PJ09.W2.S44 and PJ10.W2.S96 EXERCISE 05

"DAC Integration into DCB and ATC Process"

Open Day 29-09-2022
SINTEF, Oslo

Patrizia Criscuolo, ENAV
Carlo Andreotti, IDS
Amela Karahasanović, SINTEF

Founding Members
EUROPEAN UNION EUROCONTROL

AGENDA

- INTRODUCTION TO THE EXERCISE 05
- THE DCB, DAC AND ATC PROCESSES IN EXERCISE 05
- OVERVIEW OF THE VALIDATION PLATFORM AND TOOLS
- AIRSPACE AND TRAFFIC: REFERENCE AND SOLUTION SCENARIOS
- LTLMT Platform
- OBJECTIVES
- EXERCISE AND DEMO

INTRODUCTION TO THE EXERCISE 05

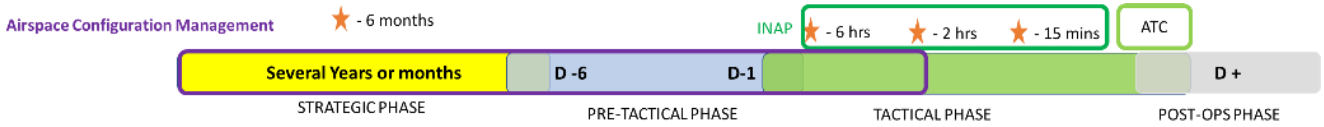
- EXERCISE 05 is a joint validation of the SESAR projects Digital Network Management Services (**PJ09-W2 DNMS**) and Separation Management and Controller Tools (**PJ10-W2 PROSA**)

- It is the natural continuation of **SESAR 2020 Wave 1** validation activities carried out separately in **PJ08.01 on DAC** concept (**EXE 08.01.06**) and in **PJ09.02.03 on DCB** concept (**EXE 09-02.03 b**), now **combining the two concepts in a seamless process from the planning phase up to the execution phase, covering the gap between ATFCM and ATC activities**.

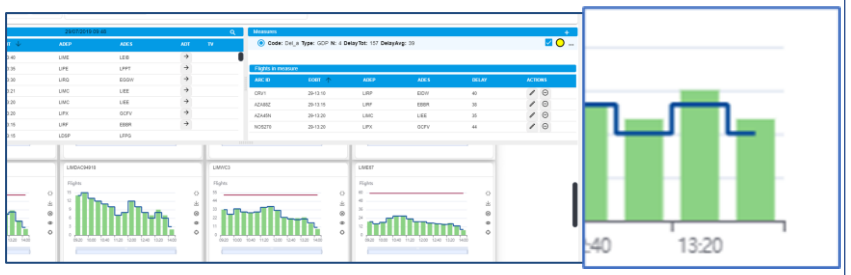
- It is a **Human-in-the-loop Real-Time Simulation** at V3 maturity level carried out on the **high complexity FRA environment of Milan ACC airspace** (their highest sectors between **FL305** and **FL660**) and using the **27 and 29 July 2019 traffic sample**, referred to the busiest day of AIRAC cycle 1908, to validate the operational feasibility of the concept solution and demonstrate its benefits:
    - To assess the **feasibility** and **usability** of **advanced supporting tools** (algorithms to monitor and adjust traffic workload and complexity and to smooth traffic flows in support of DAC process, and to create and shape dynamic sectors) for continuously monitoring, prediction and resolution of local complex situations (hotspots) in both planning and execution phases based on the implementation of airspace configuration according to new En-Route ATC sector design principles, including workload and complexity.
    - To demonstrate the **feasibility of combining DAC with DCB** to optimally adapt the capacity to the demand.

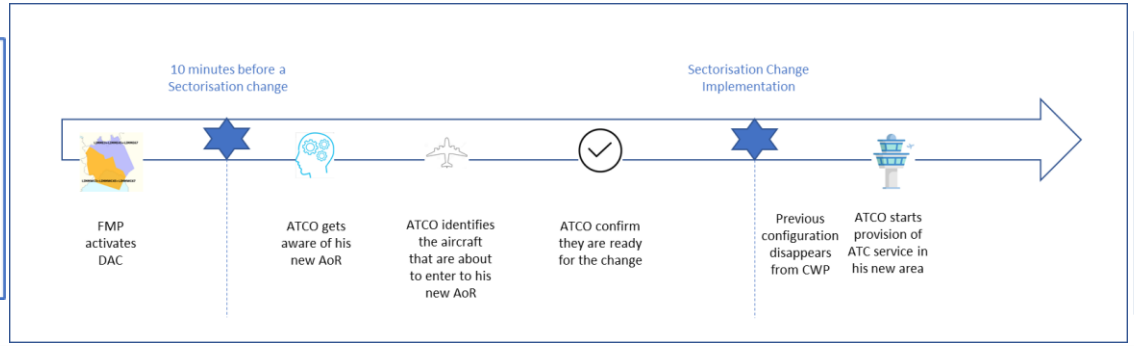
- Led by **ENAV** in cooperation with **SINTEF** and **EUROCONTROL** (ENAV/IDSAirnav provides the Local Traffic Load Management – LTLMT Tool, SINTEF provides the DAC Tool, the WL calculator, the SIMADES simulator and ATCO CWP supporting DAC, and EUROCONTROL the INNOVE simulator).

