

ATM 2005 – 6th USA/Europe ATM R&D Seminar



Simulated Free Routing Operations in the Marseilles UIR: Results and Issues from a Human Factors Perspective

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Presentation Plan

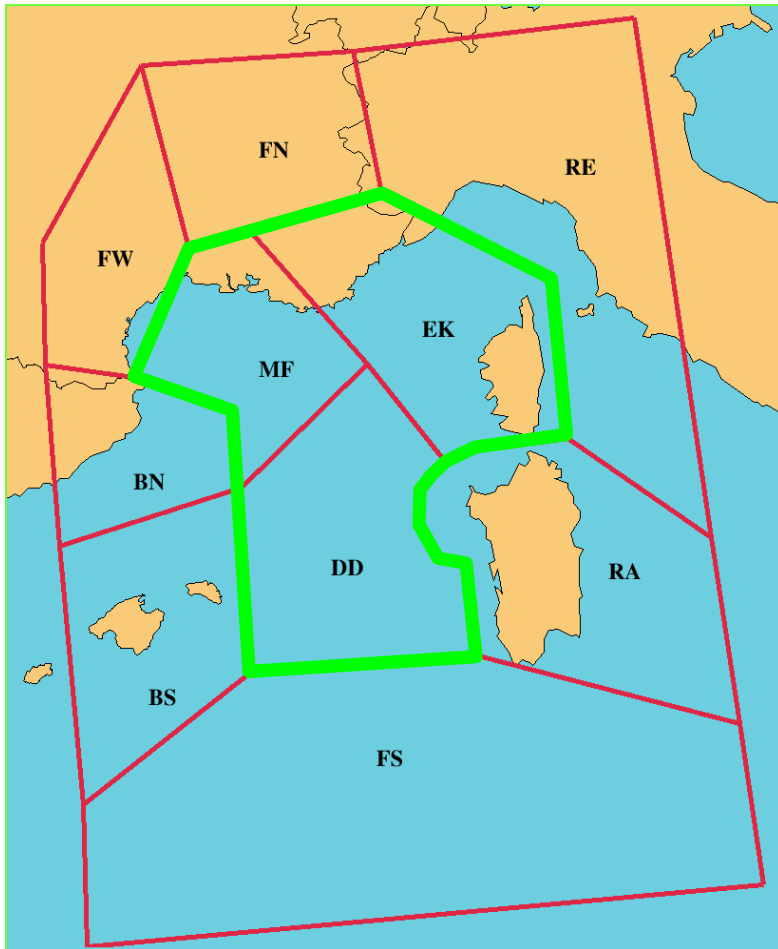
- The Free Route real time simulation trials, a participation of DSNA-SDER in the [Mediterranean Free Flight \(MFF\)](#) program:
 - Background and objectives
 - Simulation design and FR tools
 - Principles of the HF analysis
- Results on:
 - Integration of flights and memorization
 - Conflict detection
 - Workload
- Main conclusions from the human factors perspective



Background and Objectives

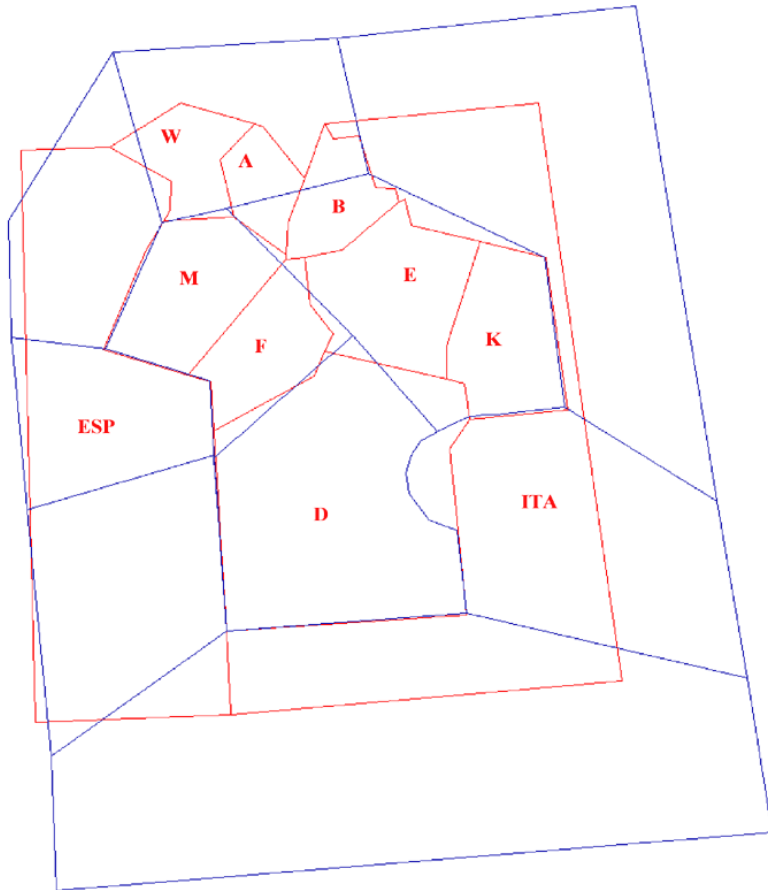
- Background:
 - MFF: study of a series of applications, from Free Route (FR) to Free Flight in a busy Mediterranean area
 - DSNA real time simulation trials focused exclusively on FR
 - FR operations:
 - flights planned without reference to a fixed route network in a designated FR airspace
 - Controllers retain responsibility for separation
- Objectives of the real time simulation trials on FR by the DSNA:
 - Get a feedback from controllers on FR with high density traffic
 - Can controllers effectively do their job ?
 - Are the proposed tools fit for the purpose ?
 - Investigate safety aspects in the simulated FR concept

