

Supporting ATCOs During Sector Configuration Changes in Dynamic Airspace Configurations



9th SESAR Innovation Days

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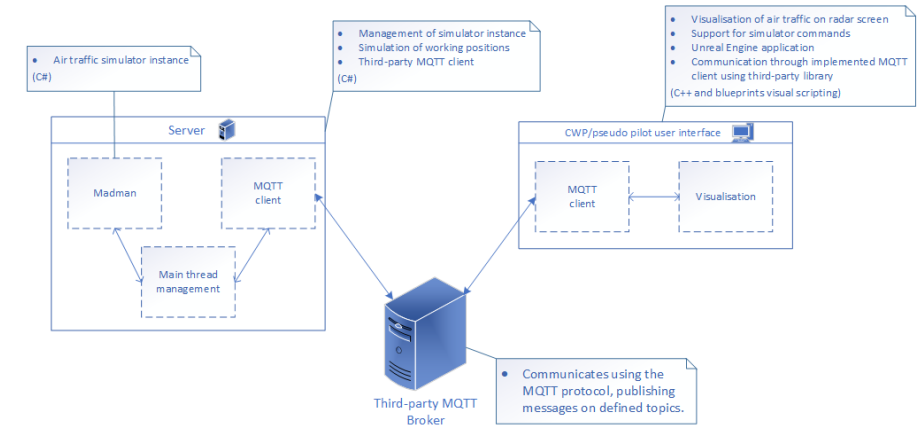
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Overview

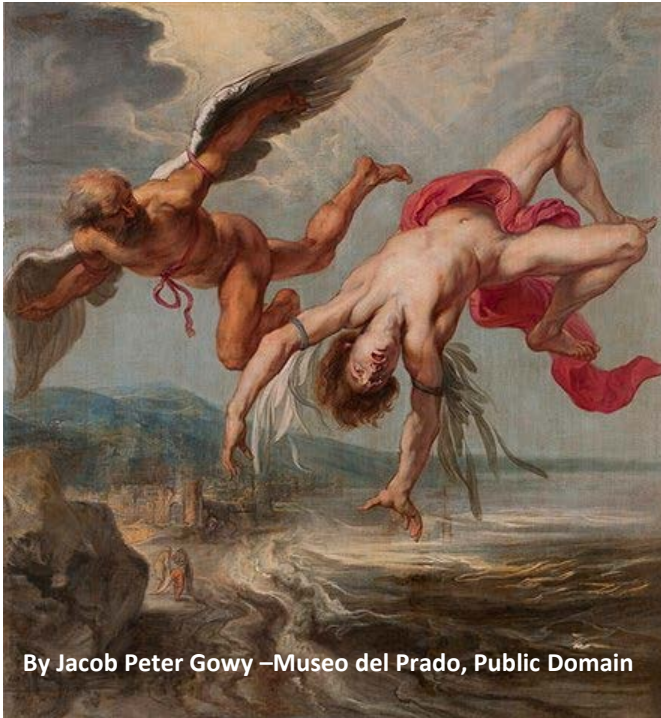
- Human factors in aviation
- Dynamic Airspace Configuration (DAC) concept
- Prototype of CWP with DAC approach
- Evaluation of the concept with ATCOs (exercise and findings)
- Lessons learned and future work



DAC algorithms developed by EUROCONTROL and evaluated by ENAV experts

Traffic simulator for ATCOs and pilots for en-route traffic that copes with dynamic airspace sector configurations developed by SINTEF

