

Webinar

Webinar recording link:

<https://www.youtube.com/watch?v=iQWznvoM6kA>

Human-AI Teaming in aviation: Developing the next generation of EU Digital Assistants

29 October 2025 - 9:30/12:30 CET

Moderator: Stefano Bonelli
Head of Innovative Human Factors
Deep Blue

Supported by Engage 2

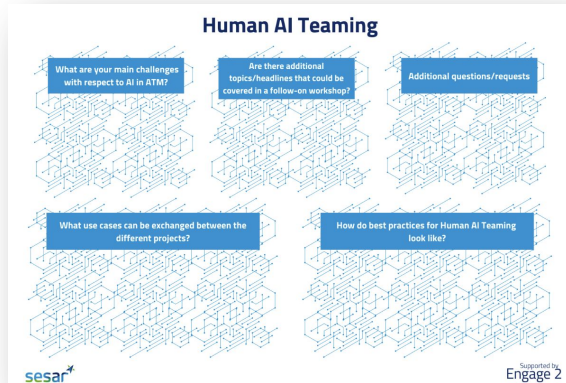
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CODA JARVIS RESPONSE TADA

Where we come from...

- Several workshops have been hold including **SESAR AI related projects**, to share and harmonise the work among them (more on this in the Engage 2 presentation)
 - One topic that has been discussed in them was **“Human AI teaming”**



- Today we focus specifically on it, with **4 concrete examples** of SESAR projects exploring how to achieve good Human AI teaming + an open discussion on the topic



Agenda:

9:30 - 9:45	INTRODUCTION WELCOME BY SJU ENGAGE 2	  	Moderator: Stefano Bonelli <i>Deep Blue</i> Riccardo Massacci <i>SESAR Joint Undertaking</i> Micol Biscotto <i>Engage2</i>
9:45 - 10:30	JARVIS 20min RESPONSE 20min Q&A 5min	  	Presenter: Elena Rankova <i>DLR</i> Presenters: Carmen Bejarano <i>Collins Aerospace</i> Sara Ruano Ferrer <i>CRIDA AIE</i>
10:30 - 10:45	COFFEE BREAK		
10:45 - 11:30	TADA 20min CODA 20min Q&A 5min	 	Presenter: Ana Ferreira <i>Deep Blue</i> Presenter: Anna Giulia Vicario <i>Deep Blue</i>

What we will talk about

ATCO Mental States prediction

Validating AI based systems

Tasks allocation

Adaptation strategies

HUMAN AI TEAMING

Automation levels

Explainability

Proactiveness

Transparency

Digital assistants

Pilot-ATCO Monitoring

...

AI Classification scheme

No automatic decision-making at high-level task

Increasing Automation with cooperation or collaboration

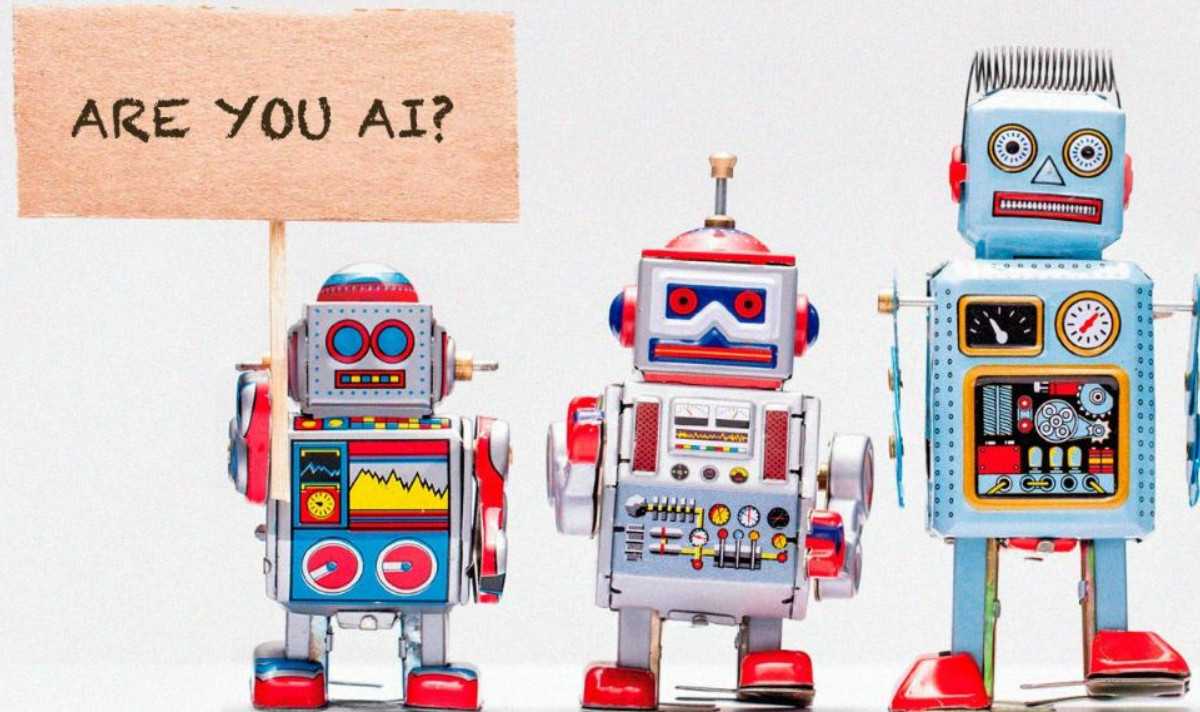
Advanced automation

AI level	Function allocated to the system to contribute to the high-level task	Authority of the end user
Level 1A Human augmentation	Automation support to information acquisition	Full
	Automation support to information analysis	Full
Level 1B Human assistance	Automation support to decision-making	Full
Level 2A Human-AI cooperation	Directed decision and automatic action implementation	Full
Level 2B Human-AI collaboration	Supervised automatic decision and action implementation	Partial
Level 3A Safeguarded advanced automation	Safeguarded automatic decision and action implementation	Limited, upon alerting
Level 3B Non-supervised advanced automation	Non-supervised automatic decision and action implementation	Not applicable

Increasing authority of the machine

Some more introduction..., then we will dive into the projects (promise)

- Introduction and overall considerations from **SESAR JU**
- **Engage 2** introduction





THANK YOU FOR BEING HERE!

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<https://www.youtube.com/watch?v=iQWznvoM6kA>

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Engage 2

Engage 2: the SESAR 3 Knowledge Transfer Network

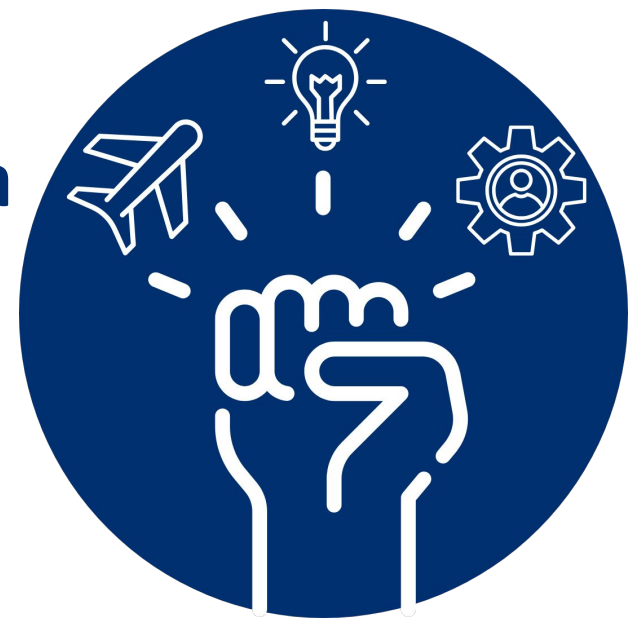
Micol Biscotto

Human-AI Teaming in Aviation, Webinar

29.10.2025

Engage 2

serves as a **bridge between academia and industry** in the ATM domain.



With the aim to empower the next generation aviation workforce in the ever-evolving digital economy, its mission stands on 4 pillars, the so-called **strands of activities**:



Knowledge Hub (Wiki)



Future Skills and ATM Career



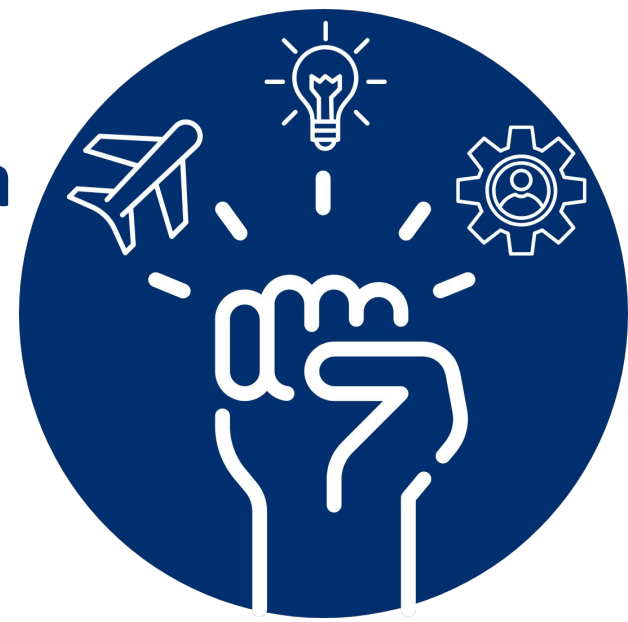
Triple helix collaboration



Education and Training

Engage 2

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Knowledge Hub (Wiki)



Future Skills and ATM Career



Triple helix collaboration

- Thematic challenges
- ATM concepts roadmap
- Catalyst funding
- Roundtable consultation & thematic and cross-fertilization workshops

Engage 2 Engage 2 support to AI flagship: GOALS



Foster meaningful interaction and knowledge-sharing between SJU projects working with AI technologies in ATM;



Promote a structured and forward-looking dialogue with EASA on regulatory needs and frameworks;



Contribute to shaping a common vision and strategy for AI deployment in ATM, supported by research-driven input.

Engage 2 AI Coordination Meeting – Online, 20 Sept 2024

- Co-organised with S3JU
- Objective of identifying synergies among SESAR-funded projects working on AI and fostering opportunities for future collaboration
- + 50 participants involved in projects applying AI technologies in aviation

Following a round of pitch presentations, participants were divided into groups and asked to discuss their projects in relation to four key topics:

1. AI explainability and transparency
2. Human-AI teaming
3. Technical robustness
4. AI safety assessment

MAIN RESULTS: Collected insights were used to design the AI Flagship event.

Engage 2 AI Flagship Event – Rome, 11 Nov 2024

- Co-organised with S3JU
- Objective of deepening collaboration, address implementation challenges, and advance the regulatory dialogue around AI in ATM
- 68 participants from key SESAR 3 projects, regulatory bodies, and technical experts

The event opened with a presentation by EASA. Then, five SJU3 projects (JARVIS, CODA, TRUSTY, AI4HyDrop, HUCAN) shared challenges and insights they encountered while applying EASA's AI guidelines. Finally, a series of interactive round tables focused on:

1. Technical Robustness
2. AI Explainability / Transparency
3. Human-AI Teaming
4. AI Certification

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Main results

Technical Robustness

- Two main topics emerged: “Rare Events” and “Reinforcement Learning”
- Need for common terminology.

AI Explainability and Transparency

- Answers provided by ChatGPT in advance quite in line with the discussion.
- Differences according to the phase of operation, but also as a function of stakeholder or time.
- Basic definitions are still missing.

Human AI Teaming

- Explainability is a key pre-requisite
- Harmonization required

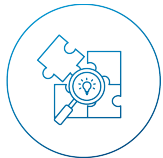
AI Certification

- Quality and availability of data is key enabler
- Liability is important, already at the level of the research project (not only in operational systems)



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Opportunities, Events & Resources



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MatchMaking App

A way to easily connect with potential opportunities, like jobs, universities, events, only in the aviation domain.



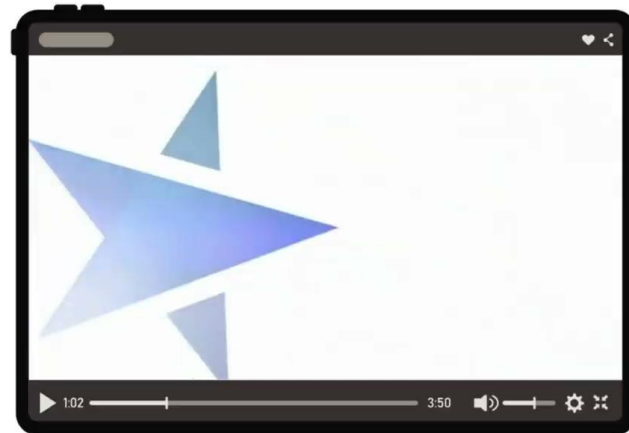
Wiki

The Engage 2 go-to hub for ATM research.
Explore it on www.wikiengagektn.com

Engage 2

Job videos and cards

A set of interactive cards and videos featuring ATM job descriptions, required qualifications, average salaries, and inspiring stories from professionals who share what they do and why they love it.



AIR TRAFFIC SAFETY ELECTRONICS PERSONNEL

SALARY
€€

DAILY ROUTINE
A typical day involves inspecting and maintaining air traffic control systems, troubleshooting issues.

JOB DESCRIPTION
ATSEPs maintain, operate, and supervise electronic systems used in air traffic control. They ensure radar, communication, and navigation systems are installed, calibrated, and functioning to support safe and efficient aircraft operations. They also conduct safety assessments and ensure compliance with aviation standards.

ATM POLICY AND REGULATION SPECIALIST

SALARY
€€

DAILY ROUTINE
The position involves monitoring regulatory changes and assessing their impact on aviation operations. It requires developing and updating ATM policies and procedures, coordinating with aviation authorities and industry stakeholders, conducting compliance audits and risk assessments, and providing regulatory guidance to airlines. The role includes researching aviation policies, attending industry conferences, and ensuring that all air traffic control procedures align with current laws and standards.

IMPACT ON PRIVATE LIFE
The position generally involves standard office hours with occasional requirements for extended hours during critical policy development phases or audits. Travel may be necessary for meetings with regulatory bodies or industry stakeholders.

CREW RESOURCE MANAGER

SALARY
€€€

DAILY ROUTINE
Developing and conducting CRM training sessions, using flight simulators for real-world scenario training, assessing crew performance, and maintaining compliance with international regulations. Reviewing aviation incidents related to human factors, working with safety departments, and preparing training reports.

JOB DESCRIPTION
Crew Resource Managers train and oversee flight crew members and operational teams to enhance safety through effective communication, teamwork, and decision-making. They implement CRM programs based on ICAO and EASA standards, ensuring crews can mitigate human error and manage in-flight emergencies efficiently. They also contribute to regulatory compliance, training program development, and human performance monitoring.

IMPACT ON PRIVATE LIFE
CRM trainers often work regular office hours, but may be required to travel for training sessions and attend industry conferences. Training demands and compliance deadlines may require extra hours.

Engage 2

Opportunities for MSc students

Peer-review on Master's thesis and mentoring on key ATM topics is offered by Engage 2 consortium.
Open call available until 6 months before the project's end.



Catalyst fund call

To enhance collaboration between industry and researchers during early concept development through financial support and access to industrial collaboration.

