ORCI Project

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Digital Airport & Multimodality
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Project Overview

Optimised Runway Centreline Interception (ORCI)

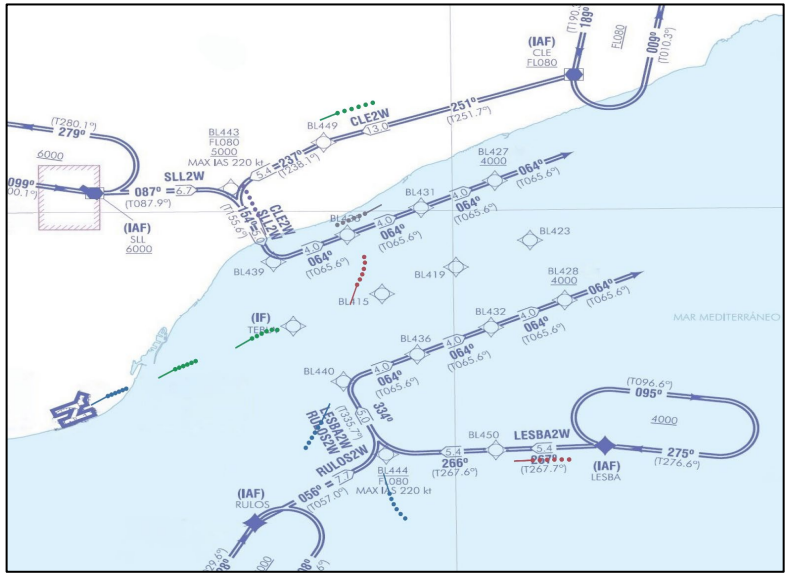
- AI-based Decision Support Tool for Final Approach Sector operations
- Supports EC managing arrival spacing at merge/interception point
- Focused on TMA environments (*medium* to *very high* complexity)
- Applicable to:
  - Trombone systems (e.g., Barcelona-type operations
  - Point Merge Systems (e.g., Lisbon-type operations)
  - Other (*future research*)
- Supports runway operation in both segregated and mixed modes

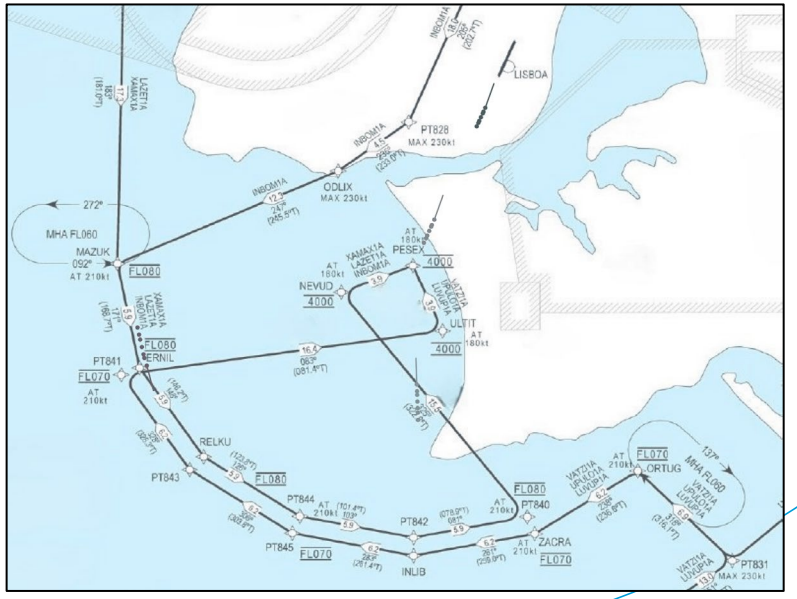
ORCI is an Advisory tool – ATCO remains sole decision-maker

- No change to existing separation minima or regulatory framework
- Can work to any desired target separation
  - … thereby accounting for sub-nominal conditions - by design
- Easy to integrate in the future into existing CWP

- Positioned within Digital European Sky objective:

AI supporting human roles





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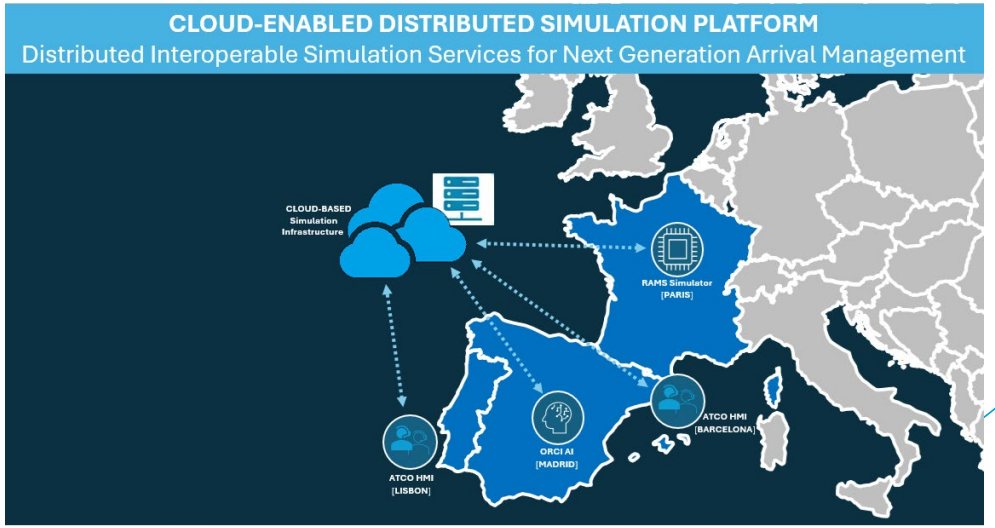
Scope, Technology & Objectives

Technology

- ML-based predictive model
- Continuously predicts spacing at ILS interception/PM merge point
- Accounts for:
  - ATCO phraseology delay
  - Pilot response time
  - Aircraft turn dynamics/momentum
  - Wind & compression effects
  - Refresh rate target < 5 seconds
  - Transparent AI approach to maintain controller trust
- Validation using SDM aligned distributed, service-based validation platform

Overall Objectives

- Improve interception timing precision
- Increase arrival throughput without reducing existing separation minima
- Reduce excess spacing buffer
- Reduce unnecessary vectoring and path extensions
- Improve human performance and peak-hour resilience
- Contribute to Capacity, Efficiency, Safety and Cost KPAs



ATC Experts in Lisbon/Barcelona manage arrival flows using "*Hybrid*" Human-in-the-Loop / Model-based simulations (RAMS / ORCI-AI DST / ORCI-ATCO HMI) in a fully distributed ATM simulation environment via the cloud

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ANSP/ATCO Operator Experience

ANSP Perspective – System Operator

- Increased effective TMA throughput without reducing separation minima
- Optimised Arrival Spacing Buffer → reduced excess spacing margin
- Higher peak arrival handling capability (segregated & mixed mode)
- Fewer merging issues under high/very high complexity
- Reduced communication load during peak periods
- Potential increase in flights handled per ATCO hour
- Improved resilience during demand > capacity situations

ATCO Perspective – Human Operator

- Real-time predicted spacing at interception point
- Reduced cognitive burden in estimating timing uncertainties
- Lower need for corrective second vector instructions
- Improved situation awareness through dynamic spacing visibility
- Better workload distribution during peak traffic
- Increased confidence in decision timing
- Maintains full authority and tactical control

Experience Shift:

From mentally managing uncertainty → supported precision decision-making.

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Airport/Airline Operator Experience

Airport Operator Perspective

- Increased peak runway throughput (segregated & mixed mode)
- More consistent arrival spacing → improved runway slot predictability
- Better gap management enabling departure integration in mixed mode
- Reduced arrival variability at threshold
- Improved operational stability during traffic peaks
- Supports surface and turnaround planning predictability

Experience Shift:

From reactive runway gap management → more predictable & homogeneous arrival streams.

Airline Operator Perspective

- Reduced unnecessary vectoring and outbound leg extensions
- Reduced nautical miles flown in TMA
- Lower fuel burn during sequencing phase
- More stable and predictable arrival times
- Reduced variability in final approach management
- Fewer speed/vector corrections

Experience Shift:

From tactically stretched paths → to more optimized & consistent sequencing.

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Human Performance [HP]

Mechanism:

- Reduced ATCo cognitive estimation burden
- Improved ATCo situation awareness
- DST trust through transparent AI & reliable prediction

KPIs Impacted

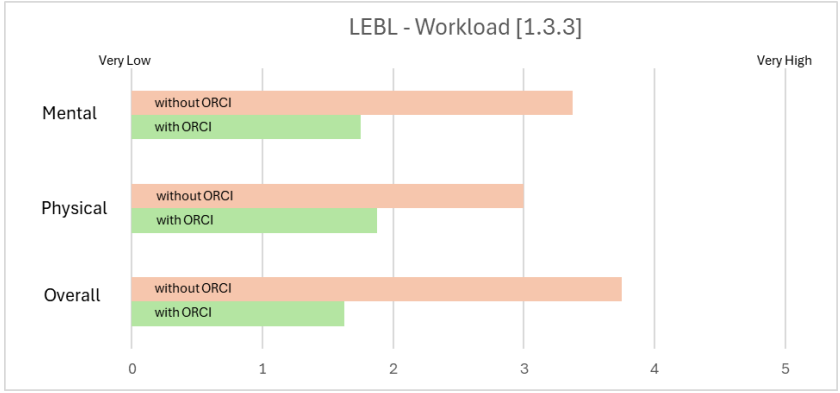
- Controller workload indices
- Situation awareness metrics
- Trust in DST predictions

