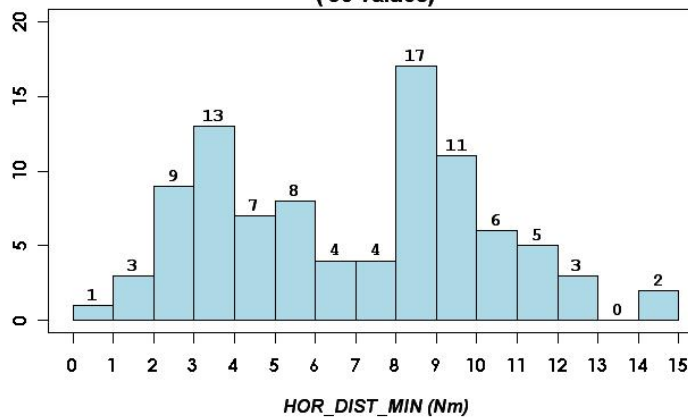




# Case study : the ERASMUS project

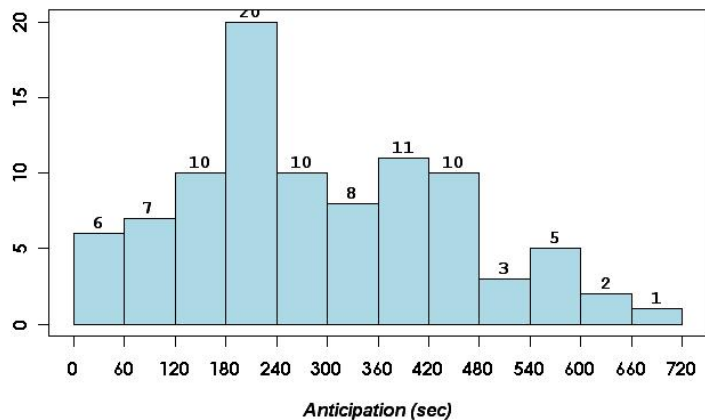
# ATC instructions in horizontal

**Minimal horizontal distance (if ATCO instruction not followed)  
for horizontal encounters without ERASMUS  
(93 values)**

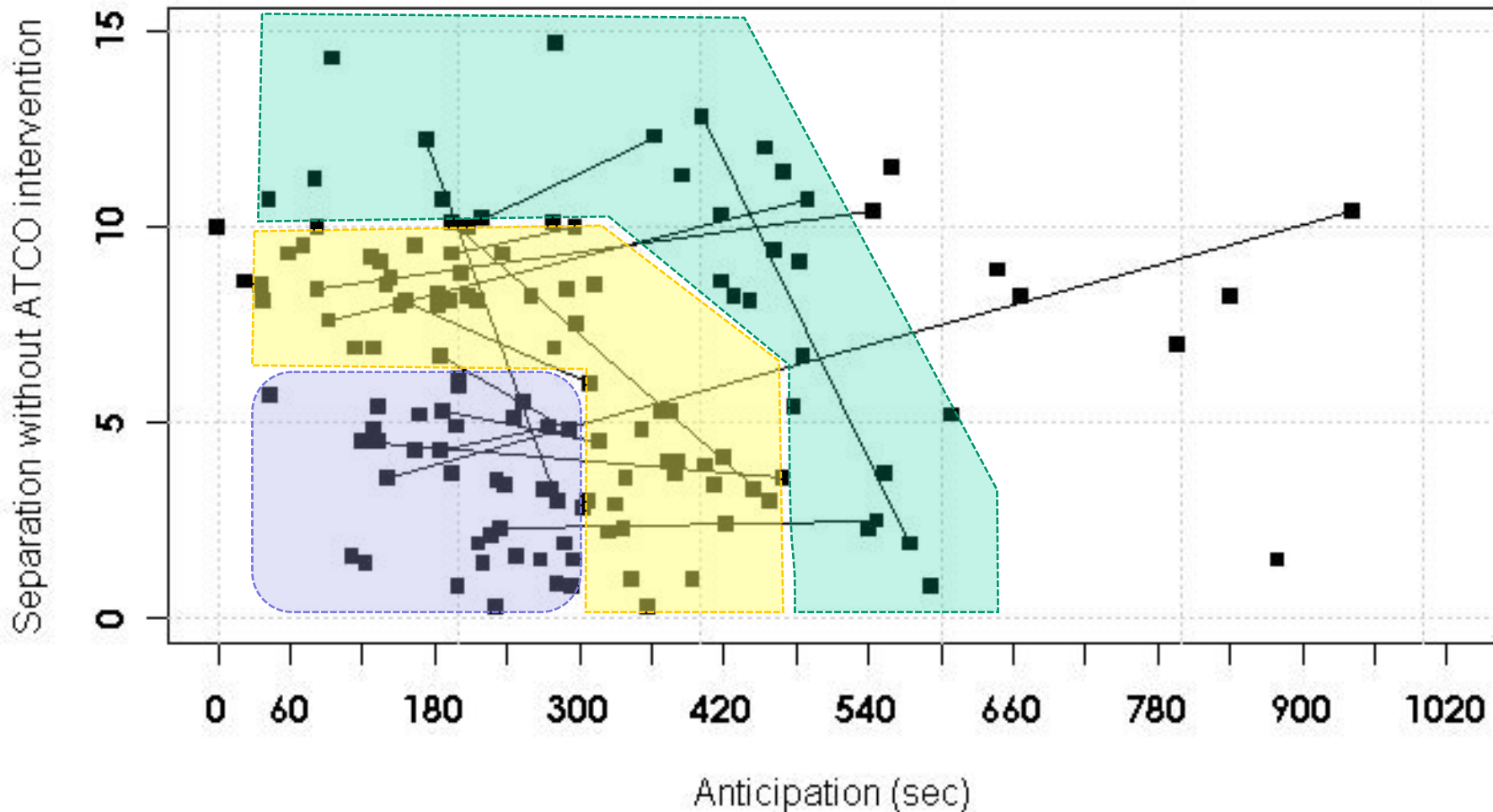


# ATC anticipation in horizontal

Anticipation for horizontal encounters without ERASMUS  
( 93 values)



## Clusters of encounters without Erasmus ( 119 ATC Instructions)



## Clusters of encounters with Erasmus ( 48 ATC Instructions)