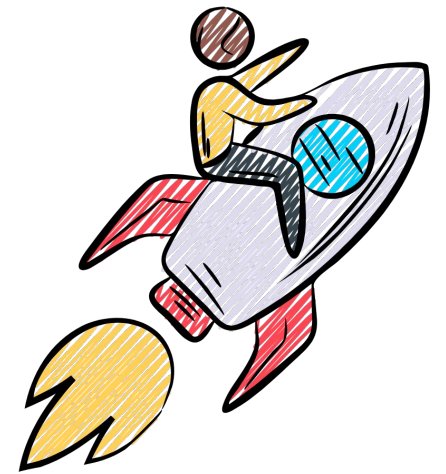
Next call in December 2025.

Engage 2

Winter/Summer schools

A unique chance to boost your skills, connect with experts, and explore the future of ATM.

Next Summer school will be in Trieste in 2026.



Hackathons

Engage 2 Hackathon brings together top young talents in aviation and data science to tackle a real ATM challenge.

The next hackathon will be held in September 2026.

Events & Workshops

Aviation 4 Girls: 10 November 2025, at EUROCONTROL Headquarters in Brussels.

Dissemination Event: 5 December 2025 in Bled.

Engage 2

How can you stay tuned about Engage 2?



Engage 2 Wiki



LinkedIn



Newsletter



Engage 2

**Thank you
for attention!**





JARVIS

Foundational AI: Human-AI Teaming

Webinar Human-AI Teaming in Aviation – 29.10.2025



Co-funded by
the European Union

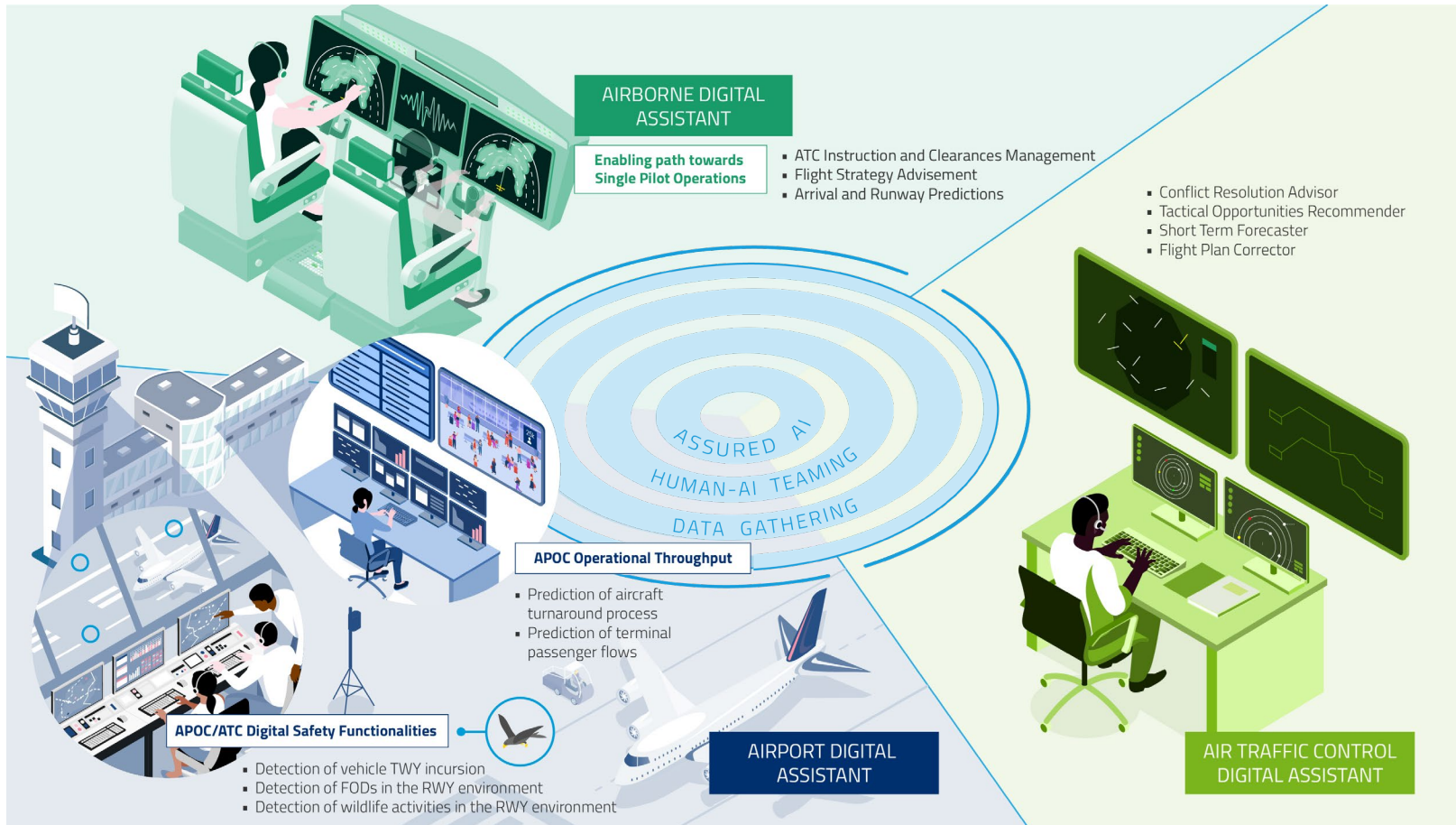
Presented by: Elena Rankova (DLR)
Authors: Elena Rankova (DLR), Anne Papenfuss (DLR), Rolf Zon (NLR)

JARVIS

JARVIS Outline

- **Project Overview**
- **Human-AI Teaming Activities**
- **Insights Workshop: Practitioner Challenges**
- **Small-Scale Study: Explainability and Temporality**
- **Small-Scale Study: Proactivity**
- **JARVIS Insights on HAT**

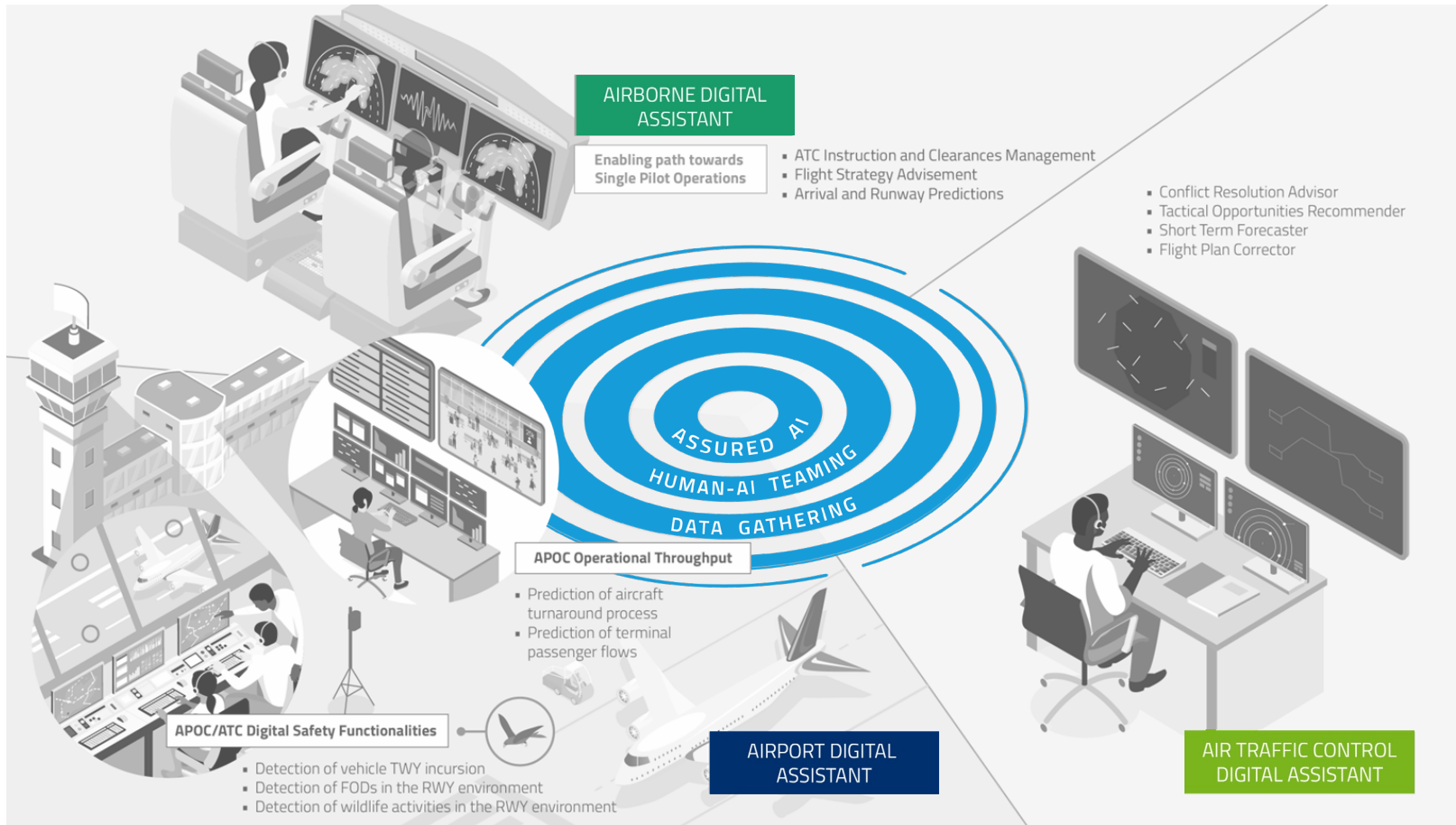
JARVIS Project Overview



Development and validation of **AI-based digital assistants** for enhancing ATM operations, combined with cross-sectional and research activities on **foundational AI topics**.

- **Airborne** digital assistant
- **ATC** digital assistant
- **Airport** digital assistant
- **Foundational AI** activities, gathering transversal insights and academic knowledge.

JARVIS Project Overview: Foundational AI



Objectives:

- Provide guidance through academic knowledge and experience.
- Identify knowledge gaps and opportunities.
- Conduct in-depth literature research and small-scale studies.
- Collect lessons learned, best practices, standard procedures.

Outcome: A whitepaper on the topics Human-AI Teaming, AI Design Assurance, Data Gathering

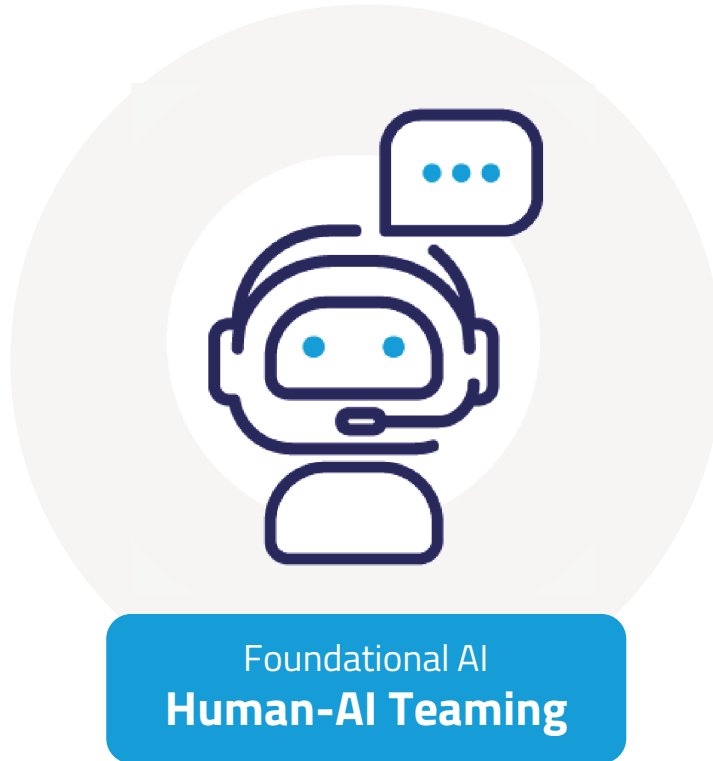
JARVIS Human-AI Teaming Activities

Literature Research

- State-of-the-Art HAT in Aviation
- Knowledge Gaps and Opportunities

Insights Workshops

- HAT Developer Challenges
- Lessons Learned



Small-Scale Studies

Fill knowledge gaps on topics relevant for developers and practitioners

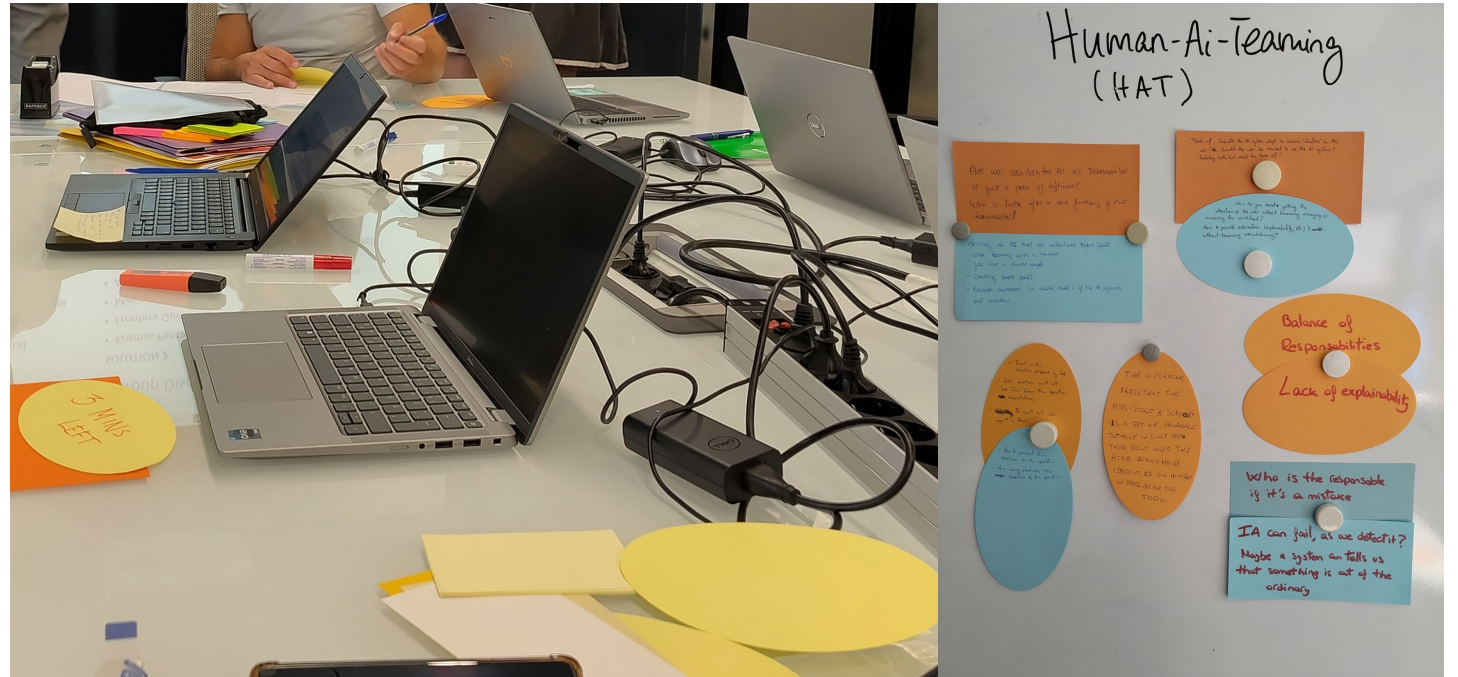
- Explainability Temporality (NLR)
- Proactive Interaction Patterns (DLR)
- AI Explainability and Transparency (Leonardo)

