

SESAR's European Knowledge Transfer Network – benefits delivered, opportunities ahead

Andrew Cook and Tatjana Bolić
University of Westminster
Airspace World 2023, Geneva, 10 March 2023

SESAR 2020 SHOWCASE

- **Background and overview**
 - context; objectives; a tale of two KTNs
- **Thematic challenges and projects**
 - provenance; industry role; three examples

Q&A #1

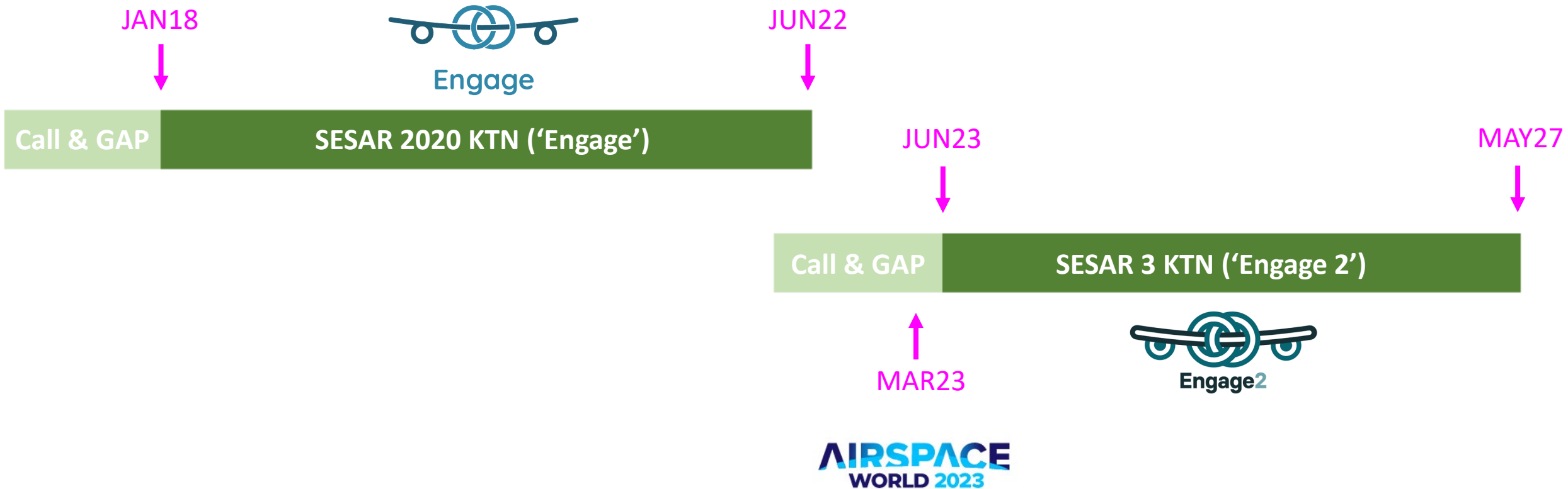
- **The EngageWiki, maps and repository**
- **PhDs and educational elements** (very brief insight)
- **Heads-up on Engage 2 & getting involved**

Q&A #2, close



1. Background and overview

Background and overview



Engage: call open: 15DEC16-11MAY17; project ran 01JAN18-30JUN22
Engage 2: call open: 07APR22-13OCT22; project runs 01JUN23-31MAY27 (tbc)

SESAR's European KTN; Airspace World 2023, Geneva, 10 March 2023

Background and overview



UNIVERSITY OF
WESTMINSTER 
(coordinator)



FREQUENTIS



engagektn.com
wikiengagektn.com
 twitter.com/EngageKTN

Background and overview



Advanced Logistics Group (ALG)
 AGIFORS - Airline Group of the International Federation of Operational Research Societies
 Air Traffic Controllers European Unions Coordination (ATCEUC)
 airBaltic
 Airport Gurus
 Airport Regions Conference (ARC)
 American Airlines
 ANS CR
 Aslogic
 Association for the Scientific Development of ATM in Europe (ASDA)
 Autoridade Nacional da Aviação Civil (ANAC)
 Barcelona Supercomputing Center (BSC)
 Boeing Research and Technology Europe (BR&T-Europe)
 Bundesaufsichtsamt für Flugsicherung (BAF)
 Cirium
 Civil Aviation Authority (CAA)
 COOPANS Consortium
 Department for Transport (UK)
 Direction des Services de la Navigation Aérienne (DSNA)
 Direktorat civilnog vazduhoplovstva Republike Srbije (DCV)
 Egis
 European Meteorological Services Network (EUMETNET)
 European Passengers' Federation (EPF)
 Executive Airlines
 Ferrovial Agroman
 Finnair
 Flughafen München / Munich Airport
 Gestair SL
 Heathrow Airport Limited

HEMAV - High Endurance Multipurpose Aerial Vehicles
 Honeywell Aerospace
 HungaroControl
 Icelandair
 IFSTTAR - Institut Français des Sciences et Technologies des Transports, de l'Aménagement et des Réseaux
 INFORM - Institut für Operations Research und Management GmbH
 International Air Transport Passenger Association (IATPA)
 International Federation of Air Traffic Controllers' Associations (IFATCA)
 International Federation of Air Traffic Safety Electronics Associations (IFATSEA)
 Irish Aviation Authority (IAA)
 LFV - Luftfartsverket
 London Luton Airport
 Lufthansa Systems
 Manchester Airport
 NATS
 Naviair
 Network Manager - nominated by the European Commission
 NEXTOR II Consortium - University of California, Berkeley and University of Maryland
 PACE Aerospace Engineering & Information Technology
 Pegasus Airlines
 QinetiQ Ltd
 Raytheon UK
 Sabre Airline Solutions
 skeyes
 SWISS - Swiss International Air Lines
 TÜBİTAK - The Scientific and Technological Research Council of Turkey
 Turkish Airlines



Background and overview

- ‘One-stop’ European knowledge hub, concepts roadmap, research repository
- 4 series of SESAR Innovation Days (non-disruptive; industry)
- 4 series of thematic challenge workshops (plus *ad hoc*)
- 3 European summer schools (Belgrade '19, virtual event '20, virtual event '21)
- 10⁹ PhDs; 16¹⁸ catalyst fund projects; 65⁵⁸ deliverables
- Future ATM skilled work-force; student mobility
 - under-/post-graduate teaching & training initiatives
 - internships & employer links
 - journal publication grants; (travel) grants

40% of €4m as consortium effort



The Engage wiki



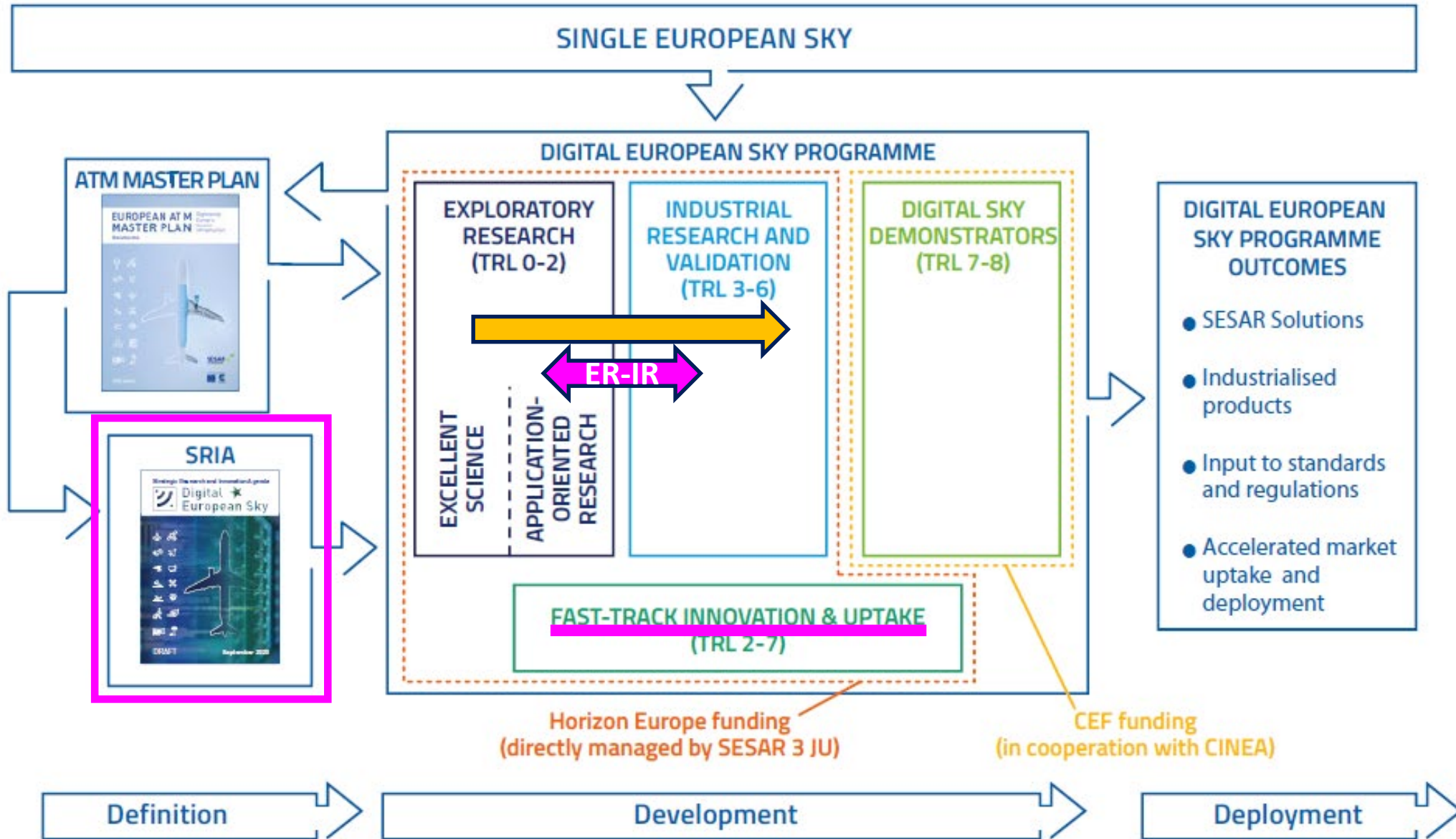
Research and innovation insights

SESAR Digital Academy

Integrate IR and ER

Thematic challenges

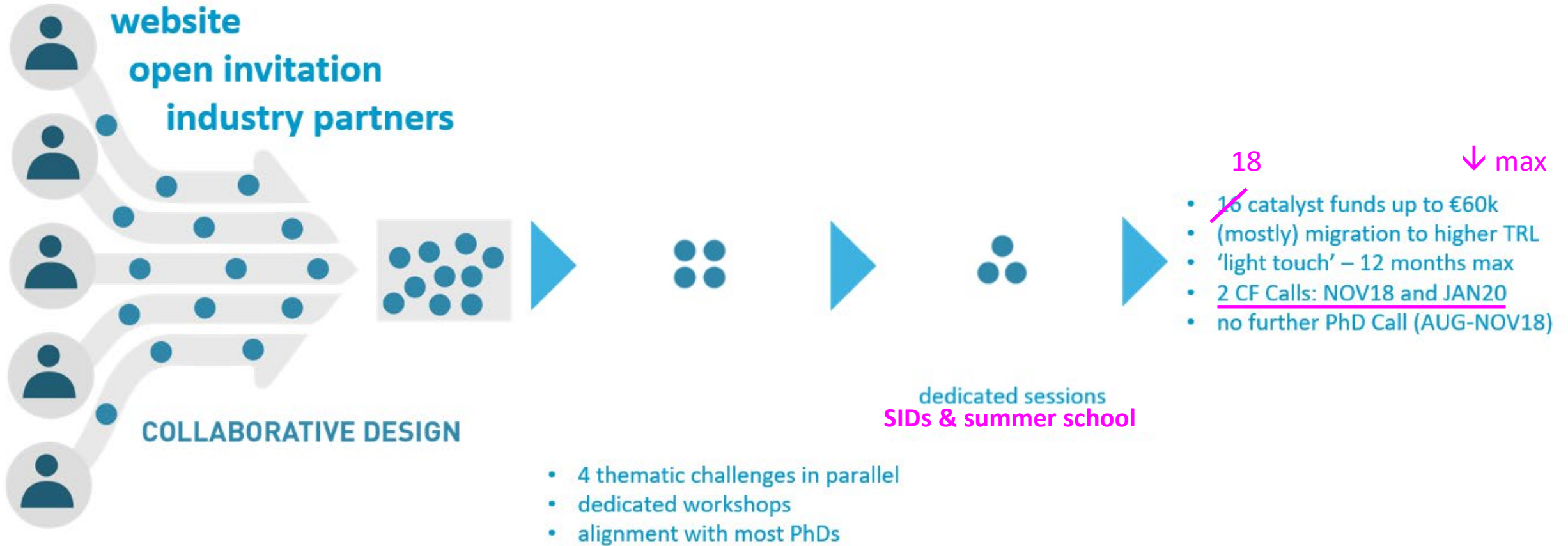
Background and overview



2. Thematic challenges and projects

Thematic challenges and projects

Industry: role in proposing and evaluating



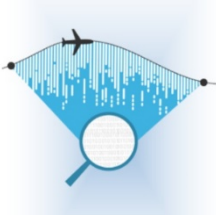
Thematic challenges and projects

Workshops through to 2021, informing SESAR 3



#1. CNS vulnerability and security

Paula López, Innaxis



#2. Data-driven trajectory prediction

“AI, ML and automation”

Dirk Schaefer, EUROCONTROL



#3. Efficient use of MET data

Tatjana Bolić, Uni. of Westminster



#4. Novel market mechanisms in ATM

“Economic incentives for future ATM implementation”

Andrew Cook, Uni. of Westminster



Research and innovation insights

Thread (TCs in brackets)	SRIA flagship(s)	Summary
1 (1)		Establish and develop a SESAR 3 cybersecurity community: CNS/ATM components (e.g., ADS-B, SWIM, datalink, Asterix) of the current and future air transport system present vulnerabilities that could be used to perform cyber-attacks. Further investigations are necessary to mitigate these vulnerabilities, moving towards a cyber-resilient system, fully characterising ATM data, its confidentiality, integrity and availability requirements, taking into account the fact that new and old ATM systems will continue to operate concurrently for years to come. All these issues are especially challenging in a multi-stakeholder, multi-system environment such as ATM, where confidentiality and trust are key. Nevertheless, the cybersecurity awareness and security culture is still rather immature in ATM research, whilst there is much interest in addressing this topic and creating a SESAR 3 cybersecurity community.
	5	Virtualisation and cyber-secure data sharing: This flagship addresses several high-level R&I needs/challenges, with that of ‘cyber resilience’ describing the need for monitoring and adapting to the changing threat landscape and emergence of new actors, aiming at the development of cyber-resilience guidelines and procedures tailored to ATM. However, a large and positive impact could be obtained through continuous collaboration and updates within a dedicated SESAR 3 cybersecurity community. This flagship is the place for setting up such guidelines and procedures, although not necessarily the best place for the establishment and nurturing of a cyber community, which might be developed through the SESAR 3 KTN or Digital Academy, overarching the flagship and its corresponding work components and actors.



