# 8th SESAR Innovation Days

*Hosted by the University of Salzburg*


SESAR

UNIVERSITÄT SALZBURG

founding members

EUROPEAN UNION

EUROCONTROL

# Welcome and opening

Vicerector Ferreira-Briza,

University of Salzburg

#SIDS2018

# Welcome and opening

Elisabeth Landrichter,
Director General, Austrian Civil Aviation Authority

#SIDS2018

# Keynote

Filip Cornelis,
Director Aviation, DG MOVE, European Commission

#SIDS2018

# Keynote

Philippe Merlo,
Director ATM, EUROCONTROL

#SIDS2018

# SESAR Innovation Days

Salzburg – 4 Dec. 2018

## Key role of exploratory research in ATM

Philippe Merlo
Director DECMA

# Permanent need for ATM exploratory research

- Significant effort to be preserved
- No immediate practical application
- Accept to consider possible dead-ends
- Great potential to shape future of ATM
- Feed innovation pipe-line

- Innovate to meet ATM challenges

# Knowledge transfer is key

- Use innovations from other sectors
- Enable Out-of-the-box thinking
- Inspire new researchers with ATM challenges
- From Fundamental to Industrial Research
- Connect Universities with R&D and Industry
- Grow ATM skilled researchers workforce

- ENGAGE ATM knowledge network

# ATM Challenges today

- Many challenges of different nature:
  - Increasing Airspace capacity
  - Minimizing Aviation environmental footprint
  - Flight efficiency
  - Cost efficiency
  - Training for new generation military jets (J35)
  - Allowing new entrants (drones, balloons, gliders, …)

- Need for new innovative ideas

# Data sciences as a key enabler

- Many new promising technologies:
  - Big Data / Data driven techniques
  - Machine Learning
  - Artificial Intelligence
- Well adapted to ATM sector:
  - Massive data bases already available
  - Flight plans, Airspace, Met, Incidents, etc…
  - Rather repetitive activity with lots of variables

- Master ATM complexity

# ATM Economics as critical enabler

- Incentivising changes
- Eg : Aviation/Electricity/Telecom
- Performance & Charging regulation as 1st step
- More developments considered:
  - Inclusion of delays, flight efficiency, environment ?
  - Different levels of services for ATFM ?
  - Network Manager as capacity broker ?

- Explore new business models

Thank you for your attention !