JARVIS Insights Workshop: Practitioner Challenges

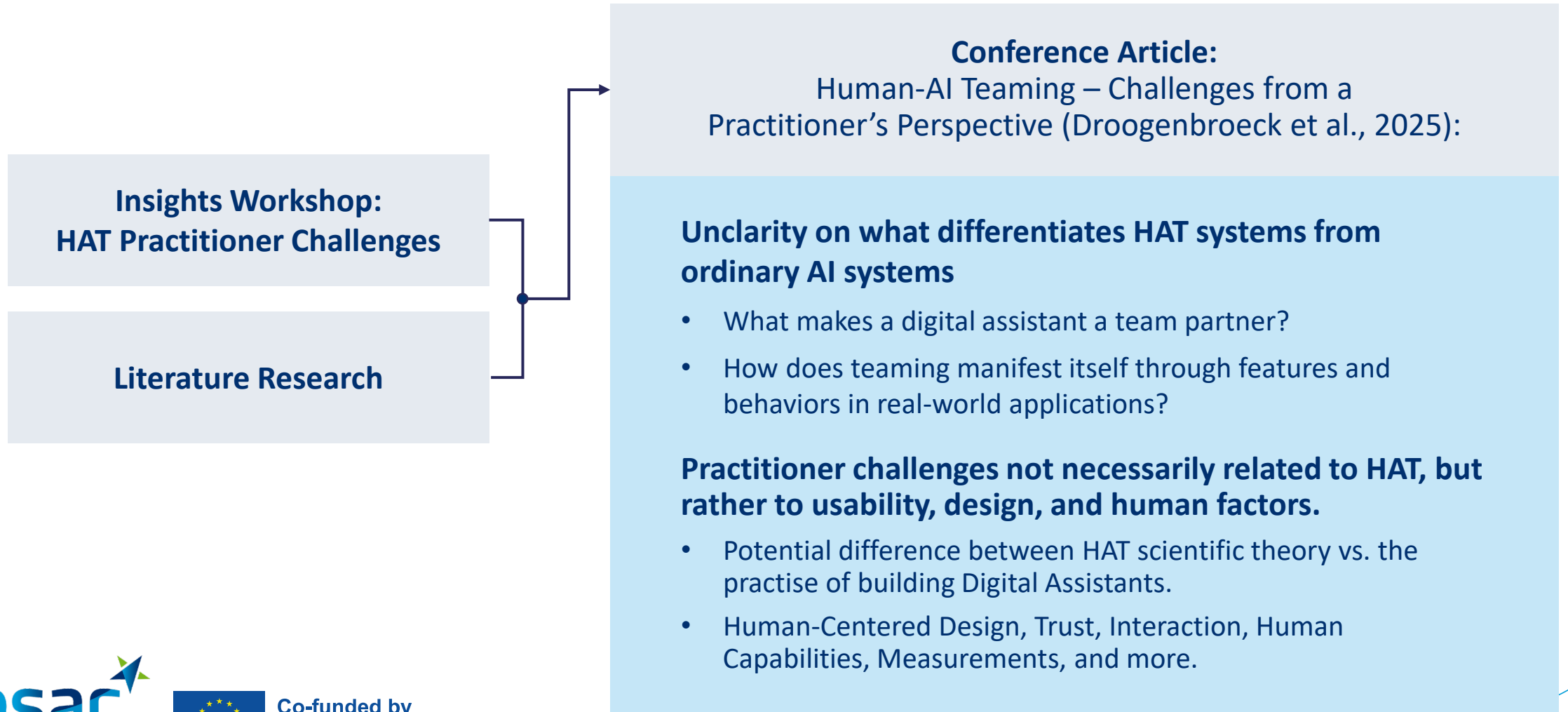
Insights Workshop: HAT Practitioner Challenges

*“What are your solution’s **major questions, unclarities and concerns** regarding the teaming between your system and the human operator currently?”*

*“Write a minimum of three **challenges** regarding the teaming between your system and the human operator **that your team has reported to you?**”*



JARVIS Insights Workshop: Outcomes



JARVIS Explainability Study

Small-Scale Study: Explainability and Temporality

At what point is offering an explanation most beneficial in terms of Trust, Workload and Situational Awareness in Human-AI Teams?

JARVIS Explainability Study: Task



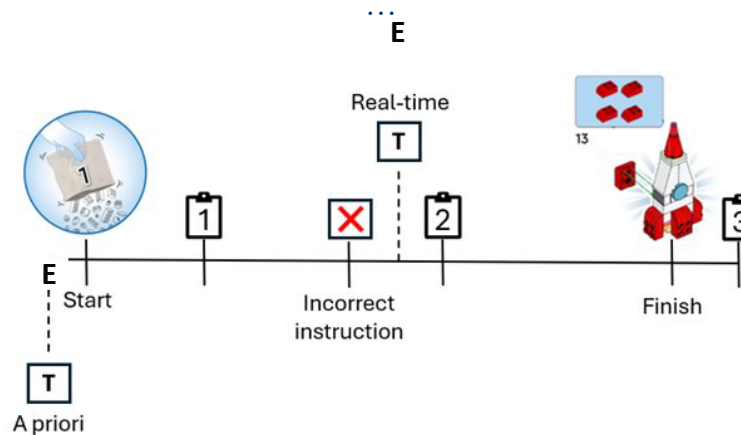
Use of a Wizard of Oz paradigm.

The AI was in reality a person monitoring via a camera and sending predefined instructions.

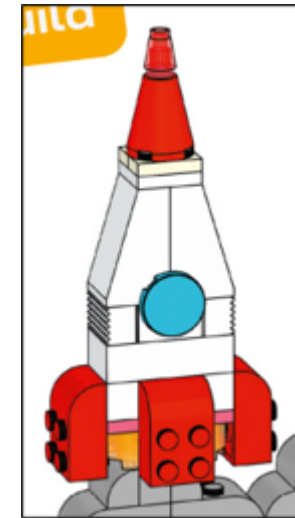
Example of instructions the AI gave

Instruction 4: Grab piece B and place it on top of the current structure.

Instruction 5: Grab one piece F and one piece G and place them in the centre of piece B, place the side studs of piece F facing y. (wrong instruction (programmed error) – another piece F should be inserted with its side studs facing -y)



=



Human and AI built a Lego structure. The AI knew how, while the human just executed.

JARVIS Explainability Study: Design

- The impact of **explainability temporality on trust, workload, situation awareness**.
- Planned **trust violation** in the form of error made by AI during the LEGO building.
- Between subjects design. Two conditions: **a priori explanation of AI** versus **real time explanation of AI**.

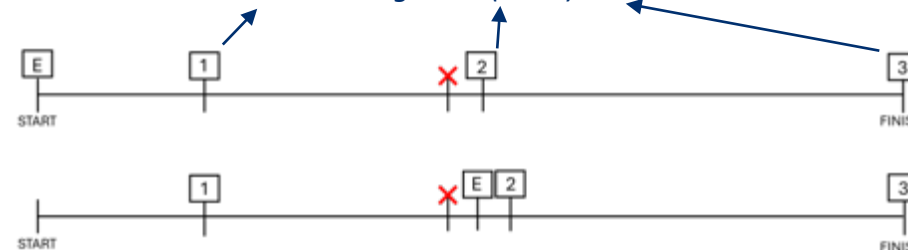
PRE-TASK QUESTIONNAIRES

- **Background**

Demographic Questionnaire
General Attitudes Towards AI Scale (GAAIS)
General Questions on Familiarity with LEGOs,
AI & Questions on Opinions about AI

TASK + QUESTIONNAIRES

- **Trust**
ABI trust framework
- **Situation Awareness**
Crew Awareness Rating Scale (CARS)



POST-TASK QUESTIONNAIRES

- **Workload**
NASA-TLX
- **Teaming**
Shape Teamwork Questionnaire (STQ), Inter Team Collaboration Scale (ITC)
- **General Questions**
opinion on AI teammate

JARVIS Explainability Study: Findings

Trust:

- Trend towards lower trust in a priori, compared to real time, condition, but not statistically significant
- Real-time explanations may aid in trust repair after trust violations

Workload : Significant difference in mental demand: real-time condition increased mental workload

Situation Awareness: No significant effect of condition on situational awareness.

Qualitative:

- Importance of clear communication, conditional trust, and task-dependent usefulness
- Participants were open to working with AI again, but with reservations depending on task stakes.

Conclusions:

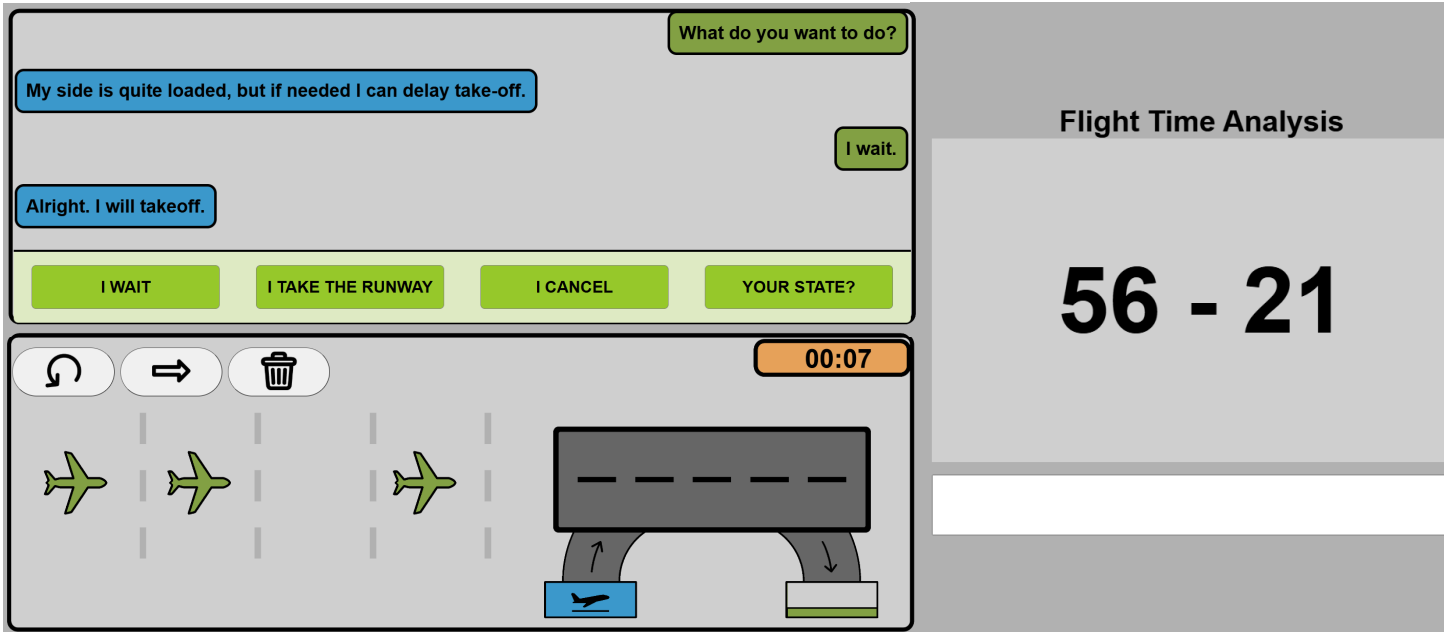
We **created** a structured **methodology** to study the **Human-AI-teaming** relationship. While real-time **explainability during** a task might contribute to **trust repair**, it significantly increases workload. Highlighting an important dilemma in HAT.

Small-Scale Study: Proactivity

Which features of human-human teams should be transferred to Human-AI teams?

How should the interaction between human and AI-based systems be designed to support team performance?

JARVIS Proactivity Study: Background



An adaptation of a serious game for validating chatbot systems (Zeppenfeld et al., in press), adjusted to better support testing and measuring HAT interaction patterns.

A lack of an aviation-centered environment for experimenting with and measuring HAT interaction patterns.

Our approach: Adapting an existing serious game for chatbot validation (Zeppenfeld et al., in press) with the following overall objectives in mind:

- **Reflect real-world environments**, but suitable for non-experts
- Generate **comparable conditions** between participants.
- Supports **objective team performance measurements**.

Observations:

- Challenging to predict and avoid variances in the interaction. Reduced interaction and multiple preliminary tests were needed.
- Challenging to standardize assistant communication.
- Challenging to find balance between overloading and underloading participants.

JARVIS Proactivity Study: Task

The screenshot displays the JARVIS Proactivity Study interface. On the left, a chat window shows a dialogue between the user and the assistant. The user asks, "What do you want to do?" and the assistant responds, "My side is quite loaded, but if needed I can delay take-off." The user then says, "I wait." and the assistant replies, "Alright. I will takeoff." Below the chat, there are four buttons: "I WAIT", "I TAKE THE RUNWAY", "I CANCEL", and "YOUR STATE?".

On the right, a "Flight Time Analysis" section displays the number "56 - 21". Below this, a runway diagram shows three green airplanes on the left, a grey runway in the center, and a blue airplane on the right. A timer shows "00:07".

At the bottom, a vertical stack of three light blue airplane icons is shown, indicating a queue of airplanes waiting to take off.

Main Task: Runway Coordination:

- Coordinate the usage of the runway as efficiently as possible, avoiding crashes, delays and cancellations.
- The waiting line moves in an interval of 12 seconds => coordination + decision must happen in this interval.

Secondary Task: Workload Manipulation

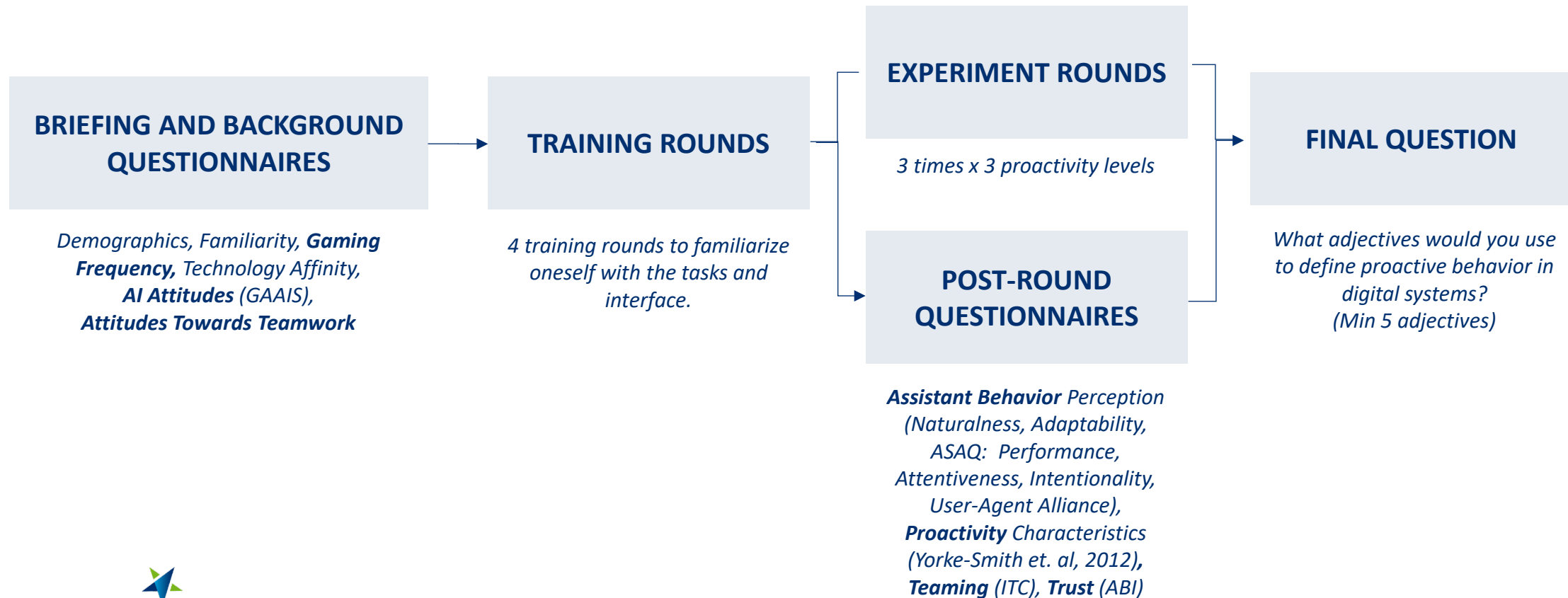
- Simultaneous Subtraction Equations

Conditions (Proactive Behaviors):

- **None**
- **Rhythm:** assistant communicates their state at the beginning of each round
- **Cost/Benefit:** assistant communicates every time their waiting line is full, meaning they have to cancel. And in case they have a free spot and have not communicated their free space the last round.