+ tracking outcome flows

Catalyst fund projects – wave 1

Project title	Coordinator	Consortium partners
Probabilistic weather avoidance routes for medium-term storm avoidance ('PSA-Met')	Universidad de Sevilla	MeteoSolutions GmbH
Airport-scale severe weather nowcasting ('CARGO')	Università degli Studi di Padova	LMU Munich; GReD srl; Leonardo GmbH
Authentication and integrity for ADS-B	TU Kaiserslautern	SeRo Systems GmbH
Data-driven trajectory imitation with reinforcement learning	University of Piraeus Research Center	Boeing Research and Technology Europe
A data-driven approach for dynamic and adaptive trajectory prediction ('DIAPasON')	CRIDA	Deep Blue; ZenaByte
Operational alert products for ATM via SWIM ('OPAS')	Royal Belgian Institute for Space Aeronomy	-
An interaction metric for an efficient traffic demand management: requirements for the design of data-driven protection mechanisms ('INTERFACING')	Aslogic 2011 SL	-
MET enhanced ATFCM	France Aviation Civile Services	MetSafe
Exploring future UDPP concepts through computational behavioural economics	Nommon Solutions and Technologies	-
The drone identity - investigating forensic-readiness of U-space services	Open University	NATS

Catalyst fund projects – wave 2



Project title	Coordinator	Consortium partners
Proof-of-concept: practical, flexible, affordable pentesting platform for ATM/avionics cybersecurity ('ATM-cybersec')	University of Jyväskylä	-
Safe drone flight - assuring telemetry data integrity in U-space scenarios ('SDF')	NATS	Open University
Flight centric ATC with airstreams ('FC2A')	NEOMETSYS	ENAC
● Meteo sensors in the Sky ('METSIS')	NLR	AirHub BV
Probabilistic information integration in uncertain data processing for trajectory prediction ('PIU4TP')	CIRA	-
Collaborative cybersecurity management framework	Winsland Ltd	Movable-type; MSDK Research; BULATSA
Role of markets in AAS deployment ('RoMiAD')	Think Research Ltd	-
● Weather impact prediction for ATFCM ('WIPA')	France Aviation Civile Services	MetSafe

Thematic challenges and projects

	Open	TC1	TC2	TC3	TC4	Σ
		cyber	TP	MET	market	
PhDs	2	-	5 ↔ 2	2	2	10
CF Wave 1	-	2	3	4	1	10
CF Wave 2	1 → 3	1	2	1	8	
Σ	3	5	9 ↔ 8	4	28	

Some reflections

- Catalyst fund projects **‘light touch’ approach effective**; (required) industry context valuable; **good ‘catalysts’**
- Projects delivered **very high value for money** (ambitious)
- Virtual formats (e.g. workshops) offered **greater accessibility**; difficult to manage **high & low TRL** in same events

Three examples (then a pause for Q&A)



Operational alert Products for ATM via SWIM (OPAS)

Royal Belgian Institute for Space Aeronomy (BIRA)

Mentoring and advisories from

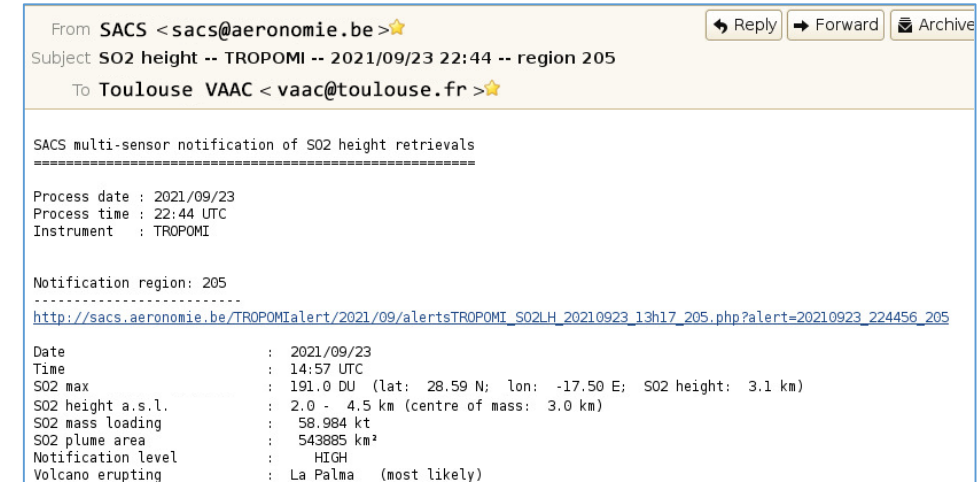
EUROCONTROL and Rolls-Royce



Development of a SWIM Technical Infrastructure Yellow Profile service providing notification & data access to volcanic SO₂ height

Objectives:

- 1) Algorithmic development of TROPOMI (satellite sensors) SO₂ height
- 2) Operational implementation of SO₂ height
- 3) Tailored alert products of SO₂ height
- 4) Implementation of SO₂ height early warnings
- 5) SWIM registry of OPAS as a notification service (Yellow Profile)



[Extended iterative spectral fitting]

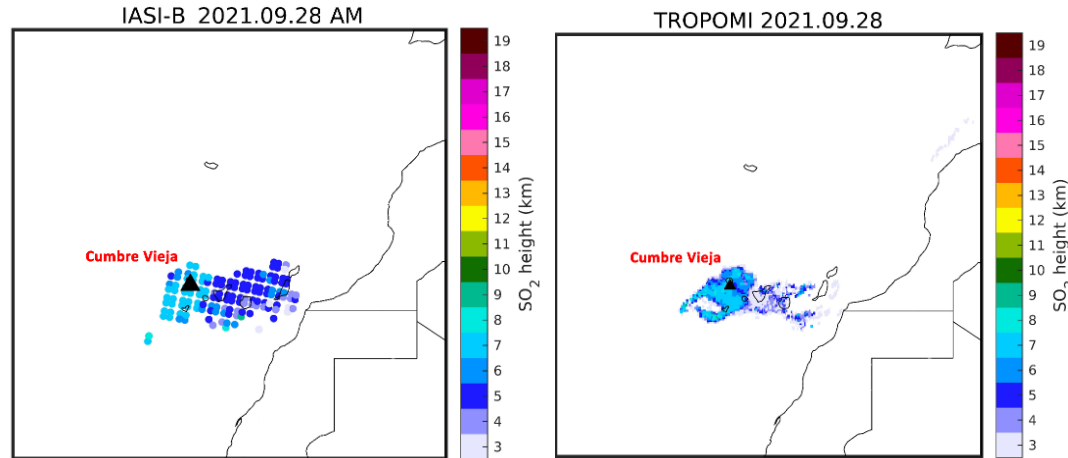
[Automatisation]

[AI and machine learning]

[Build on existing service]

[Design, definition, publication]

Key results



Visualisation

- **Algorithm development and operational run of SO₂ height (from TROPOMI satellite sensors)**
 - Use of BIRA facilities and expertise in NRT SO₂ retrievals (*Brenot et al. 2014, NHESS; Theys et al. 2017, AMT*)
 - **Validation using external observations** (*Brenot et al. 2020, SIDs*) → **TRL4**
- **Alert products of SO₂ height from TROPOMI and upgrade for IASI sensors**
 - **Benefits of early warning system:** SACS (Support to Aviation Control Service) & Transfer of EUNADICS-AV (European Natural Airborne Disaster Information and Coordination System for Aviation) development (*Brenot et al. 2021, NHESS**) → **TRL5**
- **SWIM Yellow Profile Notification service: “OpasSo2lhDatasetNotification”**
<https://eur-registry.swim.aero/services>

* NHESS is an interactive, open-access journal of the European Geosciences Union





WIPA

Weather impact prediction tool for ATM



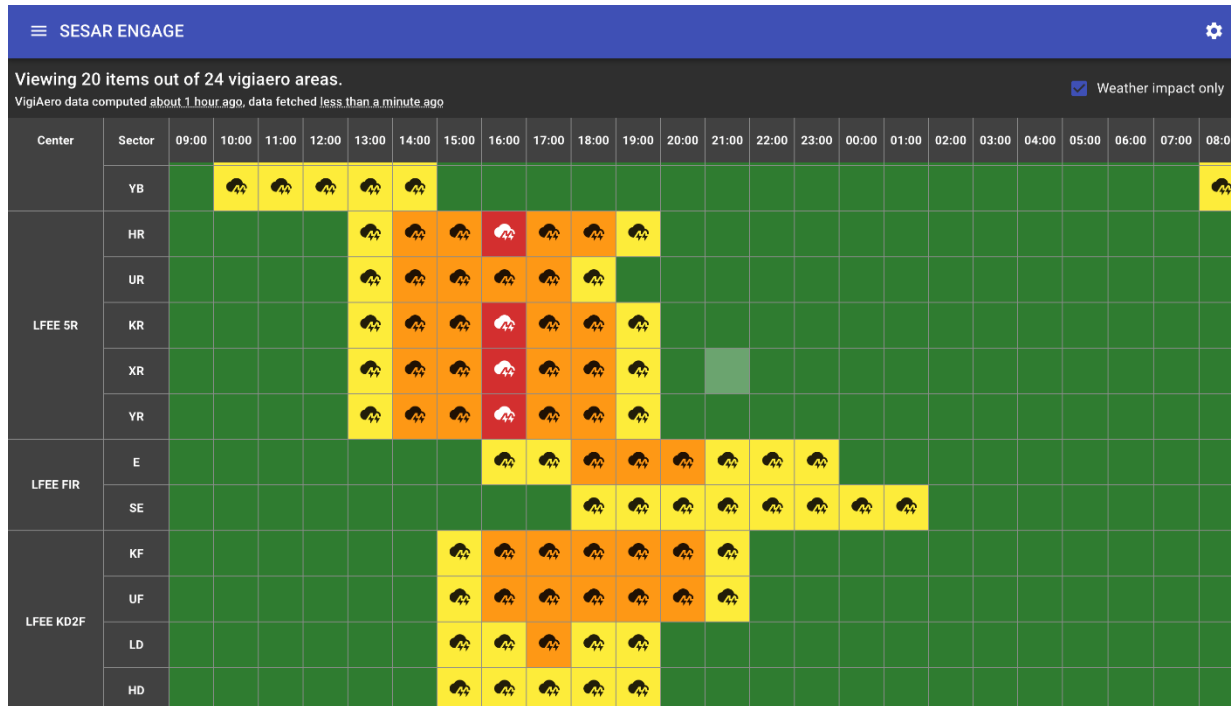
July 1st, 2020 to July 30th, 2021

Ambition: to provide weather hazards impact information for ATFCM

- **3 steps**
 - Use cases definition
 - Delivery of WIPA tool as a SWIM webservice
 - built on Engage 'MET Enhanced ATFCM' results: multi-model convection forecast
 - Technical and operational validation
 - DSNAs air traffic controllers' involvement

Expected benefits: (i) anticipation of hazardous weather effect on capacity; (ii) better use of weather regulations; (iii) better use of airspace