**Questions ?**

Philippe Merlo
Director DECMA

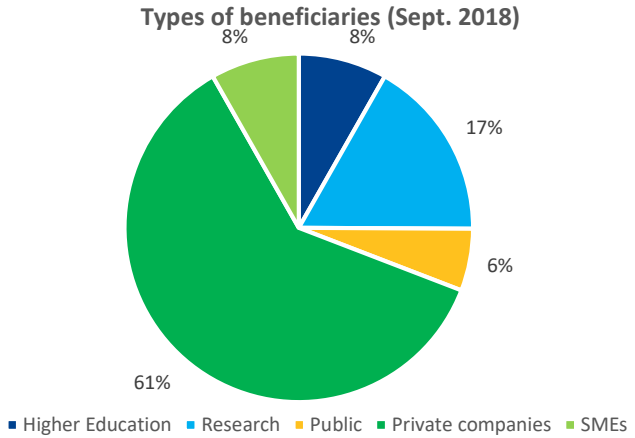
# Keynote

Florian Guillermet,
Executive Director, SESAR JU

#SIDS2018

# GROWING COMMUNITY OF SESAR JU STAKEHOLDERS & BENEFICIARIES


**SESAR 2020 projects: blended academic & industrial expertise**

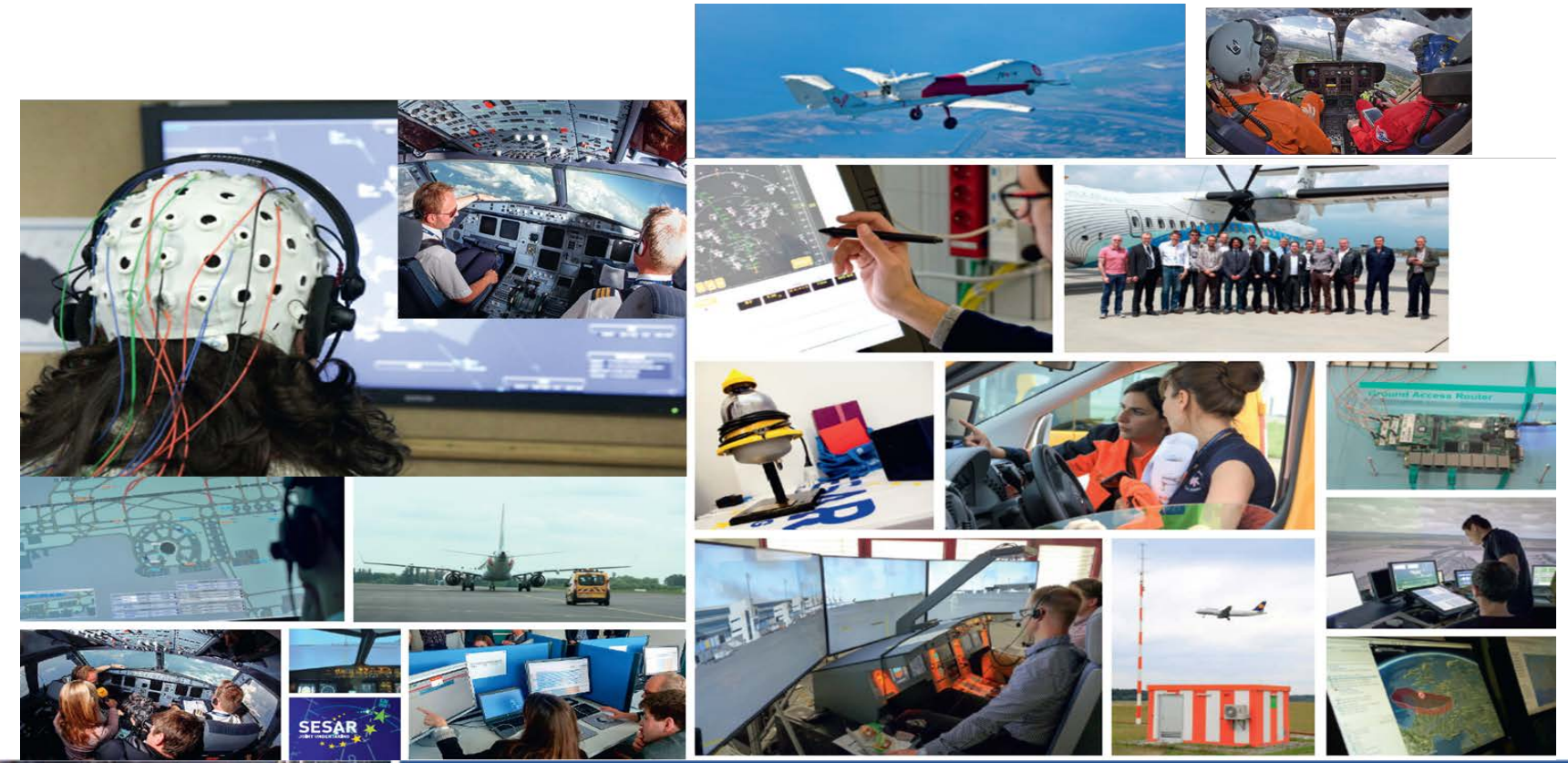


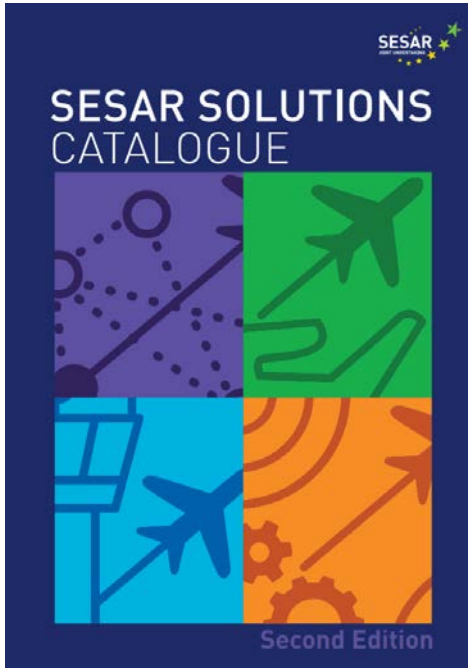

**26 EU Member States participating**

# DELIVERING TIMELY SOLUTIONS:

SMART, GREEN, INTEGRATED

- **63 SESAR Solutions**
- **40+** already **under deployment** across Europe
- Disseminated through **EU aviation standards**
- **Clear associated benefits** and **deployment timeline**




+11% Airport capacity

-39% flight variance

-5,3% costs

-2,4% fuel per flight

# SESAR 2020

PJ20 – Master Plan Maintenance

Engage

ITUIT | APACHE | Domino

AURORA | PACAS | EVOAtm

PJ19 – Content Integration

PJ22 – Validation, Verification & Demo Infrastructure

## Fundamental Scientific Research

BigData4ATM
DART
BEST
TaCo
TBO-MET
MINIMA
PNOWWA
AGENT
MALORCA
AUTOPACE
ATM4E
STRESS
COCTA
COMPAIR
Vista


CLASS
DREAMS
TERRA
SECOPS
IMPETUS
CORUS
PercEvite
DroC2om
Airpass
PODIUM
Safedrone
*USIS (GAP)*
GEOSAFE
VUTURA
SAFIR
GOF USPACE
DOMUS
DIODE
EURODRONE

## ATM Application Oriented Research

### High-performing airport operations

MOTO
RETINA
ENVISION

### Optimised ATM network services

### Advanced ATS

OptiFrame
COPTRA
PARTAKE
SALSA
R-WAKE
ADAPT
COTTON
EMPHASIS (PJ11)

### Enabling aviation infrastructure

NAVISAS
SAPIENT
GATEMAN

## Industrial Research & Validation

PJ02 – Increased Runway and Airport Throughput
PJ03a – Integrated Surface Management
PJ03b – Airport Safety Nets
PJ04 – Total Airport Management
PJ05 – Remote Tower for Multiple Airport

PJ07 – Optimised Airspace Users Operations
PJ08 – Advanced Airspace Management
PJ09 – Advanced DCB

PJ01 – Enhanced Arrivals & Departures
PJ06 – Trajectory Based Free Routing
PJ10 – Separation Management en-route & TMA
PJ11 – Enhanced Air & Ground Safety Nets

PJ14 – CNS
PJ15 – Common Services
PJ16 – CWP/HMI
PJ17 – SWIM Infrastructures
PJ18 – 4D Trajectory Management

## Very Large Scale Demonstration

PJ28 – Integrated Airport Ops (incl. TBS)
AAL2
AUDIO (GAP) (PJ28)

PJ24 – Network Collaborative Management
Airline Team NCM (PJ24)

PJ25 – Arrival Management Extended to en-route Airspace
Airline Team xStream (PJ25)

PJ31 – Initial Trajectory Information Sharing
DIGITS-AU (PJ31)
GRADE
*EAGLES*
GAINS
PJ27 – Flight Information Exchange

# SESAR 2020 EXPLORATORY RESEARCH CALLS

## **H2020 open calls:** not limited to SJU Members

- **ER-1** *(€20,6)*
  ATM excellent science & outreach and ATM applications oriented research
- **ER-2** *(€ 9M)*
  Remotely-piloted aircraft systems (RPAS) in very low-level (VLL) drone operations
- **ER-3** *(€ 10M)*
  Transversal activities, including knowledge transfer networks (KTN) and ATM applications oriented topics
- **ER-4** *(€ 38+M)*
  ATM excellent science & outreach and ATM applications oriented research

#SIDS2018

# FEEDING THE INNOVATION PIPELINE

**Overview**

- 28 ER1-projects, from 2016-2018
- 80 academic and industry partners from European Union and EU Associated Countries (Switzerland, Norway, Iceland, Serbia, Israel, Turkey).

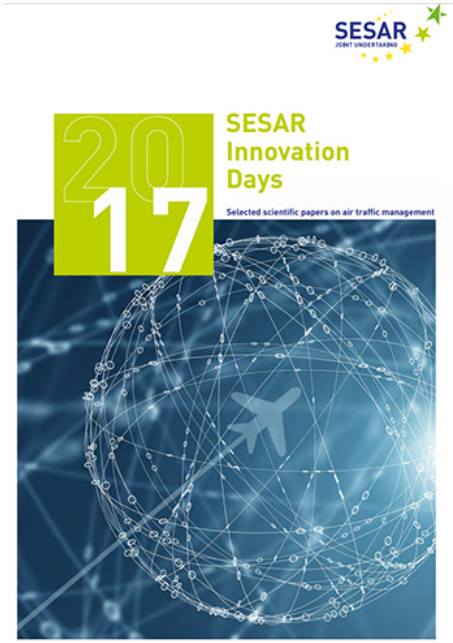
**ATM excellence & outreach**

- Automation, robotics and autonomy
- Complexity, data science and information management
- Environment and meteorology for ATM
- Economics, legal and regulation

**ATM application-oriented research**

- High-performing airport operations
- Advanced air traffic services
- Enabling aviation infrastructure
- ATM operations, architecture, performance and validation

# GROWING RECOGNITION FOR EXPLORATORY RESEARCH RESULTS


CORDIS
Community Research and Development Information Service
European Commission > CORDIS > Projects and Results > Results page

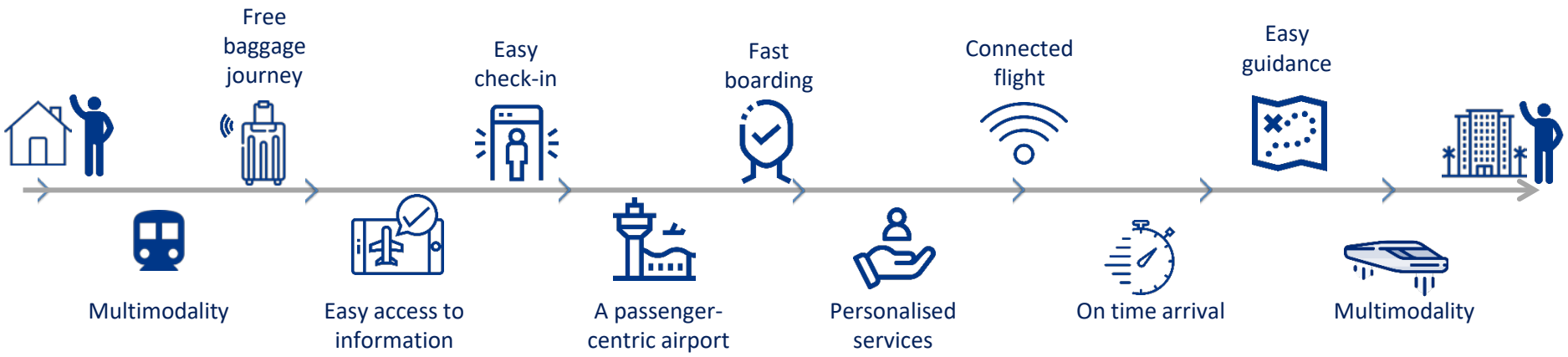
[RESULT IN BRIEF] Better winter weather forecasts for airports
EU-funded researchers developed up to the minute probabilistic forecasts for winter weather that enable air traffic and airport operators to make their operations more efficient and to mitigate risks.
**Programme:** H2020-EU.3.4.7.1
**Record Number:** 239886
**Last updated on:** 2018-10-05
**Available languages:** DE, EN, ES, FR, IT, PL
Booklet