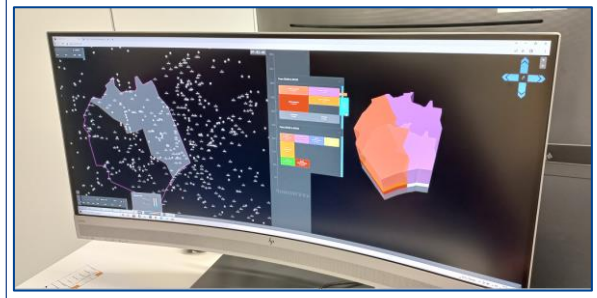
THE DCB, DAC, ATC PROCESSES IN EXERCISE 05



- The **LTM analyses** the **traffic situation** and the **initial configurations plan** using the **LTLMT tool**:
  - For each Traffic Volume under the Area of Responsibility of the LTM, both per flight and per group of flights, the Traffic Counts (Hourly Entry Counts and Occupancy Counts) are displayed to him; if the evaluated complexity is detected as being outside the thresholds, the related situation will be marked as a non-acceptable situation.
- The choice of a **DAC** (through a request to the **DAC Algorithm integrated into the ATFCM tool**) or **ATFM measures** will be evaluated by the LTM through the **What-If capability** of the LTLMT Tool (**DAC and Traffic What-If**).
  - **Traffic What-if activity** allows consultation of demand in order to gain a more detailed understanding of the traffic and identify potential demand-led solutions to resolve the imbalance using e.g.: STAM measures (Ground Delay).
  - As for **DAC What If,** the LTM can select the area and adjacent areas to know the status of available capacity to understand not only what sector configuration is planned around the time of the hotspot, but also what alternative options are available/feasible.
- Finally, if a **Capacity measure is selected**, the **LTM coordinates** with the **SUP and the new configuration is sent to the ATC Platform**. **ATCOs**, in addition to their ATC services tasks, will **implement the change of sectorisation**: each ATCO involved in the configuration change gets aware of his/her future area of responsibility as soon as upcoming DAC is displayed on the HMI (but not activated yet) i.e.: as from a minima 10 min, or more, before new DAC activation time.

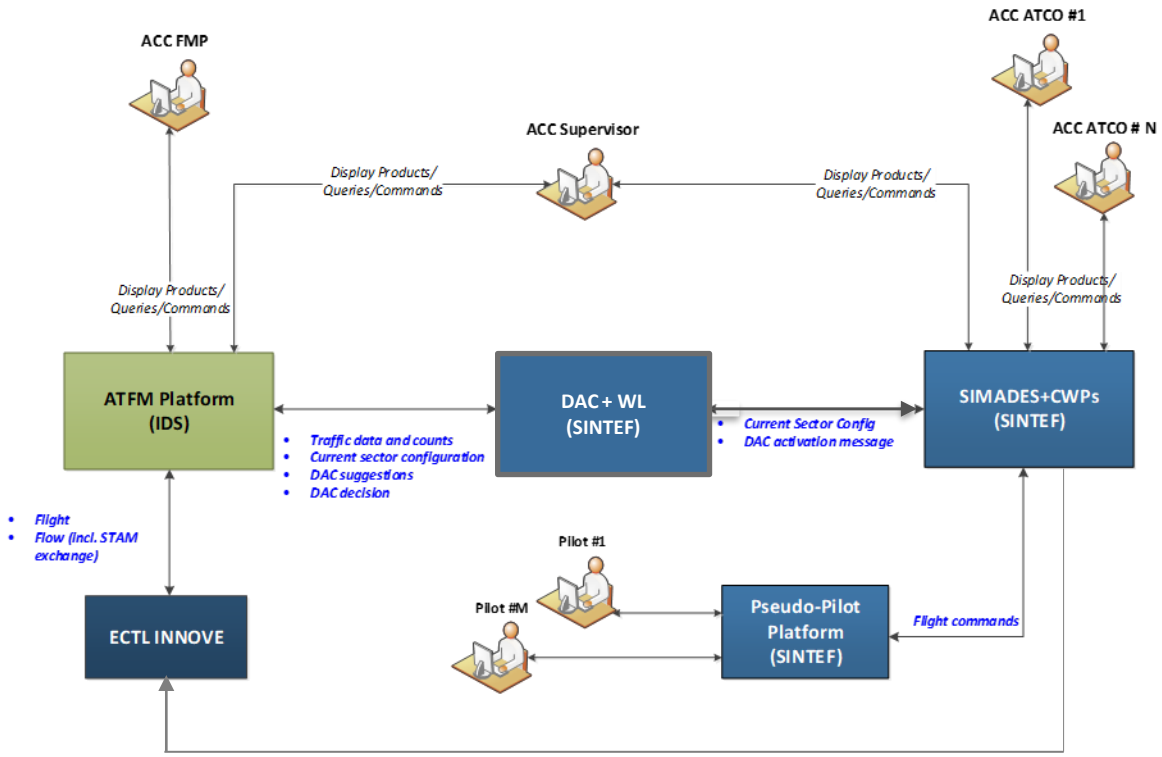






OVERVIEW OF THE VALIDATION PLATFORM AND TOOLS/1

- **LTLMT**, by **IDS** designed to manage air traffic demand and capacity in the context of a specific ANSP's business targets.
- **INNOVE**, by **EUROCONTROL** to receive traffic and flights data
- **DAC and Workload Calculator**, by **SINTEF** to provide the proposed DAC to reduce/solve the demand/capacity unbalance and the Controllers workload associated to a specific sector/TV.
- **SIMADES + CWPs**, by **SINTEF** where ATCOs personnel provides update of the flights for each sector.