JARVIS Proactivity Study: Design

Within-subject design: 9 rounds = 3 times x 3 proactivity levels, 33 participants



JARVIS Proactivity Study: Preliminary Findings

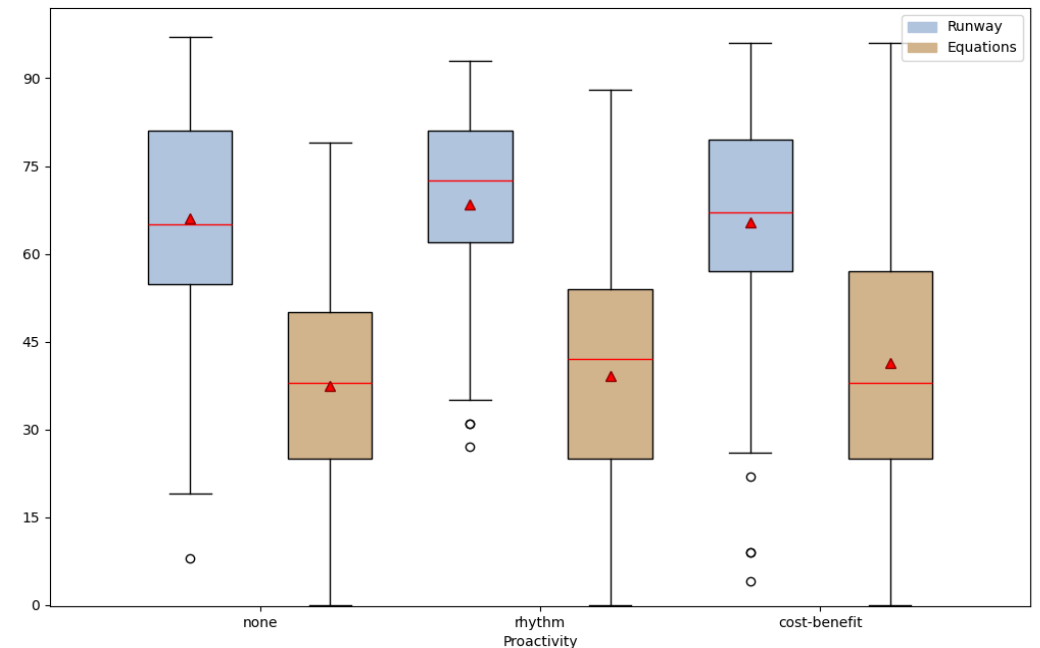
Proactive Interaction Patterns:

Proactive interaction might be more suitable for a secondary, rather than primary tasks – a primary tasks require a constant, predictable and complete overview of the situation.

Performance x Task x Proactivity: Visible difference in performance between the two tasks. Subtraction task potentially too challenging -> decreased motivation and overfocus on the runway.

Teaming and Assistant Perception: Most Participants didn't notice a difference between runs, however some variance in the answers of their perception of the assistant can be observed.

Performance in percent per task and proactivity level.



JARVIS Proactivity Study: Preliminary Findings

Proactive Interaction Patterns:

Proactive interaction might be more suitable for a secondary, rather than primary tasks – a primary tasks require a constant, predictable and complete overview of the situation.

Performance x Task x Proactivity: Visible difference in performance between the two tasks. Subtraction task potentially too challenging -> decreased motivation and overfocus on the runway.

Teaming and Assistant Perception: Most Participants didn't notice a difference between runs, however some variance in the answers of their perception of the assistant can be observed.

Conclusion:

The serious game provides a platform for testing interaction strategies in a controlled environment, mirroring real-world tasks and potential Human-AI teams.

Designing comparable tasks and scenarios is challenging, but iterative improvements and integrating some interaction limitations help along the way.

JARVIS Insights Summary

- Human-AI Teaming raises many questions: what makes a digital assistant a team partner and **how should teaming manifest through features and behaviors** in real-world applications are topics that developers seek more guidance with.
- **Small-scale studies are an effective approach** to efficiently gain relevant insights, particularly on complex topics such as HAT.
- The design specifics of **interactive behaviors can simultaneously influence multiple factors and levels**. As demonstrated by the explainability LEGO experiment, highlighting the complex relationships between trust, workload, and situational awareness.
- Even when **participants don't explicitly notice certain interaction behaviors** during complex and high-workload tasks, these can still have effects on them. Such interactions **could have behavioral impacts** and should be identified and designed carefully.
- Measures for evaluating digital assistant teaming are lacking. The **adaptation of existing human-human teaming scales** for HAT should be further studied.
- Interaction patterns, their characteristics and impact on performance, perception, and cognitive states remain relatively understudied and represent topics that practitioners seek further insights on. This offers **an opportunity for research that can actively support designers and developers**.

Further findings from the project will be published in the JARVIS whitepaper next year.

JARVIS

THANK YOU FOR YOUR ATTENTION

References:

- Van Droogenbroeck, C., Rankova, E., Papenfuss, A., Bos, T., & Zon, R. (2025). Human-AI Teaming – Challenges from a Practitioner’s Perspective. In Lecture notes in computer science (pp. 337–354). https://doi.org/10.1007/978-3-031-93718-7_22
- Yorke-Smith, N., Saadati, S., Myers, K. L., & Morley, D. N. (2012). The Design Of a Proactive Personal Agent For Task Management. International Journal of Artificial Intelligence Tools, 21(01), 1250004. <https://doi.org/10.1142/s0218213012500042>
- Zeppenfeld, D., Schier-Morgenthal, S. (in press). A Serious Gaming Schematic Design for Efficient and Application-Specific Chatbot Validation on the Example of Air Traffic Control [Unpublished manuscript]. GALA 2025. Lecture Notes in Computer Science

RESPONSE

REduced or Single Pilot Operation iNcapacitation Safety Enhancement RESPONSE

Safe Return-to-Land Operations in Future Cockpits

Presenters: Carmen Bejarano & Sara Ruano

Human-AI Teaming and Digital Assistants, 29 October 2025

RESPONSE Project Summary

Project Ambition: Develop an air-to-ground integrated SiPO CONOPS and a pilot cognitive state monitoring technology enabler to directly support pilots' incapacitation transition monitoring and enhance safe return to land operations (TRL2).

OBJ1

Deliver a **pilot incapacitation transition monitoring technology enabler** to detect pilot incapacitation with **functional near-infrared spectroscopy (fNIRS)** and **electroencephalography (EEG)** sensors and an **eye-tracking camera system**.

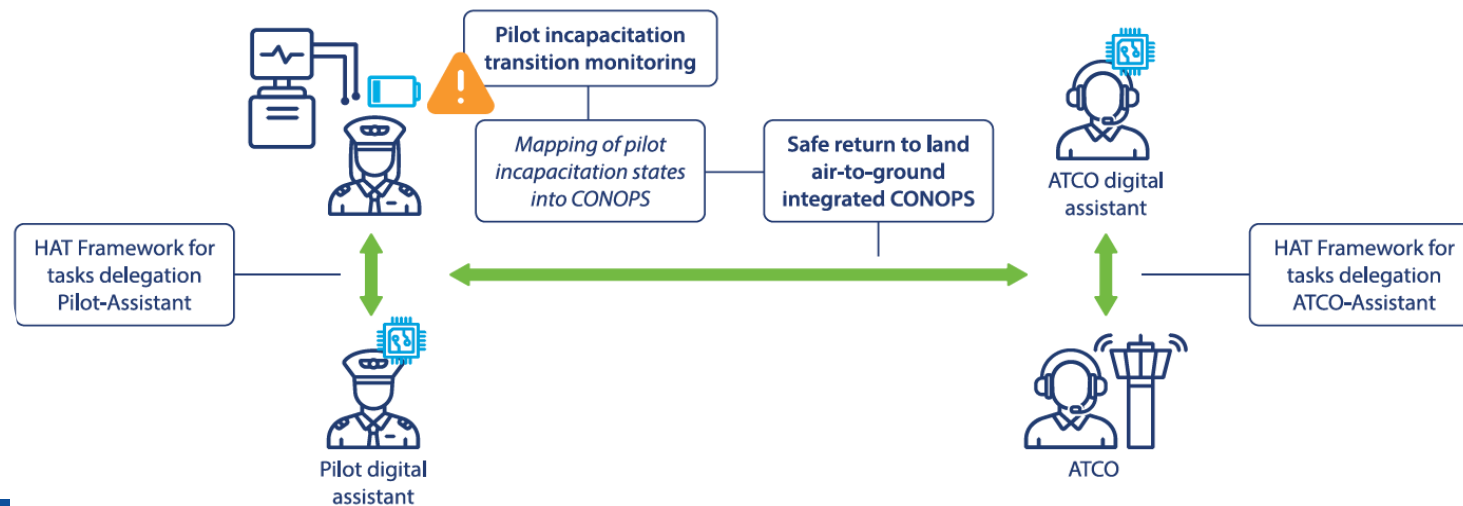
OBJ2

Deliver a **Safe Return to Land CONOPS** introducing the role of **air-to-ground digital assistants** and **minimizing the required changes from DPO to SiPO**, including dealing with a pilot incapacitation in the flight deck.



RESPONSE Scope & Motivation

- Safe return to land CONOPS in abnormal and emergency operations
 - Pilot state monitoring technologies
 - Switch points from DPO to SiPO, Formalizing the R&R of pilots, digital assistants, AOCC and ATCO
 - Introduce the role of digital assistants in the air-to-ground integration
 - Update CRM as needed
 - Propose updated HAT frameworks for pilots – airborne DA and ATCO – ATC DA

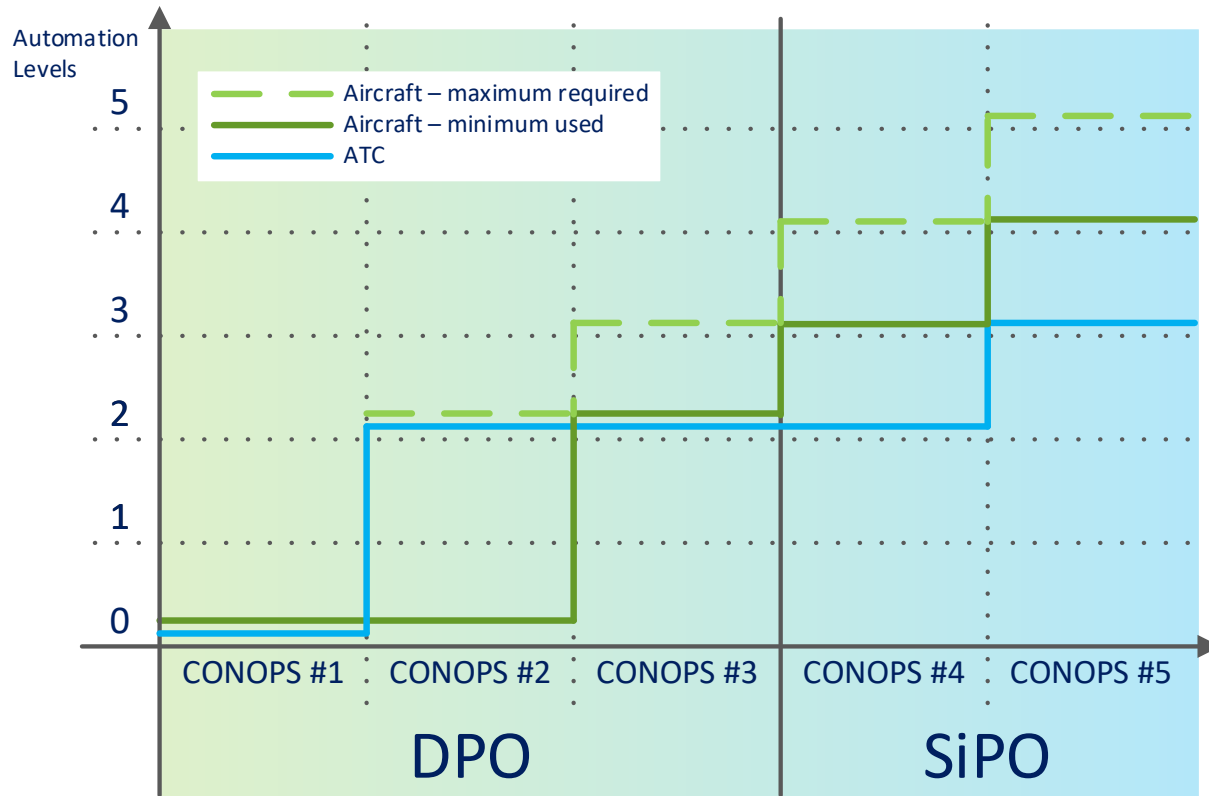


RESPONSE CONOPS Framework for DAs introduction



- CONOPS → Transition of operational environments from DPO to SiPO
- Each CONOPS is enabler for the next
- Minimum changes required for transitions
- Assistant will offer different support based on situation – dynamic task allocation
 - Definition of representative scenarios
 - GDTA