Key results



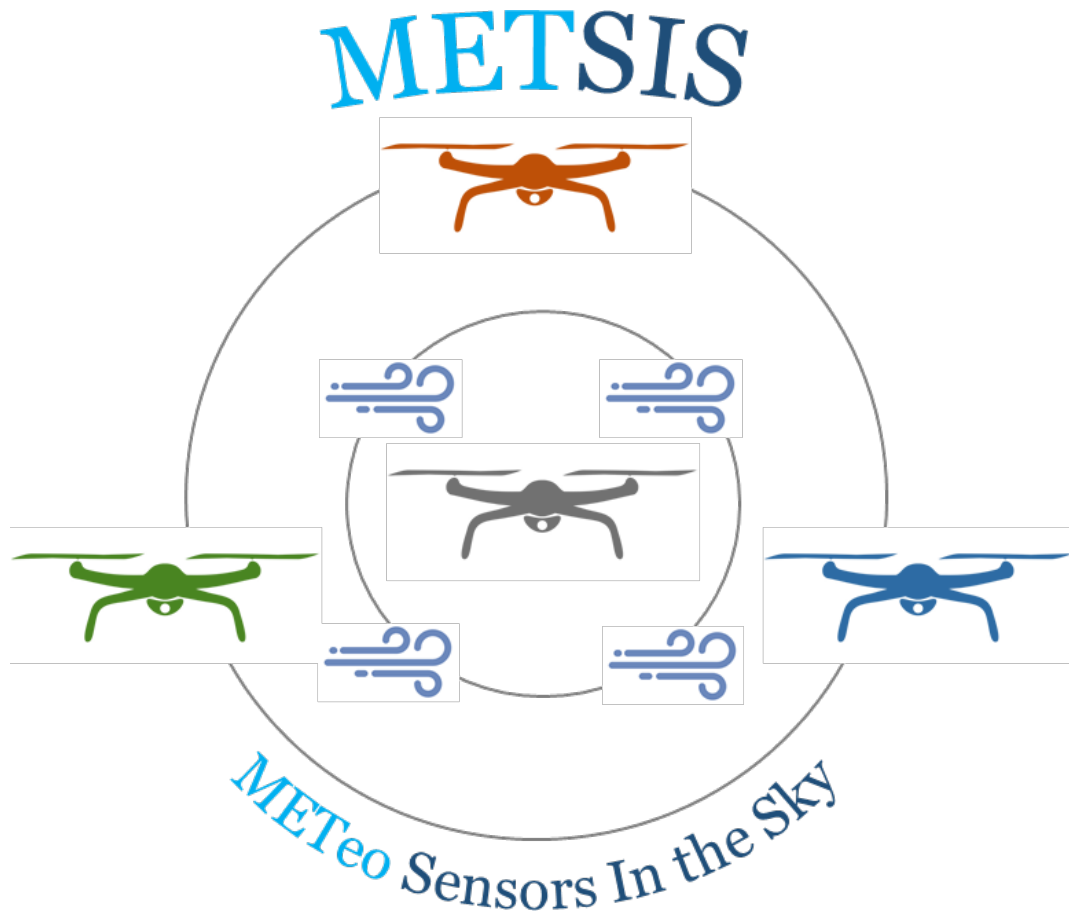
Thunderstorm impact, per hour, per sector
for the next 24H+



WIPA operational validation
Aix and Reims ATC rooms
May-July 2021

- From technical validation (15 reference days)
 - Thunderstorm behaviour different between Mediterranean and continental area: local tuning is needed on weather impact
 - ATM complexity needed to be introduced through consideration of ATM hotspots
 - For further experiments: using MET regulations from the NM, => need for an automated post ops analysis tools
- From operational validation (3 months validation)
 - Different operational approach to hazardous weather between Aix and Reims ATCOs
 - Strengths of the tool: temporal progression of weather events, hourly update of the forecast, lightning impact information on the sectors
 - Better anticipation of ATC workload

cf. CDA



Investigating the use of drones as an aerial sensor network for low altitude hyper-local wind now-casting

Consortium



Advisory Board





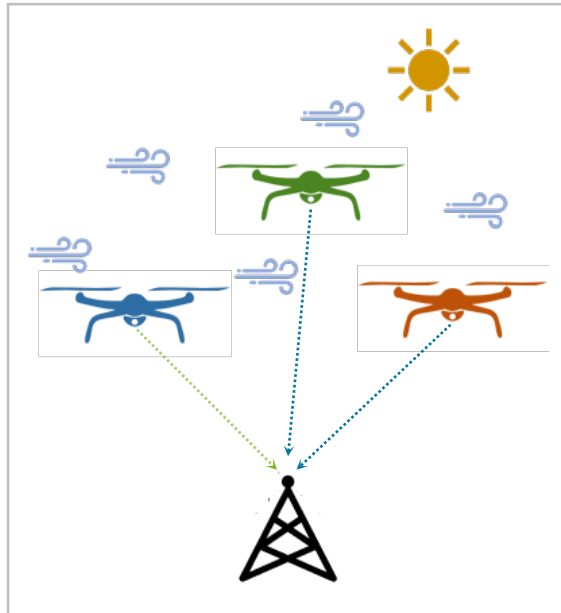
Objectives



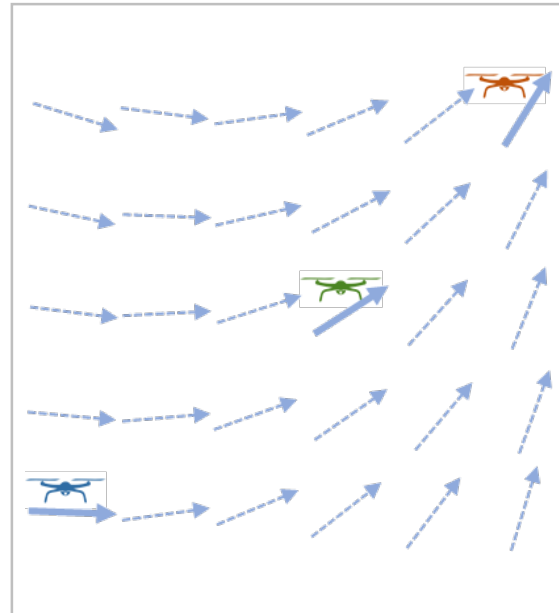
1. Determine accuracy of METSIS concept in presence of static obstacles to estimate low altitude winds below 500 ft
2. Determine how low-altitude wind information should be communicated to drone operators within a U-space system



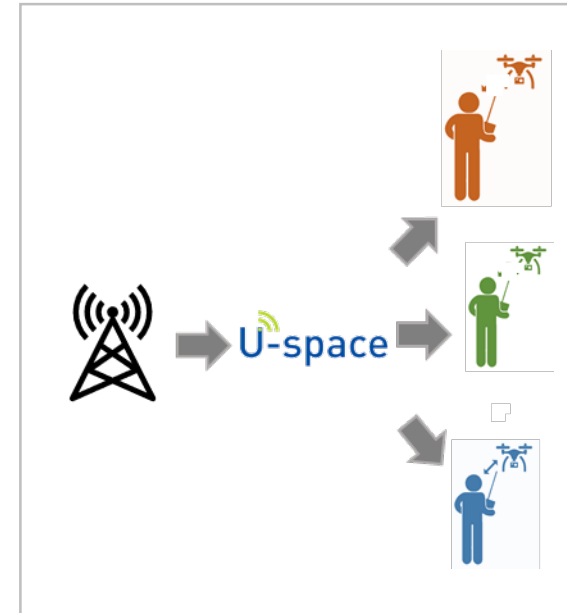
Using drones as an aerial sensor network for low altitude hyper-local wind now-casting



Step 1: Airborne drones measure **instantaneous wind states** and transmit data to a ground station

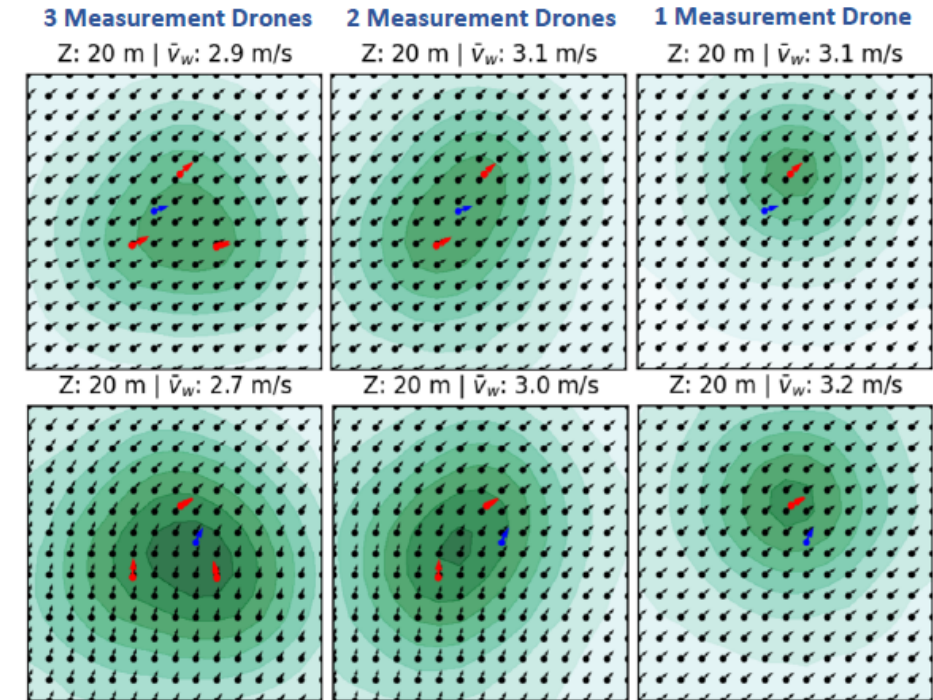


Step 2: Ground station uses the meteo particle model to estimate the **wind field in real time**



Step 3: The ground station communicates wind field data to **drone operators** via the **U-space weather information service**

- Key results
 - Concept is feasible
 - on average, speed is reasonably accurate for both static and dynamic conditions – very promising
 - Accuracy is promising but needs to be further improved
 - direction is less accurate than the WMO standard, particularly in dynamic conditions – caused by propeller induced flow over the sensors during dynamic conditions and low wind speeds
- Future research
 - Increase scalability and accuracy of concept
 - Looking for partners to cooperate with



SIDs 2021 paper

Q&A #1

3. The EngageWiki, maps and repository

The EngageWiki, maps and repository



Welcome to the EngageWiki

The one-stop European knowledge hub

A repository and interactive research map for exploratory and industrial research in ATM, also compiling European events and learning opportunities, and hosting discussion fora.

Check out the main wiki features

Interactive research map of ATM



European university programmes



ATM concepts roadmap



Discussion fora



Research repository: Projects and Papers



Education and learning

European university programmes

113

SESAR Digital Academy

PhD funding opportunities

5

Jobs and internships

19

Teaching resources

3

Multiple firsts in ATM

Interactive research map

Interactive concepts roadmap

Combined repository

(later)



EngageWiki: interactive research map of ATM

[\[video link\]](#)

The EngageWiki, maps and repository

ER & IR

SWIM

filter

reset

[734161] [PJ18-4DTM] 4D Trajectory Management

Website Reports Web search

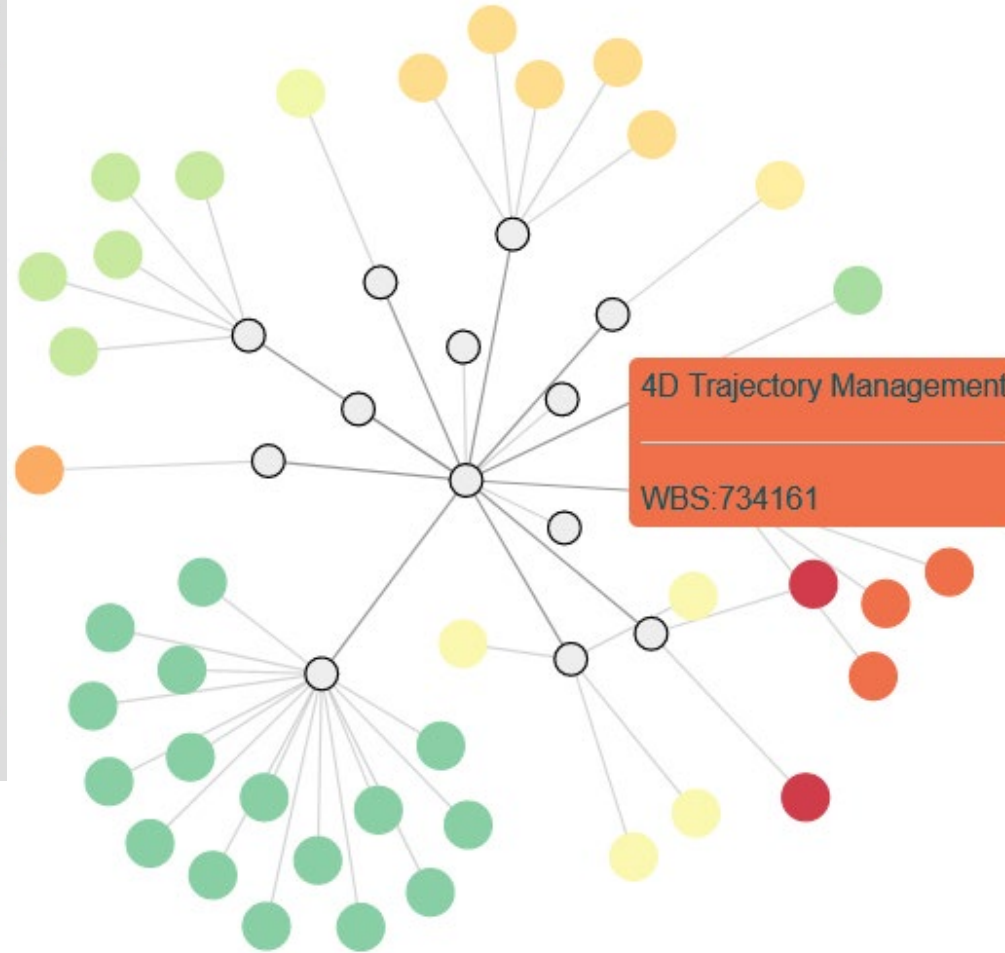
Call: IR Wave 1
Call ID: H2020-SESAR-2015-2
Partners: Indra Sistemas, Airbus, Atos Belgium, Austro Control, Croatia Control, Dassault Aviation, DLR, DFS, DSNA, ENAIRE, ENAV, EUROCONTROL, Frequentis, Honeywell Aerospace, HungaroControl, Leonardo, LPS SR, LFV, NATS, Navair, PANSA, ANS CR, Skyguide, NLR, Thales AVS France, Thales LAS France, IAA, Oro navigacija
Theme: 4D Trajectory Management
Budget: 49.249 M EUR
Duration: 2016 - 2020

Public deliverables:

- 18-01a - Input to final project report
- 18-02a - V1 Data Pack
- 18-02c - TRL6 Data Pack
- PJ18-04a TVLR for TRL6
- SESAR 2020 Solution PJ 18-04a TRL6 Technical Specification (TSIRS)
- TVLR TRL6 18-04b
- SESAR 2020 Solution PJ 18-04b TRL6 Technical Specification (TSIRS)
- 18-04c - TRL4 Data Pack
- 18-06b - TRL4 Data Pack
- 18-06a - TRL6 Data Pack
- 18-02b - TRL6 Data Pack
- Final Project Report

Keywords

service, information, solution, system, validation, exercise, validation, flight, airport, requirement, wind, operation, trajectory, exercise, management, function, success, criterion, capability, bora, condition, gwns, weather, aircraft, profile, swms, status, description, use, forecast, information, service, provision, interface, runway, maturity, met, lidar, camera, dataset, service, performance, enabler, prototype, ground, product, area, atm, level, tte, monitoring, definition, block, term, alc, feasibility, airspace, specification, case, detection, consumer, protocol, classification, assessment, thunderstorm, scope, user, air, traffic, service, service, input, contral, scenario, solution, validation, quality, output, image, observation, improvement, req, order, solution, solution, part, step, metformam, concept, algorithm, validate, infrastructure, message, event, information, phase, change, type, identifier, environment, atm, requirement, exchange, category, radar, context, a, violation, atm, validation, validation, provider, cover



Interactive concepts roadmap

SESAR Calls

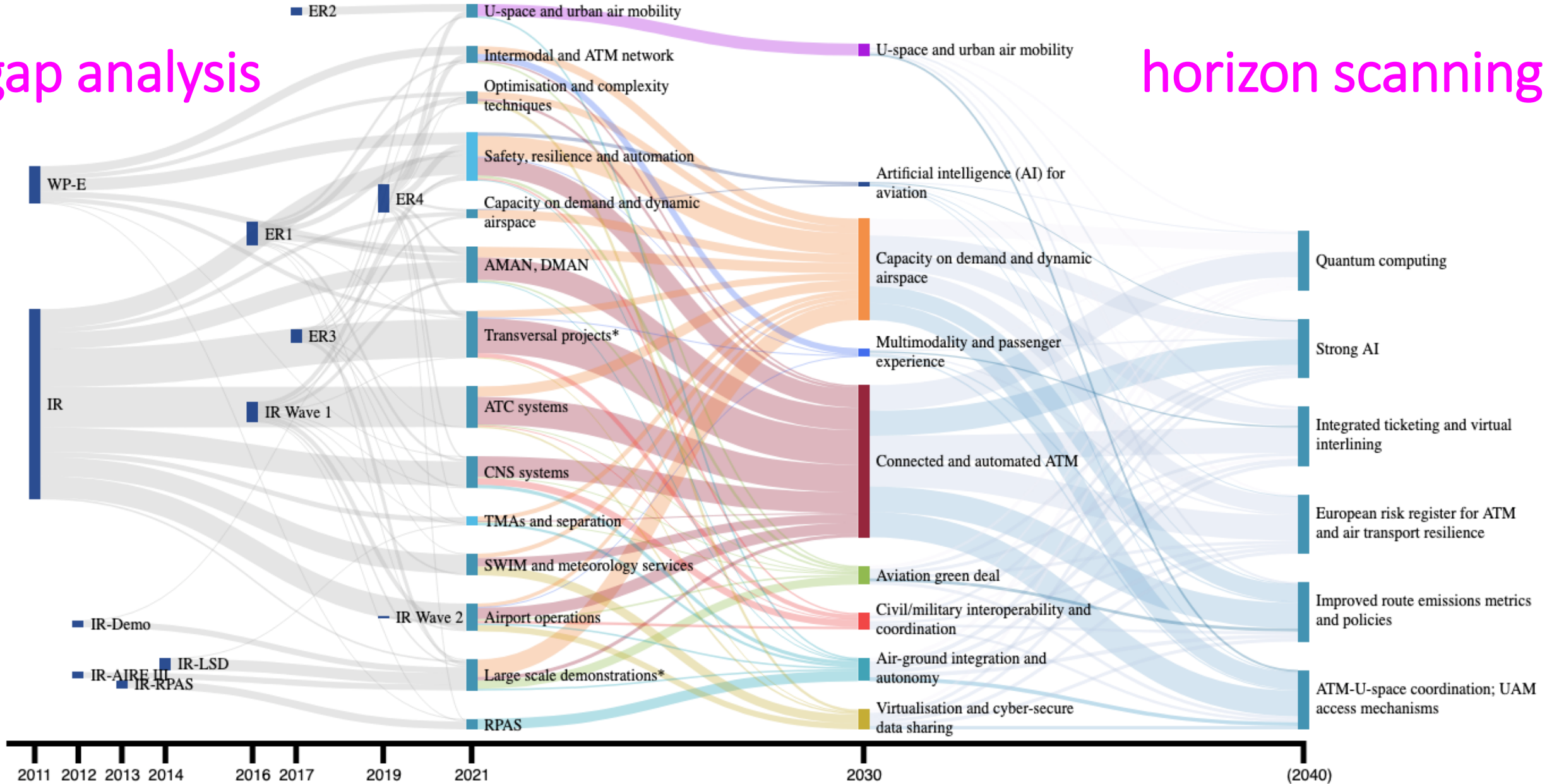
2021 Engage mapping

SRIA flagship activities

Horizon flagship activities

gap analysis

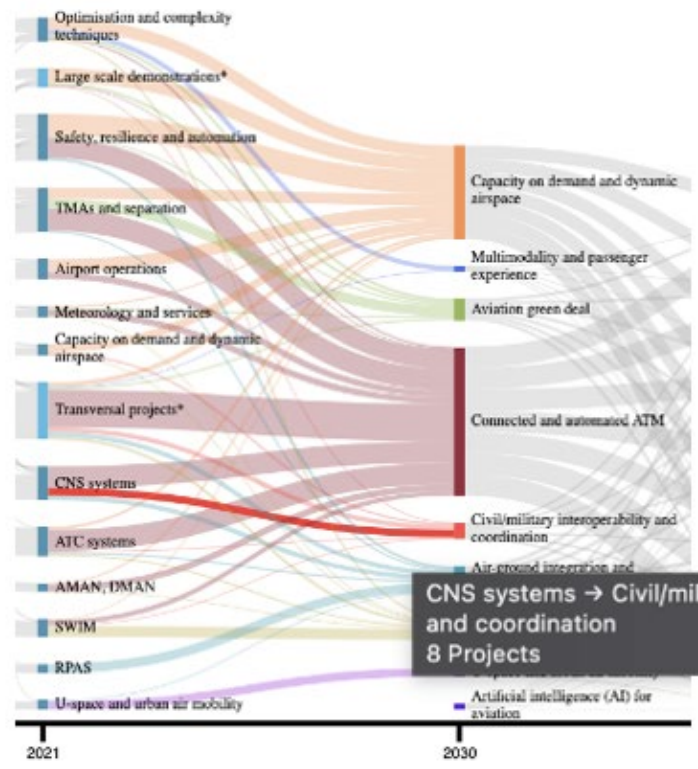
horizon scanning



ER & IR

2021 Engage mapping

SRIA flagship activities



dynamic reference table below

CNS systems → Civil/military interoperability and coordination
8 Projects

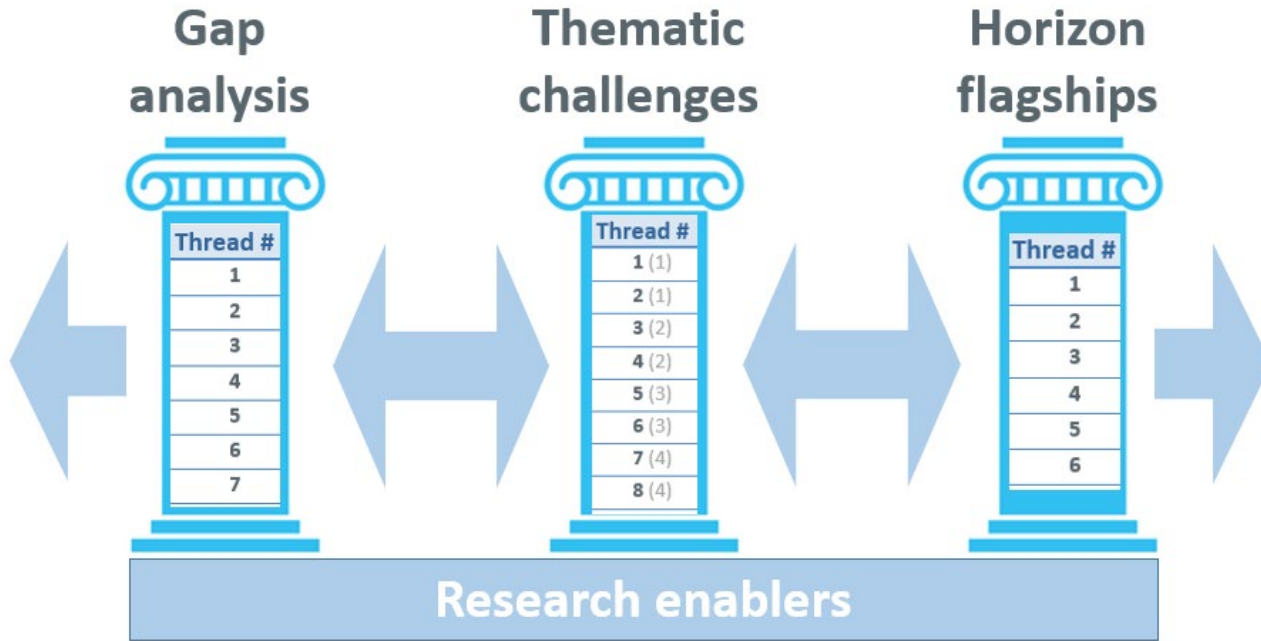
x

Link: CNS systems → Civil/military interoperability and coordination

Number of projects: 8

Project Name	SESAR Call	Engage mapping	SRIA flagship activities	Research repository
[09.24] ADS-B In/Out for military aircraft	IR	CNS systems	Civil/military interoperability and coordination	Link
[15.01.07] CNS System of System definition and roadmap	IR	CNS systems	Civil/military interoperability and coordination	Link
[15.00] Global Co-ordination & Management	IR	CNS systems	Civil/military interoperability and coordination	Link
[09.20] Military Data Link Accommodation	IR	CNS systems	Civil/military interoperability and coordination	Link
[15.02] Non Avionic CNS System	IR	CNS systems	Civil/military interoperability and coordination	Link
[15.04] Surveillance Infrastructure Rationalisation	IR	CNS systems	Civil/military interoperability and coordination	Link
[15.04.01] Surveillance Infrastructure Rationalisation	IR	CNS systems	Civil/military interoperability and coordination	Link
[15.04.05.b] Surveillance ground system enhancements for ADS-B (Prototype development)	IR	CNS systems	Civil/military interoperability and coordination	Link

The EngageWiki, maps and repository



D3.10

Research and innovation insights

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(slides on methodology in this pack)

The EngageWiki, maps and repository



EngageWiki: research repository

[\[video link\]](#)

The EngageWiki, maps and repository



<< Search in Papers

WBS
Select a filter value

Project
Select a filter value

Acronym
Select a filter value

Years
2009 2011 2018 2021
2009 2012 2015 2018 2021

Programme
 SESAR 1
 SESAR 2020

Call
× ER3

- SESAR 2020** 783112
Augmented Approaches to Land 2
Acronym: AAL2 | Call: ER3 | Years: 2018-2020 | Documents: 8
- SESAR 2020** 783116
Airspace User Support to Arrival Management
Acronym: Airline Team xStream | Call: ER3 | Years: 2018-2020 | Documents: 2
- SESAR 2020** 783117
Airspace User support to the development of Network Collaborative Management
Acronym: Airline Team NCM | Call: ER3 | Years: 2018-2020 | Documents: 2
- SESAR 2020** 783170
GNSS Solutions for Increased GA and Rotorcraft Airport Accessibility Demonstration
Acronym: GRADE | Call: ER3 | Years: 2018-2019 | Documents: 11

4. PhDs and educational elements (very brief insight)

SESAR Digital Academy

PhDs and educational elements

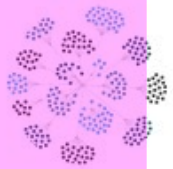
Welcome to the EngageWiki

The one-stop European knowledge hub

A repository and interactive research map for exploratory and industrial research in ATM, also compiling European events opportunities, and hosting discussion fora.

Check out the main wiki features

Interactive research map of ATM



European university programmes



ATM concepts roadmap



Discussion fora



Research repository: Projects and Papers



Education and learning

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113

SESAR Digital Academy

PhD funding opportunities

5

Jobs and internships

19

Teaching resources

3

Request an account first to be able to edit the list or, if you already have one, add a programme here.