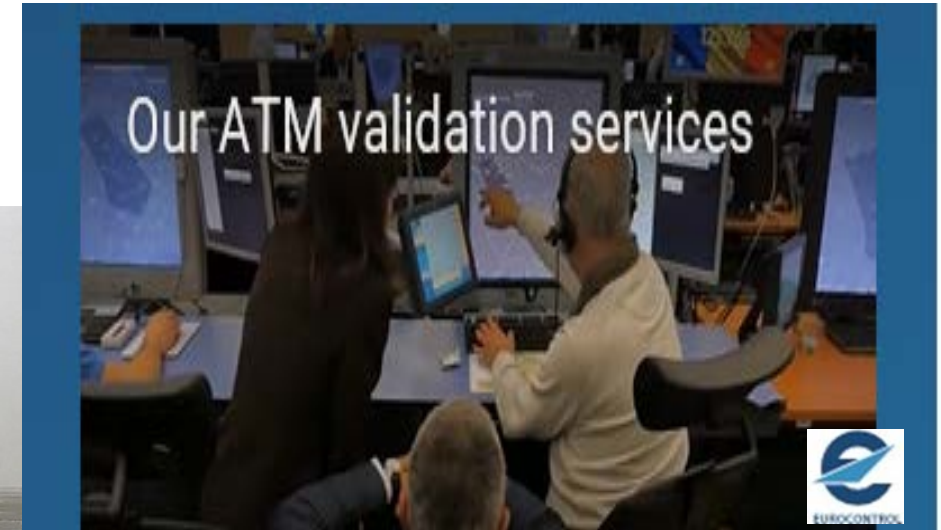
Human factors in aviation



By Jacob Peter Gowy –Museo del Prado, Public Domain

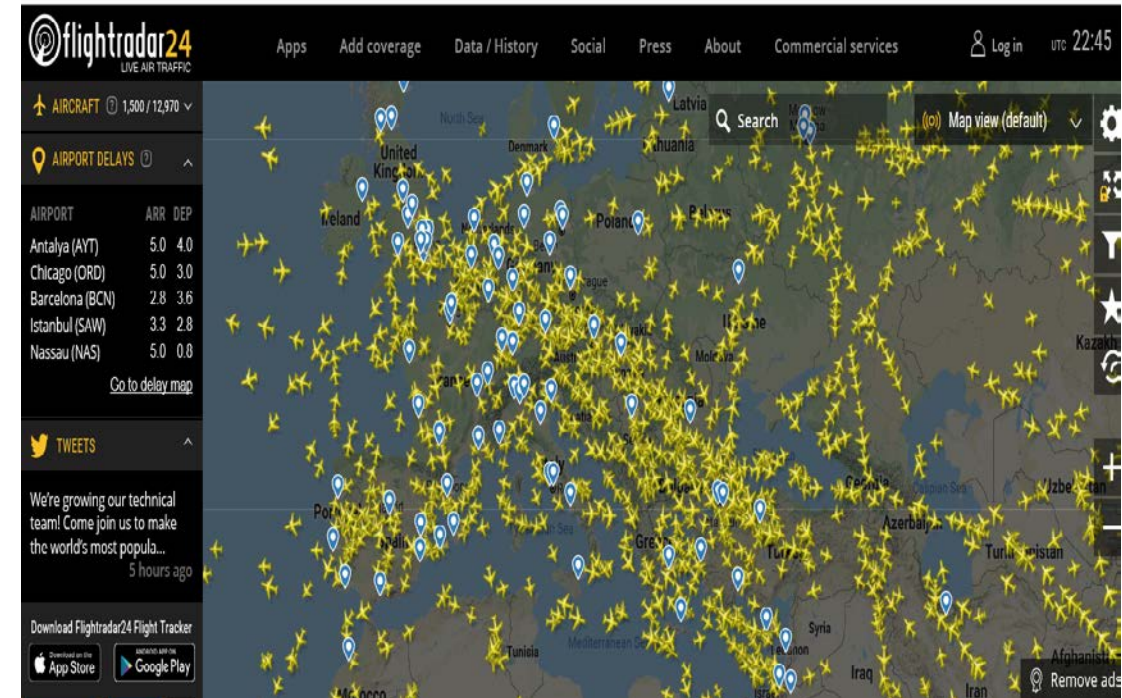


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Challenges

- Rapidly increasing traffic
 - High financial and environmental costs
 - Fragmented services
-
- Need for quick development
 - Need for flexible evaluation platforms



SESAR PJ08 - Advanced Airspace Management

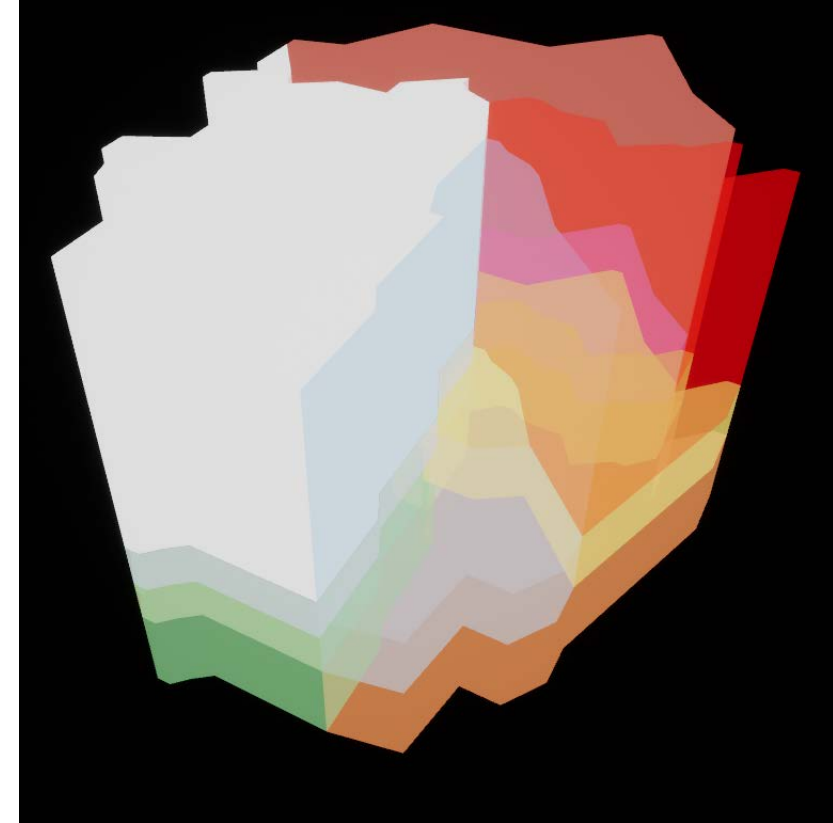


- Currently – static sectors, defined and published in advance
- Dynamic Airspace Configurations (DAC) function
 - based on improved traffic prediction
 - used to **adjust capacity** in order to meet traffic demand and **respond to performance objectives**
 - New sectorisations are built dynamically from small building blocks based on the volume and complexity of air traffic
 - Dynamic mobile areas e.g. for military operations are also included

SIMADES ATC

SINTEF's Multiagent Discrete Event Simulator for Air Traffic Control

- Flexible platform for
 - Experimental development
 - Validating new concepts
- Easy to adapt
 - Simulator to new airspace and traffic
 - Visual details and behaviour of the CWP