OVERVIEW OF THE VALIDATION PLATFORM AND TOOLS/2

- LTLMT

- The system, a **tool for Flow Managers and Supervisors**, addresses **DAC** and **What-If functionality to choose the more adapt measure to solve a traffic unbalance**.
- It performs the **monitoring of the traffic demand** within the Area of Responsibility (AOR).
- In addition to the **traffic count**, the tool represents the **Controllers workload** by applying algorithms he monitoring can be performed at the whole airspace level or ACC level and, within an ACC, at sector level (elementary or collapsed), **providing users with warnings on the expected traffic load.**
- The update of sector configuration and opening scheme for the selected ACC over a certain time range is available at a tactical level.
- The tool also provides a map view to display flight trajectories and static data as pre-configured layers on a background map and 3D volumes for sectors.
- In offline mode LTLMT is fed by ENV data containing the information about the sectors and configurations.

- DAC Algorithm and Workload Calculator

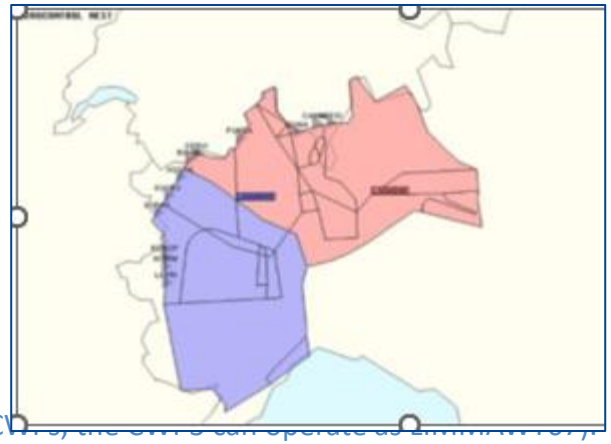
- Starting from an initial airspace sectorisation that supports the capacity requirements, **new sectors configurations will be defined according to the traffic flows and using DAC design principles together with a set of decision criteria/indicators** (e.g.: maximum Nb of open sectors, Nb of layers to implement the new sectorization).
- Workload estimate takes into account entry counts, average flight time, conflicts, number of flights close to the boarders and limbo flights. Limbo flights are the flights that appear in a sector as new to an ATCO due to changes of sector boarders.

- CWP

- During each session the airspace will be controlled by five controllers (each controlling one sector) and one master controller responsible for managing the rest of the airspace. Five pseudo-pilots are also participating in the exercise.
- A novel CWP to notify ATCOs of the sector configuration changes has been developed. The change in sector configuration can happen from planning phase to execution time.
- The CWP prototype mimics the current CWP being used by ATCOs working in the Milan ACC, augmented with tools to aid the ATCOs in **managing the traffic when sectorization changes**. This includes **tools to ease the understanding of how the sectorization will change** (both the sector being controlled by a given ATCO, and the rest of sectors), as well **as tools to ease the understanding of how the sectorization changes will affect the traffic**. Selected parts of the CWP functionality supporting DAC might be controlled **either using traditional mouse/keyboard interaction, and through using voice commands**. The PJ10 part of the exercise focus on the utility and usefulness of such voice commands.

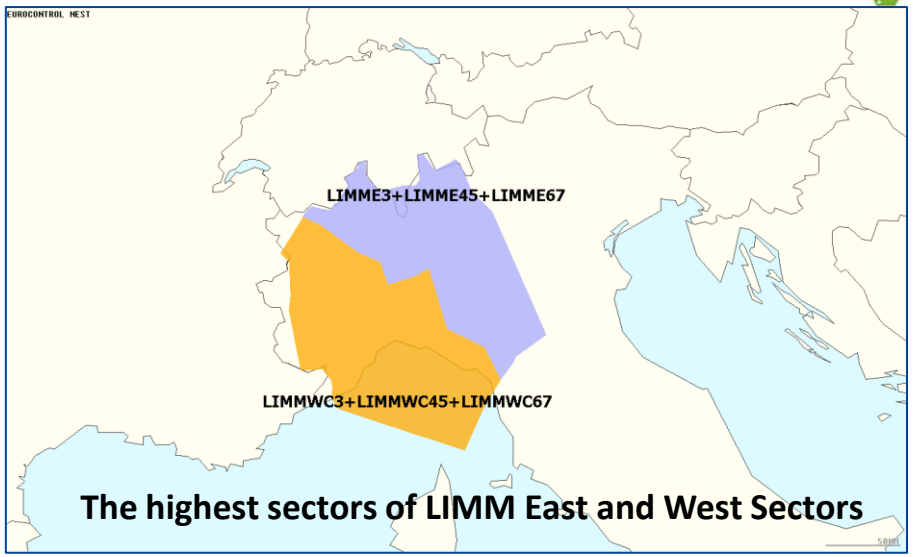
AIRSPACE AND TRAFFIC: REFERENCE AND SOLUTION SCENARIO

- The **REFERENCE SCENARIO** is based on the **LIMM West** and **East** sectors of Milan ACC airspace, a **Free Route environment**
  - **LIMMCTAW CNF5G**
    1. LIMMWSC12 (master)
    2. LIMMWN12X (master)
    3. **LIMMWC3 (cwp1)**
    4. **LIMMWC45 (cwp2)**
    5. **LIMMWC67 (cwp3)**
  - **LIMMCTAE CONF5A**
    1. LIMMES12 (master)
    2. LIMMEN2X (master)
    3. **LIMME3 (cwp4)**
    4. **LIMME45 (cwp5)**
    5. **LIMME67 (cwp6)** (in case of only 5 CWPs, the CWP 5 can operate as LIMMAWY67)