Institution
Select a filter value

Country
Spain

Type
 Postgraduate
 Undergraduate

Degree
 Bachelor of Arts
 Bachelor of Arts (Hons)
 Bachelor of Science
 Bachelor of Science (Hons)
 Masters

Language
Select a filter value

Add a Programme **View full table**

Spain	Years: 2
Aeronautical Engineering Universidad Carlos III de Madrid Postgraduate Masters English	Web
Spain	Years: 2
Aeronautical Engineering Universidad Politécnica de Madrid Postgraduate Masters Spanish, English	Web
Spain	Years: 1.5
Air Transport System Universidad Politécnica de Madrid Postgraduate Masters Spanish, English	Web

Free teaching resources

Introduction to ATM
Airline planning and operations
Airport planning and operations



[\[video link\]](#)

PhDs and educational elements

PhDs (1...5) ... application-oriented, industry engaged



Candidate	Jonas Langner
PhD title	Decision support system for airline operation control hub centre
Proponent	TU Braunschweig
Candidate	Alevizos Bastas
PhD title	Trajectory planning for conflict-free trajectories: a multi agent reinforcement learning approach
Proponent	University of Piraeus
Candidate	Evgenii Munin (to 15APR22)
PhD title	Detection, classification, identification and mitigation of GNSS signal degradations by means of ML
Proponent	Ecole Nationale de l'Aviation Civile (ENAC)
Candidate	Manuel Mateos
PhD title	Machine learning for aircraft trajectory prediction: a solution for pre-tactical ATFCM
Proponent	Nommon (Madrid), with Technical University of Catalonia (UPC)
Candidate	Ralvi Isufaj
PhD title	Deep multi-agent reinforcement learning applications in ATM
Proponent	Universitat Autònoma de Barcelona (UAB)

PhDs and educational elements

PhDs (6...10) ... application-oriented, industry engaged



Candidate	Anastasia Lemetti
PhD title	Integrating weather prediction models into ATM planning
Proponent	Linköping University

Candidate	Homeyra Khaledian
PhD title	Advanced statistical signal processing for next generation trajectory prediction
Proponent	Technical University of Catalonia (UPC)

Candidate	Eduardo Andrés
PhD title	A pilot/dispatcher support tool ... enhanced provision of thunderstorm forecasts considering ... uncertainty
Proponent	Universidad Carlos III de Madrid (UC3M)

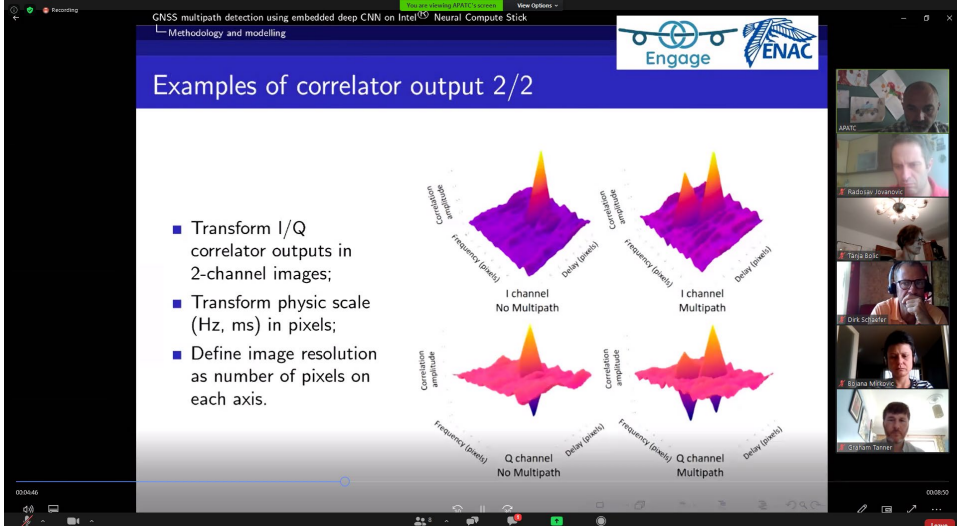
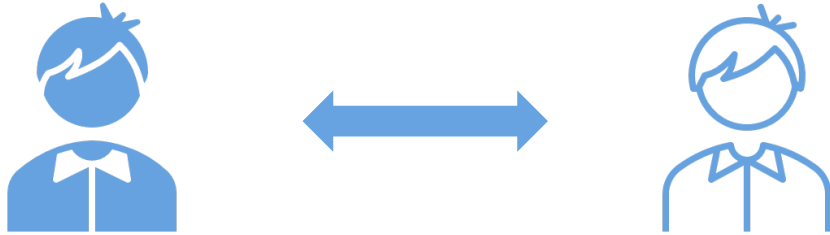
Candidate	Sashiko Shirai Reyna
PhD title	Second generation agent-based modelling for improving APOC operations
Proponent	Amsterdam University of Applied Sciences (AUAS), with ENAC

Candidate	Jan Evler
PhD title	Resource-constrained airline ground operations: optimizing schedule recovery under uncertainty
Proponent	TU Dresden

- Summer school 2019



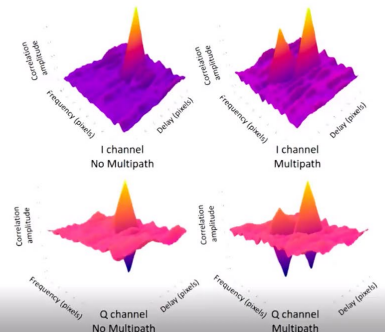
- Summer school 2020



Methodology and modelling

Examples of correlator output 2/2

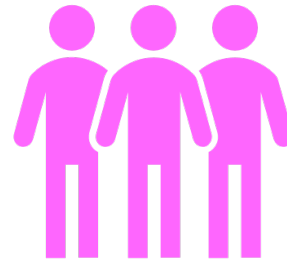
- Transform I/Q correlator outputs in 2-channel images;
- Transform physic scale (Hz, ms) in pixels;
- Define image resolution as number of pixels on each axis.



The figure displays four 3D surface plots arranged in a 2x2 grid. The top row shows the I channel, and the bottom row shows the Q channel. The left column represents 'No Multipath' and the right column represents 'Multipath'. Each plot has 'Frequency (pixels)' on the vertical axis and 'Delay (pixels)' on the horizontal axis. The 'No Multipath' plots show a single, sharp peak, while the 'Multipath' plots show multiple peaks, indicating signal interference.

Participants: ARAC, Radoslaw Jozanovic, Tarja Koti, Dirk Schuster, Edward Meehan, Giuliano Tarnier

- Summer school 2021



industry



PhDs and educational elements



Monday 30 AUG AM

Eva Puntero (SJU)

Luca Crecco (SJU)

Diogene De Souza (Heathrow Airport)

Alan Marsden (EUROCONTROL)

Monday 30 AUG PM

Olivia Nunez (SJU)

Gideon Wormeester (Skyguide)

Emmanuel Isambert (EASA)

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Anaïs Lacroix (Skyguide)

Jose Manuel Cordero Garcia (CRIDA)

Nadine Pilon (EUROCONTROL)

Giuseppe Murgese (EUROCONTROL)

The logo consists of a pink outline of a house roof above the text "ER & IR" in a bold, pink, sans-serif font.

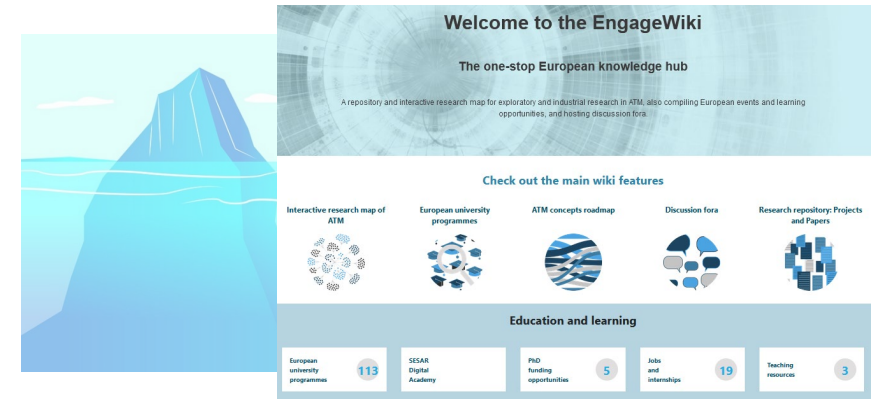
5. Heads-up on Engage 2 & getting involved

Engage 1 ... in numbers

Wide range of synergistic elements underpinned by key overall objectives, such as integrating ER and IR

- supported **4 SESAR Innovation Days**; ran **3 summer schools**; **14 thematic challenge workshops** (+ others)
- **4 thematic challenges**; supporting **18 projects**, working with **31 unique institutions**, producing appx. **130 research outputs**
- supported **10 PhDs** (financing and co-mentoring), working with **21 unique institutions**, producing appx. **100 research outputs**; plus travel bursaries, publication grants, training course places; **3 rounds** of additional budgetary support to PhDs
- research repository describes **>350 projects**, **>1400 deliverables/reports** and **>650 conference papers**
- database of **>110 under- & post-graduate** teaching programmes
- **3 introductory teaching courses**
- **>300 events** publicised; appx. **100 job and internship ads**
- appx. **60 industry partners**

SESAR's European KTN; Airspace World 2023, Geneva, 10 March 2023



Research and innovation insights



Engage 2 ... the new team (pending GA)



For industry – why and how to get involved



Why

- co-developing (research) needs directly with application-oriented academia: improved
- getting **new domains onto research agenda** (short- and medium-term); e.g. catalyst funding to support
- **shaping new tools** (e.g. repository, mapping) and their functionality at the design stage – **more user-centred**
 - access to **match-making platform** – mobile app, identify *mutual* opportunities and align with skill pathway maps
- supporting the next generation of ATM operational and engineering staff
 - two-way processes, and often altruistic, e.g. SESAR Digital Academy / EUROCAE WG-125



How

- **Industry Board** (more formal role); deeper integration into network; dedicated WP5
- **roundtable consultations** aimed at industry to help embed engagement across KTN and ensure relevance
- **18 events**, with **industry design input**, including **interdisciplinary & thematic workshops**, plus **open days** (hosted at universities, inviting industry) and **hackathons** (driving digitalisation solutions for ATM)

Over 120 references to 'industry' in proposal!

Next

- promotion via SJU channels; re-inviting Engage 1 industry partners; other partners identified in advance
- in interim: **cookaj@westminster.ac.uk**

Thank you



Q&A #2

Stand-by slides

Background and overview

Extract from the Call



“**Communication** – organisation of workshops and symposiums ... summer schools ...

Observatory and roadmap – monitoring, identification and analysis of new opportunities for innovative ATM research of relevance to the evolution of the European ATM system and the development of a long-term roadmap ... beyond SESAR 2020 ...

Take-up – stimulate the transfer of exploratory research results towards ATM applications-oriented research and onwards towards industrial research...

Future ATM Skilled work-force – supports European ATM education and training in the ATM Community to develop new talent with a deep knowledge of the future ATM scientific research needs which will sustain a supply of bright young ATM research talent in the long term as well as stimulating the next generation of ATM operational and engineering staff ...

Support to SJU initiatives – support the organisation of the SESAR Innovation Days research conference and the SESAR Young Scientist Award ...”

Legacy, lessons, impact

Lessons learned (extensively reported by WP)



UoW 24.8 PM 'in kind'!

- SESAR 3 KTN needs a **lot more effort in WP1** (e.g. contracting; some off-sets)
- PhD contracting & management across academic institutions **very heterogenous**; also, **tighten 60-day** reporting
- Too many **deliverables** (esp. outdated cf. wiki; time invested (consortium and SJU) cf. **alternative investment**)
- PhDs & TCs need to **launch very early** in SESAR 3 KTN (stagger the launches – maybe)
- Catalyst fund projects **'light touch' approach effective**; (required) industry context valuable; **good 'catalysts'**
- Projects delivered **very high value for money** (ambitious)
- Virtual formats (e.g. workshops) offered **greater accessibility**; difficult to manage **high & low TRL** in same events
- **SESAR e-news vital tool** for dissemination and workshop promotion (GDPR a barrier)




- *Project documents/licences processing & metadata for repository very labour intensive
=> increased systemisation & key-wording (indexing)*
- *Need data (and code) standardisation for projects & PhDs (sunk effort) (access, licencing framework, synthetic data)*
- *Need a common, single, indexable and fully searchable repository – kept fully up to date*

D3.10 – Table 2-9 extract



Research and
innovation
insights

Table 2-9. Research threads for the gap analysis pillar & relationships with SRIA flagships


Thread	SRIA flagship(s)	Summary
1		Additional focus on safety performance: In the analyses presented on the semantic similarity index for each of the projects in our database with respect to the descriptions of the nine SRIA flagship activities, it is noteworthy that the two weakest-linked past projects are safety related. This raised the question regarding the extent to which the SRIA is sufficiently safety oriented, given the clearly accepted view of the priority of this operational performance criterion.
	1 	Connected and automated ATM: The SRIA has not allocated safety as an area of specific work <i>per se</i> , but rather as a horizontal performance criterion forcing safety evaluations to be undertaken in each area. However, the foreseen contributions of the nine flagship activities to the safety dimension seem to be quite modest, from “maintaining” to “maintained if not improved”, falling rather short, it seems, of earlier ACARE/SES objectives of a ten-fold safety improvement. This flagship (connected and automated ATM) aims at higher levels of automation and specific tools for safety improvement in higher levels of automation. It would be of value to stress even more the need for a well-designed and executed safety assessment, as that is usually the stepping stone for faster development and deployment, especially for safety-critical innovations. Approaches to safety assessment developed since SESAR 1 could add value here.
2		Developing techniques for dynamic risk modelling: The analyses presented here flagged that modelling in some projects often ran ahead of corresponding validation and use. Therefore, developing techniques for dynamic risk modelling was supported, with, <i>inter alia</i> , a suggestion that R&D relating to human performance management systems should be analysed further before selective follow-up could be recommended.
	1, 2  	Connected and automated ATM; Air-ground integration and autonomy: These two flagships propose research into safety-critical areas, which require rigorous safety assessments. It would be of value to stress the need for well-designed and executed safety assessments for research performed in these flagships (also for other flagships, but the link to these two is more critical). However, it is readily acknowledged that material on the application of dynamic risk modelling is included in the <i>Guidance to Apply SESAR Safety Reference Material*</i> , whereas it would be endorsed that actual safety assessments should deploy tools specific to the safety requirements in question.