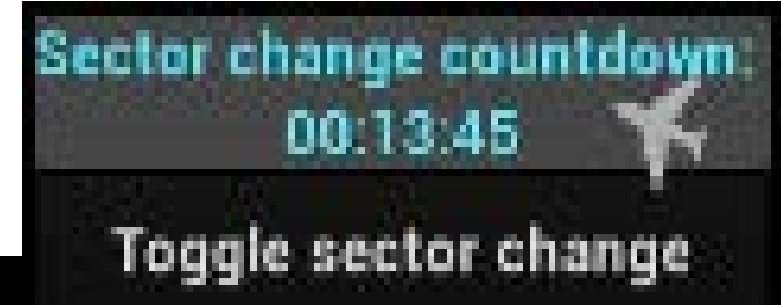
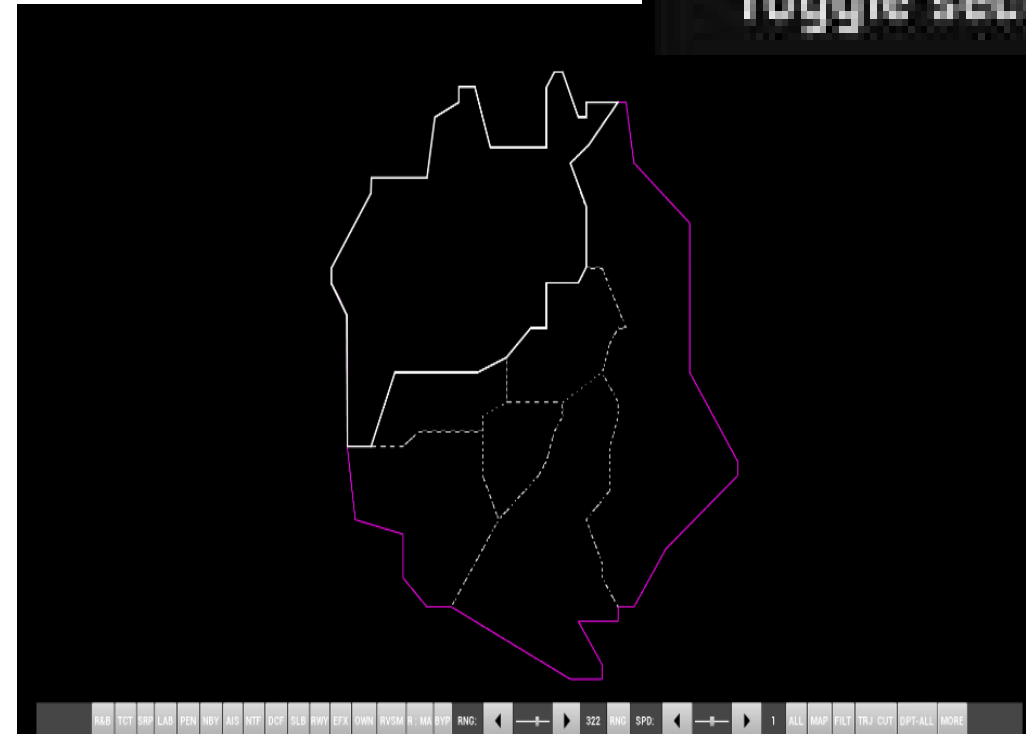
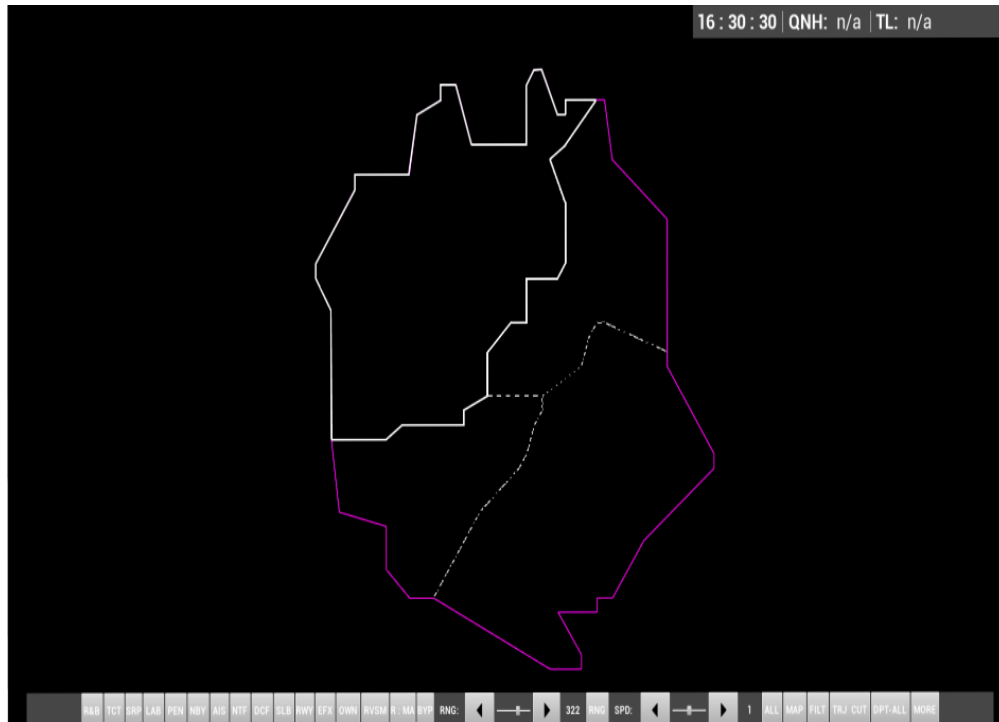