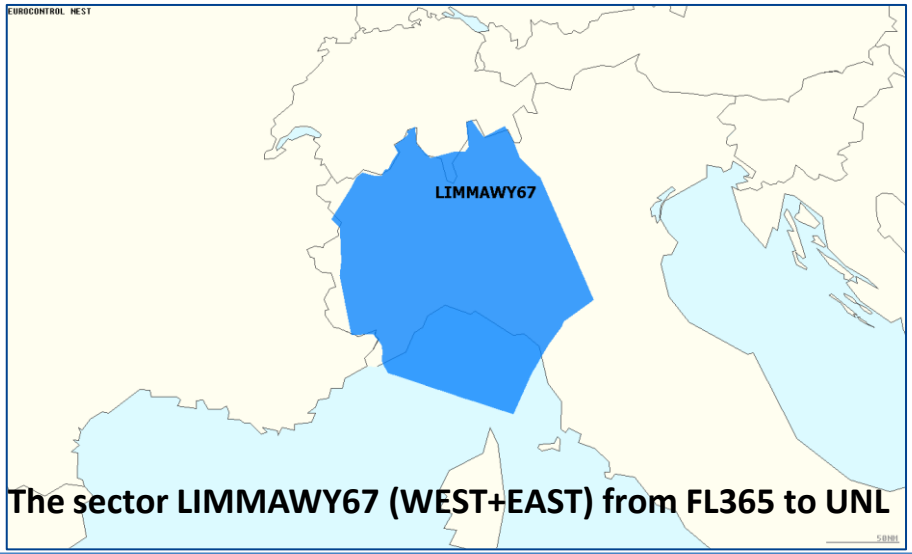


  - The selection of the sectors has started from the analysis for each of the two main sectors of the current airspace configurations of Milan ACC, West and East, and considering those compliant with the following two aspects:
    - A high traffic demand/complexity in which synchronization of DCB measures is applicable.
    - An optimal vertical split in order to have a perfect adherence to the free route environment (currently FL305).
- The platform will be fed by traffic recorded in 2 busy days: 27/07/2019 and 29/07/2019

- The configurations of **SOLUTION SCENARIOS** are calculated by the **DAC algorithm**.



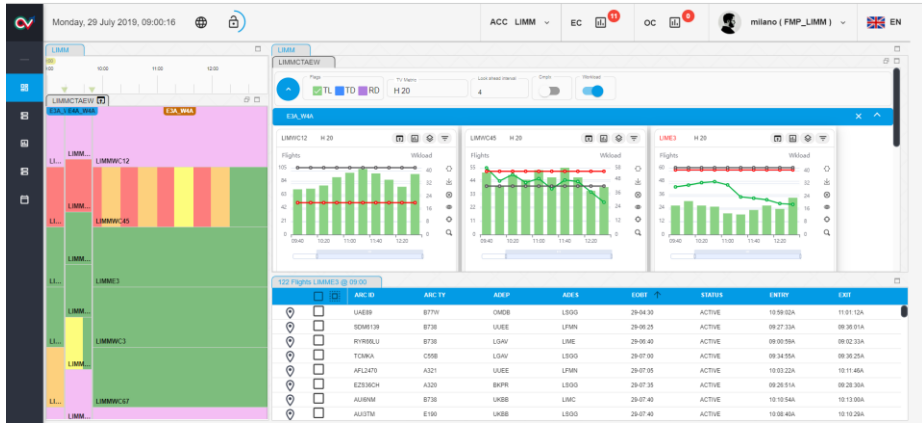
The highest sectors of LIMM East and West Sectors

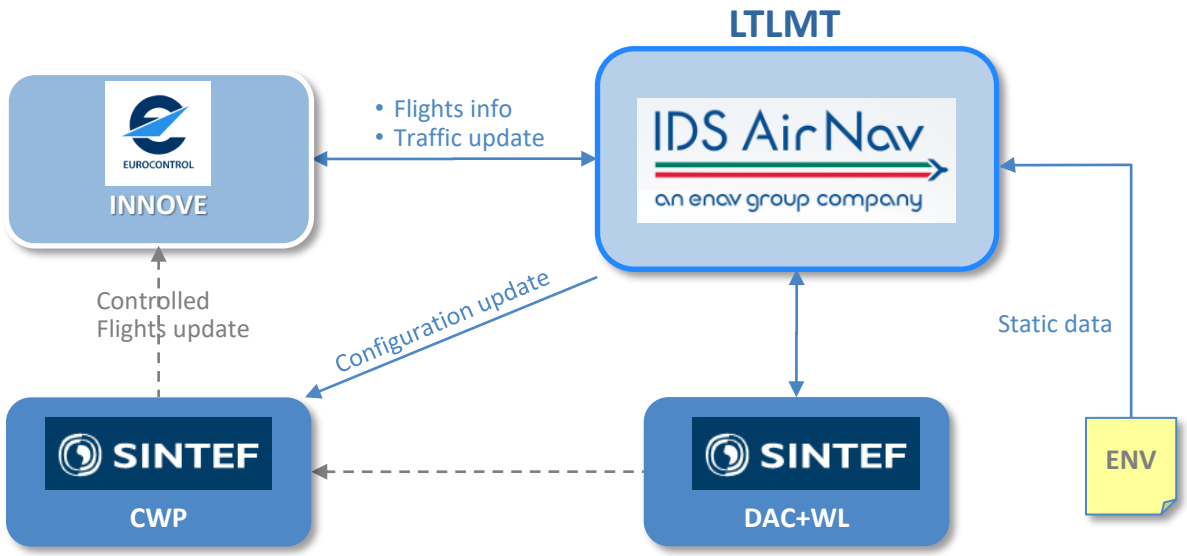


The sector LIMMAWY67 (WEST+EAST) from FL365 to UNL

IDS Airnav platform

LTLMT (Local Traffic Load Management Tool) is a tool to support operational personnel in identifying the best ACC room configuration and to propose ATFCM measures to manage the **Demand/Capacity imbalances** in coordination with NM and with ATC.