D3.10 – Table 2-11 extract



*Research and
innovation
insights*

Table 2-11. Research threads for the thematic challenges pillar & relationships with SRIA flagships

Thread (TCs in brackets)	SRIA flagship(s)	Summary
1 (1)		<p>Establish and develop a SESAR 3 cybersecurity community: CNS/ATM components (e.g., ADS-B, SWIM, datalink, Asterix) of the current and future air transport system present vulnerabilities that could be used to perform cyber-attacks. Further investigations are necessary to mitigate these vulnerabilities, moving towards a cyber-resilient system, fully characterising ATM data, its confidentiality, integrity and availability requirements, taking into account the fact that new and old ATM systems will continue to operate concurrently for years to come. All these issues are especially challenging in a multi-stakeholder, multi-system environment such as ATM, where confidentiality and trust are key. Nevertheless, the cybersecurity awareness and security culture is still rather immature in ATM research, whilst there is much interest in addressing this topic and creating a SESAR 3 cybersecurity community.</p>
	<p>5</p> 	<p>Virtualisation and cyber-secure data sharing: This flagship addresses several high-level R&I needs/challenges, with that of ‘cyber resilience’ describing the need for monitoring and adapting to the changing threat landscape and emergence of new actors, aiming at the development of cyber-resilience guidelines and procedures tailored to ATM. However, a large and positive impact could be obtained through continuous collaboration and updates within a dedicated SESAR 3 cybersecurity community. This flagship is the place for setting up such guidelines and procedures, although not necessarily the best place for the establishment and nurturing of a cyber community, which might be developed through the SESAR 3 KTN or Digital Academy, overarching the flagship and its corresponding work components and actors.</p>
2 (1)		<p>Support a culture of responsible disclosure & sharing experimental scenarios*: In order to improve the cybersecurity awareness and security culture research in particular, in ATM, there is a need for common data sets and synthetic data. Responsible disclosure mechanisms for research and, more importantly, for the ATM community, are particularly relevant. Such mechanisms tend to be highly bureaucratic and troublesome, complicated further for researchers by some tech companies making use of cease-and-desist orders. This is a very complex topic in cybersecurity – and for data privacy in general, across the flagships, impacting research output validation, for example (since projects use different input data).</p>

D3.10 – Table 2-13 extract



Research and
innovation
insights

Table 2-13. Research threads for the horizon flagships pillar & relationships with SRIA flagships

Thread	SRIA flagship(s)	Summary
1		Quantum computing: Quantum computers use quantum physics properties to enable certain types of computations to be performed vastly quicker than classical computers. A fundamental advantage of quantum computers is the ability to consider large numbers of combinations simultaneously. Quantum computing could expose cybersecurity vulnerabilities, through solving integer factorisation problems, which underpin many public key cryptographic systems, including blockchain applications, thus already generating improved cybersecurity research. Quantum computing is likely to bring particular opportunities for simulation, especially when coupled with machine learning and AI.
	8 	Artificial intelligence (AI) for aviation: whilst the strongest correspondence of quantum computing is unsurprisingly with the 'AI' flagship, the wider implications for this new technology are very broad and deep, considering the applications of much faster solutions to search space and combinatorial problems, potentially offering vastly improved capabilities both for operational/tactical searches of improved solutions to complex capacity constraints in ATM, and e.g. (safety) validation. Exposing cybersecurity vulnerabilities and supporting public key cryptographic systems are clearly important in the ATM context regarding not only CNS, but also in the context wider of information exchange over networks, supporting SWIM and privileged data exchange (e.g. for UDPP).
2		Strong AI: this is also known as general AI or artificial general intelligence, usually referring to a form of AI whereby a computer has intelligence comparable to that of humans, with the ability to solve problems, learn, and plan future contingencies. Reinforcement learning is arguably a sufficient basis for strong AI, e.g. with the inclusion of agents that learn through interaction with the environment through operational sensors. Coupled with deep neural networks, more powerful dimension reduction and polynomial classification, such technologies could help to build better predictive models from specific aircraft and component safety profiles through to full socio-technical system models at the design stage.
	8, 1 	Artificial intelligence (AI) for aviation: the strongest correspondence of strong AI is not unexpectedly with the 'AI' flagship, which cites "AI for prescriptive aviation". Whilst strong AI represents a step-shift in the state of the art, it builds on the current science, for example, whereby the coupling of advanced sensor technologies with ML/AI techniques, could support system development in multiple contexts, such as risk mitigation, system diagnoses, performance assessment, forecasting, predictive support and design. Connected and automated ATM: may be supported specifically through more efficient resource allocation for humans and machines, although this is just one of many other SRIA flagships potentially impacted strategically and tactically e.g. through strong AI's foresight capabilities, 'strong emergence' and policy generation.

SESAR Digital Academy initiative. The network will support the European ATM education and training required to develop new talent with a deep knowledge of future ATM scientific research needs, sustain a supply of bright young research talent in the long term and stimulate the next generation of ATM operational and engineering staff. To achieve this, the selected consortium will carry out at least the following activities.

- It will launch calls for PhD research projects, managing the call text, the selection process, funding and promotion, and coordinating the participation of the funded PhD students in key SESAR Digital Academy events. It will also be responsible for signposting other financial support opportunities for students pursuing PhDs and other postgraduate theses or dissertations on innovative research ideas.
- It will facilitate placements and/or training opportunities, offering students a chance to develop new skills and gain valuable industry experience.
- It will support the promotion of the SESAR Young Scientist Award campaigns, helping to ensure the visibility of the campaign and encouraging aviation students to submit applications.
- It will support the SESAR 3 JU in the preparation and execution of webinars and other similar events (see also the following bullet point).

D3.9

- D3.9: The Engage wiki – functionality and user-manual
- Details on the data sources in the wiki; repository functionality
- How the interactive map was built, deriving the clusters
- Concepts roadmap – relationship with the SRIA
 - Horizon flagships – seeding future-oriented research ideas (e.g. ‘strong AI’)
- University progs, teaching resources, internships, PhD Calls
 - how to engage and edit yourself (instructions also in the wiki itself)
- Full provision to maintain in 2022, videos, handover to SJU
 - *Detailed* lessons (e.g. attacks); next steps (e.g. building discussion fora, SESAR 3)

D3.10

- Research enablers
 - Data and code issues (e.g. access, licencing framework, synthetic data)
 - Community collaboration (people, networks, momentum)
 - Extending the SESAR KPI state of the art
 - Distributed and remote simulations (Covid-19)
- Research platforms
 - *Possibilities* for the wiki going forward
 - Sources of project data – consolidation and recency
 - Format and implementation of virtual workshops

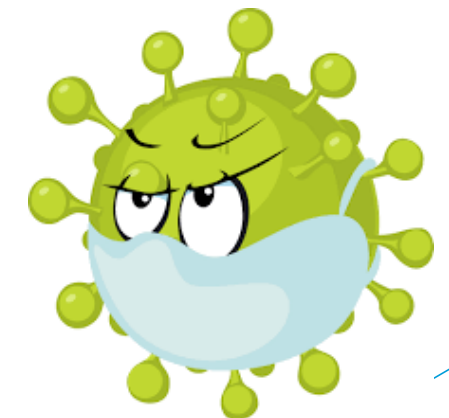
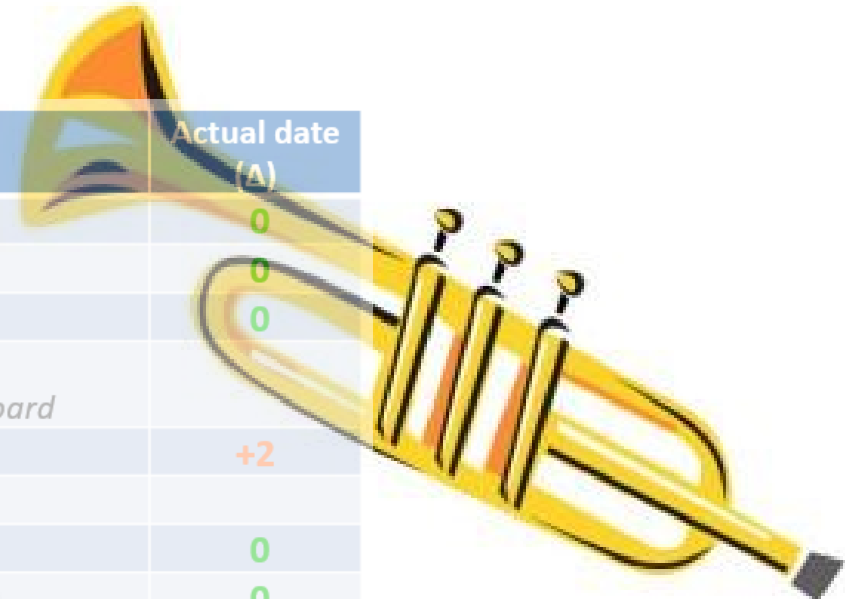
Detailed lessons
learned across the KTN

Thematic challenges and projects

Second Call for CF projects

Scheduled date	Activity	Actual date (Δ)
06JAN20	Call opened (Commission's Participant Portal; Engage website)	0
30MAR20	Ensure everything ready for the evaluation process	0
06APR20	Call closes (2 day turnaround)	0
	– submission checks	
	– resolve any potential conflicts of interest; allocation to Awards Board	
08APR20	Evaluation begins (4 weeks to contracting process)	+2
	– 3 weeks for the evaluation, incl. Easter break	
20APR20	Reminder to Awards Board about evaluation process	0
28APR20	Evaluation deadline (latest to return evaluation forms to ECTI)	0
	– 1 week to process and determine the outcome (up to 8 projects)	
05MAY20	Funding decision finalised	+1
06MAY20	Send notification letter to all proposers	+1
06MAY20	UoW contracting process begins; then UoW to each CF2 project coordinator	+1
11MAY20	Start consolidating evaluation feedback across evaluators (110 forms)	-5
[endMAY]	Send detailed, consolidated feedback (+ve/-ve outcomes) prior to launch	0
08JUN20	CF2 projects begin launching (once agreement signed)	-8
03JUL20	All CF2 projects launched	0

On time



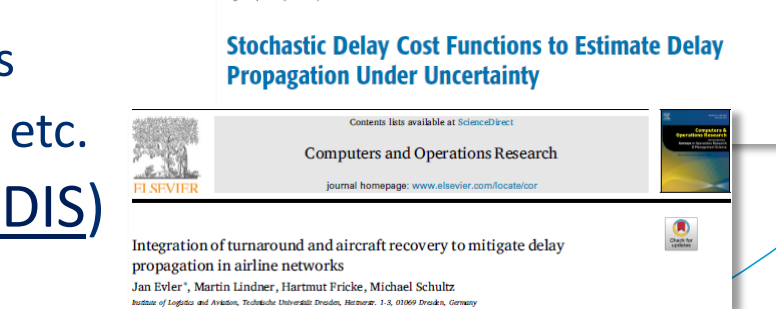
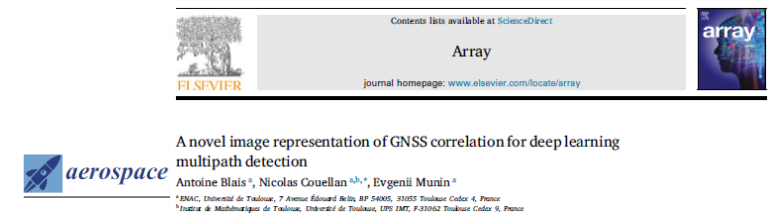
- Engage C&D activities have
 - i. supported European ATM **education & training** in the ATM community
 - ii. stimulated the **transfer of ER** results towards ATM application-oriented research

- Engage PhDs & CF projects have produced **over 200 research outputs**, including:

- 15 open access journal articles (peer-reviewed)
- 40 conference papers (peer-reviewed)
- 100+ presentations at workshops & other events
- plus book chapters, code, tools, videos, posters, etc.

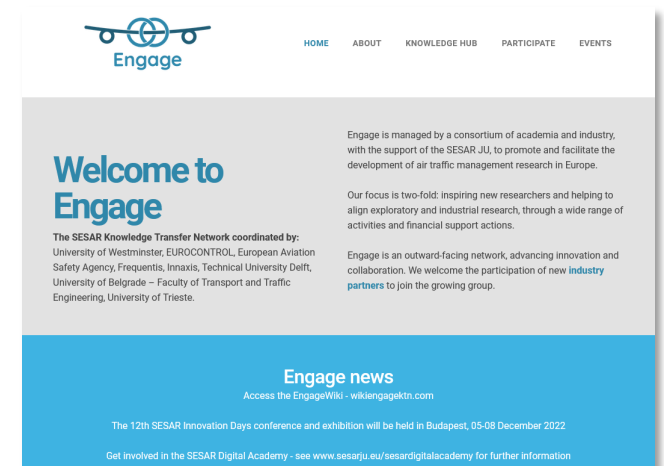
- **50 publications** logged in EC Portal (via [CORDIS](#))

e.g. ATM R&D Seminar,
EIWAC, EMSS, ICRAT,
OpenSky, SIDs conferences



- Website

- engagektn.com launched in M1 (JAN18)
- ≈52k page views over the lifetime of Engage; **approx. 1000 hits per month**, with peaks in the build-up to key KTN activities e.g. PhD/CF Calls, summer schools & workshops
- top 3 pages: home (incl. news items), thematic challenge workshops & events
- key information is being maintained **after the closure of Engage**: SIDs conference & Call opportunities



- Social media

- twitter.com/EngageKTN launched in MAY18; **850+ followers**
- supported & promoted content relevant to ATM community; supported all S3JU Tweets for the duration of Engage
- key content is being supported **after the closure of Engage**, e.g. SIDs 2022 conference & its Call for contributions
- custom banners to help promote key events



PhDs and education – SDA

SESAR Digital Academy

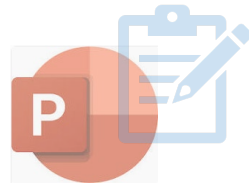
PhDs and education – SDA



June 2021



EngageWiki



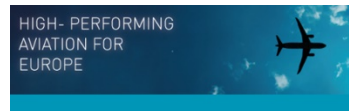
Introduction to ATM
Airline planning and operations
Airport planning and operations