SIMADES ATC

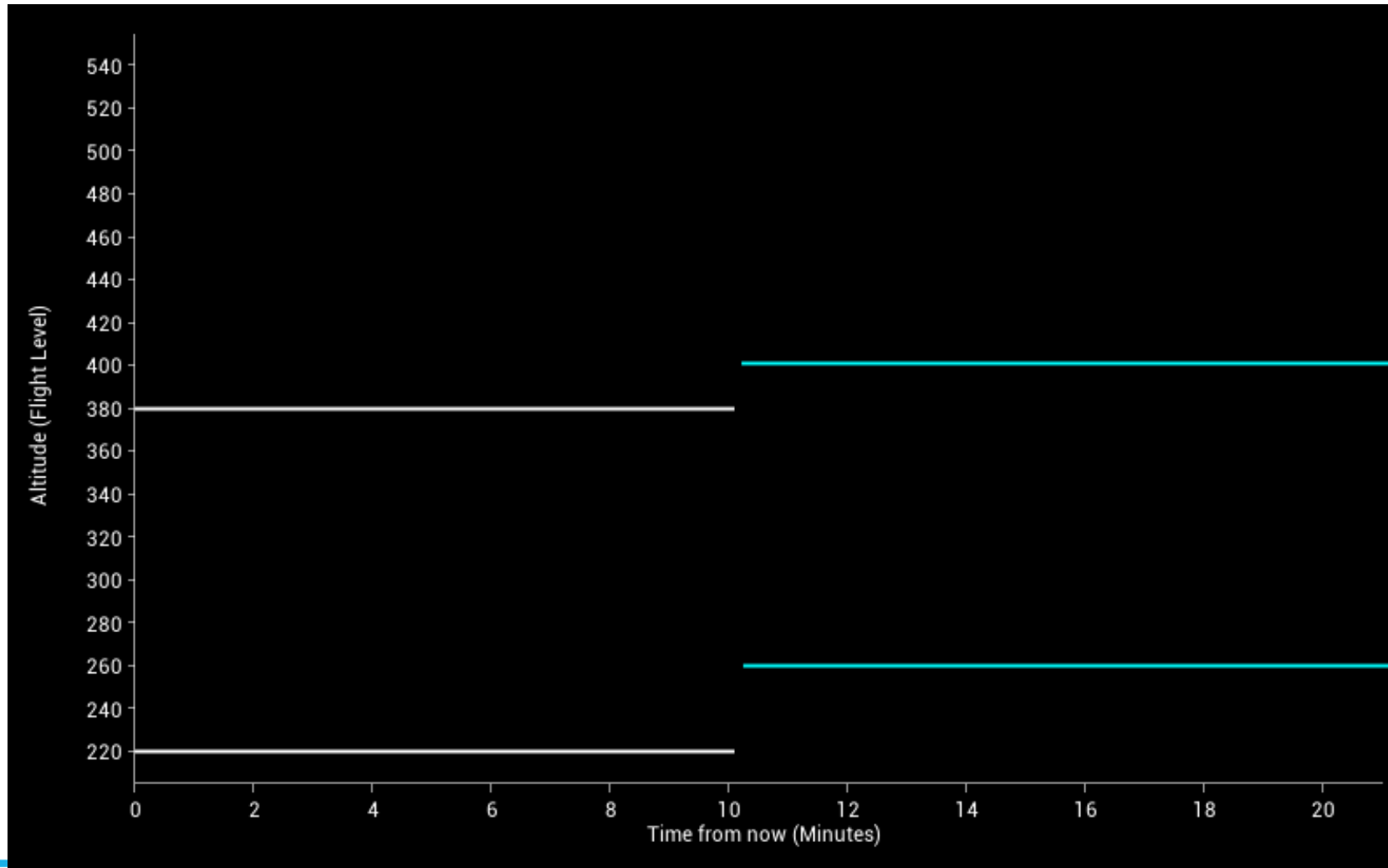
- CWP and simulator supporting DAC
- Notification of changes
- Visualization of changes
 - Horizontally on the radar image
 - Vertically on a separate screen
 - Using 3D visualization on a separate screen