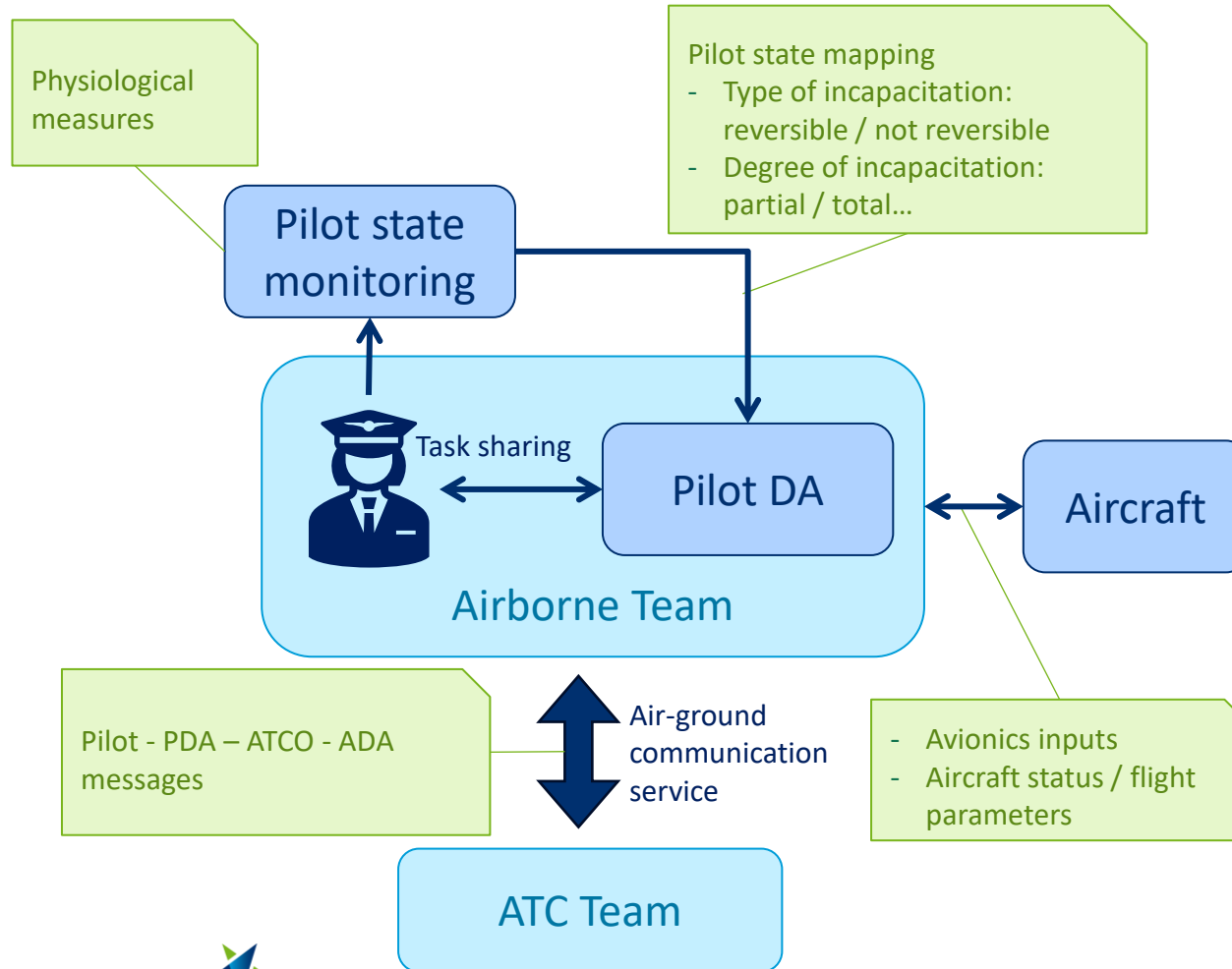
RESPONSE DA automation levels defined



AL as defined in SESAR Automation in ATM Roadmap 2020

- Automation level increase with CONOPS evolution
- Support focused in keeping pilot in the loop (SA)
- Automation used can be below maximum level required by the CONOPS
- Different roles / behaviours expected for pilot and ATCO assistants

RESPONSE Pilot Digital Assistant - Overview



- Reduce pilot workload
 - Track pilot health and cognition
 - Enhance air-to-ground effectiveness
 - Summarize info and boost analysis
- Support SA reattainment
 - Get pilot up to speed
 - Indicate priority items
- Replace incapacitated Pilot
 - Near/Full-autonomous operation

RESPONSE Pilot Digital Assistant – Scenarios for tasks analysis

- DA to support operation in case of system failure:

- Engine failure
- Fire
- Electrical failure
- Hydraulic failure
- Pressurization failure
- Fuel system failure



AL 0-2: Focus on improving SA and reducing human error. Support with information acquisition and exchange and implementation of some actions delegated by the pilots



AL 3-4: Focus on monitoring and support implementing directed, supervised and/or safeguarded actions. Pilot remains responsible for primary / critical tasks and decisions

- DA to support remaining pilot in case of incapacitation (mild, moderate, severe):

- Fatigue
- Cognitive Impairment
- Physiological Distress
- Motor Impairment



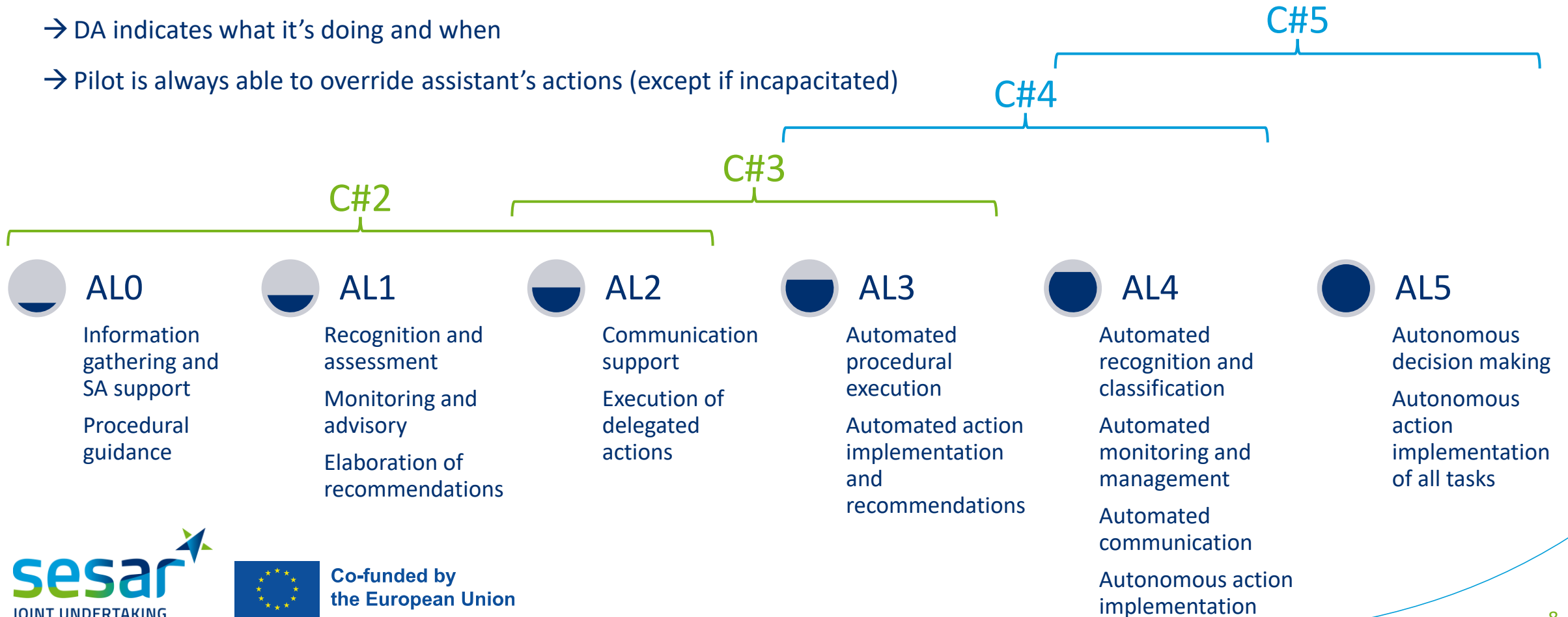
AL 2-3: DA adapts based on pilot state, assistant implements actions to support remaining pilot after initial approval or in predefined conditions, maintaining human oversight



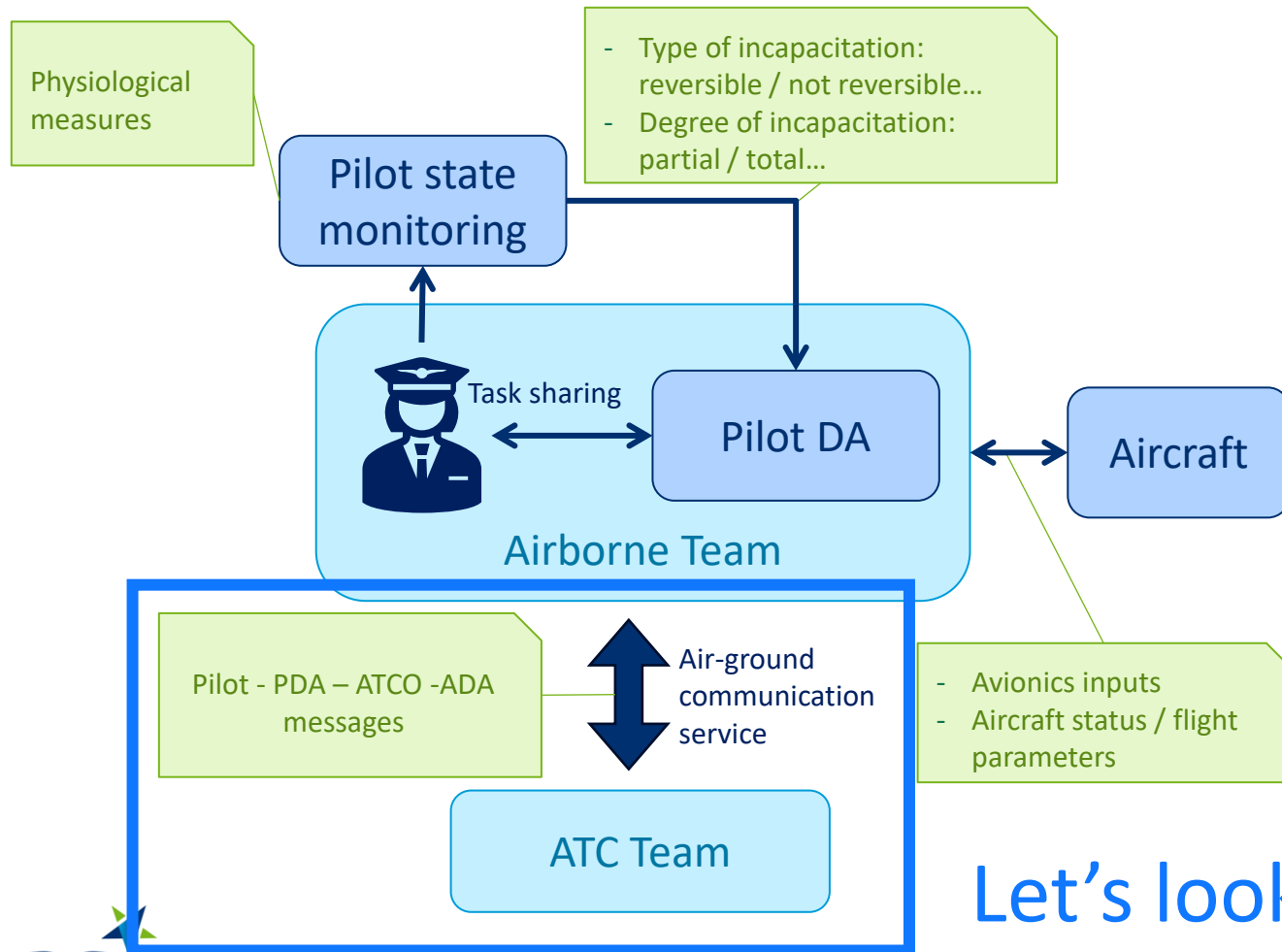
AL 4-5: DA able to perform all the tasks to return to land in case of total incapacitation, pilot maintains overriding authority when capable. Response thresholds are lower than in C#3

RESPONSE Pilot Digital Assistant – Tasks allocation

- Pilot is kept in the loop
- DA performs at minimum AL required by the operation
- DA indicates what it's doing and when
- Pilot is always able to override assistant's actions (except if incapacitated)