Simulated Free Routing Operations



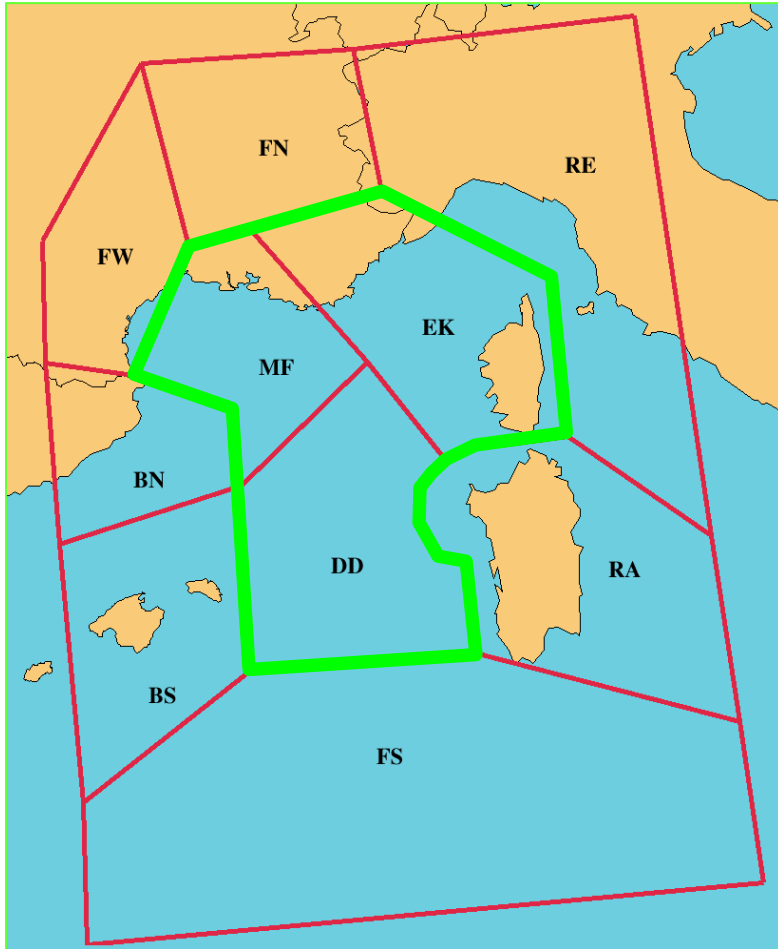
- Area in the Mediterranean airspace controlled by Marseilles
- FR airspace is above a floor level set at FL 285
- Design of the MF, EK, and DD sectors modified for FR operations

FR Sectors Design vs. Current Design



- **Current design**
- **FR design**
- FR sectors characterized by:
 - Larger flat areas
 - Simpler shapes

Simulated Free Routing Operations



- Area in the Mediterranean airspace controlled by Marseilles
- FR airspace is above a floor level set at FL 285
- Design of the MF, EK, and DD sectors modified for FR operations
- Scenarios from the unregulated traffic demand for peak days of 2002
- Direct routes between entry and exit of a FR airspace