REFERENCES

SESAR Deployment Program (SDP)

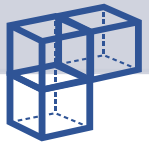
- Sub AF: S-AF 4.4 - Automated Support for Traffic Complexity Assessment

ICAO ASBU

- NOPS-B1/4 - Dynamic Traffic Complexity Management
- NOPS-B1/6 - Initial Dynamic Airspace configurations

LTLMT main functionalities

Traffic Monitoring	Sector configuration	Traffic Measures	Airspace Impact
• Traffic Counts • Complexity indicators	• What-if on sector • Ranking w/ roster info	• ATFCM Reg • STAM • Ranking of measures	• FUA • Weather Event • Staff

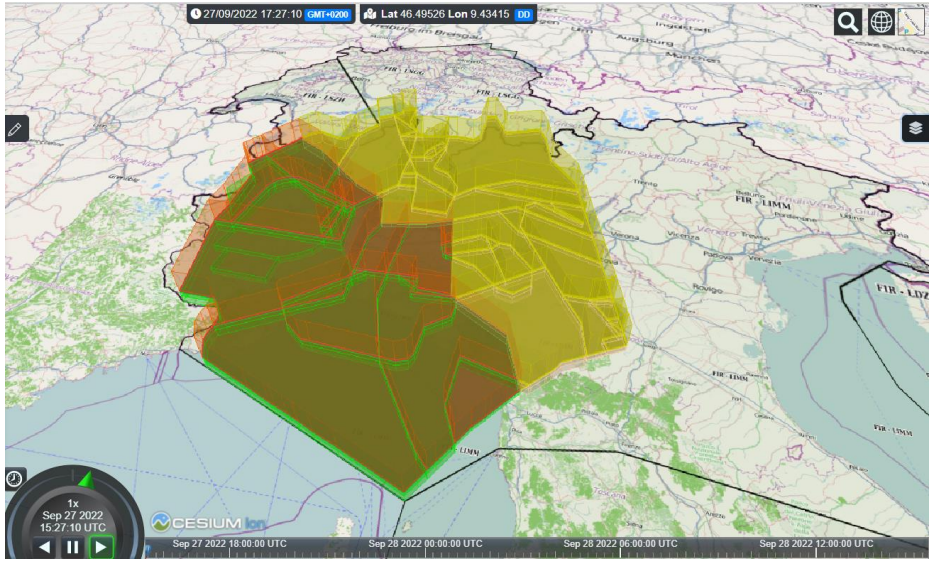



Modes of operation

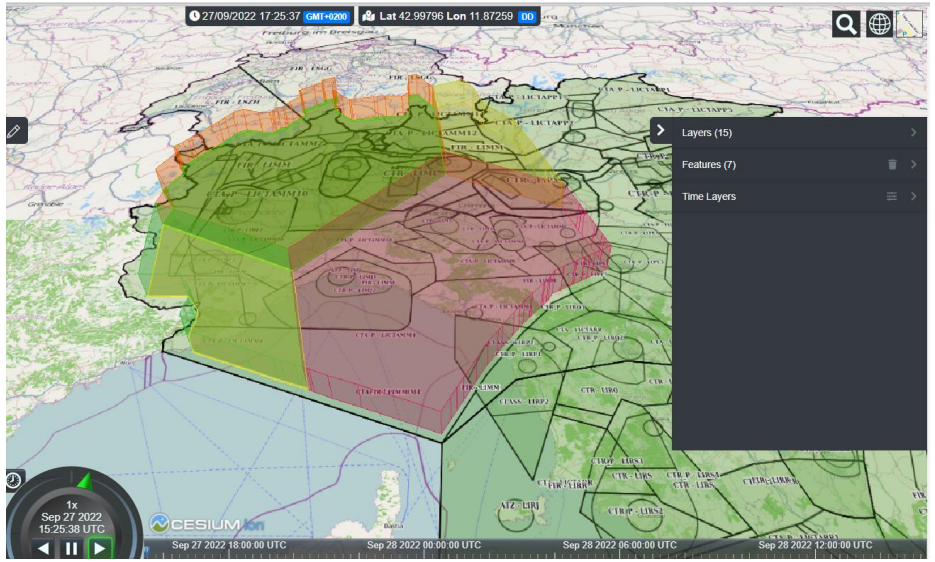
Operational | **Training** | **Playback** | **Demo**

LTLMT in PJ09 Solution44

- Demand/Capacity calculation
- Check Workload estimation
- Sector What-if analysis to apply different configurations
- DAC algorithm engagement and proposal evaluation
- Update of opening scheme configuration including DAC results
- Configuration change notification to CWPs
- Traffic what-if



DAC Solution

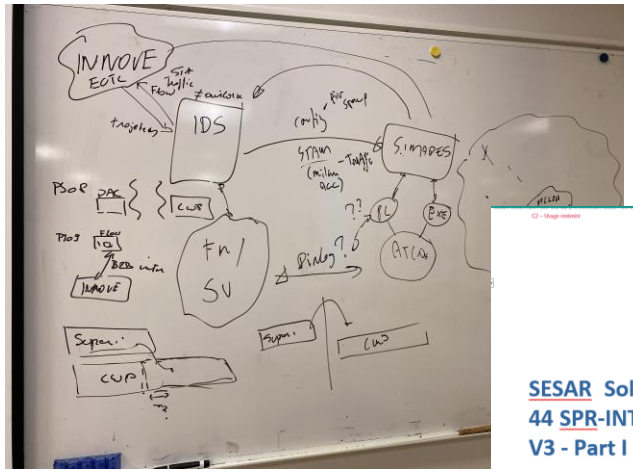


WHAT ARE THE OBJECTIVES?