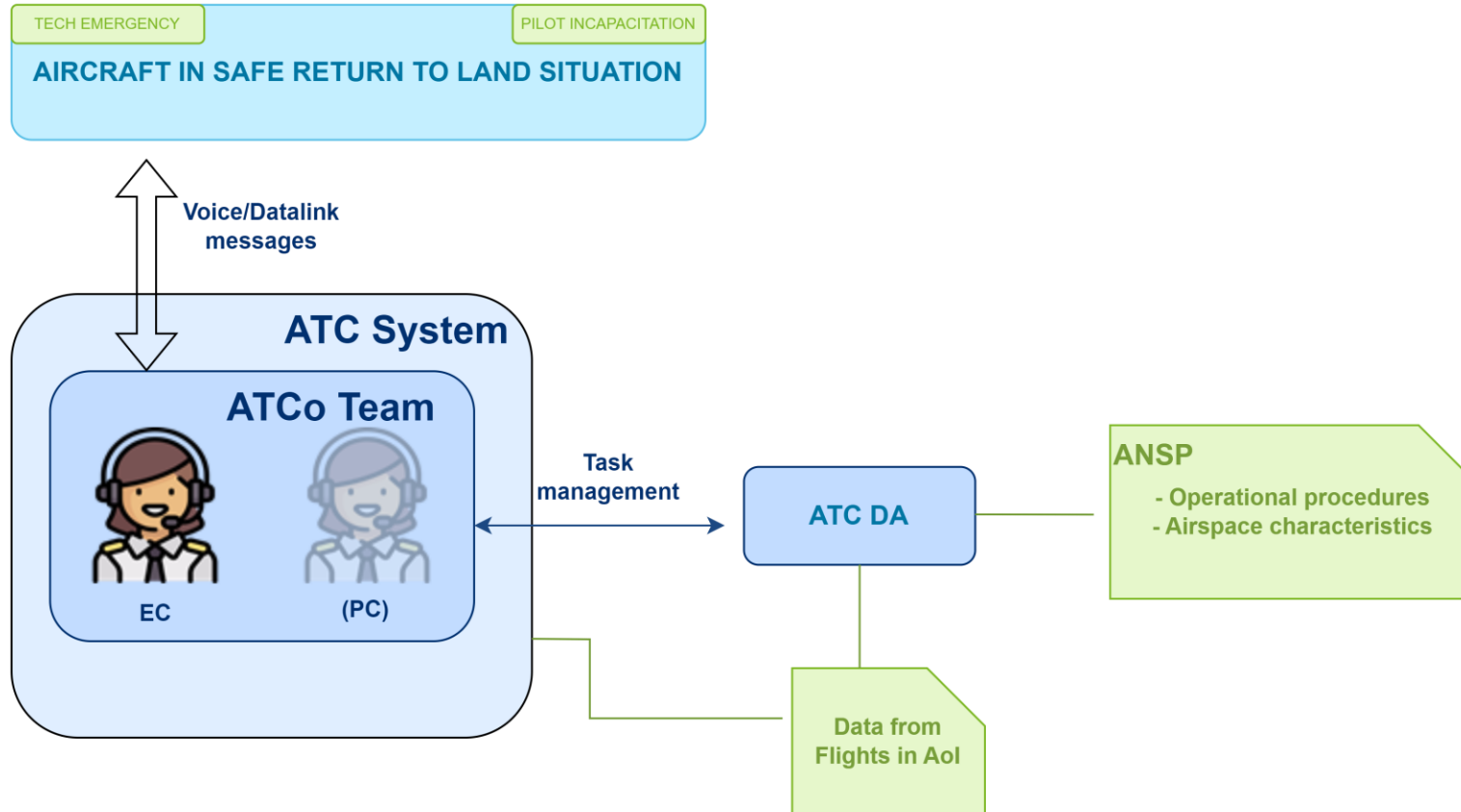


RESPONSE ATCO DA - Overview



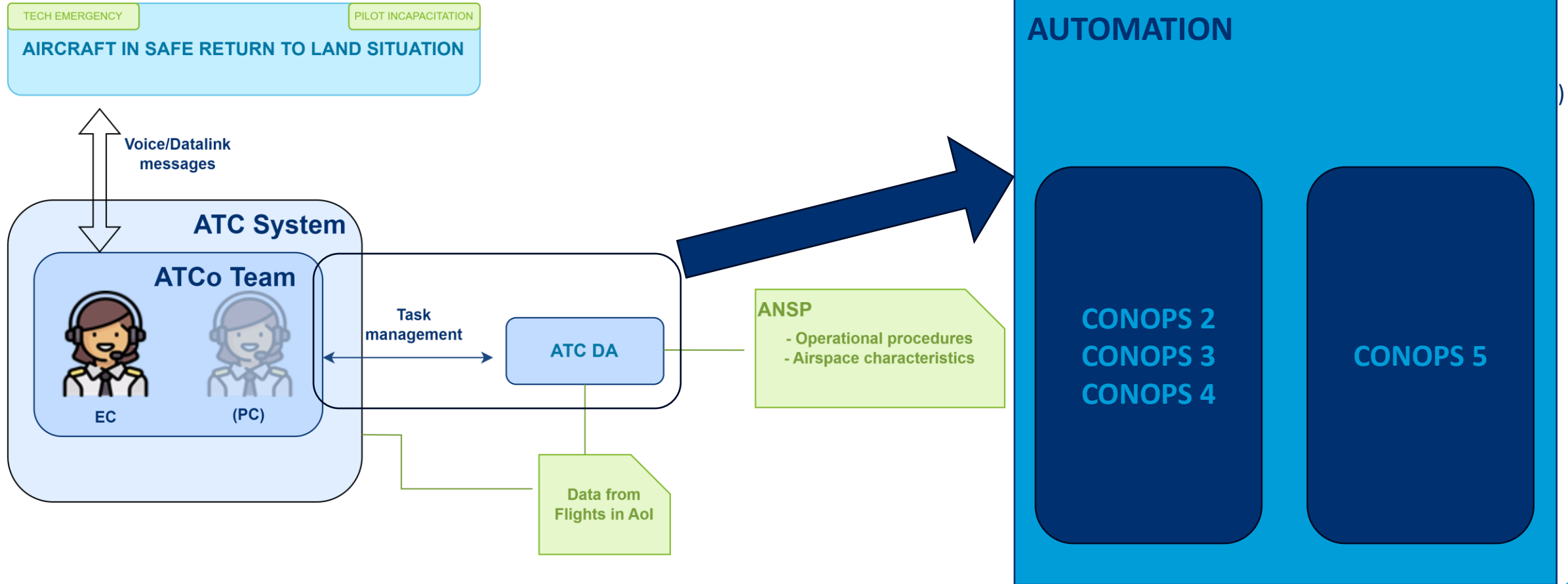
Let's look into the ground side...

RESPONSE ATCO Digital Assistant - Overview



- Relevant information dynamically suggested to the ATCo depending on the emergency context.
- Dynamic Situations
- Outcome to ATCo
 - List of suggested tasks
 - Relevant information for emergency handling
 - Automation on certain tasks

RESPONSE ATCO DA - Overview



RESPONSE ATCO DA – Task Analysis En-Route Sectors

- Emergency acknowledgement and situation assessment
- Notification to all units (supervisor, other sectors/ACC, emergency services, airport, tower, airline)
- Flight intent processing
- Alternative airport constraint detection and negotiation
- Conflict detection & resolution
- Frequency assignment

RESPONSE ATCO DA – First Look at the Prototype

- LLM-based prototype
- Linked to ATC simulator and PDA
- Dynamic Interface

CRIDA - Ground Digital Assistant

EMERGENCY CONTEXT
flight ib 1234 is declaring an emergency. The emergency is depressurization. Pilot is thinking of flying to another airport. Send

Current Airspace
Visualization of geographic points of interest.
Map showing Madrid and surrounding regions. Coordinates: Lat: 39.7917, Lng: -3.2684.

Emergency Timeline
Emergency declared for flight IB 1234 due to depressurization
23/10/2023, 2:00:00

Emergency Situation 22/10/2025, 16:37:42
Callsign: IB 1234 | Status: MAYDAY | Phase: ENROUTE
EMERGENCY: flight ib 1234 is declaring an emergency. The emergency is depressurization. Pilot is thinking of flying to another airport.

Comms
Relevant communication records with air traffic units
No contacts

Nearby Airports

Airport ICAO	Airport Name	Runway Number	Runway Length	Status
LEMD	Madrid-Barajas Airport	-	-	-
LEBL	Barcelona-El Prat Airport	-	-	-

Task Manager
Add a new task. open Add

EMERGENCY IDENTIFICATION suggested
suggested Save Proceed

EMERGENCY CONFIRMATION waiting
waiting Save Blocked Blocked by: EMERGENCY IDENTIFICATION

RESPONSE ATCO DA – First Look at the Prototype

- LLM-based prototype
- Linked to ATC simulator and PDA
- Dynamic Interface

CRIDA - Ground Digital Assistant

EMERGENCY CONTEXT
B123 is declaring emergency. Pilot is thinking on flying to another airport. Aircraft parameters has been modified. Emergency is Depressurization. Reduced Flight Level to FL310 Due to Right Inletions. No passengers injured. Communicated the issue to ground emergency services. Communicated the issue to Supervisor and ATIS. Includes nearby Airports, Conflicts and Critical Aircraft.

Current Airspace
Visualization of geographic points of interest

Emergency Timeline

- B123 declared emergency due to depressurization 23/10/2023, 16:00:00
- Aircraft reduced flight level to FL310 23/10/2023, 16:05:00
- Emergency communicated to ground services, supervisor, and airline 23/10/2023, 16:10:00

Nearby Airports

Airport ICAO	Airport Name	Runway Number	Runway Length	Status
LEMD	Madrid Barajas Airport	-	-	Open
LEBL	Barcelona-El Prat Airport	-	-	Open

Flight Conflicts

Callign	Destination	Current Waypoint
No conflicts detected.		

Critical Aircraft Parameters
A319

Critical Parameter	Value
Aircraft Ceiling	FL310
Aircraft Max Ground Speed	250kts
Aircraft Weight	7000kg
Aircraft Remaining Fuel	5000kg

RESPONSE What's next?

- Refine concept – IAB feedback
- Prototype proof of concept for assistants
- Integrate prototypes in CRIDA simulators
- Validate concepts – Demo exercise
March 2026 (TRL2)



RESPONSE

THANK YOU FOR
YOUR ATTENTION



Co-funded by
the European Union

<https://www.linkedin.com/company/responsesesar>

<https://www.sesarju.eu/projects/RESPONSE>

<https://research.dblue.it/response>

TADA

Terminal Airspace Digital Assistant (TADA)

Ana Ferreira and Ginevra Fedrizzi (Deep Blue)

Human-AI Teaming in aviation webinar
29 October 2025

TADA

Terminal Airspace
Digital Assistant

AIM

- Develop an **AI-based digital assistant** that supports air traffic controllers in **decision-making in TMAs.**
- Enhance **predictability, efficiency, and sustainability** in terminal airspace operations.

Duration: 2024-2027



INGENAV

deepblue

enav

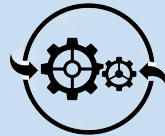
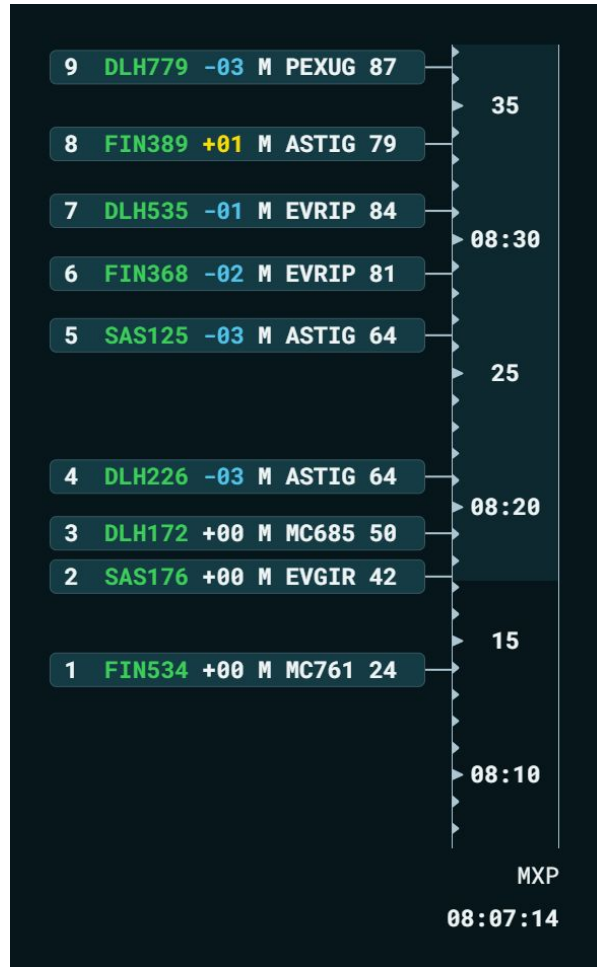
L-Università
ta' Malta

MONAD

FREQUENTIS

TADA

OVERVIEW



- dynamically receives **sequence** and **TTG/TTL** information from **AMAN (Arrival manager)**.
- uses **algorithms** (augmented historical ATCO data) to generate a **4D proposed trajectory (4DPT)** for each inbound flight.
- **supports ATCOs in meeting the 4DPT** by showing the trajectory and the necessary ATC instructions.

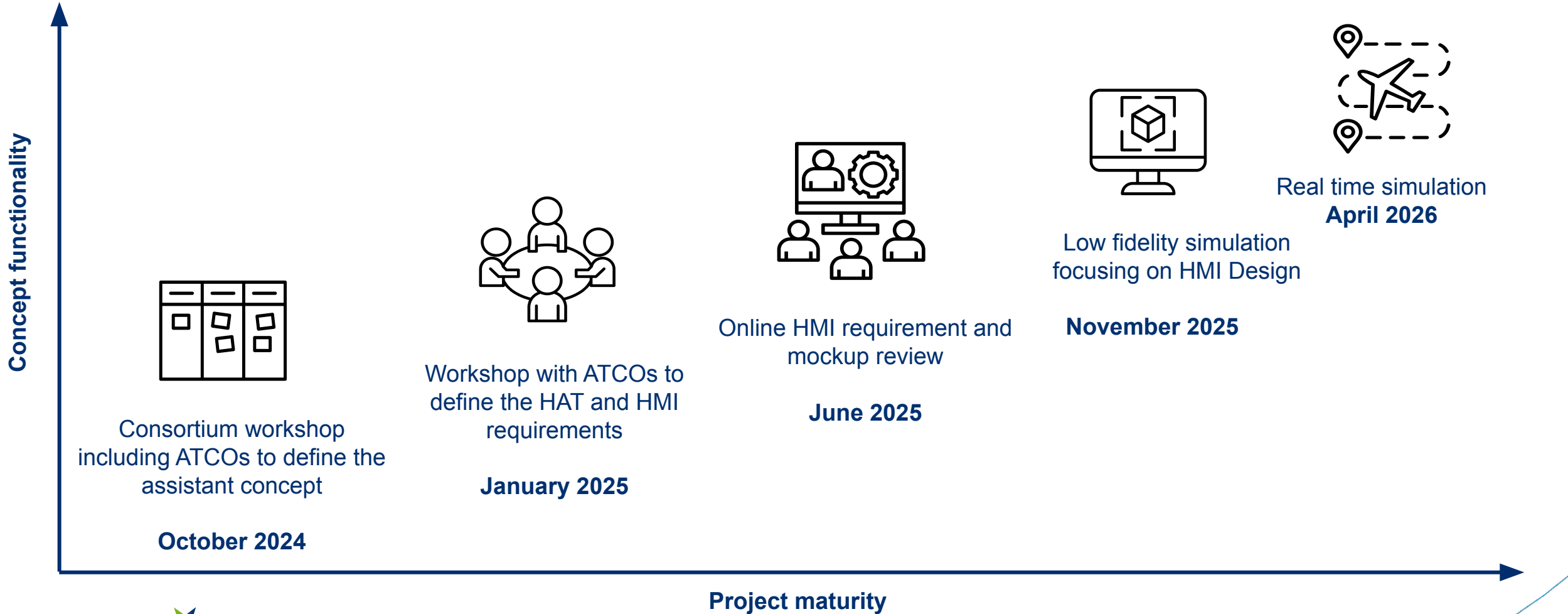
Where and when

- in **Terminal Airspace** with **moderate to heavy traffic** density and operational complexity.
- **from** the moment flights enter the **TMA until** they initiate their **final approach**.



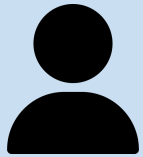
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APPROACH TO DEFINE HAT REQUIREMENTS



TADA

Terminal Area Assistant Target Role



Approach ATCO (APP ATCO): executive role that issues clearances and instructions to flights.

Sequence Manager (SM): manages and coordinates the arrival sequence for each airport.

Tasks of the **Approach ATCO**

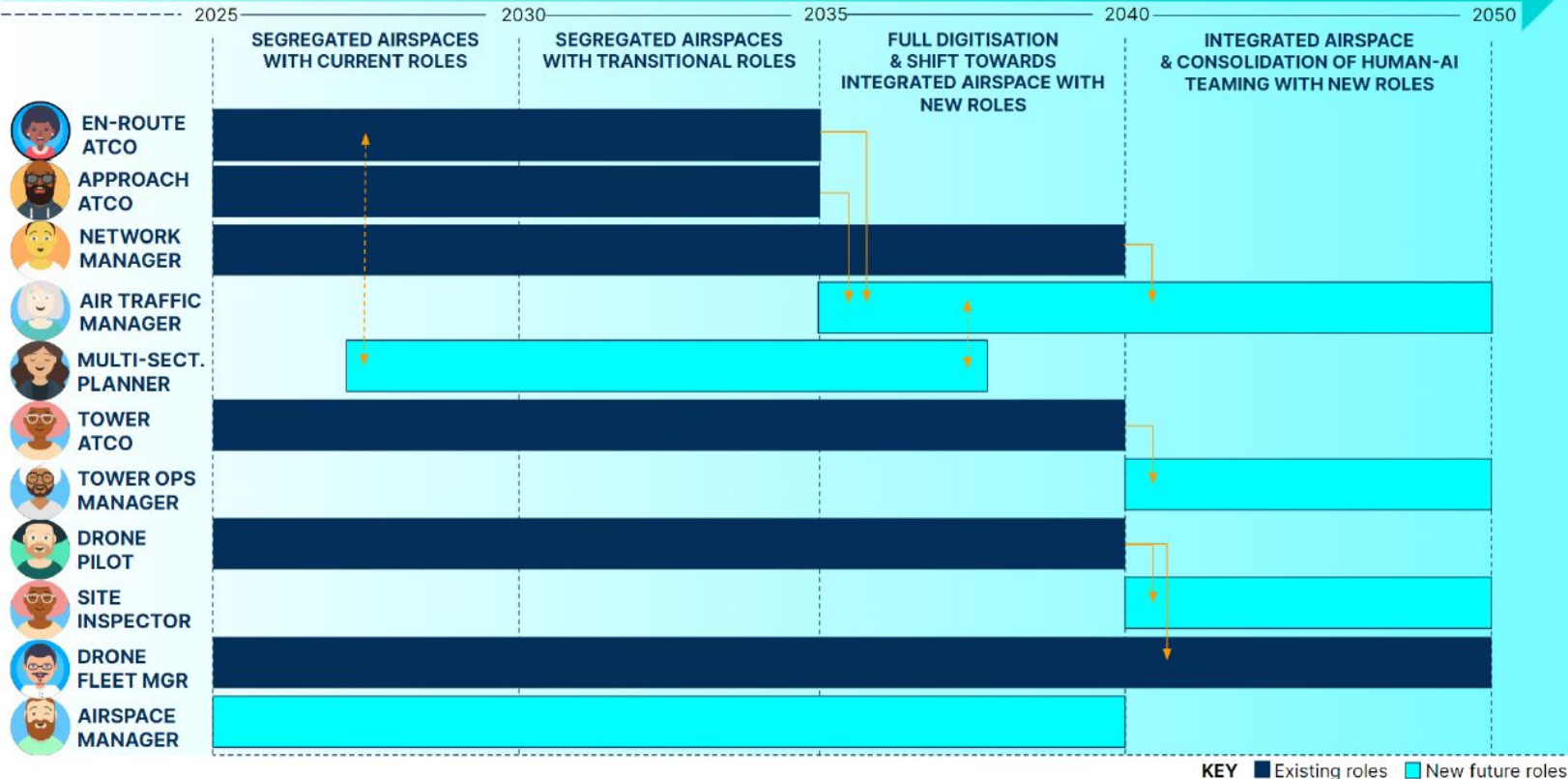
- takes AMAN sequence and TTL/TTG for each flight
- decides whether to follow the published arrival procedure (e.g. the trombone or PMS)
- interrupts it to gain or lose time, or deviate from it to maintain separation from other traffic in the airspace.