Measured Control Units and FR Tools

- Two measured units / control working positions,
each manned by an executive and a planning controller

Control Working Position



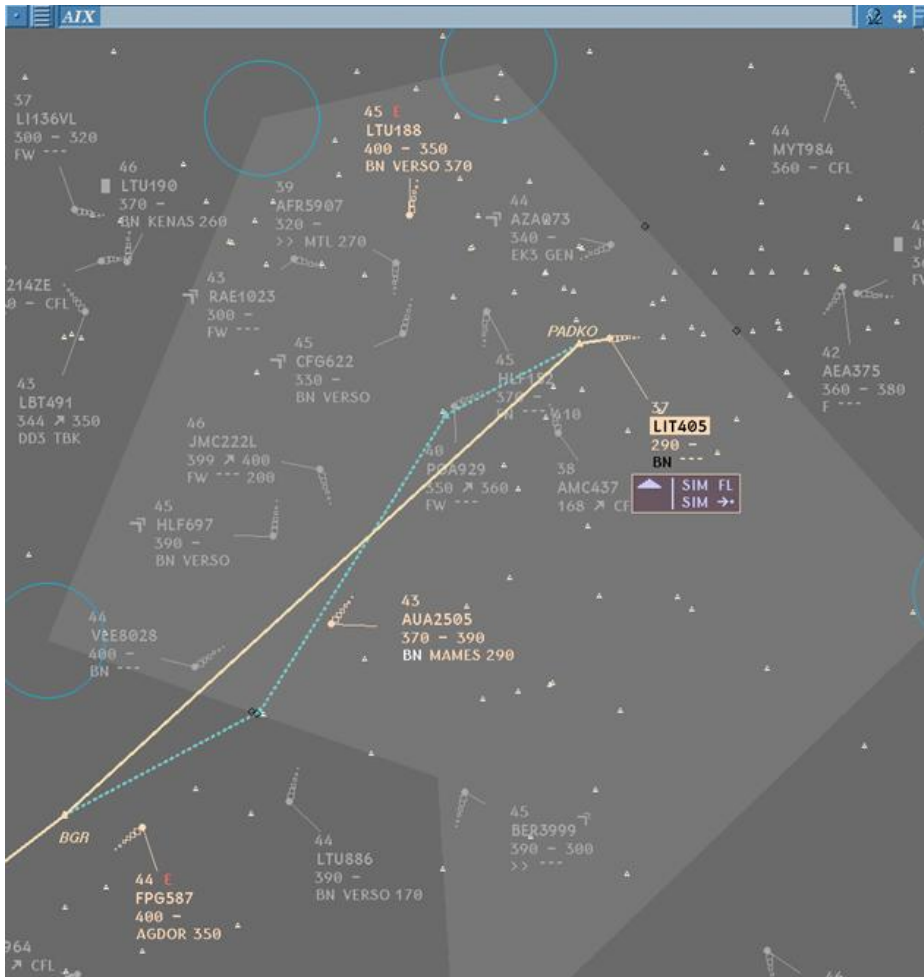
- One such CWP for each measured unit
- Left hand side: executive controller
- Right hand side: planning controller



Measured Control Units and FR Tools

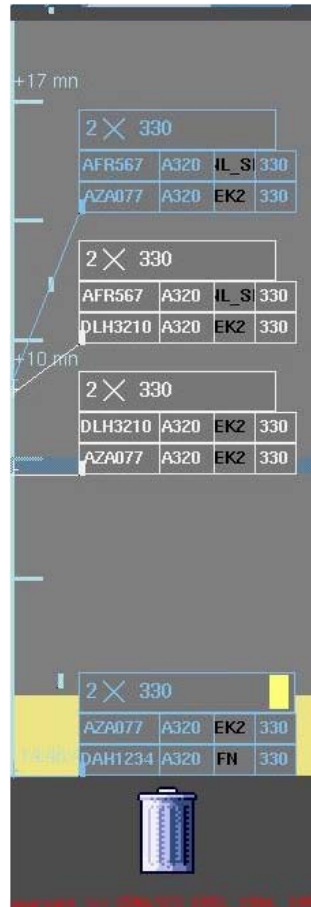
- Two measured units / control working positions, each manned by an executive and a planning controller
- FR tools integrated with functions of a state-of-the-art, stripless control working position:
 - Route editor
 - Medium Term Conflict Detection (MTCD), in the form of
 - Filtering functions
 - Tasks Scheduler