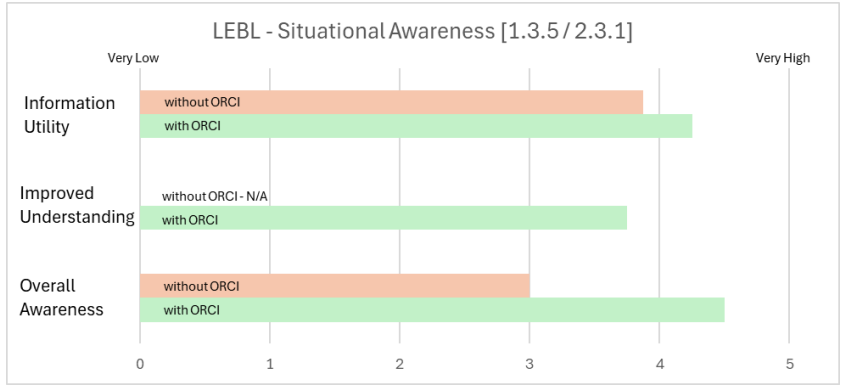
Quantifiable Effects [*Qualitative from HITL validation runs with ATCo*]

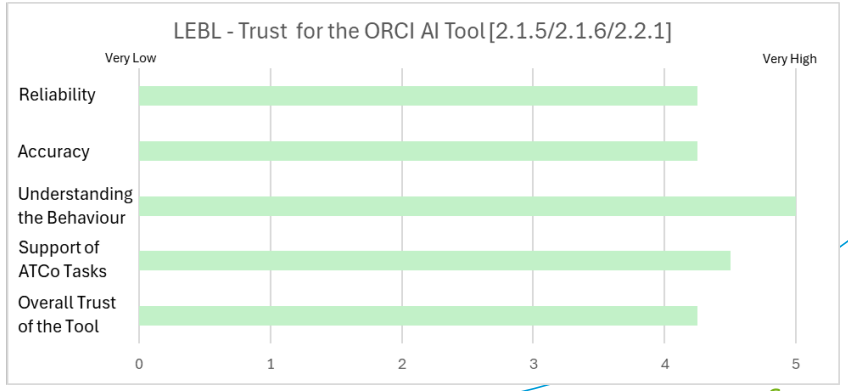
- Reduction in perceived workload
- Increase in situational awareness
- High level of trust in the tool

Operator Experience

- ATCO: Supported decision precision
- ANSP: Improved peak-hour human/team performance







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Capacity

Mechanism:

- Improved separation management at interception point
- Reduced excess Arrival Spacing Buffer
- More frequent single-vector interceptions

KPIs Impacted

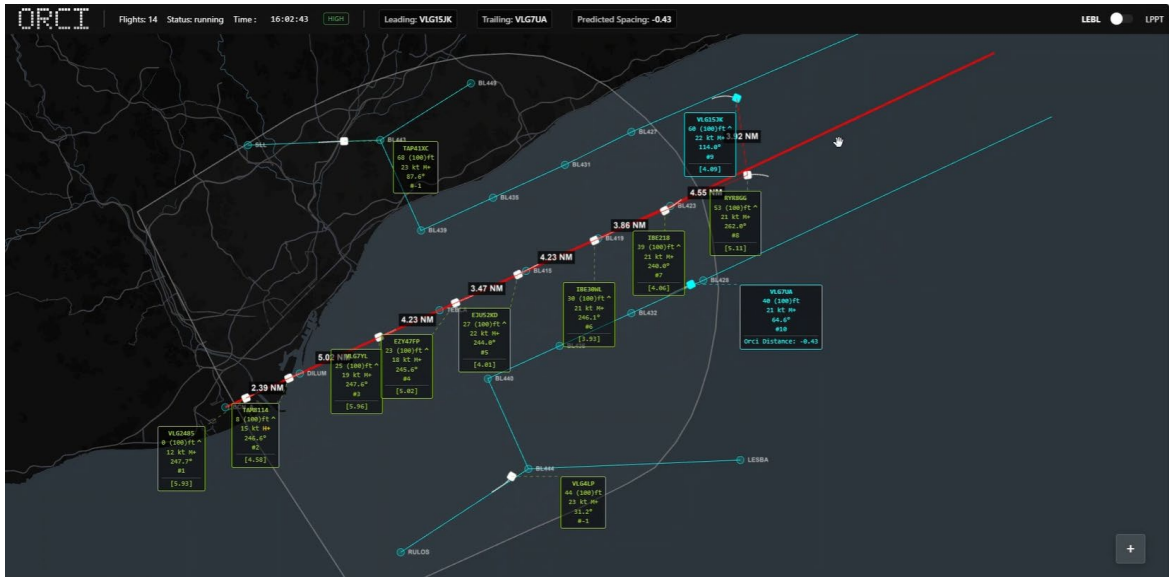
- CAP1 – TMA throughput per unit time
- CAP3.2 – Peak arrival throughput (segregated mode)
- CAP3 – Peak runway throughput (mixed mode)