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EVOLUTION OF HUMAN ROLES IN ATM

COMMERCIAL AIR TRANSPORT

ATM & UTM | THE EVOLUTION OF HUMAN ROLES



From 2035
En-route + Approach ATCOs

- monitoring **nominal operations** and manage **non-nominal operations** and **emergencies** for both ATM and UTM traffic, aided by AI in tactical and strategic deconfliction.
- APP ATCO will have a more supervisory and strategic role.



ATCO SUPPORT NEEDS

- To build a good sequence;
- To manage traffic in the most efficient and safe way possible.
- Sequence, speed and relative distances monitoring.
- To deal with meteorological events in the managed airspace:
- Consider efficiency constraints, CO2 emissions and noise level;
- Consider airspace restrictions;
- Maintain an optimal workload and engagement level to deal with unexpected events.

TADA Terminal Area Assistant Concept

Level of Automation

ATCOs will be supported up to a Level 1- corresponding to EASA 2A level. Full authority must be kept in terms of decision of action to be implemented.

EASA AI level 1B – Human assistance

Dynamic trajectory optimization: suggest trajectories that optimize sequencing while considering aircraft trajectory, profiles and speeds, ensuring alignment with the appropriate sequence of arrivals.



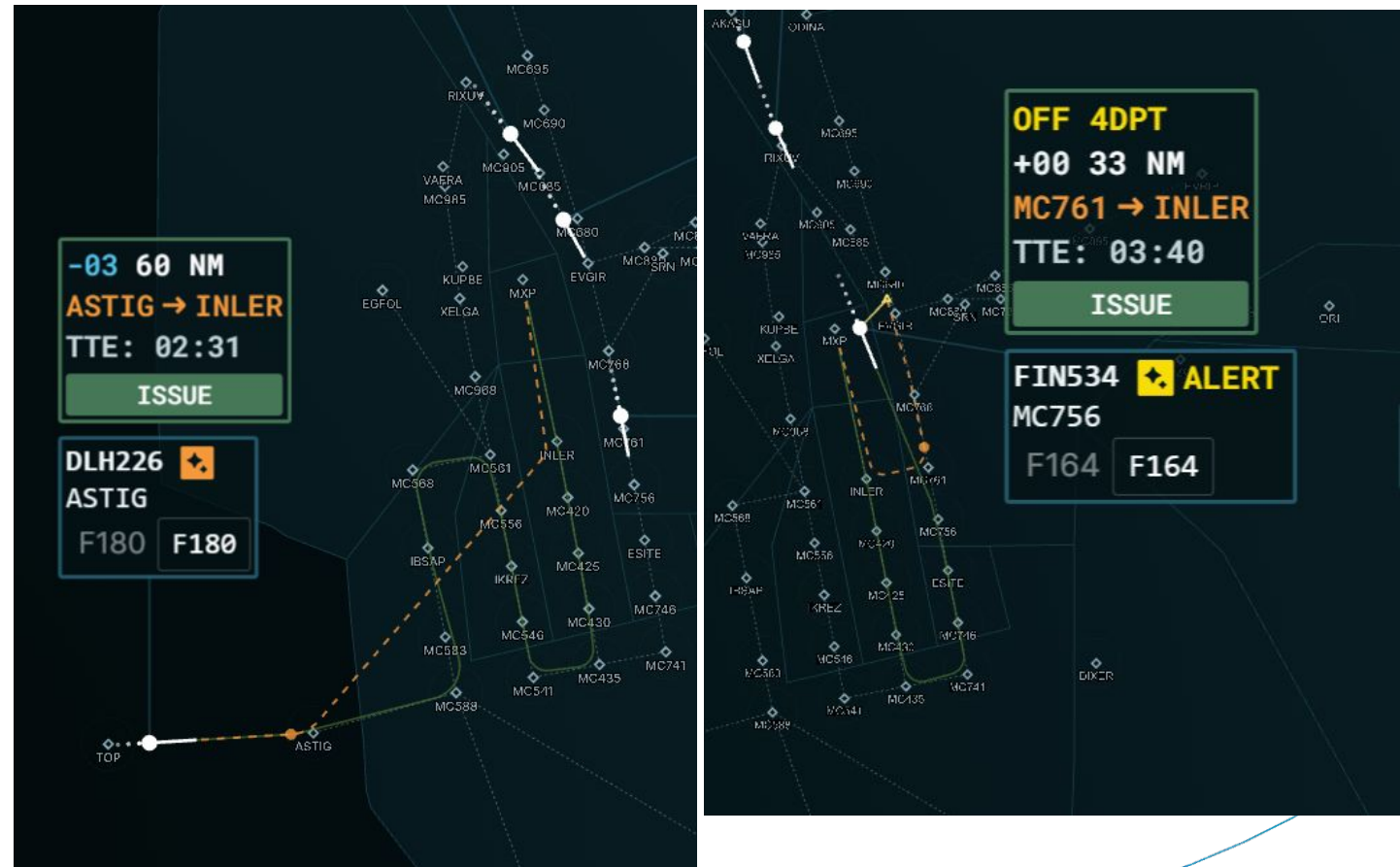
DEFINITION	EASA AI level	PERCEPTION Information acquisition and exchange	ANALYSIS Information analysis	DECISION Decision and action selection	EXECUTION Action implementation	Authority of the human operator
LEVEL 0 LOW AUTOMATION Automation gathers and exchanges data. It analyses and prepares all available information for the human operator. The human operator takes all decisions and implements them (with or without execution support).	1A	●	●		◐	 FULL
LEVEL 1 DECISION SUPPORT Automation supports the human operator in action selection by providing a solution space and/or multiple options. The human operator implements the actions (with or without execution support).	1B	●	●	◐	◐	 FULL
LEVEL 2 RESOLUTION SUPPORT Automation proposes the optimal solution in the solution space. The human operator validates the optimal solution or comes up with a different solution. Automation implements the actions when due and if safe. Automation acts under direction.	2A	●	●	◐	●	 FULL
LEVEL 3 CONDITIONAL AUTOMATION Automation selects the optimal solution and implements the respective actions when due and if safe. The human operator supervises automation and overrides or improves decisions that are not deemed appropriate. Automation acts under human supervision.	2B	●	●	●	●	 PARTIAL
LEVEL 4 CONFINED AUTOMATION Automation takes all decisions and implements all actions silently within the confines of a predefined scope. Automation requests the human operator to supervise its operation if outside the predefined scope. Any human intervention results in a reversion to Level 3. Automation acts under human safeguarding.	3A	●	●	●	●	 LIMITED

TADA

HMI REQUIREMENTS TO DESIGN

TADA will display the instructions to be followed by the Approach ATCO on the flight labels. Three levels of display are envisaged:

- On-demand display of the full 4DPT of the flight
- Display of the instructions to be issued
- Alert for flight deviations from the 4DPT's tolerance envelope.



Explainable AI and Teamwork



ATCO will receive a **single proposal to meet the TTL/TTG**



ATCO will have a **limited time to consider and accept/reject the proposal.**



ATCO need to have a good **understanding of the proposal being made** (either trajectory; speed or level) **and how it is generated.**



Explainability is the way that ATCO can **build trust** in the digital assistant → to support this level of operation the explainability module will need to be built to support **training** and **post-operational phases (debriefings).**

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Expected benefits

Decision-making

Decision support in aircraft trajectory optimization and sequence maintenance.

Advisory

Non-adherence advisory in case of overlooked aspects during their tasks (instructions).

Workload

Better workload management thanks to the suggestions to implement AMAN sequencing.

Safety

TADA learning assurance.
TADA calculation shall propose only conflict-free trajectories.

TADA

Possible drawbacks

Complacency

- Continuous training
- Procedures

Information overload

- HMI Design and test with users
- Procedures

Skills degradation

- Continuous training
- Periods of work without system

TADA

THANK YOU FOR YOUR ATTENTION

CODA

Predictive Adaptable Systems to improve Human-AI Teaming

Anna Vicario, Deep Blue

On Line - Human-AI Teaming in Aviation - Developing the next
generation of EU Digital Assistants

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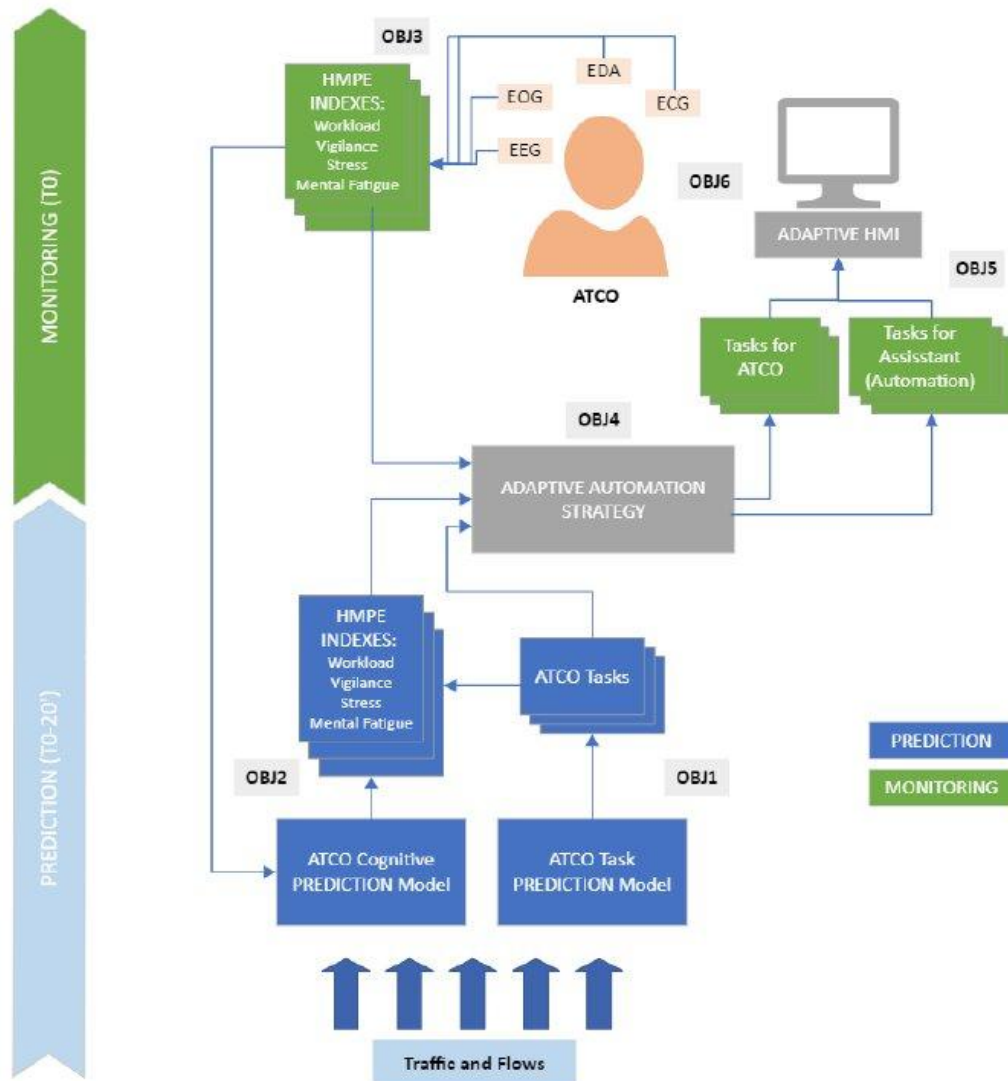
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Agenda

- **Description of CODA DA concept**, outlining its objectives, and architecture
- **Explanation of the methodology** used to derive **Human–AI Teaming (HAT) requirements**
- **Description of the final validation exercises**
- **Summary of key outcomes, validation results, user feedback, and lessons** for future adaptive AI assistant development in ATM.



Adaptable Systems to improve Human AI Teaming



CODA is a **SESAR** exploratory research project

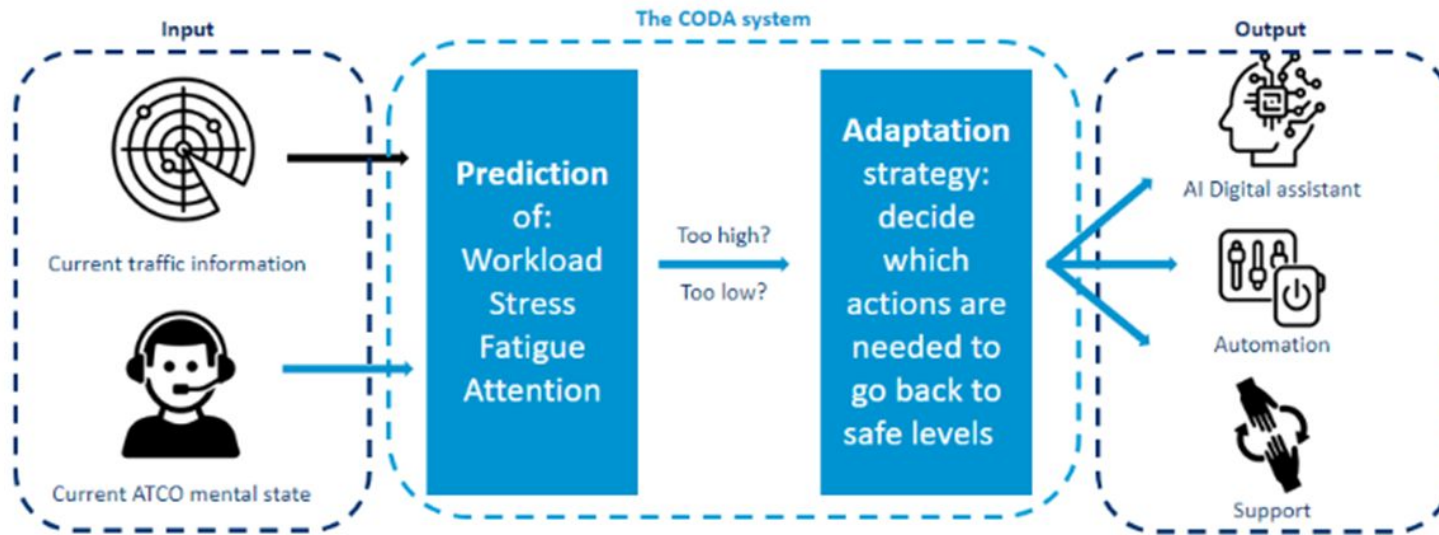
The goal is to **strengthen collaboration between Air Traffic Controllers and Artificial Intelligence systems**

HOW DOES CODA WORKS?

