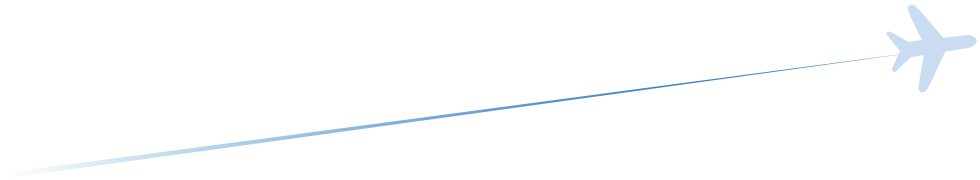


D5.12 Engage SESAR Summer School 2019

Deliverable 5.12

Engage

Grant:	**783287**
Call:	**H2020-SESAR-2016-2**
Topic:	**SESAR-ER3-01-2016 Knowledge Transfer Network**
Consortium coordinator:	**University of Westminster**
Edition date:	**16 March 2020**
Edition:	**01.02.00**

Founding Members

EUROPEAN UNION EUROCONTROL

SESAR JOINT UNDERTAKING

Authoring & Approval

Authors of the document

Name/Beneficiary	Position/Title	Date
Radosav Jovanović / University of Belgrade - FTTE	Consortium member	13 March 2020
Graham Tanner / University of Westminster	Consortium member	13 March 2020

Reviewers internal to the project

Name/Beneficiary	Position/Title	Date
Radosav Jovanović / University of Belgrade - FTTE	Consortium member	16 March 2020
Graham Tanner / University of Westminster	Consortium member	16 March 2020
Andrew Cook / University of Westminster	Project coordinator	16 March 2020

Approved for submission to the SJU By — Representatives of beneficiaries involved in the project

Name/Beneficiary	Position/Title	Date
Andrew Cook / University of Westminster	Project coordinator	16 March 2020

Rejected By - Representatives of beneficiaries involved in the project

Name/Beneficiary	Position/Title	Date
N/A		

Document History

Edition	Date	Status	Author	Justification
01.00.00	08 October 2019	Release	Engage Consortium	New document for review by the SJU
01.01.00	15 January 2020	Release	Engage Consortium	Incorporating SJU comments
01.02.00	16 March 2020	Release	Engage Consortium	Incorporating SJU comments

Engage

THE SESAR KNOWLEDGE TRANSFER NETWORK

This deliverable is part of a project that has received funding from the SESAR Joint Undertaking under grant agreement No 783287 under European Union's Horizon 2020 research and innovation programme.

Abstract

This report describes the first edition of the Engage SESAR summer school, which took place in Belgrade, Serbia, between 9th and 13th September 2019.

Table of Contents

List of figures

Executive summary

The first Engage SESAR summer school took place between 9th and 13th September 2019 in Belgrade, Serbia.

30 participants from 13 European countries and Singapore attended the summer school. These included nine Engage-funded PhD students, each of whom presented their PhD topic and the findings obtained thus far. Over four full days, 13 tutorials on key concepts and challenges in air traffic management, as well as on research methods, were given, and two SESAR ER case studies presented by 10 lecturers from the University of Westminster, the University of Belgrade – Faculty of Transport and Traffic Engineering, the University of Trieste, TU Delft and EUROCONTROL.

1 Introduction

1.1 Engage support for the summer school

Engage is the SESAR Knowledge Transfer Network (KTN), established to promote and facilitate the development of air traffic management research in Europe. The organisation of the summer school received support and expertise from Engage consortium members (led by the University of Belgrade – Faculty of Transport and Traffic Engineering), from initial planning through to post-summer-school activities.

1.2 Objectives of this document

This document describes the 2019 edition of the Engage SESAR summer school.

1.3 Scope of D5.12

The following sections describe the:

- Summer school programme;
- Participants;
- Participants' feedback;
- Conclusions, lessons learned and outlook.

2 Programme

2.1 Building and publicising the 2019 summer school programme

As envisaged in the GA [1], the Engage summer schools *have the purpose of providing high quality education and training in the field of ATM, gathering together PhD students, experienced researchers and industry representatives*. Given the early stage and varied backgrounds of Engage-funded PhDs, the 2019 programme focused on key ATM concepts and challenges as well as on research methods, and was tailored to the Engage PhDs' needs and preferences. More specifically, the programme was compiled based on the following procedure, which was launched in April 2019:

1. The professors and researchers from the Engage KTN consortium were invited to propose one or more relevant topics they could give lectures on, including the topic title and an abstract of the lecture proposed (100-200 words).