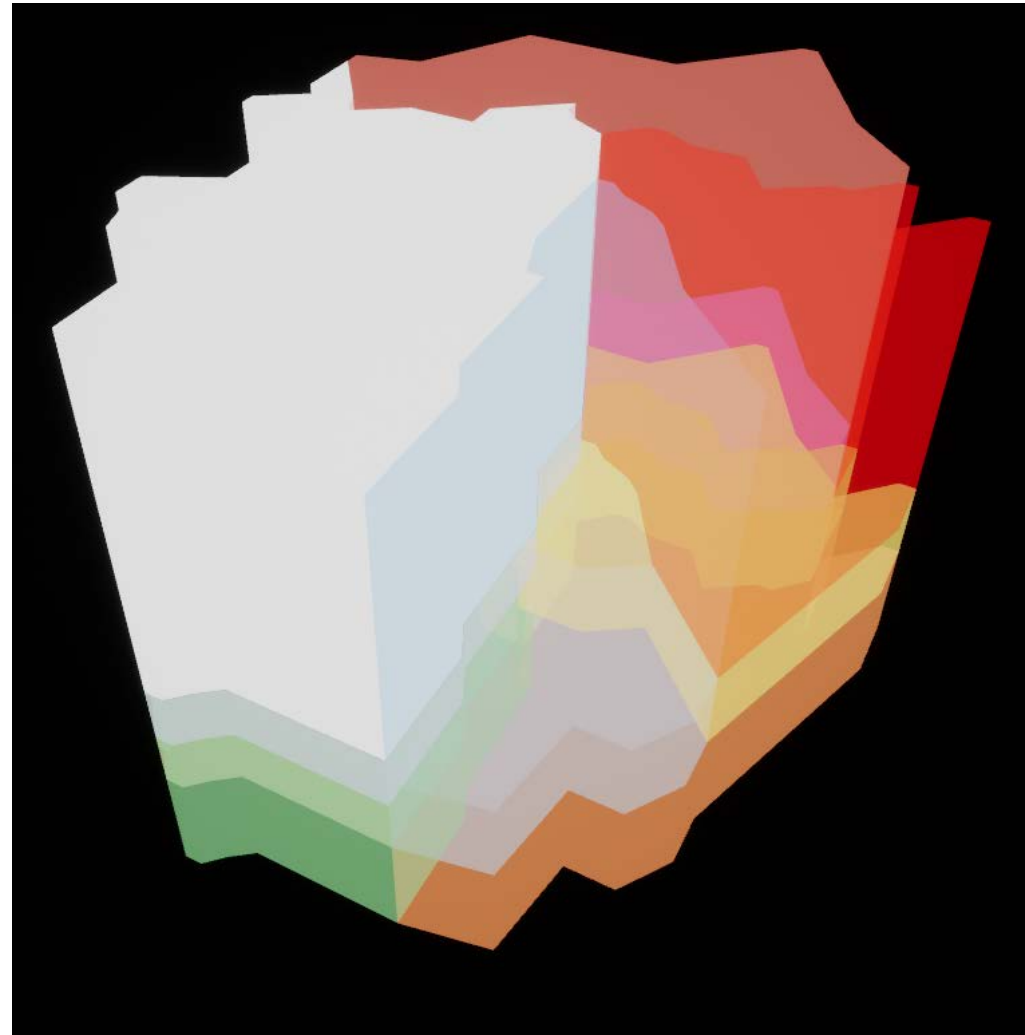
Sector changes on radar screen



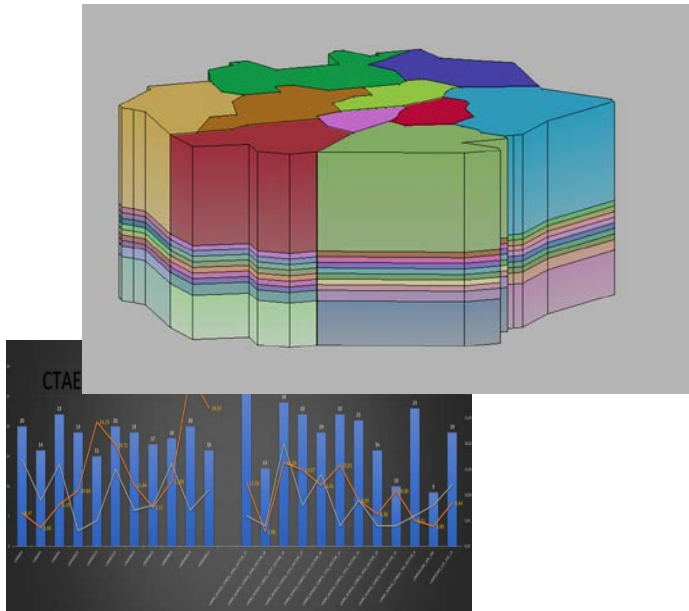
Sector changes viewed vertically on separate screen



Sector changes viewed in 3D on separate screen



DAC is here...ATCOs CWP is here...



What does the ATCO say?