Example Display of Filtering



- Filtering in route edition mode for LIT405

Example Display of the Tasks Scheduler



Measured Control Units and FR Tools

- Two measured units / control working positions, each manned by an executive and a planning controller
- FR tools integrated with functions of a state-of-the-art, stripless control working position:
 - Route editor
 - Medium Term Conflict Detection (MTCD), in the form of
 - Filtering functions
 - Tasks Scheduler
 - Electronic inter-unit co-ordination tools
 - Controller-Pilot Data Link Communication (CPDLC) services, addition of the capability to uplink edited routes



Human Factors Analysis Principles

- Collection of qualitative and quantitative data:
 - Observations by HF experts on the measured positions
 - Post exercise questionnaire and individual interviews after each exercise
 - End of day debriefings
 - Post-simulation questionnaire at the end of the 2-week trials
 - Final round-table discussion
 - Automatic recordings (source of most of the quantitative data)
- Activity split for the analysis into:
 - **Integration and memorization**
 - **Conflict detection**
 - Conflict resolution
 - Anticipation
 - Co-operation
- Further analysis on **tools** and **workload**
- Controllers had opportunities to react to the interpretation



Integration of Flights and Memorization

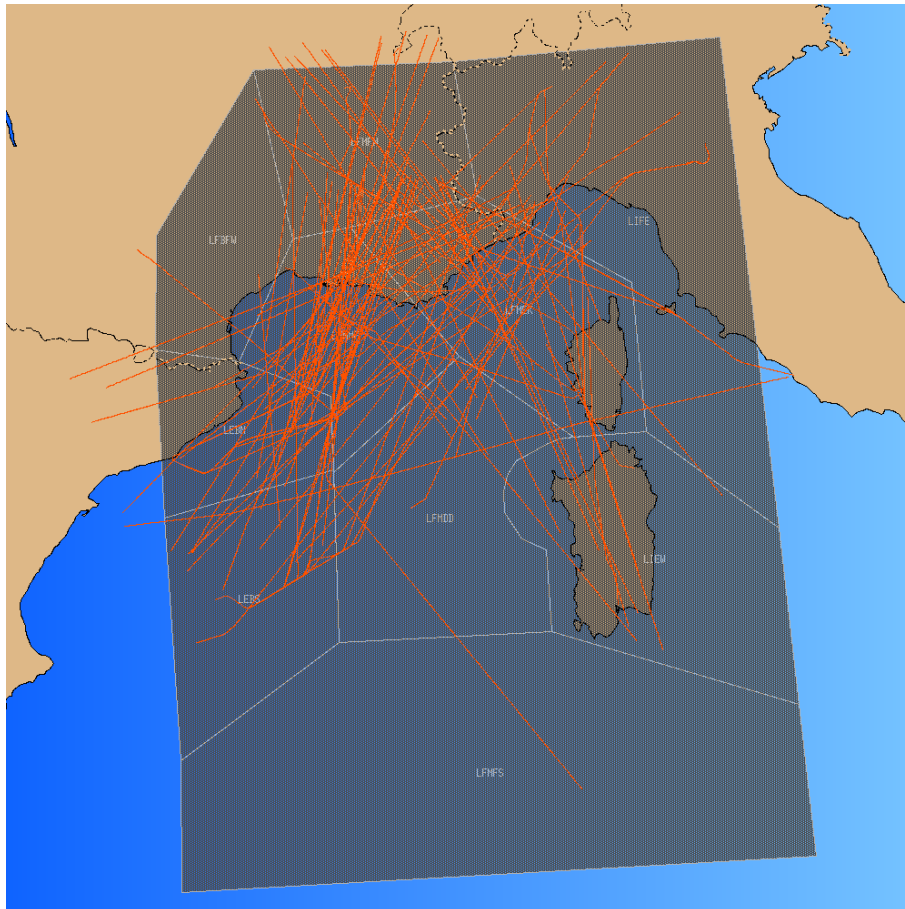
- FR operation had a major impact on both integration of flights, and memorization
- Flights integration was made more difficult in FR:
 - Absence of stable geographical references
 - Existence of flights that remain near the edges of the units
 - Simultaneous entry of flights on unregulated trajectories in the same direction
- Memorization of diverse and variable trajectories was too costly:
 - Repeated consultation of information
- Provided filtering functions did not sufficiently facilitate the integration



Conflict Detection

- Conflict detection and resolution in FR are within the scope of expertise of the controllers
- Difficulties due to FR operation:
 - Possible points of conflicts numerous, unmarked, and not known in advance
 - Monitoring of flights at the edges of the units
 - Convergences in variable configurations