SESAR JOINT UNDERTAKING

Founding Members

EUROPEAN UNION EUROCONTROL



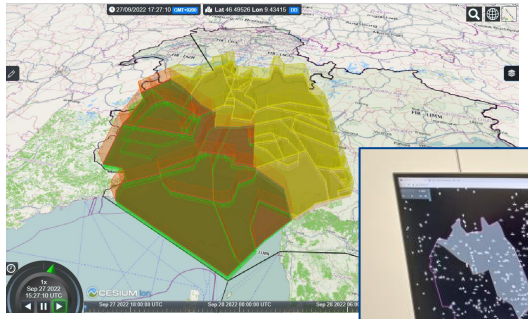
Ideas

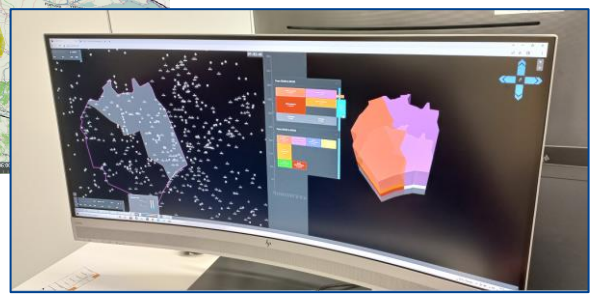
SESAR Solution PJ09-W2-44 SPR-INTEROP/OSED for V3 - Part I

Deliverable ID:	D2.1.001
Dissemination Level:	PU
Project Acronym:	DNMS
Grant:	874463
Call:	H2020-SESAR-2019
Topic:	SESAR-IR-VLD-WAV
Consortium Coordinator:	ECIL
Edition Date:	September 2022
Edition:	00.01.05
Template Edition:	02.00.04

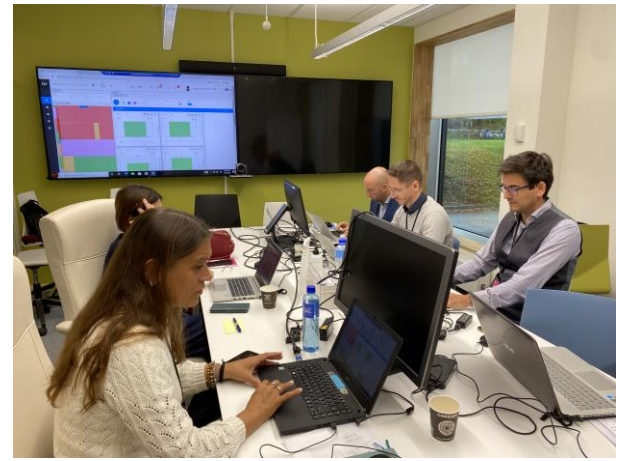
User Involvement in the Design of ML-Infused Systems

Requirements and research behind





Tools



Tools in a real-life action

How would that work with the humans in the loop?
What are the benefits of the proposed solutions?

OPERATIONAL FEASIBILITY OBJECTIVES

- FEASIBILITY of:
  - Implementing Dynamic Airspace Configurations (DAC) [EX5-OBJ-005]
  - Local Traffic Manager (LTM) supporting tools for the assessment and resolution of imbalances through demand and capacity measures [EX5-OBJ-014]
  - Air Traffic Controllers (ATCO) supporting tools for the Air Traffic Control procedures including Coordination procedures between Extended ATC Planning (EAP), Supervisors, Planner, Executive controllers for the implementation of the Air Traffic Flow and Capacity Management (ATFCM) measures [EX5-OBJ-018]
- ACCEPTABILITY of:
  - Implementing DAC [EX5-OBJ-006]
- SITUATIONAL AWARENESS of:
  - All actors involved in DAC [EX5-OBJ-007]
- BENEFITS of:
  - Implementing DAC [EX5-OBJ-008]

TECHNICAL FEASIBILITY AND PERFORMANCE OBJECTIVES

TECHNICAL FEASIBILITY OBJECTIVES

- FEASIBILITY of:
  - Automated support for the DAC based on complexity [EX5-OBJ-009]
  - Combining Capacity and Demand measures to solve imbalances with a minimum impact on demand [EX5-OBJ-015]
- ABILITY of:
  - Automated system to monitor sector configurations and detect imbalances [EX5-OBJ-010]
  - Automated system to assess the identified imbalance and to solve it [EX5-OBJ-011]

PERFORMANCE OBJECTIVES

- PERFORMANCE BENEFITS of DAC for Cost Efficiency [EX5-OBJ-020], Flight Time Efficiency [EX5-OBJ-021], Predictability [EX5-OBJ-023]

HUMAN PERFORMANCE OBJECTIVES

- IMPACT ON HP OF DAC INTEGRATION [EX5-OBJ-025]

Data collection

- Observations
- Questionnaires
- Interviews (audio records)
- Audio records of the communication between the ATCOs and pilots
- Audio records of speech commands
- Log files (SIMADES, INNOVE)


Observer workload log Observer: _____Run: ___ Sheet: ___

Timestamp	ATCO	Workload low	Workload moderate	Workload high


2. SITUATION AWARENESS

2.1 Please read the statements and rate your overall level of situation awareness (SA) you experienced during the run (circle appropriate number).