[RESULT IN BRIEF] Speech recognition technology for air traffic controllers
The popularity of air transport continues to grow, placing an even greater workload on air traffic controllers (ATCOs). Their predicament can be improved through an automatic speech recognition system closely integrated with an arrival manager developed by EU and SESAR funded...
**Programme:** H2020-EU.3.4.7.1
**Record Number:** 239630
**Last updated on:** 2018-09-24
**Available languages:** DE, EN, ES, FR, IT, PL
Booklet

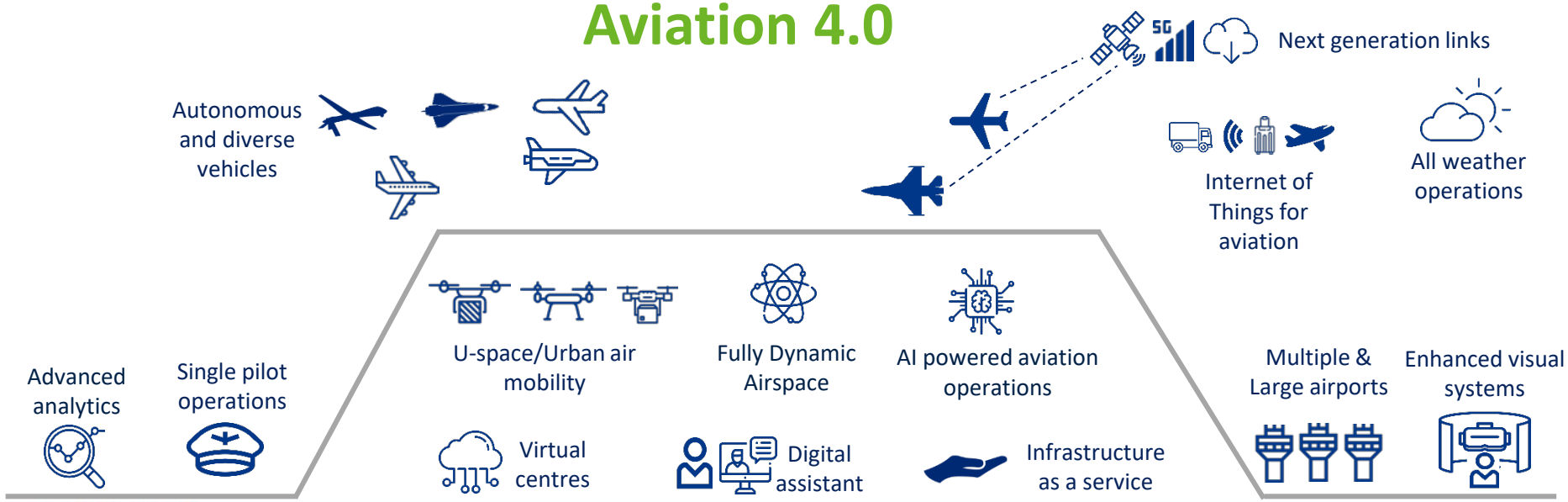
[RESULT IN BRIEF] Air traffic management for the future
An automated system developed by EU-funded scientists can help air traffic control coordinate departures and reduce the probability of conflicts without reducing air space capacity, while preserving airline preferences.
**Programme:** H2020-EU.3.4.7.1
**Record Number:** 239575
**Last updated on:** 2018-09-17
**Available languages:** DE, EN, ES, FR, IT, PL
Booklet

# DELIVERING THE VISION – UPCOMING CALLS & ACTIVITIES

## Passenger




## Aviation 4.0



# SJU SCIENTIFIC COMMITTEE

- SJU Scientific Committee has been working hard
- Progressing thinking on key issues
- Supporting SESAR policy and guidance
- A number of focus areas addressed by small Task Forces
- Dedicated Innovation Pipeline Task Force to help streamline the innovation pipeline
- Helping us define the future

#SIDS2018

# Engage KTN

## Thematic challenges update; SIDs look ahead

Andrew Cook, Paula López, Tatjana Bolić, Dirk Schaefer

8th SESAR Innovation Days
Salzburg, 03-07 December 2018

Founding Members
EUROPEAN UNION EUROCONTROL

# Overview

- Introduction to Engage
  - four thematic challenges
- Teaser slides on each challenge
  - know who to come and talk to
- Next steps for the challenges
  - funding opportunities and support
- Look ahead
  - more from Engage coming up
  - SESAR Innovation Days programme

# Introduction to Engage

# the SESAR Knowledge Transfer Network

engagektn.com

twitter.com/EngageKTN

# Industry partners


Advanced Logistics Group (ALG)
AGIFORS - Airline Group of the International Federation of Operational Research Societies
Air Traffic Controllers European Unions Coordination (ATCEUC)
airBaltic
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)
Belgocontrol
Boeing Research and Technology Europe (BR&T-Europe)
Bundesaufsichtsamt für Flugsicherung (BAF)
Civil Aviation Authority (CAA)
COOPANS Consortium
Department for Transport (UK)
Direction des Services de la Navigation Aérienne (DSNA)
Direktorat civilnog vazduhoplovstva Republike Srbije (DCV)
European Meteorological Services Network (EUMETNET)
European Passengers' Federation (EPF)
Executive Airlines
Ferrovial Agroman
Finnair
FlightGlobal
Flughafen München / Munich Airport
Gestair SL
Helios
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)
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
SWISS - Swiss International Air Lines
Thomas Cook Airlines
TÜBİTAK - The Scientific and Technological Research Council of Turkey
Turkish Airlines