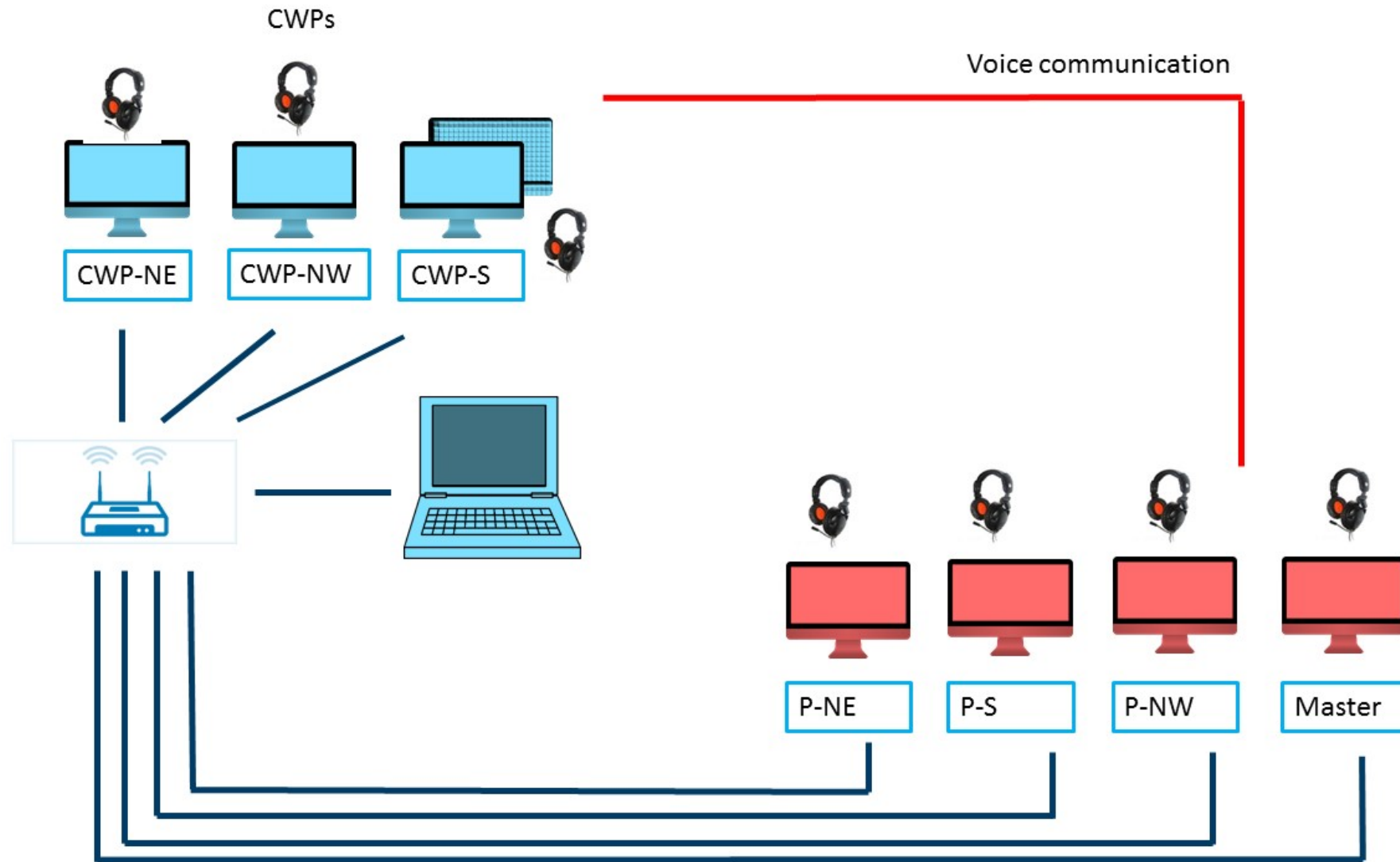
SIMADES ATC on the road



Validation exercise



- First validation of the DAC concept with ATCOs
- Simulates and compares ATCOs working with
 - DAC approach via ATCOs CWP prototype; notification about the sector change 15 min in advance, time between two sector changes - 30 minutes
 - Static approach via ATCOs CWP prototype; no sector changes during the exercise
- Training and validation
- One week exercise – two days training and three days exercise
- Italian airspace (ENAV), May 2018
- 6 ATCOs and 3 pseudo-pilots from ENAV
- Realistic traffic samples – a busy spring day at Milan Area Control Centre (June 18th 2013 and 2023)



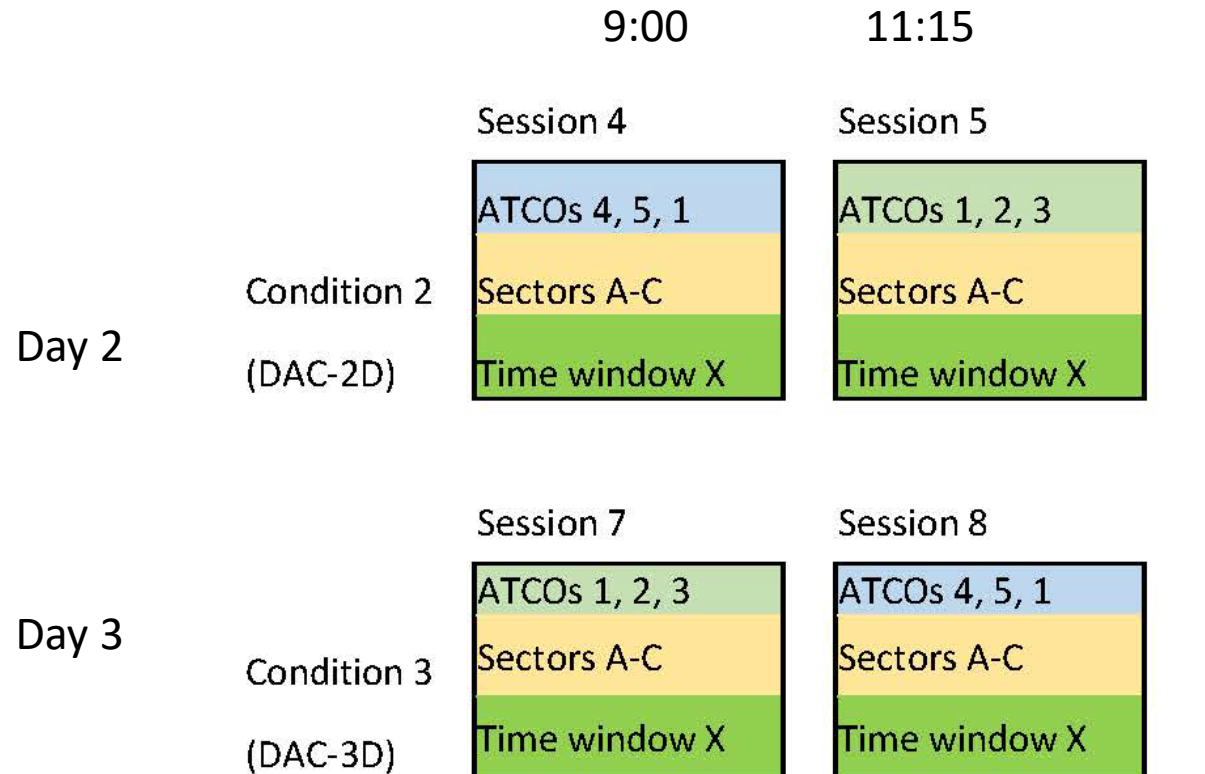
Layout of the exercise



Experiment design

	9:00	11:15	14:00
Day 1	Session1	Session 2	Session3
	NE NW S A1 A2 A3 Ref. scenario 1	NE NW S A4 A5 A1 Ref scenario. 1	NE NW S A2 A3 A4+A5 Ref. scenario 2
Day 2	Session 4	Session 5	Session 6
	NE NW S A4 A5 A1 Sol. Scenario 1	NE NW S A1 A2 A3 Sol. Scenario 1	NE NW S A4 A5 A2+A3 Sol. scenario 2