Free use for all academic / research institutions



Engage website



SESAR JU E-News



SESAR JU website



E-mail subscribers

EngageWiki: European university programmes

[\[video link\]](#)

PhDs and education – SDA

PhD: Jonas Langner



Candidate	Jonas Langner
PhD title	Decision support system for airline operation control hub centre ('DiSpAtCH')
Lead supervisor	Prof. Dr.-Ing. Peter Hecker
Proponent	TU Braunschweig
Summary	During airline disruption , decision making mainly relies on the experience of staff working in the operation control centre. 'DiSpAtCH' is developing a decision support tool using machine learning algorithms – three ML modules have been defined of which one aims to propose a suitable action/solution in a disrupted situation. Since the required training data are unavailable, an airline simulation tool has had to be built in order to produce generic operational data of an airline and its daily operations.
Start date	15JUL19
End date	(14JUL22) Q3 2022 +2 months
Final reporting	Approved
Funding	€125 792 (99.8%)

D5.18

PhDs and education – SDA

PhD: Alevizos Bastas



Candidate	Alevizos Bastas
PhD title	Trajectory planning for conflict-free trajectories: a multi agent reinforcement learning approach (RL4CFTP)
Lead supervisor	Prof. George Vouros
Proponent	University of Piraeus
Summary	This PhD is exploring AI/machine learning algorithms in order to plan conflict-free trajectories in computationally efficient ways, for a large number of trajectories across airspace in multiple FIRs.
Start date	29MAR19
End date	(28MAR22) NOV 2022 +8 months
Final reporting	Approved
Funding	€41 554 (89.1%)

D5.19

PhDs and education – SDA

PhD: Evgenii Munin



Candidate	Evgenii Munin
PhD title	Detection, classification, identification and mitigation of GNSS signal degradations by means of machine learning
Lead supervisor	Prof. Nicolas Couellan
Proponent	ENAC
Summary	The quality of the position calculated by on-board GPS equipment can be reduced when the received signal is degraded. The objective of this PhD was to use machine learning techniques to detect, classify, identify and reduce the impairments of the Global Navigation Satellite System signals seen by the on-board receiver.
Start date	16APR19
End date	(15APR22) (N/A; candidate <i>withdrew from PhD</i>)
Final reporting	Publishable final report only (no formal assessment; no further payment)
Funding	€43 811 (69.9%)

D5.20

PhDs and education – SDA

PhD: Manuel Mateos



Candidate	Manuel Mateos
PhD title	Machine learning for aircraft trajectory prediction: a solution for pre-tactical ATFCM
Lead supervisor	Dr. Xavier Prats
Proponent	Nommon (with UPC)
Summary	The overall goal is to develop and evaluate innovative approaches to air traffic demand forecasting based on AI and machine learning techniques, focusing on the pre-tactical phase of the ATFM process. The solution being developed aims to improve the predictive performance of the NM's PREDICT tool while being able to cope with the entire set of flights in the ECAC network in a computationally efficient manner.
Start date	01MAR19
End date	(28FEB22) SEP 2022 +7 months
Final reporting	Approved
Funding	€87 834 (100.0%)

D5.21



PhDs and education – SDA

PhD: Ralvi Isufaj



Candidate	Ralvi Isufaj
PhD title	Deep multi-agent reinforcement learning applications in ATM
Lead supervisor	Dr. Miquel Angel Piera
Proponent	UAB
Summary	This PhD is built on the future work proposals of the AGENT ER project and seeks possible improvement of several critical aspects of the system through the application of machine learning techniques. There are two goals in this project: define airspace complexity in a way that challenges current definitions and overcomes their limitations, and investigate how ML can be applied to safety in aviation. These problems have been investigated for en-route traffic at the tactical level, as well as UAV systems.
Start date	01MAY19
End date	(30APR22) JUL 2022 +3 months
Final reporting	Approved
Funding	€45 586 (91.2%)

D5.22

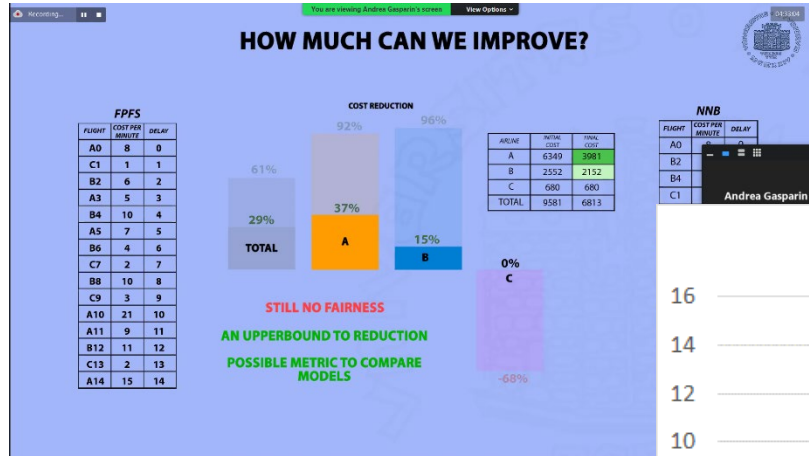
MON 30AUG	09.45-10.00	10.00-11.15	11.30-12.30	Lunch break	13.30-14.10	14.10-14.45	15.00-15.30	
	Opening Andrew Cook (UoW) & Lorenzo Castelli (University of Trieste)	 Airline and airport operations centres Jonas Langner (TU Braunschweig), Sashiko Shirai Reyna (Amsterdam UAS/ENAC)	Panel discussion Moderator: Bojana Mirkovic (University of Belgrade-FTTE)		 Signal processing for trajectory prediction Homeyra Khaledian (UPC Barcelona)	Panel discussion Moderator: Junzi Sun (TU Delft)	SESAR Young Scientist Award Junzi Sun (TU Delft)	
TUE 31AUG		11.15-12.00	12.00-12.30	Lunch break	13.30-14.45	15.00-16.00		
		The Engage wiki Pablo Hernandez (Innaxis)	Teaching resources in the wiki (University of Belgrade-FTTE*)		 DCB hotspot detection and machine learning for traffic demand prediction Sergi Mas Pujol (UPC Barcelona), Manuel Mateos (Nommon/UPC Barcelona)	Panel discussion Moderator: Lorenzo Castelli (Uni. of Trieste)		
WED 01SEP		10.00-11.15	11.30-12.30	Lunch break	13.30-15.30	15.30-16.00		
		 Machine learning and traffic deconfliction Alevizos Bastas (University of Piraeus), Ralvi Isufaj (UAB Barcelona)	Panel discussion Moderator: Fedja Netjasov (Belgrade-FTTE)		Shaping a future European ATM Academy SESAR Scientific Committee	 Engage PhDs Q&A UoW		
THU 02SEP		10.00-11.15	11.30-12.30	Lunch break	13.30-14.45	15.00-16.00	16.15-17.00	17.00-17.15
		 Weather prediction / forecasting models Anastasia Lemetti (Linköping University), Eduardo Andrés (Universidad Carlos III Madrid)	Panel discussion Moderator: Tatjana Bolic (University of Westminster)		 Flight prioritisation, UDPP and route charging Jan Evler (TU Dresden), Andrea Gasparin (University of Trieste), Natalia Solčianska, (University of Trieste)	Panel discussion Moderator: Andrew Cook (University of Westminster)	Future research horizons Dirk Schaefer (EUROCONTROL)	Close and what's coming next Andrew Cook (UoW)

*Bojana Mirkovic, Fedja Netjasov, Danica Babić

PhDs and education – SDA Summer schools

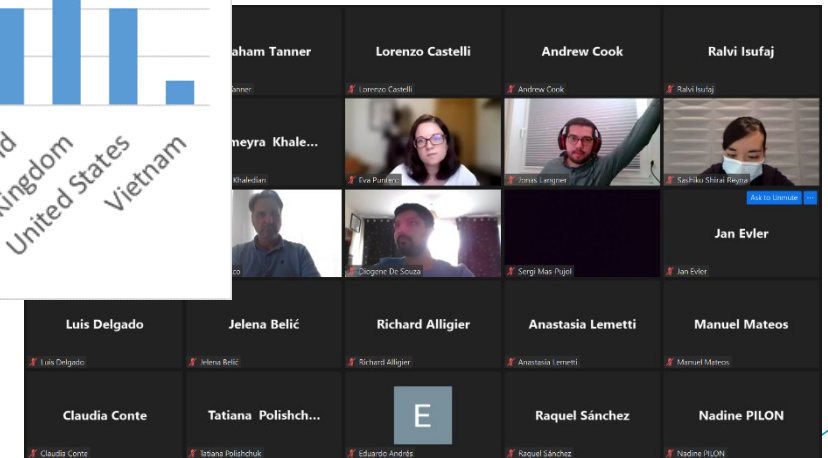
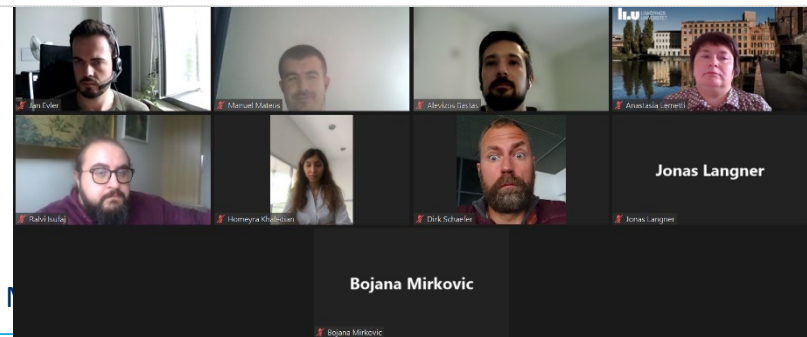
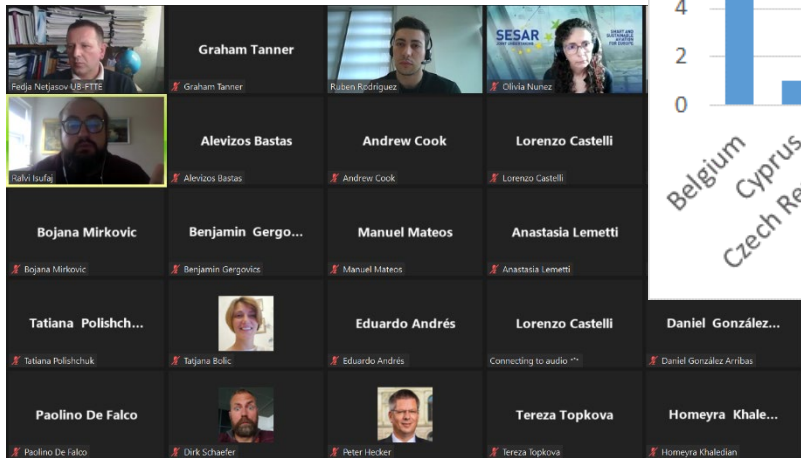
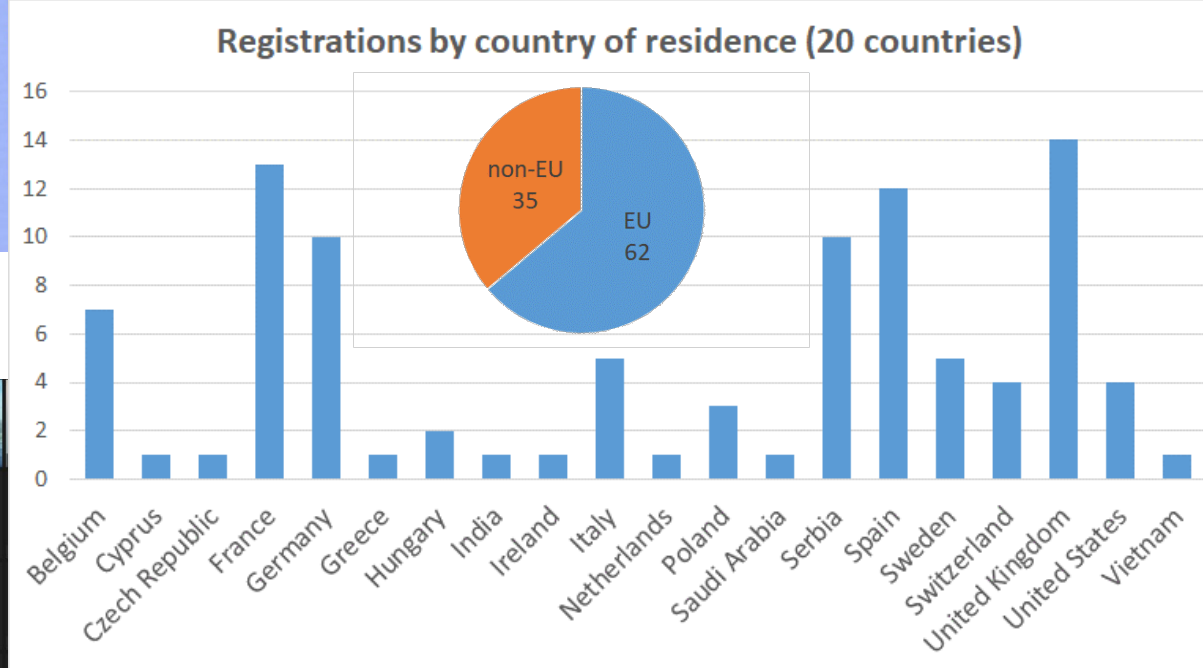
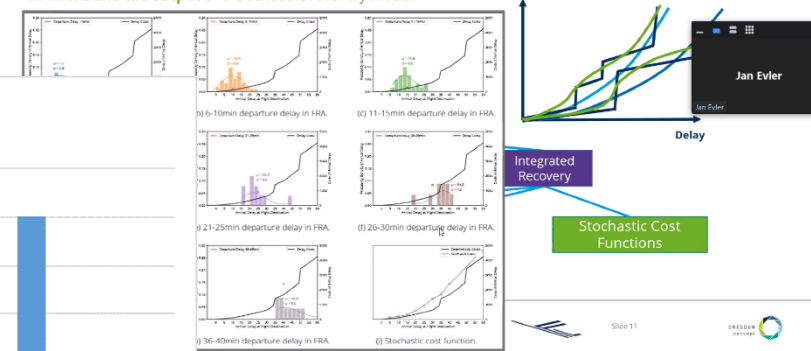


97 participants



Research Question 2 – SIDs Paper 2020

RQ2.1: How can flight-specific delay cost functions be defined, such that they include downstream network dependencies, scheduled slack and active recovery potential?
RQ2.2: How does uncertainty about downstream delays and costs influence the shape of such delay cost functions and the output of the schedule recovery model?