# Introduction to Engage

## Key features and objectives (2018-2021)

heads-up, for now

- Better integrate more applied/industrial & exploratory research (two-way process)
    - mutual benefit, integrated into the fabric, funded; interdisciplinary
- Education and training: future ATM skilled workforce
    - “develop new talent with a deep knowledge of the future ATM scientific research needs ... stimulating the next generation of ATM staff”
    - PhD and post-graduate thesis Call
    - 3 summer schools; ATC training courses; lecture progs
    - SESAR Innovation Days
- Knowledge hub (wiki) as a ‘go-to’ source, single point of entry for ATM knowledge
    - popular demand: improved search functionality; consolidated repository
- Not only larger concepts, but sum of large number of support actions
    - multiple grants; ‘light touch’

thematic challenges

# Thematic challenges and workshops

Engage

HOME ABOUT KNOWLEDGE HUB PARTICIPATE EVENTS CONTACTS

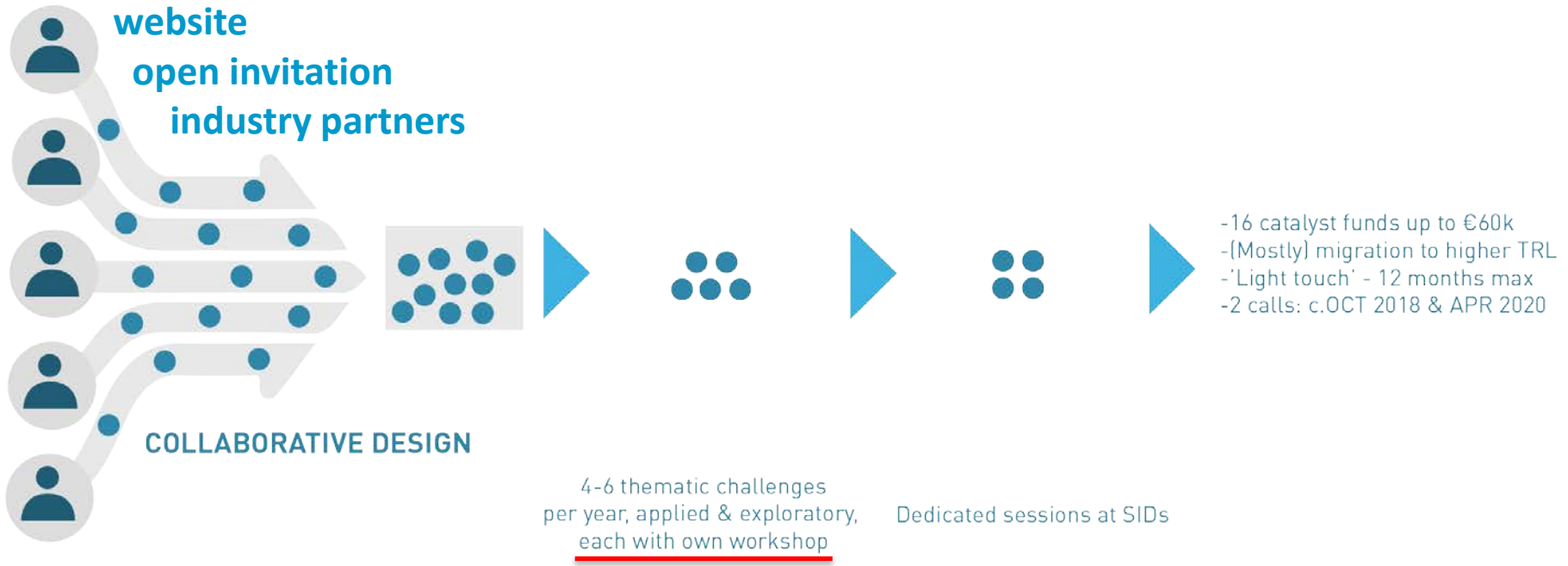
## Engage Thematic Challenges

**At the core of the KTN is the definition of various thematic challenges: new ideas suggested by the research community, not already included within the scope of an existing SESAR project. They are developed along with the ATM concepts roadmap and complementarily with some of the network's PhDs and theses.**

engagektn.com

twitter.com/EngageKTN

# Thematic challenges and workshops




Call for catalyst fund proposals open until **15 February 2019** (more later); consortium **ineligible**

# Thematic challenges and workshops

## Workshop planning and dissemination

- **Objectives**
  - mature the state of the art for each challenge (short- and longer-term)
  - identify barriers and possible solutions
  - provide opportunity for proponents to further develop ideas
  - inform the final stages of the SESAR ER4 Call

- **Workshop design**
  - brief presentations summarising state of the art
  - invited industry and interdisciplinary experts
  - extended, in-depth discussions (facilitated, break-outs)

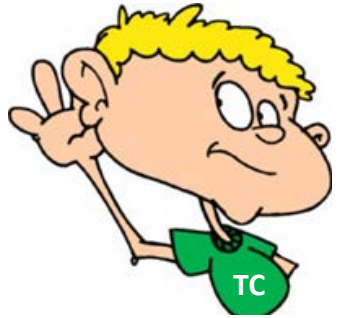
- **Dissemination**
  - SESAR e-news, Engage website, other networks, targeted campaigns, etc.
  - SJU, ANSPs, airlines, EUROCONTROL, PRU, NM, associations, academia (incl. interdisciplinary fields), SMEs

# Thematic challenges and workshops

## Workshop discussion sessions

- **Invited the participants to suggest:**
  - what specific follow-up research is likely to be useful to mature the state of the art (incl. flagging what may be addressed by catalyst funding)
  - what measures of success could be used to assess progress of challenge:
    - **short-term:** wholly within catalyst-funded project
    - **longer-term:** outside/beyond such a project (could be *identified* within it)
  - what are likely barriers to prevent progress towards maturing challenge – how might we overcome them?

- **listening mode:** to refine (dynamic) challenge texts, maintained on the Engage website



# Teaser slides on each challenge

# Teaser slides on each challenge

## Know who to come and talk to

### #1. CNS vulnerability and security

**Paula López**

Innaxis

### #2. Data-driven trajectory prediction

**Dirk Schaefer**

EUROCONTROL

### #3. Efficient use of MET data

**Tatjana Bolić**

University of Trieste

### #4. Novel market mechanisms in ATM

**Andrew Cook**

University of Westminster

# CNS vulnerability and security

Paula López

# CNS vulnerability and security

## Abstract (1/2)

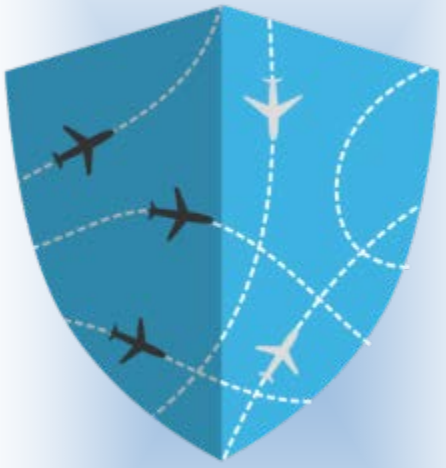
CNS/ATM components (e.g., ADS-B, SWIM, datalink, Asterix) of the current and future air transport system present vulnerabilities that could be used to perform an ‘attack’.

Further investigations are necessary to **mitigate these vulnerabilities**, moving towards a **cyber-resilient system**, fully characterising ATM data, its confidentiality, integrity and availability requirements.

A better understanding of the **safety-security trade-off** is required.

# CNS vulnerability and security

## Abstract (2/2)



Additional security assessments for legacy systems are also needed to identify possible mitigating controls in order to improve cyber-resilience **without having to replace and refit**.

Future systems security by design is essential: a new generation of systems architectures and applications should be explored to ensure confidentiality, cyber-resilience, **fault tolerance, scalability, efficiency, flexibility and trust** among data owners.

Collaborative, security-related information exchange is essential to all actors in aviation. This is specially challenging in a multi-stakeholder, multi-system environment such as ATM, where confidentiality and trust are key.