Experiment design



Data collection

- Observations
- Log files (simulator, UI)
- Screen captures
- Video recording of screens
- Interviews (audio records)
- Audio records of the communication between the ATCOs and pilots
- Questionnaires

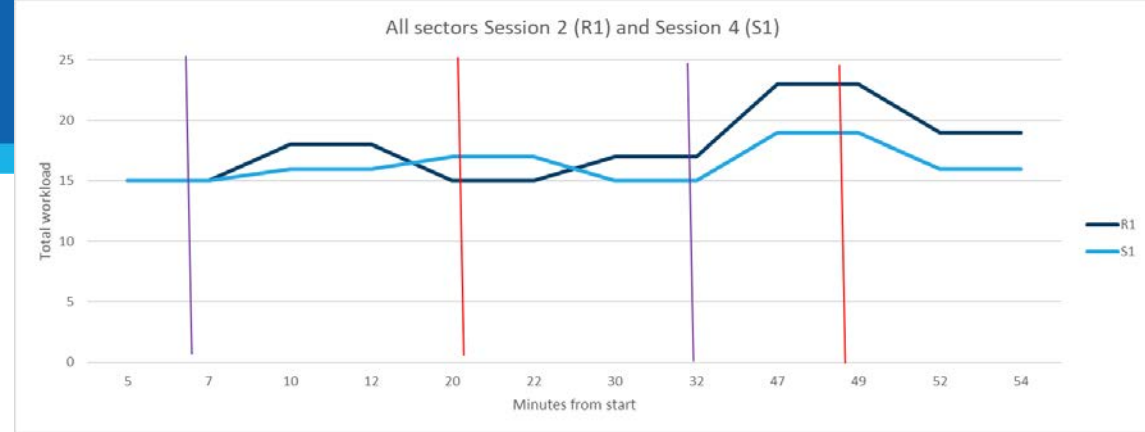


Measures

- Usability and acceptance
- Feedback on CWP interface and procedures
- Workload
- Situation awareness
- Communication burden
- Safety (number of safety violations)
- *Traffic was the same – capacity checked in other exercises*



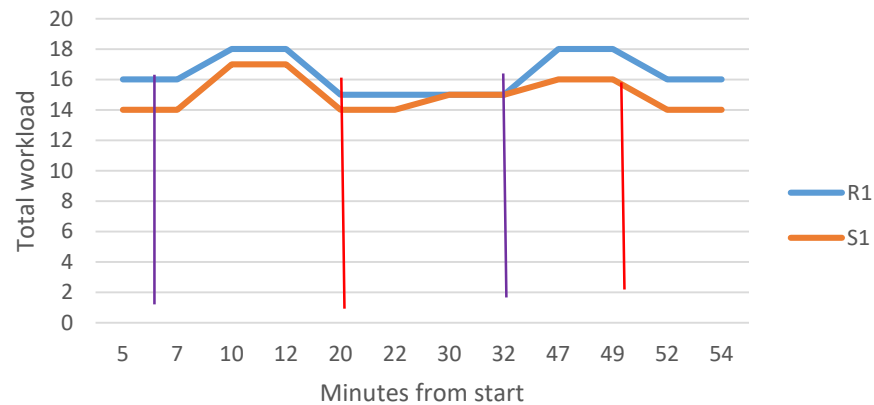
Results overview



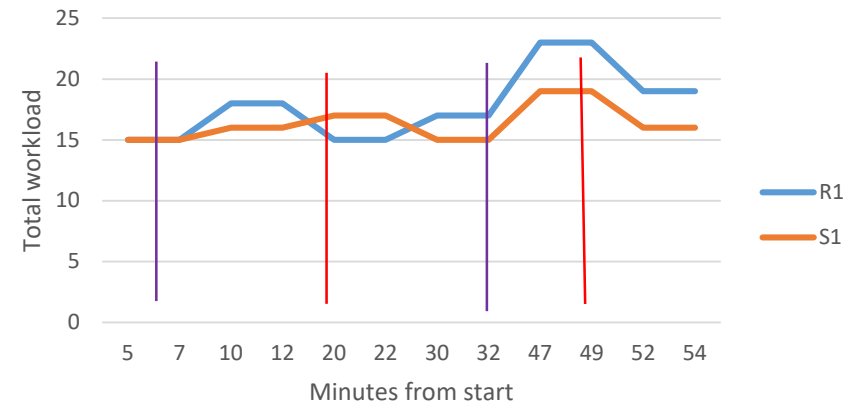
- The overall workload - acceptable and the same or slightly reduced for DAC scenario
- Few errors - mostly due to the simplifications of the prototype's UI
- Overall feedback positive
 - "Good", "almost perfect", "it enabled us to easily maintain the picture of the traffic"
 - Solutions for notifying and visualizing both horizontal and vertical changes were useful
 - Some improvements proposed

Static (R1) versus dynamic (S1)