The system proposes the **delegation of certain aircraft to the AI**, considering several factors:

- The **current and predicted traffic**
- The **controller’s mental state** (workload, fatigue, stress, and vigilance)
- The **current and upcoming control tasks.**

En-route use case, multiple other applications



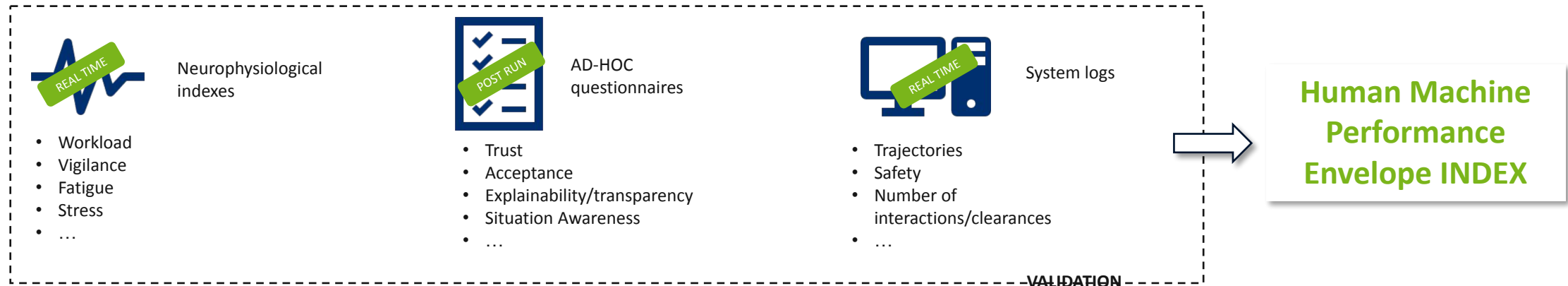
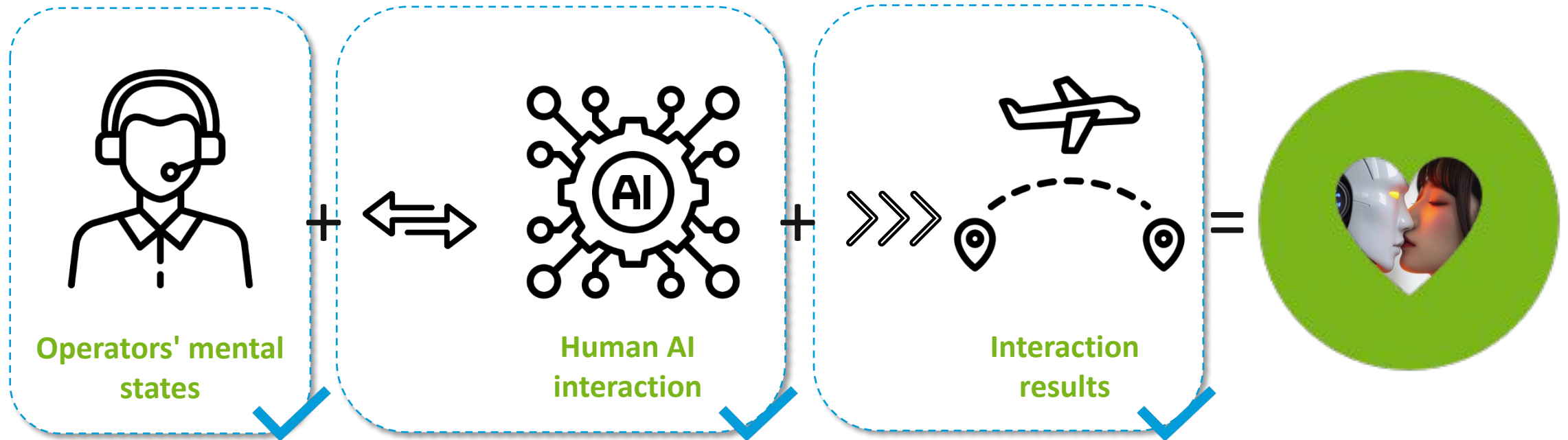
“ONE **TOOL** TO RULE THEM ALL”

It has to be *emphasised* that the CODA system is not a tool per se. It is a **technological enabler, to be integrated into ATM systems** (not limited to en-route CWP), providing adaptation capabilities.

The AI tools/Digital assistants that are expected to be activated by the adaptation strategy are out of the scope of the project.



“A” definition for Human – AI Teaming

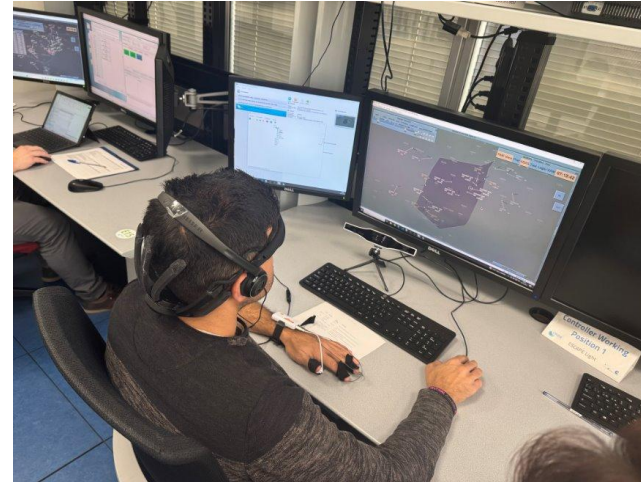


CODA system validation



Concept, prediction modules and finals system validation

EXE3: Final Human in the Loop simulation



Human-in-the-Loop Simulation

- **When:** 17–20 March 2025
- **Where:** CRIDA premises at Universidad Politécnica de Madrid
- **Who:** 4 ATCOs (IFATCA)
- **Objective:** Validate CODA system

Key Points:

- Real-time ops with ATCO & AI supervisor
- Same CWP for both roles
- CODA proposed flights 7 min before sector entry
- AI supervisor confirmed assignments
- ATCO saw AI flights 2 min before entry
- Yellow circle marked AI flights
- ATCO could reassign if needed

Final Validation, data collection

EXE3: Final Human in the Loop simulation

Objective assesment of Workload, Stress, Fatigue, Vigilance

- Electroencephalography (EEG): brain electrical activity
- Hearth Rate & Hearth Variation Rate: heart beating activity
- Galvanic Skin Response (GSR): electrical skin activity

- Voice: fundamental frequency

Additional research activities

At the end of each run: questions about teaming quality
At the end of the sim.: questions on overall impact on ATCO Job

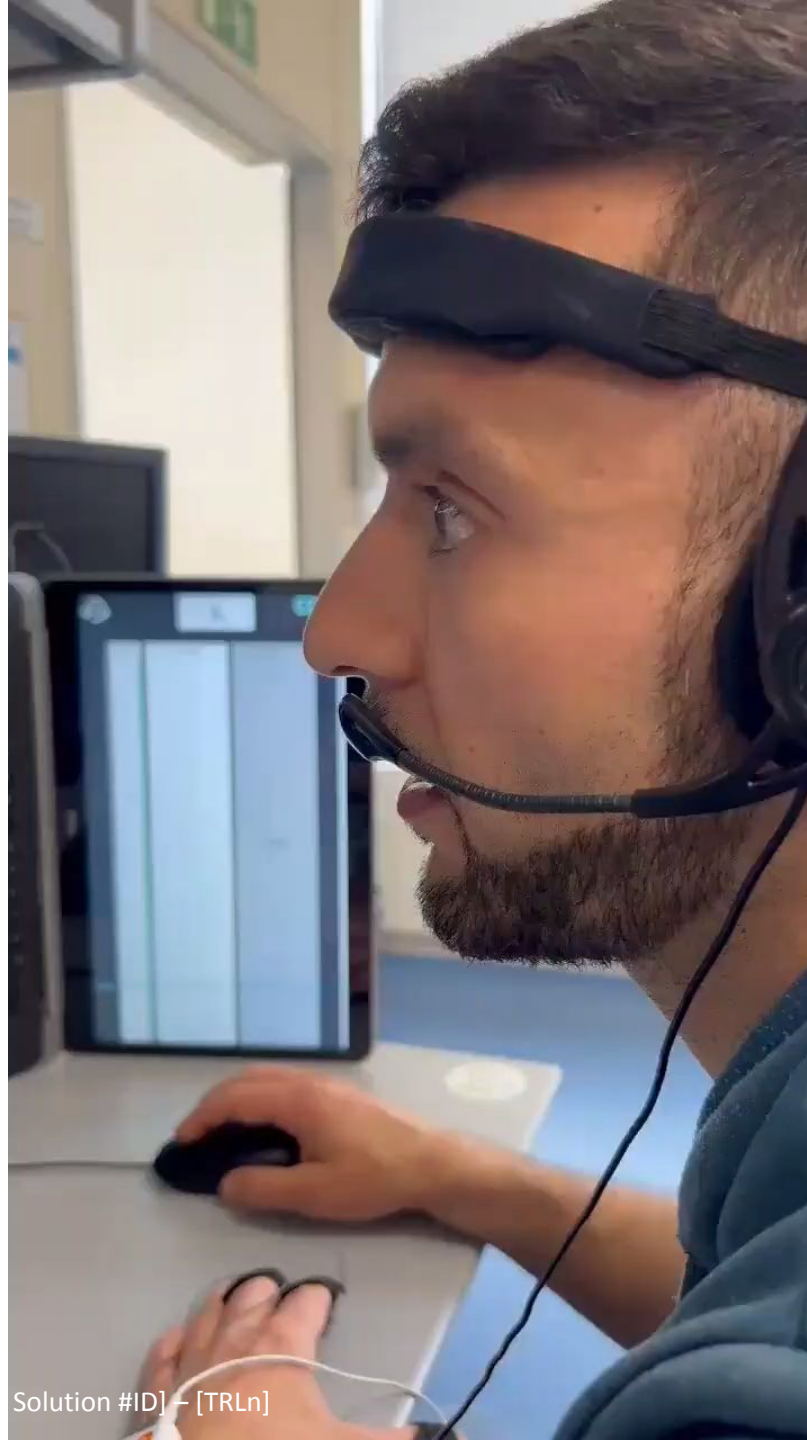
- Questionnaires
- Debriefings

Open discussion. Useful to get information to make sense of our results

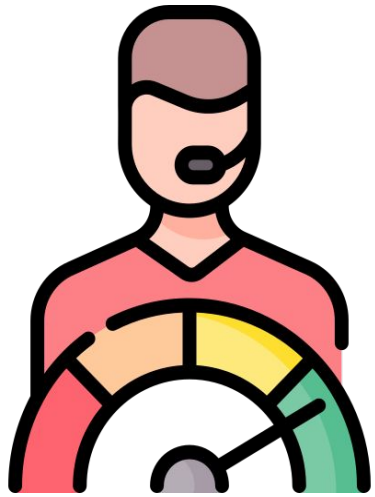
Performance measures

- Radar tracks
- Control events
- Flight plans
- Radio communication

To get a measurement of the overall performance in terms of traffic management and safety



HITL Validation Final results (1)



Human Performance

- A generally positive impact on **ATCO performance**
- Improved **vigilance and situation awareness**, reduced **stress and fatigue**
- Not significant change in mental **workload** (due to learnability curve plus a need for monitoring AI-managed aircraft)
- Relatively clear **responsibilities and tasks** as well as new procedures for ATCOs
- CODA's **task allocation** was reported to be logical and efficient
- The **HMI** was relatively supportive but there's still room for improvements
- The **HMPE framework** proved to be a strong indicator of controller-AI collaboration, showing that CODA consistently maintained balanced workload, sustained performance, and positive teaming without compromising safety or trust.

HITL Validation Final results (2)

- CODA maintained **safety** in normal conditions and measurably reduced conflicts during peak traffic
- CODA delivered slight improvements in **operational efficiency**
- No measurable improvement in **cost efficiency** was observed
- No measurable impact on en-route throughput was observed, CODA will likely enable an increase in capacity

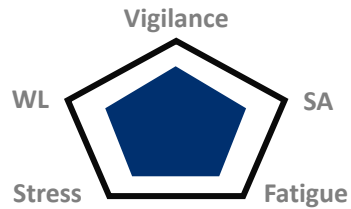


**OTHER
KPA**

The Next Step in Human-AI Teaming Research

Previous projects

HPE

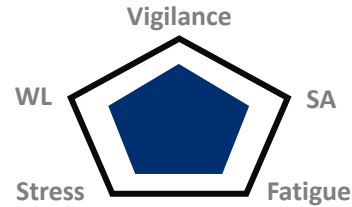


Operators' mental states



CODA

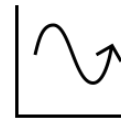
HMPE



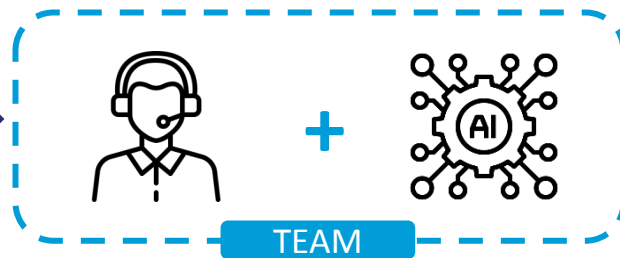
Operators' mental states



Teaming indicators

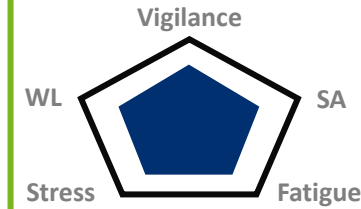


Team performance



Future research

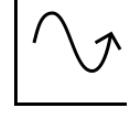
TMPE



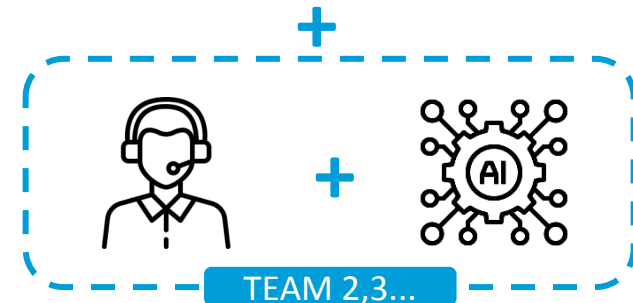
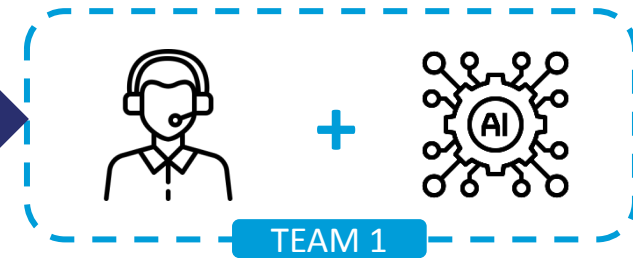
Operators' mental states



Teaming indicators



Team performance



CODA

Thank you!

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