# CNS vulnerability and security

## Workshop planning (Spring 2019, SJU, Belgium)

- Facilitate discussion among aviation stakeholders (airlines, ANSPs, airports...) regarding systems security challenges
- Foster a multidisciplinary community of researchers to enhance the transferability of knowledge from other disciplines (e.g. IT security) into ATM

- Open a debate on the trade-off between the opportunities and risks of data sharing among aviation stakeholders
- Identify the potential ATM systems vulnerabilities and the measures that should be further investigated to mitigate such risks

- Propose ideas on how to perform an initial security assessment and detect security threats in current and future ATM
- Create awareness of the on-going initiatives in the CNS/ATM systems security field

- Discuss common ideas on how to model emerging security problems

# CNS vulnerability and security

## Example ideas for potential exploration

- Assessing the security of ATM elements and relationships to identify vulnerabilities and ensure protection against global threats
- Enhancing cybersecurity of systems without having to replace and refit, including certification, legal and liability issues
- Building data-sharing architectures capable of connecting and providing access to distributed data while preserving privacy

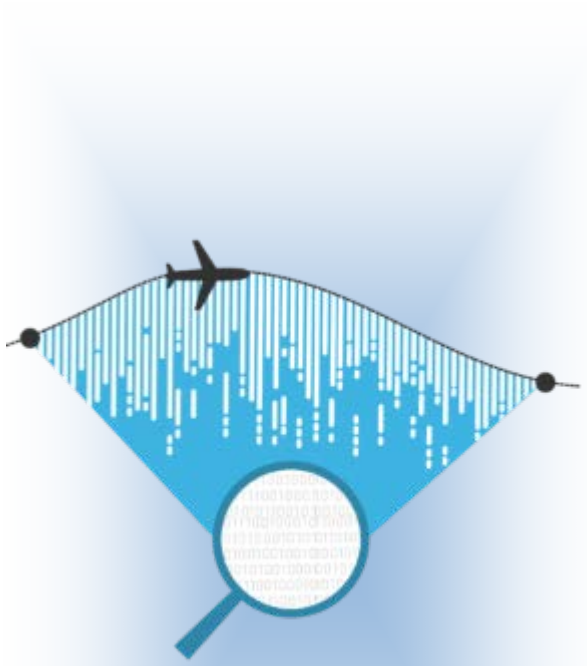
- Adapting mental models to prepare operators to understand and manage cyber threats
- Updating software and firmware of IT components to resolve security vulnerabilities of critical infrastructures
- Further researching security analyses of aviation-specific protocol implementations (vulnerabilities, trust, software libraries)

# Data-driven trajectory prediction

Dirk Schaefer

# Data-driven trajectory prediction

## Abstract (1/2)



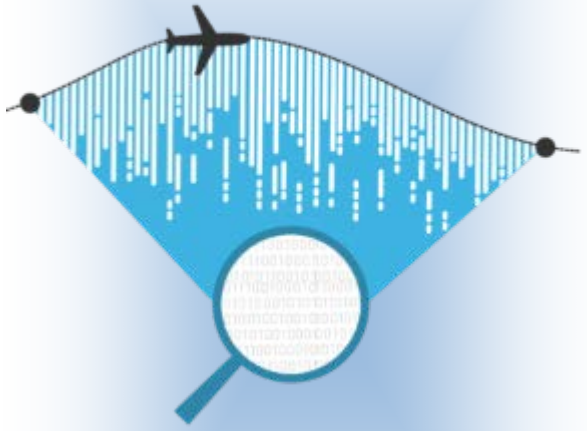
Accurate and reliable trajectory prediction (TP) is a fundamental requirement to support trajectory-based operations.

Lack of advance information and the **mismatch between planned and flown** trajectories caused by operational uncertainties from airports, ATC interventions, and ‘hidden’ flight plan data (e.g., cost indexes, take-off weights) are important shortcomings of the present state of the art.

New TP approaches, **merging and analysing different sources of flight-relevant** information, are expected to increase TP robustness and support a seamless transition between tools supporting ATFCM across the planning phases.

# Data-driven trajectory prediction

## Abstract (2/2)



The exploitation of historical data by means of **machine learning, statistical signal processing and causal models** could boost TP performance and enhance the TBO paradigm.

Specific research domains include machine-learning techniques, the aggregation of probabilistic predictions, and the development of tools for the identification of flow-management **'hotspots'**.

These could be integrated into network and trajectory planning tools, leading to enhanced TP.

# Data-driven trajectory prediction

## Example ideas for potential exploration

- Trajectory predictors supporting airborne self-separation: definition of requirements (accuracy, robustness, run time) & concept development of enabling technologies and capabilities
- Improved matching of capacity to demand: enhanced TPs integrating uncertainty assessment, robust planning and cost-efficiency assessment allowing better demand assessment at network level – and better capacity planning
- Data-driven approaches for understanding and prediction of AU preferences and behaviours enabling improved NM operations and flexibility-predictability trade-off
- Collaborative multi-sector CD&R: requirements definition and concept development of data-driven TP in support of CD&R involving various sectors
- Optimising and integrating local planning activities to assess, contain and communicate their network effects
- Improving data-sharing and data access to satisfy AU, NM and ANSP technical and organisational requirements and expectations: data format and availability, incentives for data sharing, confidentiality issues

# Efficient use of MET data

Tatjana Bolić

# Efficient use of MET data

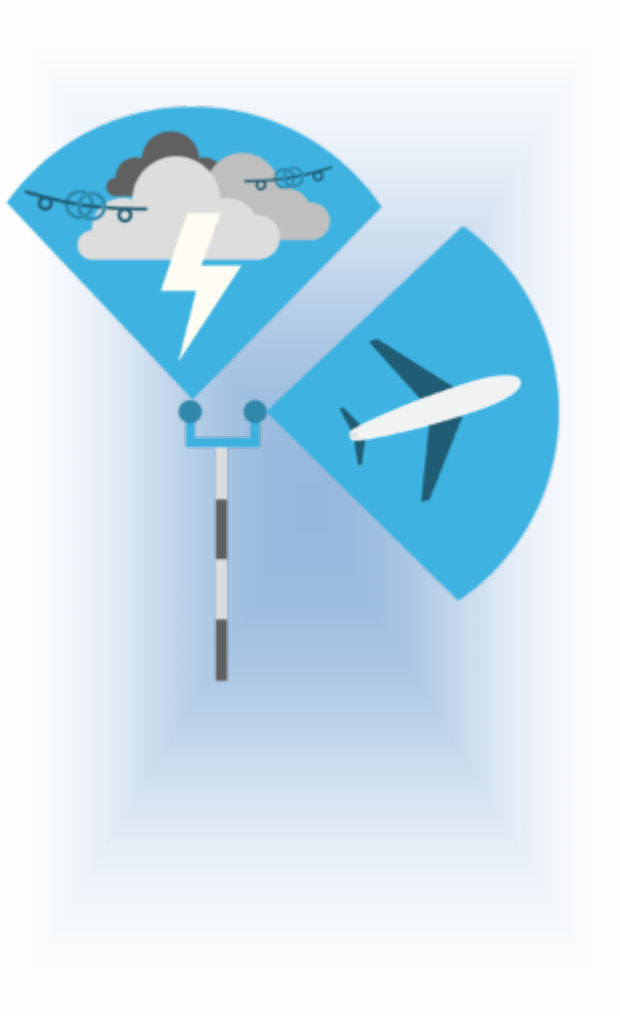
## Abstract (1/2)

The main objective of this challenge is to **improve** overall **ATM system performance** by providing better user-support tools based on **improved meteorological ('MET') products**.

The focus is on the synergy of several methods and techniques in order to better meet the **needs of operational users** and to support aviation safety (e.g., through creating early warning systems) and regulation-makers (e.g., moving from text-based to graphical information provision).

# Efficient use of MET data

## Abstract (2/2)



All stakeholders may benefit from this synergy: ANSPs (e.g., sector reconfiguration and separation provision), airlines (e.g., storm avoidance), airport operators (e.g., airport management under disruptive events), and the Network Manager (e.g., demand-capacity balancing).