Was it possible to perform the task given your level of SA? — No: My SA with respect to the task was far too low. I could not perform the task because I did not possess the necessary information. (1)

Yes

Was your level of SA acceptable? — No: My SA with respect to the task was very low. I was unaware of almost all of the information required to perform the task effectively. (2)

My SA with respect to the task was low. I was aware of most of the information required to perform the task effectively. (3)

Yes

Was your level of SA satisfactory? — No: My SA with respect to the task was low. I was unaware of about half of the information required to perform the task effectively. (4)

My SA with respect to the task was reduced. I was unaware of some of the important information required to perform the task effectively. (5)

My SA with respect to the task was insufficient. I was not aware of all the information required to perform the task effectively. (6)

Yes

My SA with respect to the task was not complete. I was able to perform the task, but not satisfactorily. (7)

My SA with respect to the task was good. I was able to perform the task well most of the time. (8)

My SA with respect to the task was very good. I was able to perform the task well all of the time. (9)

My SA with respect to the task was excellent. I was able to perform the task extremely well all of the time. (10)

Organisation

Sessions

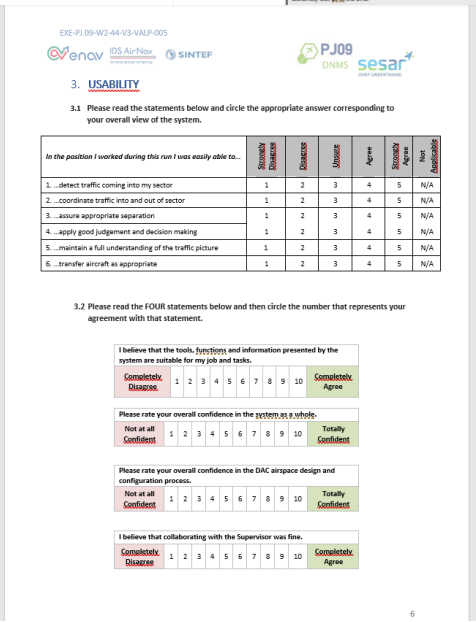
- Training
- Current and new operating methods
- With and without speech recognition for CWPs
- FMPs sessions 2-3 hours
- ATCOs sessions about one hour

PLANNING OF THE EXECUTION WEEK

LEGENDA

TRAINING	
BREAK	
TRAFFIC 1	
TRAFFIC 2	
NO FMP	
→	Correlation between runs
User Interface modality to be tested in the PJ10/S96	Traditional UI – Mouse + keyboard ASR – Automatic Speech Recognition (for the CWP, speech control)

	ACTIVITY FMP/SUP	ACTIVITY ATCO	
MONDAY, 26 SEPTEMBER 2022 – DAY 1			
09:00 – 12:00	TRAINING	09:00 – 12:00	TRAINING
12:00 – 13:00	BREAK	12:00 – 13:00	BREAK
13:00 – 15:00	TRAINING	13:00 – 15:00	TRAINING
15:00 – 16:00	RUN 1/1 – REFERENCE SCENARIO – TRAFFIC 1 – 2H	15:00 – 16:00	TRAINING
16:00 – 17:00	Current Operating Methods	16:00 – 17:00	RUN 1/1 REFERENCE SCENARIO with ATCO – 1H
TUESDAY, 27 SEPTEMBER 2022 – DAY 2			
09:00 – 09:30	TRAINING	09:00 – 09:30	Training, incl. Voice control
09:30 – 10:00		09:30 – 10:00	
10:00 – 10:30	BREAK	10:00 – 10:30	
10:30 – 11:00	RUN 1/2 - REFERENCE SCENARIO – TRAFFIC 2 – 2H	10:30 – 11:00	
11:00 – 11:30	Current Operating Methods	11:00 – 11:30	BREAK
11:30 – 12:00		11:30 – 12:00	RUN 1/2 REFERENCE SCENARIO with ATCOs – 1H
12:00 – 12:30		12:00 – 12:30	
12:30 – 13:00	BREAK	12:30 – 13:00	BREAK
13:30 – 14:00		13:30 – 14:00	Voice control user test 1
14:00 – 14:30		14:00 – 14:30	
14:30 – 15:00		14:30 – 15:00	BREAK
15:00 – 15:30	RUN 3/1 - SOLUTION SCENARIO – TRAFFIC 1	15:00 – 15:30	
15:30 – 16:00	Solution Operating Methods	15:30 – 16:00	RUN 3/1 – SOLUTION SCENARIO - ATCO SESSION
16:00 – 16:30	DAC (-2H to 20')	16:00 – 16:30	traditional UI
16:30 – 17:00		16:30 – 17:00	
WEDNASDAY, 28 SEPTEMBER 2022 – DAY 3			
09:00 – 09:30		09:00 – 09:30	Voice control user test 2
09:30 – 10:00		09:30 – 10:00	