Example Recording of Simulated FR Flights



- Measured units:
MF and EK
- Played hourly load:
 - About 80 flights in EK
 - About 70 flights in MF



Conflict Detection

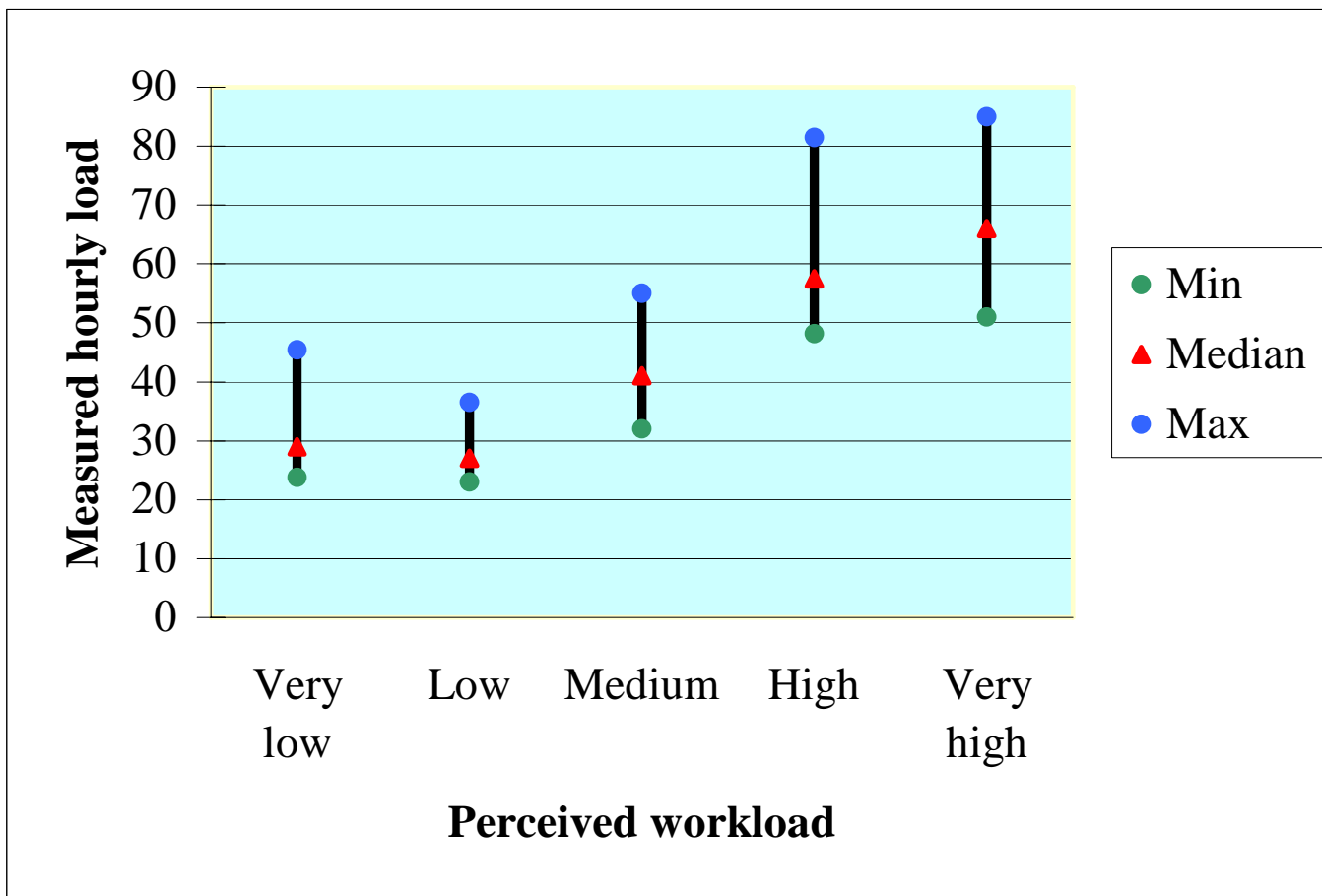
- Conflict detection and resolution in FR are within the scope of expertise of the controllers
- Difficulties due to FR operation:
 - Possible points of conflicts numerous, unmarked, and not known in advance
 - Monitoring of flights at the edges of the units
 - Convergences in variable configurations
- Management of climbing and descending flights particularly difficult:
 - More face to face situations than with the current fixed route network
 - Negative impact of entry and exit points at FL 285
- Wide agreement on judging the Tasks Scheduler useful, or even essential in principle, but:
 - Tools must be made totally reliable
 - Not efficient enough in high workload/high complexity situations