The challenge is, therefore, to bring the following perspectives closer: (a) for meteorological/atmospheric science, the development of **products tailored** to ATM stakeholders' needs, which are unambiguous and easy to interpret; (b) for stakeholders, the identification of the most **suitable information** available and its integration into **planning and decision-making** processes.

# Efficient use of MET data

## Workshop overview (13 November, SJU, Belgium)

- Goal of enhanced situational awareness (re. MET conditions) for ATM stakeholders
- Consistent and agreed European weather ‘picture’ does not exist yet

- Trend in MET products is towards ensembles, which calls for education of ATM stakeholders re. interpretation of results

- MET products can be classified by two dimensions:
  - spatial resolution - global, limited area and high-resolution
  - time resolution - long, medium, short and very short range

- Often research funding and fragmentation of MET provision present a barrier to holistic European progress

- User trust and reliability, plus sensitivity of operational processes, cited as barriers
- Long-term effort in both communications and research needed

# Efficient use of MET data

## Example ideas for potential exploration

- Very high-resolution, very short-range forecasts using numerical weather prediction models & observational data assimilation
- Quantifying the sensitivity of operational processes to MET uncertainty, comparing these with other sources of uncertainty
- Incorporation of ensemble weather information into decision-support tools, adapted for different ATM stakeholders

- Accurate prediction of weather conditions (e.g. visibility, glide-path wind) influencing airport arrival and departure operations
- Consolidation of climate risk assessment methodologies for airports
- Creating a climate forecast ‘baseline’ for aviation from the IPCC UN panel report

# Novel market mechanisms in ATM

Andrew Cook

# Novel market mechanisms in ATM

## Abstract (1/2)


This research explores the design of **new allocation markets** in ATM, taking into account real stakeholder behaviours. It focuses on designs such as auctions and ‘smart’ contracts for slot and trajectory allocations.

It seeks to **better predict the actual behaviour** of stakeholders, compared with behaviours predicted by normative models, taking into account that decisions are often made in the context of uncertainty.

# Novel market mechanisms in ATM

## Abstract (2/2)


Which mechanisms are more robust against behavioural biases and likely to reach **stable and efficient solutions**, equitably building on existing SESAR practices? The research will address better modelling and measurement of these effects in ATM, taking account of 'irrational' agents such as airline 'cultures'.

A key objective is to contribute to the development of **improved tools to better manage the allocation of resources** such as slots and trajectories, and incentivising behaviour that benefits the network - for example by investigating the potential of centralised markets and 'smart' contract enablers.

# Novel market mechanisms in ATM

## Workshop overview (25 October 2018, UoW, UK)

- New market designs for allocation & trading of tactical slots may support potential future mechanisms for slot swapping & trading *between* AUs
- Potential beyond FPFS: matching market, centralised batch auctions, primary & secondary markets (double auction or bilateral exchanges)

- Need to consider trade-offs between: individual rationality, budget balance, allocative efficiency and incentive compatibility in design of new mechanisms
- Need to model more realistic human interactions in a multi-stakeholder, complex socio-technical environment, c.f. highly constrained/limited simulation environments

- Most current models are normative, making assumptions about agent rationality: do not always work as predictors
- Behavioural science in general, and behavioural economics in particular, may bring complementary solutions

*NB. Strategic airport slots are not in scope for this challenge*

# Novel market mechanisms in ATM

## Example ideas for potential exploration

- Incorporating behavioural science methods into improved traffic demand & distribution predictor tools for ANSPs & UDPP
- Assessing if incentives or penalties work as better drivers of behaviour: whether social norms can be used to improve collaboration
- Predicting and avoiding undesirable behaviour, such as gaming, in ATM allocation mechanisms

- Building a better understanding of ‘equity’ and ‘fairness’, plus trade-offs across different stakeholders, and with ‘flexibility’
- Improving the assessment of uncertainty and disturbance, and of new mechanism implications for policy recommendations
- Running models and tools in shadow-mode, with practical user interfaces and value in output metrics (e.g. costs, overloads)

# Next steps for the challenges

# Next steps for the challenges

## On the website

### Thematic challenge 3 – Efficient provision and use of meteorological information in ATM

**Workshop:** 13 November 2018, SESAR Joint Undertaking (SJU), Brussels, Belgium – Atmospheric scientists and ATM stakeholders shaping a more efficient provision and use of meteorological information in future aviation.

**Final programme here**. Presentations: **zip file1** (10MB); **zip file2** (13MB).

The main objective of this challenge is to improve overall ATM system performance by providing better user-support tools based on improved meteorological ('met') products. The focus is on the synergy of several methods and techniques in order to better meet the needs of operational users and to support aviation safety (e.g., through creating early warning systems) and regulation-makers (e.g., moving from text-based to graphical information provision). All stakeholders may benefit from this synergy: ANSPs (e.g., sector reconfiguration and separation provision), airlines (e.g., storm avoidance), airport operators (e.g., airport management under disruptive events), and the Network Manager (e.g., demand-capacity balancing). The challenge is, therefore, to bring the following perspectives closer: (a) for meteorological/atmospheric science, the development of products tailored to ATM stakeholders' needs, which are unambiguous and easy to interpret; (b) for stakeholders, the identification of the most suitable information available and its integration into planning and decision-making processes.

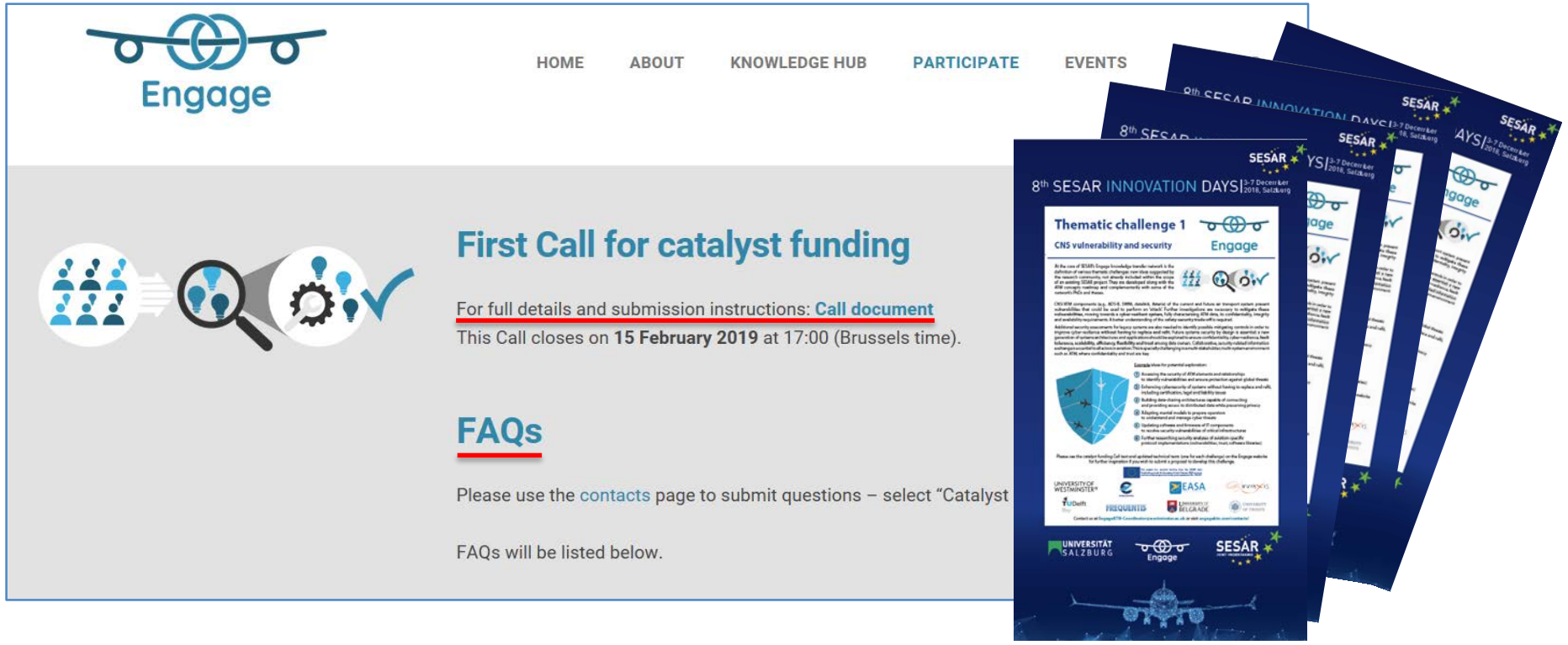
**Fuller text here** *(updated November 2018)*