PhDs and education – SDA Summer schools



Monday 30 AUG AM

Eva Puntero (SJU)

Luca Crecco (SJU)

Diogene De Souza (Heathrow Airport)

Alan Marsden (EUROCONTROL)

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Nadine Pilon (EUROCONTROL)

Giuseppe Murgese (EUROCONTROL)

Thank you
panellists!

PhDs and education – SDA

PhD: Anastasia Lemetti



Candidate	Anastasia Lemetti
PhD title	Integrating weather prediction models into ATM planning ('IWA')
Lead supervisor	Dr. Valentin Polishchuk
Proponent	Linköping University
Summary	The PhD applies probabilistic weather modelling techniques , that consider the influence of bad weather conditions on the solutions developed in related projects and integrates them into optimisation frameworks. The optimisation framework for arrival route planning in TMA has been enhanced with a convective weather avoidance technique. Probabilistic weather products have then been used to obtain an ensemble of staffing solutions, from which the probability distributions of the number of necessary ATCOs were derived . Proposed solutions were successfully tested using historical flight data from Swedish airports.
Start date	01MAR19
End date	(28FEB22) Q1 2024 (+24 months)
Final reporting	Approved
Funding	€102 000 (100.0%)

D5.23

PhDs and education – SDA

PhD: Homeyra Khaledian



Candidate	Homeyra Khaledian
PhD title	Advanced statistical signal processing for next generation trajectory prediction
Lead supervisor	Dr. Xavier Prats
Proponent	UPC
Summary	Reliable guidance mode information, i.e. the constraints and commands that specify how the aircraft should behave in order to perform a desired trajectory, is fundamental for air- or ground-based trajectory prediction. This research has focused on identifying aircraft guidance modes in the vertical plane , including a new probabilistic perspective of the trajectory prediction problem using signal processing mathematical tools.
Start date	01AUG19
End date	(31JUL22) MAY 2023 +10 months
Final reporting	Approved
Funding	€50 000 (100.0%)

D5.24

PhDs and education – SDA

PhD: Eduardo Andrés



Candidate	Eduardo Andrés
PhD title	A pilot/dispatcher support tool based on the enhanced provision of thunderstorm forecasts considering its inherent uncertainty ('STORMY')
Lead supervisor	Dr. Manuel Soler
Proponent	UC3M
Summary	The location and timing of thunderstorms are hard to predict with certainty, and this stochasticity is an important element that methodologies for aircraft trajectory planning must consider. This PhD uses two heuristic approaches (scenario-based rapidly-exploring random tree and augmented random search) that rely on the iterative manipulation of graphs, producing results in seconds through the use of GPU programming.
Start date	01FEB19
End date	(31JAN22) SEP 2022 +8 months
Final reporting	Approved
Funding	€64 226 (98.8%)

D5.25

PhDs and education – SDA

PhDs: Sashiko Shirai Reyna



Candidate	Sashiko Shirai Reyna
PhD title	Second generation agent-based modelling for improving APOC operations
Lead supervisor	Prof. Daniel Delahaye
Proponent	AUAS (with ENAC)
Summary	The objective of this work is to create a decision support tool to help the airport operation centre with the integration of different approaches, by mitigating the conflicts of critical resources . Conflicts are related to different processes of the airport management and capacity (e.g. runway, taxiway, gates and ground handling). To solve these conflicts, an adapted simulated annealing heuristic combined with a time decomposition approach (sliding window) is used.
Start date	01OCT19
End date	(30SEP22) NOV 2022 +2 months
Final reporting	Approved
Funding	€101 988 (98.5%)

D5.26

PhDs and education – SDA

PhD: Jan Evler



Candidate	Jan Evler
PhD title	Resource-Constrained Airline Ground Operations: Optimizing Schedule Recovery under Uncertainty <i>(originally 'Stochastic control of tactical airline operations in hub airport networks')</i>
Lead supervisor	Prof. Dr.-Ing. Hartmut Fricke
Proponent	TU Dresden
Summary	While ATFM regards each flight as an individual entity when it controls sector capacity utilisation, airlines evaluate each flight as part of an aircraft rotation, crew pairing and passenger itinerary. As a result, ATFM slot regulations are poorly coordinated with the resource interdependencies within an airline network , such that the aircraft turnaround is the major contributor to primary and reactionary delays in Europe. This PhD bridges the gap between both paradigms by developing an integrated schedule recovery model that enables airlines to define their optimal flight priorities for schedule disturbances arising from ATFM capacity constraints.
Start date	01JUN19
End date	(31MAY22) FEB 2022 (-3 months)
Final reporting	Approved
Funding	€122 284 (93.9%)

D5.27

“Thank you once again for this wonderful opportunity and your energy invested in organising this very instructive project. I very much appreciated the steady feedback from industry and other academic stakeholders and to cooperate with the best innovators and scholars in Europe.”

PhDs and education – SDA

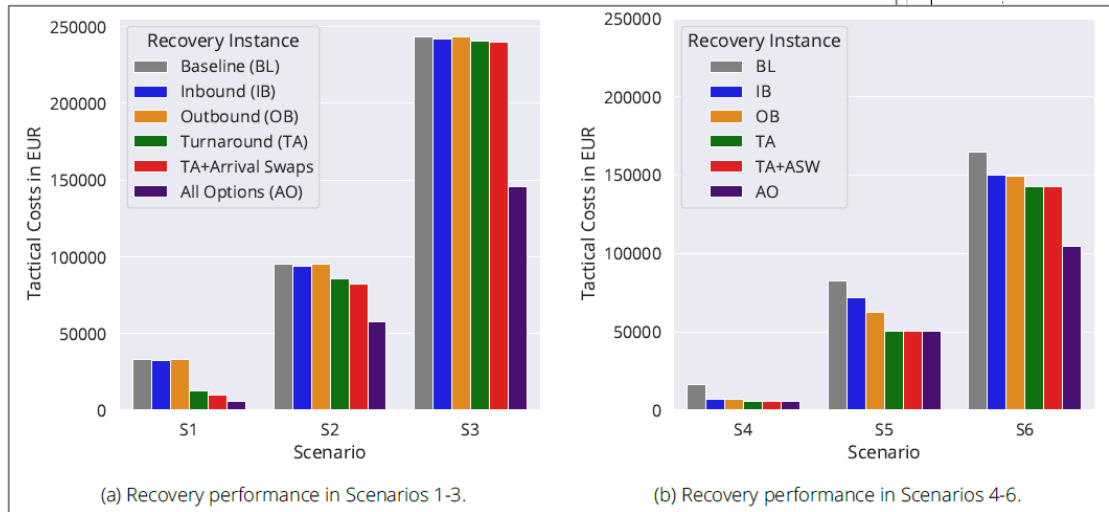
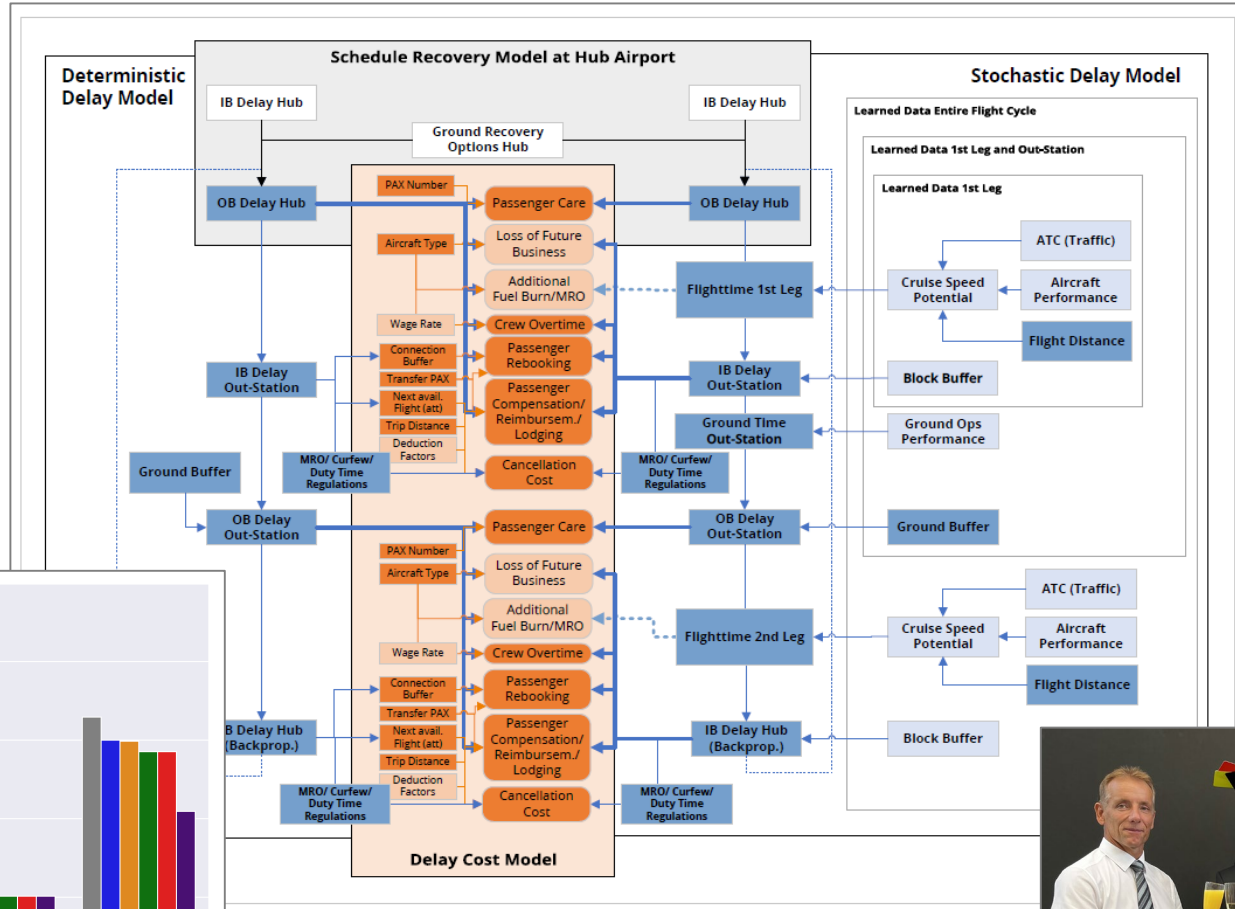
PhD: Jan Evler

TECHNISCHE UNIVERSITÄT DRESDEN

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Schedule recovery under uncertainty with focus on resource-constrained airline ground operations

AGIFORS Airline Operations Conference
11-13 May 2022



15 August 2022



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SRIA flagship activities

'forward' cluster & semantic similarity analysis

ER2

U-space and urban air mobility

U-space and urban air mobility

WP-E

ER4

Optimisation and complexity techniques

Artificial intelligence (AI) for aviation

Safety, resilience and automation

Capacity on demand and dynamic airspace

AMAN, DMAN

Transversal projects*

ATC systems

CNS systems

TMAS and separation

SWIM and meteorology services

Airport operations

Large scale demonstrations*

RPAS

Capacity on demand and dynamic airspace

Multimodality and passenger experience

Connected and automated ATM

Aviation green deal

Civil/military interoperability and coordination

Air-ground integration and autonomy

Virtualisation and cyber-secure data sharing

ER1

ER3

IR Wave 1

IR

IR-Demo

IR-LSD

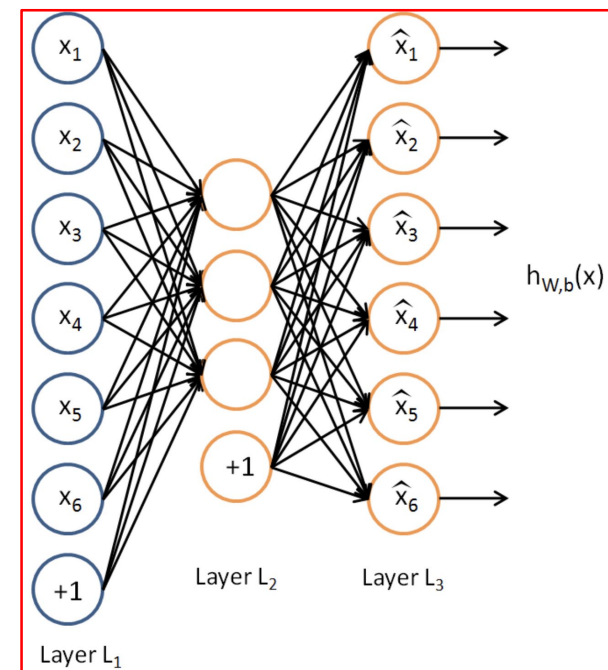
IR-AIRE III

IR-RPAS

IR Wave 2

2011 2012 2013 2014 2016 2017 2019 2021 2030

gap analysis



(1) Multi-dimensional vectorisation; auto-encoder (unsupervised ML) model; **(2)** experts

SESAR Calls

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SRIA flagship activities

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