3. USABILITY

3.1 Please read the statements below and circle the appropriate answer corresponding to your overall view of the system.

In the position I worked during this run I was easily able to...	Strongly Disagree	Disagree	Unsure	Agree	Strongly Agree	Not Applicable
1. ...detect traffic coming into my sector	1	2	3	4	5	N/A
2. ...coordinate traffic into and out of sector	1	2	3	4	5	N/A
3. ...assure appropriate separation	1	2	3	4	5	N/A
4. ...apply good judgement and decision making	1	2	3	4	5	N/A
5. ...maintain a full understanding of the traffic picture	1	2	3	4	5	N/A
6. ...transfer aircraft as appropriate	1	2	3	4	5	N/A

3.2 Please read the FOUR statements below and then circle the number that represents your agreement with that statement.

I believe that the tools, functions and information presented by the system are suitable for my job and tasks.
Completely Disagree 1 2 3 4 5 6 7 8 9 10 Completely Agree

Please rate your overall confidence in the system as a whole.
Not at all Confident 1 2 3 4 5 6 7 8 9 10 Totally Confident

Please rate your overall confidence in the DAC airspace design and configuration process.
Not at all Confident 1 2 3 4 5 6 7 8 9 10 Totally Confident

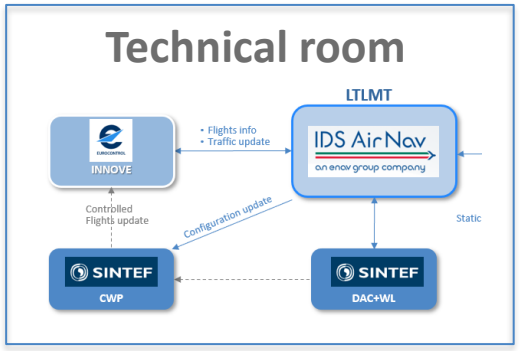
I believe that collaborating with the Supervisor was fine.
Completely Disagree 1 2 3 4 5 6 7 8 9 10 Completely Agree

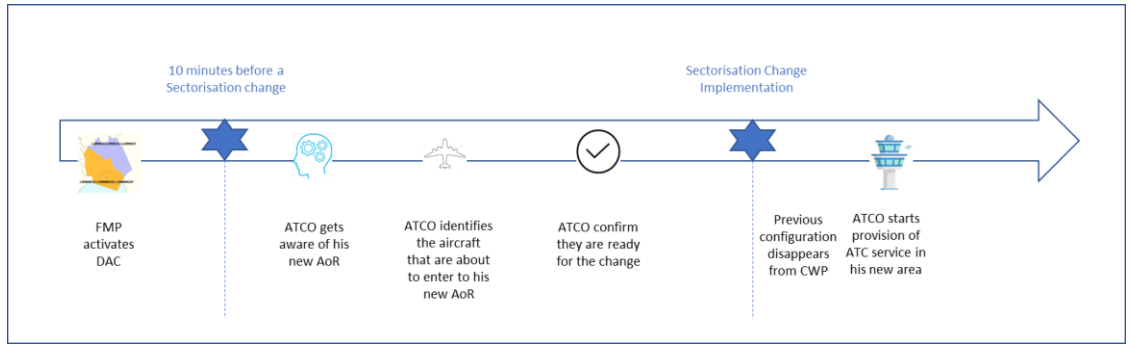
WHAT ARE YOU GOING TO SEE TODAY?

SESAR JOINT UNDERTAKING

Founding Members

EUROPEAN UNION EUROCONTROL

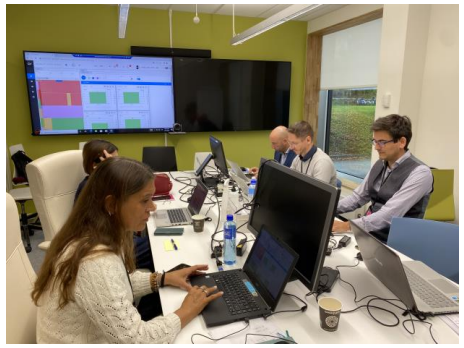




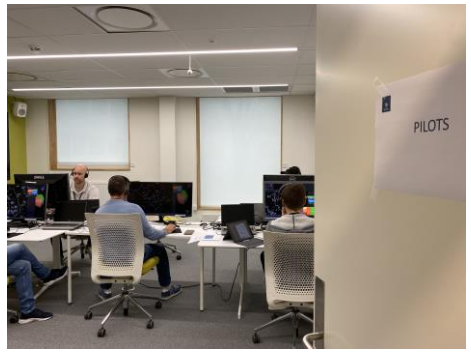
EXERCISE IN A NUTSHELL

- One week
  - 2 days - training, tuning the systems, experiment sessions
  - 3 days – experiment sessions
- 22 participants from Italy and Norway: ATCOs, FMPs, pilots, researchers and developers
- 5 platforms from three organisations communicating in real-time

FMPS ROOM



ATCOS and PILOTS ROOMS



LIVE DEMO

- From 13:40 – 15:10
- FMPS, ATCOS and PILOTS will be in action during the whole demo; 5 positions + a master ATCO
- We are more than 70 people from 28 different organisations
- Take a coffee and chat with other aviation enthusiasts ☺

THANK YOU FOR YOUR ATTENTION!

enav

IDS AirNav
an enav group company

SINTEF

EUROCONTROL

SESAR
JOINT UNDERTAKING

PJ09
DNMS

PJ.W2
PROSA

Founding Members
EUROPEAN UNION EUROCONTROL

Founding Members

EUROPEAN UNION EUROCONTROL

SESAR JOINT UNDERTAKING

PJ09 DNMS