2. The 25 tutorial proposals were collected by 4th May 2019. After checking for possible overlaps, these were compiled into a *catalogue of lectures* and (Figure 1) sent to supervisors of Engage PhDs on 8th May 2019, along with the *lecture preference form* (Figure 2). Supervisors could then make a selection of several lectures which they felt would be most useful for their candidates, given the PhD topic and the candidates' background.

3. Based on feedback received from Engage PhD supervisors (who all replied by 17th May 2019) the final selection of 13 lectures to be given was made and these were incorporated into the summer school programme.

The Call was subsequently publicised via the SESAR JU website, SESAR e-newsletters (initially in May's edition), Twitter, LinkedIn, German Aviation Research Society (G.A.R.S.) Newsletter (June edition) and the Engage website [2]. The application form was available on the Engage website from May.

Attendance to the summer school was free of charge, with costs covered by Engage. Students (only) could also apply to Engage for financial support to assist with their travel and accommodation expenses, of which 17 students were able to benefit from this assistance.

The *catalogue of lectures* and *lecture preference form* are shown on the following pages.

SESAR Engage KTN – Summer school, 9-13 September 2019, Belgrade: Catalogue of lectures

No.	Lecture title	Learning objectives (Abstract)	Duration (minutes)
1	**The principles of air traffic flow management**	Understand where ATFM fits in the ATM structure. Provide a brief introduction to ASM and ATS and how ATFM sits between them. Appreciate the relationship between ASM, ATFM and ATS. Understand why we need flow management and how it operates under capacity constraints by examining the airport and airspace contexts, with an introduction to the concept of tactical slots. Appreciate further principles of flow management, through additional details of the mechanisms deployed and through a comparison of the US and European approaches.	90-120
2	**An introduction to flight planning and ATM messaging**	Appreciate the main principles of current flight planning through discussion of the information required for an example flight plan, including available sources of aeronautical information. The role of the Network Manager at filing, subsequent message distribution and slot allocation is summarised. A comparison is given between the basic ICAO flight plan and the more detailed operational flight plans generated internally by airlines using commercial tools. The extended flight plan and its expected benefits are also introduced.	60-90
3	**Performance measurement in ATM**	Appreciate key aspects of performance measurement in ATM, with comparisons across major regions and frameworks; gain knowledge of the latest regulatory and KPI contexts, and some of the main challenges ahead. Background of the Single European Sky targets, contributions from ICAO, key aspects of the key performance areas, comparison of the SES Performance Scheme and SESAR Performance Framework discussed.	60-90
4	**Delays in European aviation: trends and costs**	Appreciate the methodology for calculating the cost of delay to European aviation; gain familiarity with the key associated trends and distributions, plus uses of the cost data by industry and academia. Understand the difference between strategic and tactical delay, plus the contributions from the various elements (aircraft ownership, maintenance, fuel, crew and passenger costs). Key challenges for future research are also discussed.	60-90
5	**Essential data sources in aviation and ATM**	Gain familiarity with the key datasets available to support aviation and ATM research. Whilst the focus is on European traffic (flights) and passenger data sources, other useful data sources (e.g. enablers, calibration) are discussed. Examples of data granularity show a contrast between high level/aggregated data and individual flight data/passenger itineraries. Costs and accessibility, dataset cleaning and preparation, pros and cons plus synergies are all considered.	60-90
6	**Modelling methods in aviation: comparative benefits**	Understand what is a model, why it is necessary to make decision. Understand basic concepts of overfitting, underfitting, prediction power, falsifiability etc. Understand the different characteristics of a model; in particular understand differences between logical/causal models and ML/correlation models. Understand how data enter the picture and what is training and calibration. Review the main models used in ATM, including agent-based models, neural networks, Bayesian networks etc. Understand their logic, the pros of and cons of each and see some examples of how they have been used in ATM.	45-60
7	**Tools for data science**	Get started on how to do data science in ATM, including following aspects: • What tools, languages and modules to use for modelling purpose? (could include Java, Python, C, but also JADE. Could also include things on code management, like git). • In particular, what languages and modules to use for statistical analysis? (could include Python and R, maybe Tableau) • How do you take care of data? (could include excel, open-source equivalent, Mysql databases, non-relational databases like DynamoDB) • How do you produce graphs? For whom? (could include simple excel, matplotlib graphs and maybe more advanced D3.js things)	60-90
8	**Future concepts in ATM**	Attain familiarity with the core challenges of future ATM, understanding links with performance measurement, with insights into trajectory-based operations (introduction to TBO concept and management of uncertainty) and free routes.	60-90
9	**Convective weather decision support tools for air traffic management, with ATM basics**	Introduction to the convective weather hazards, and the impact of convective weather phenomena on ATM and different stakeholders. Description of impacts on different parts of ATM - airports, TMA, en-route, network, and their requirements for the met information provision in terms of spatio-temporal resolution. Introduction to the needs for the weather oriented decision support tools, the basics of the tool development process, deployment and usage. Short review of the advances in the atmospheric sciences and meteo-related observation capabilities with the deployment of satellites.	90-120