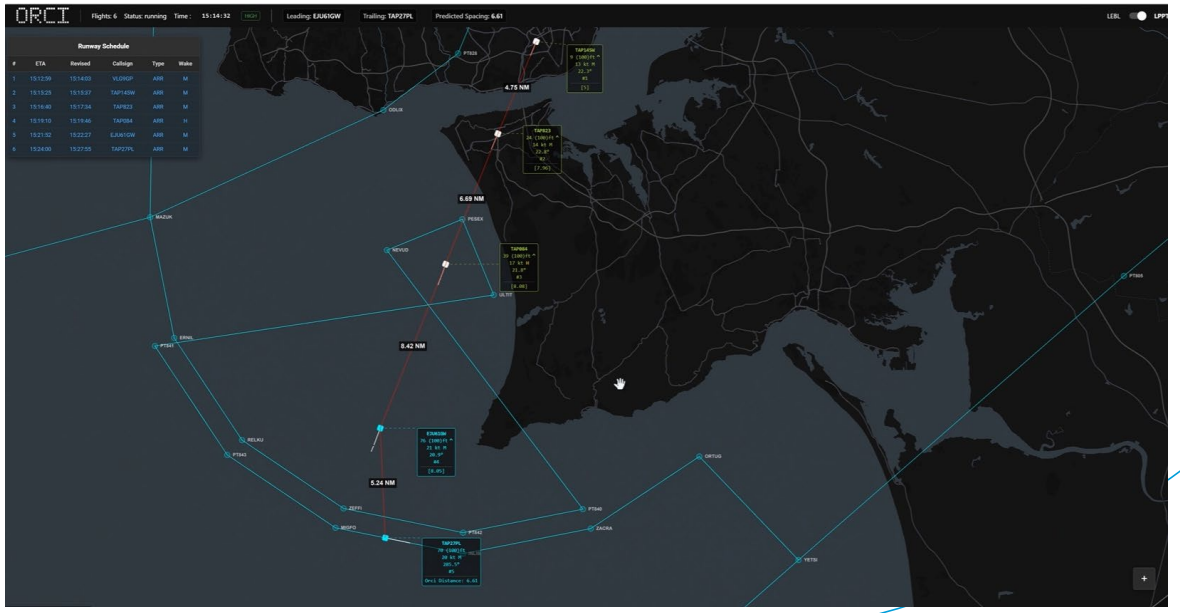
Quantifiable Effects (Validation Targets)

- Increase in peak arrivals/hour
- Reduction in average spacing buffer (NM)
- Consistent/homogeneous arrival spacing
- Increase in percentage of single-vector interceptions
- Reduction in corrective vector/speed instructions

Operator Experience

- ANSP: Higher declared capacity confidence
- Airport: Increased runway utilisation stability
- System: Better peak-hour resilience





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Operational Efficiency [OPS]

Mechanism:

- Reduced unnecessary outbound extensions
- More precise interception timing
- More stable TMA sequencing

KPIs Impacted

- TEFF4 – TMA arrival time
- Average Flying time/NM flown (in the arrival phase)
- FEFF1 – Reductions in average fuel burn per flight

Quantifiable Effects

- Reduction in average Flying time/NM flown in TMA
- Reduction in average fuel burn per arrival
- Reduced variance in TMA arrival time

Operator Experience

- Airline: Lower fuel and track-mile variability
- Airport: More predictable arrival streams

Work in Progress

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Safety [SAF]

Mechanism:
- Improved dynamic parameter awareness
- Reduced merging issues

KPIs Impacted
- **MF9** – Number of merging issues

Quantifiable Effects
- Reduction in suboptimal spacing events

Operator Experience
- ATCO: Reduced risk of LoS issues
- ATCO: Reduced risk of issues due to excessive workload/overload
- System: Maintained or improved safety/risk levels

Work in Progress

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Optimised Runway Centreline Interception - Grant n° 101167539

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