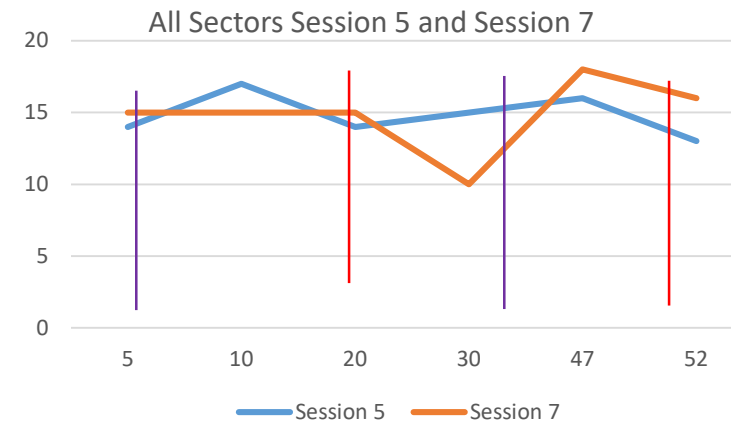
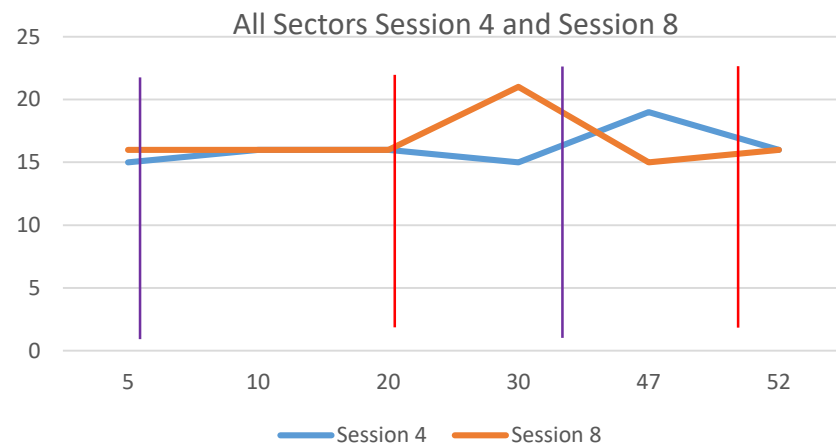
All Sectors Session 1 (R1) and Session 5 (S1)



All Sectors Session 2 (R1) and Session 4 (S1)



DAC-2D versus DAC-3D



Results overview cont.

	MED	MIN	MAX	STDEV
All sessions	8	5	10	1,43
Ref. scenario	8	5	10	1,31
Sol. Scenario	8	5	9	1,56

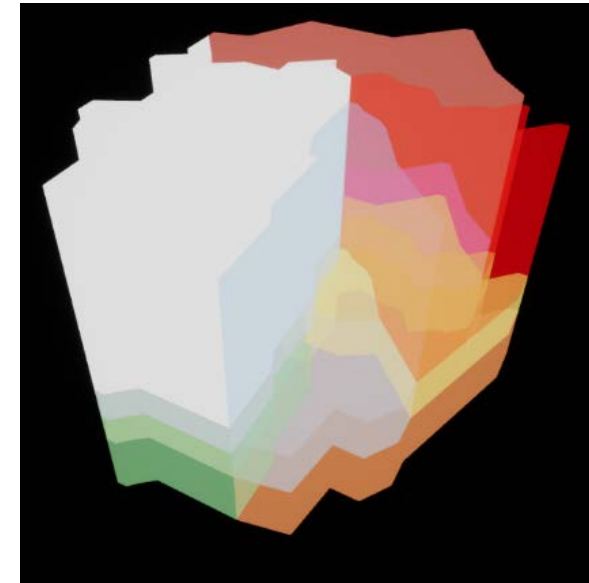
- Situation awareness was very good
- DAC concept potentially useful for supervisors
- During the requirement analysis, the controllers said that they do not need vertical presentation of changes -> in the experiment - presentations of the virtual changes were very useful

Henry Ford “If I had asked people what they wanted, they would have said faster horses.”

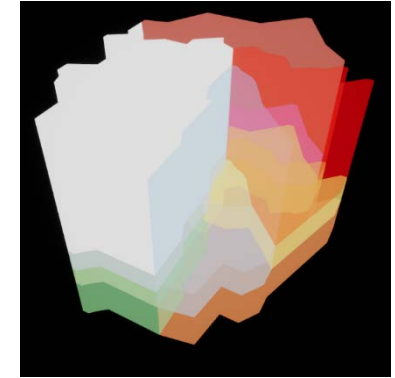
- There is a need for a better alignment of the change with the ATCOs workload
- Understanding other sectors was sometimes difficult

Results on 3D

- No differences in performance
- Mixed reception
- Used during the periods with low workload
- Extending functionality
 - Moving to the default position
 - Compass
 - Sector names ...



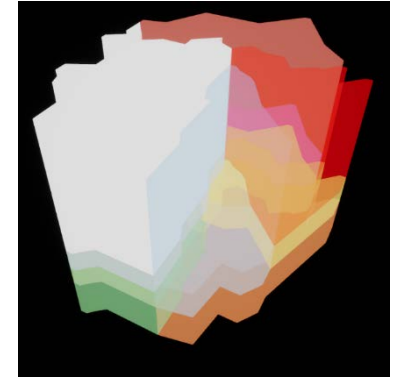
Conclusions



- Overall good acceptance of DAC concept and proposed user interface
- No changes in workload, situation awareness or performance
- No differences between 2D and 3D
- *When introducing new solutions don't rely (completely) on users and their requirements*
- *Don't underestimate the importance of proper training*



Future work



- Addressing understanding vertical changes and neighbour sectors
- Better timing of change proposal (sector change is proposed due to high workload, but it is difficult for a controller to deal with it when he/she is busy)
- Design and evaluation of prototypes for different roles (planners, supervisors)
- Exploring other modalities in combination with 3D
- Adaptive interface

A photograph of a rainy street scene. In the foreground, a large black trash bin is partially visible on the left. To its right, several bicycles with yellow wheels and black frames are parked. The ground is wet and reflective, with rain falling in vertical streaks across the entire scene. The background shows more parked bicycles and a blurred street.

Thank you!!!

QUESTIONS?