engagektn.com

# Next steps for the challenges

## Call for catalyst fund proposals

- **Call open until 15 February 2019**
  - maturing from exploratory to applied-orientation
  - up to €60k, 12 months, ‘light touch’ (also ‘open’)
  - during and post evaluation, how we can support development ...



# Next steps for the challenges

## Support from consortium and partners

Monitoring thematic challenge (and PhD / post-graduate thesis) proposals, where we:

- can add value and technical support
- coordinate with industry partners (e.g. expertise and data)
- seek interdisciplinary / expert advice
  - specific (e.g. student)
  - generic (e.g. summer school)

(More on wider picture, later)


UNIVERSITY OF WESTMINSTER

EUROCONTROL

EASA
European Aviation Safety Agency

FREQUENTIS

innaxis

TU Delft
Delft University of Technology

UNIVERSITY OF BELGRADE

UNIVERSITY OF TRIESTE

# Next steps for the challenges

## Support from EUROCONTROL

- Specific effort for supporting Engage (challenges, PhDs, etc.); + two initiatives **open to all**:
- **ESCAPE-Light**

- trial of real-time, open-source ATC simulator
- controller & pseudo-pilot positions; runs on Linux
- rich ATC data (e.g. voice, inputs, tracks)
- can run own algorithms (e.g. ML) & data analytics
- free software; users can build / propose improvements

More info: **philippe.debels@eurocontrol.int** and https://simulations.eurocontrol.int/

- **Data accessibility**


- historical PRISME (DDR) data: improved access for research purposes
- easier access to data over 2 years old
- four months per year (March, June, September, December)
- beta download site expected soon
- will be notified on Engage, EUROCONTROL and ART websites

# Look ahead

## More from Engage coming up

# Look ahead

## More from Engage coming up

- Brief thematic challenges recap; 2019-2020
- PhD / post-graduate theses Call
- Summer schools; student support
- Research community support

# Look ahead

## SESAR Innovation Days programme

| Tuesday, 4 December 2018 | | |
|---|---|---|
| **8:30 – 9:00** | **Welcome coffee** | |
| **9:00 – 9:20** | **Welcome and opening**<br>• Vicerector Ferreira-Briza, University of Salzburg<br>• Elisabeth Landrichter, Director General, Austrian Civil Aviation Authority | |
| **9:20 – 10:00** | **Keynotes**<br>• Filip Cornelis, Director Aviation, DG MOVE, European Commission<br>• Philippe Merlo, Director ATM, EUROCONTROL<br>• Florian Guillermet, Executive Director, SESAR JU | |
| **10:00 – 10:45** | **Engage network**<br>• Andrew Cook, Coordinator, Engage network<br>• Paula López, Consortium Member, Engage network<br>• Tatjana Bolic, Consortium Member, Engage network<br>• Dirk Schaefer, SIDs Programme Committee Chair<br>***(The welcome and keynote sessions will take place in the Karajan Hall)*** | |
| **10:45 – 11:15** | **Coffee & Exhibition** | |
| **11:15 – 13:00** | **Machine Learning I ***<br>Chair: *Jacco Hoekstra, TU Delft*<br><br>Flight Level Prediction with a Deep Feedforward Network<br>*Matthias Poppe, DFS*<br><br>Automated Data-Driven Prediction of Aircraft Estimated Time of Arrival<br>*Zhengyi Wang, ENAC*<br><br>A Boosted Tree Framework for Runway Occupancy and Exit Prediction<br>*Darío Martínez, Innaxis*<br><br>**(LOCATION:** Karajan Hall)<br>* including 15 min poster teaser session | **Airports ***<br>*Chair: Sara Bagassi, University of Bologna*<br><br>Identification of Complexity Factors for Remote Towers<br>*Christiane Schmidt, Linköping University*<br><br>Stochastic Control of Turnarounds at HUB-Airports<br>*Jan Evler, TU Dresden*<br><br>SESAR 1 Solutions Implementation Key Feature - High Performing Airport Operations<br>*Doroteja Timotic, University of Belgrade*<br><br>**(LOCATION:** Wolf-Dietrich Hall)<br>* including 15 min poster teaser session |

| Tuesday, 4 December 2018 | | |
|---|---|---|
| **13:00 – 14:00** | **Lunch and exhibition** | |
| **14:00 – 15:45** | **Data-driven Techniques** *<br>*Chair: Marc Bourgois, EUROCONTROL*<br><br>Smart Data Fusion: Probabilistic Record Linkage adapted to Merge Two Trajectories from Different Sources<br>*Darío Martínez, Innaxis*<br><br>Visual Analytics of Flight Trajectories for Uncovering Decision Making Strategies<br>*Gennady Andrienko, Fraunhofer Institute IAIS*<br><br>Aircraft Atypical Approach Detection using Functional Principal Component Analysis<br>*Gabriel Jarry, ENAC*<br><br>**(LOCATION:** Karajan Hall)<br>* including 15 min poster teaser session | **Economics and Legal** *<br>*Chair: Rita Markovits-Somogyi, HungaroControl*<br><br>Decision Support for an Optimal Choice of Subsidised Routes in Air Transportation<br>*Alan Kinene, Linköping University*<br><br>Shared Airspace, Shared Liability?<br>*Ivo Emanuilov, KU Leuven*<br><br>Introducing Competition through Auctions in the Air Traffic Control Market<br>*Nicole Adler, Hebrew University of Jerusalem*<br><br>**(LOCATION:** Wolf-Dietrich Hall<br>* including 15 min poster teaser session |
| **15:45 – 16:15** | **Coffee and exhibition** | |
| **16:15 – 17:45** | **Plenary session 1: ATM research in the global perspective**<br>• Saulo Da Silva, ICAO<br>• Ho Wei Sean, CAAS, Singapore<br>• Steve Bradford, FAA<br>• Tokuaki Nakajima,ENRI Japan<br>• Parimal Kopardekar, NASA<br><br>*Moderated by Michael Standar, Chief Strategy & External Affairs, SESAR JU*<br><br>**(LOCATION:** Karajan Hall) | |
| **17:45 – 19:00** | **Posters and Exhibits Cocktail** | |