Workload

- Main variation factors on the perceived workload were:
 - 1 The traffic load

Perceived Workload and Traffic Load

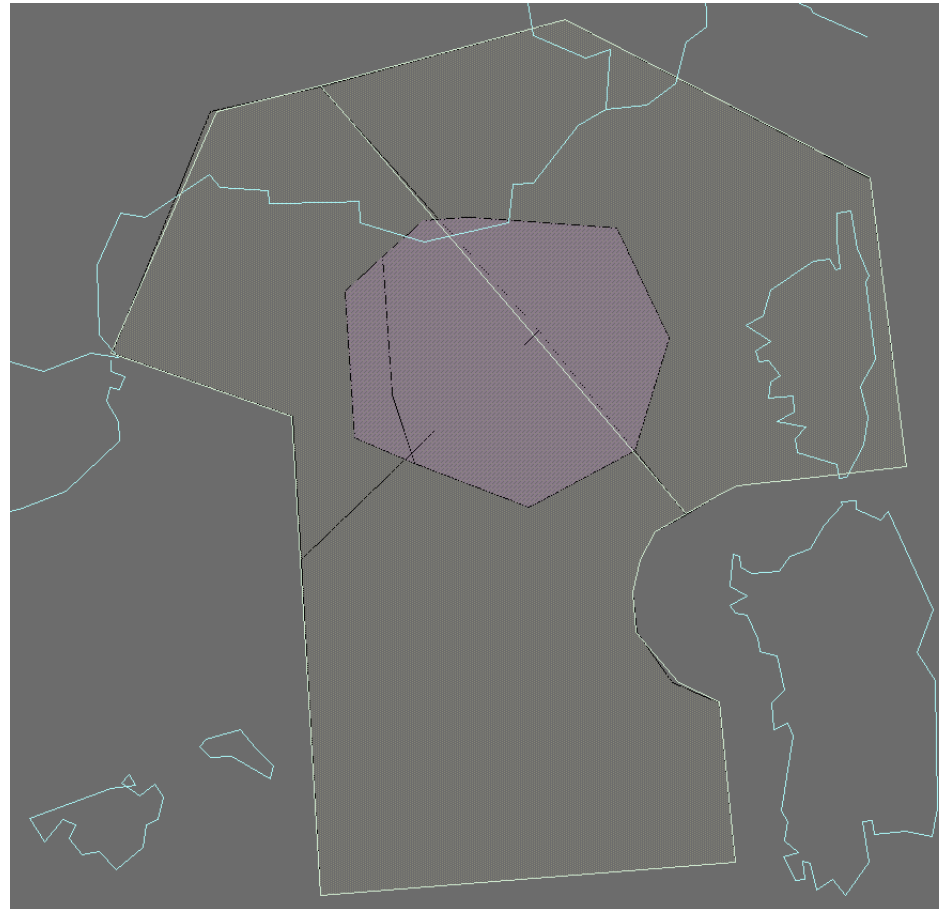




Workload

- Main variation factors on the perceived workload were:
 - 1 The traffic load
 - 2 The activation of temporarily segregated areas

Extension of the D54A+B TSAs





Workload

- Main variation factors on the perceived workload were:
 - 1 The traffic load
 - 2 The activation of temporarily segregated areas
 - 3 Occasional problems with tools in the simulator
 - 4 Problematic traffic configurations
- Controllers could not maintain their workload within acceptable limits by working at a skill-based behavior level:
 - FR traffic remains diverse and variable
- The inability to maintain workload at a proper level generated a feeling of insecurity



Main Conclusions

- As proposed, FR operations would not be accepted for high traffic loads:
 - Workload cannot be maintained within acceptable limits in all the situations
 - Feeling that safety is jeopardized in heavy traffic
- FR makes memorization of routes and conflicts more difficult:
 - Loss geographical reference frames to speed up decisions
 - Repeated consultations of information
 - Processes lose their effectiveness as the traffic increases
- Restrictions to be clearly addressed for FR operations:
 - Traffic flow management
 - Airspace management
 - Design and **reliability** of aiding tools



Results Dissemination

- HF analysis of FR operations in the Marseilles UIR is part of the MFF results
- Official public web site of the MFF programme:

<http://www.medff.it>