## Wednesday, 5 December 2018

| | | |
|---|---|---|
| **9:00 – 9:30** | **Keynote on the Human Factor in ATM R&D**<br>• Tom Laursen, EVP Europe, IFATCA<br>• Toni Waefler, IFATCA | |
| **9:30 – 11:00** | **Plenary session 2: Transport research into implementation**<br>• Carlo Borghini, Executive Director, Shift2Rail<br>• Georg Trausmuth, Head of Corporate Research, Frequentis<br>• Eric Nantier, Director Operations Control Process, Lufthansa Group<br>• Olaf Dlugi, Chairman of the Industry Consultation Body<br>• Tanja Grobotek, CANSO Europe Director<br><br>*Moderated by Peter Hotham, Deputy Director, SESAR JU* | |
| **11:00 – 11:15** | **Artistic Interlude**<br><br>*(Morning sessions to take place in the Karajan Hall)* | |
| 11:15 – 11:45 | **Coffee & exhibition** | |
| **11:45 – 13:00** | **UTM and UAS**<br>*Chair: Francisco Saez, Cranfield University*<br><br>Drone Delivery: Urban Airspace Traffic Density Estimation<br>*Jacco Hoekstra, TU Delft*<br><br>Drone Information Service Requirements for U-Space<br>*Jacco Hoekstra, TU Delft*<br><br>**(LOCATION:** Karajan Hall) | **Meteo and Environment**<br>*Chair: Damian Rivas, University of Seville*<br><br>Optimal Aircraft Path Planning in a Structured Airspace Using Ensemble Weather Forecasts<br>*Antonio Franco, University of Seville*<br><br>Mitigation potential of environmental optimized aircraft trajectories using climate metrics<br>*Sigrun Matthes, DLR*<br><br>**(LOCATION:** Wolf-Dietrich Hall) |
| 13:00 – 14:30 | **Lunch & exhibition** | |

## Wednesday, 5 December 2018

| | Machine Learning II<br>*Chair: Fedja Netjasov, University of Belgrade* | Airspace Design and Management<br>*Chair: Daniel Delahaye , ENAC* |
|---|---|---|
| 14:30 – 16:00 | Airline Disruption Management with Aircraft Swapping and Reinforcement Learning<br>*Gabriel Hondet, ENAC* | Free Route Airspaces in Functional Air Space Blocks<br>*Judith Rosenow, TU Dresden* |
| | Application of Machine Learning for ATM Performance Assessment – Identification of Sources of En-Route Flight Inefficiency<br>*Rodrigo Marcos, Nommon* | Tactical Prediction of the Number of Control Positions with Softmax Regression and Tree Search<br>*Judicaël Bedouet, ONERA* |
| | Detecting Controllers' Actions in Past Mode-S Data by Autoencoder-Based Anomaly Detection<br>*Xavier Olive, ONERA* | The Effects of the Introduction of Free Route in the Hungarian Airspace<br>*Fanni Kling, HungaroControl* |
| | (LOCATION: Karajan Hall) | (LOCATION: Wolf-Dietrich Hall) |

## NETWORKING DINNER
## Wednesday, 5 December 2018

**19:00 -22:00**

**Hangar 7 Museum**
*Wilhelm-Spazier-Straße 7a, 5020 Salzburg*

*Please note that there will be participant fee of 35 EUR to be paid in advance on-site during the main event.*

**Buses to the Hangar 7 museum will depart at 18:30 from outside the Salzburg Congress Centre**

## Thursday, 6 December 2018

| | Modelling and Simulation<br>*Chair: Lorenzo Castelli, University of Trieste* | Flow Management<br>*Chair: Radosav Jovanovic, University of Belgrade* |
|---|---|---|
| | Assessment of Future Air Traffic Management System Safety Performances using a Network-based Simulation Model<br>*Fedja Netjasov, University of Belgrade* | Occupancy Peak Estimation from Sector Geometry and Traffic Flow data<br>*Luis Basora, ONERA* |
| **9:30 – 11:00** | Towards New Metrics Assessing Air Traffic Network Interactions<br>*Silvia Zaoli, University of Bologna* | Coordinated Capacity and Demand Management in the European Core Area: Results of a Large-scale COCTA Case Study<br>*Nikola Ivanov, University of Belgrade* |
| | Aircraft Drag Polar Estimation Based on a Stochastic Hierarchical Model<br>*Junzi Sun, TU Delft* | Arrival Trade-offs Considering Total Flight and Passenger Delays and Fairness<br>*Luis Delgado, University of Westminster* |
| | **(LOCATION:** Karajan Hall) | **(LOCATION:** Wolf-Dietrich Hall) |
| **11:00 – 11:30** | **Coffee & exhibition** | |

| Thursday, 6 December 2018 | | |
|---|---|---|
| | **Controller Assistance Systems**<br>*Chair: Luis Delgado, University of Westminster* | **Performance**<br>*Chair: Dirk Schaefer, EUROCONTROL* |
| **11:30 – 13:00** | Building Blocks of Assistant Based Speech Recognition for Air Traffic Management Applications<br>*Matthias Kleinert, DLR* | Open Flight Trajectories for Reproducible ANS Performance Review<br>*Enrico Spinielli, EUROCONTROL* |
| | Hotspot Resolution with Sliding Window Capacity Constraints using the Path&Cycle Algorithm<br>*Andreas Nakkerud, University of Oslo* | A Multi-layer Model for Long-term KPI Alignment Forecasts<br>*Gérald Gurtner, University of Westminster* |
| | The Semantic Container Approach: Techniques for Ontology-based Data Description and Discovery in a Decentralized SWIM Knowledge Base<br>*Bernd Neumayr, University of Linz and Eduard Gringinger, Frequentis* | Enhanced Indicators to Monitor ATM Performance in Europe – Main findings of the APACHE Project<br>*Xavier Prats, UPC* |
| | (LOCATION: Karajan Hall) | (LOCATION: Wolf-Dietrich Hall) |
| **13:00 – 14:00** | **Lunch & exhibition** | |
| **14:00 – 15:00** | **Panel 3: Women in Aviation Research**<br>• Elisabeth Kotthaus, European Commission, DG MOVE<br>• Rita Markovits-Somogyi, HungaroControl<br>• Alison Roberts, NATS<br>• Sara Bagassi, University of Bologna<br><br>*Moderated by Tanja Bolic, SJU Scientific Committee* | |

## Thursday, 6 December 2018

| | |
|---|---|
| **15:00 – 15:30** | **Coffee break & exhibition** |
| **15:30 – 16:00** | **Look ahead from the Engage network**<br>• Andrew Cook, Coordinator, Engage network |
| **16:00 – 16:30** | **SESAR Young Scientist Award Ceremony** |
| **16:30 – 17:00** | **Closing keynote**<br>• Florian Guillermet, Executive Director, SESAR JU |

**(LOCATION:** Karajan Hall)

## Friday, 7 December 2018

**SITE VISITS**

- ***TOUR 1: Salzburg Area*** *(Salzburg University, Salzburg Airport, Hangar 8, Austrian Airforce)*
- ***TOUR 2: Vienna*** *(Frequentis, University of Vienna)*
- ***TOUR 3: Vienna*** *(Austrian Airlines, Austrocontrol)*

**(You must be pre-registered to attend these tours, please speak to someone at the SIDS registration desk should you wish to attend)**

# Engage KTN

## Thematic challenges update; SIDs look ahead

# Thank you

This network has received funding from the SESAR Joint Undertaking under the European Union's Horizon 2020 research and innovation programme under grant agreement No 783287.

Founding Members

EUROPEAN UNION EUROCONTROL

8th SESAR Innovation Days

# Thank you!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