No.	Lecture title	Learning objectives (Abstract)	Duration (minutes)
10	**Financing air navigation services**	Review of ways of financing ANS in the world, focusing on European setup of the Central Route Charges Office. Introducing the European regulation on ANS financing, performance scheme and pilot common project and their interdependence. Description of how route, terminal and airport charges are calculated and collected. Discussing different route charging options already reviewed by the Commission and some future proposals, some coming from the SESAR2020 Exploratory Research projects. Those include modulation of charges through peak load pricing, trajectory pricing. Discussion on why no modulation of charges has been applied so far.	90-120
11	**ATM and airlines' operations in volcanic ash**	The impact of volcanic ash on airframe on one hand and the impact on the ATM on the other. What happens when the volcanic ash is spreading along the active routes from the point of view of different stakeholders (ATM, airlines, CAAs). What are the regulations in place, procedures to follow, and the information flows? The current state-of-the-art and the changes 2010 Eja eruption brought. New developments in the research arena ash forecasting and observation, discussing the steps to undertake from the research to deployment.	90
12	**Survey design**	Principles of quantitative survey design in the air transport context. Key stages of the survey process and stakeholder use of data. Types of survey vehicle, with focus on quantitative questionnaire design and use of common scales (Likert, semantic differential, stapel scales; pros and cons of scale width choices and balance); visual design and layout issues. Dealing with bias. Key tips for successful survey implementation.	90-120
13	**Analysis of survey data**	Overview of (survey) data analysis methods, sampling and hypothesis testing. Detailed discussion of independence, with examples. Choosing the right statistical test, with simplified classroom example. Four in-depth examples using the most common statistical tests, using variants of t and chi-square tests, illustrating common pitfalls and issues encountered. Manual, worked examples and corresponding instructions on using SPSS software. (No prior knowledge of statistics required, equips students to carry out and interpret major tests.)	270-360
14	**The door to door perspective**	Introduction to the door-to-door perspective. Describe how flight and passenger metrics might differ and present a different perspective on the system performance. Appreciate the context of door-to-door mobility and the challenges. Describe different passenger profiles and their evolution. Identify which tools are available to model door-to-door times focusing on access/egress of airport. Example of DATASET2050/Vista modelling.	90-120
15	**Introduction to Air Traffic Control**	Acquire knowledge about ATC tasks and activities, organization of the airspace, ATC systems, ATFM, organization of processes in ATC. The following topics are covered: Air Navigation Services: main goals of service provision, type of services. Airspace organization, classification, sectorisation. Aircraft vertical position and vertical and horizontal separation. Flight rules and meteorological conditions. Priority in flight and right of way. ATC service structure: functions and division, air traffic controller (ATCO) activities, data necessary for work, communication, navigation and surveillance technology. Data for ATCOs and pilots: flight plans, meteo data, aircraft position, airspace, airport, aircraft trajectory, etc. Types of ATC systems: procedural, radar, automation in ATC, future ATC. ATC units: aerodrome (tower control), approach, terminal (TMA), area control (ACC). AIS. FIS. Alerting service. ATFM service: air traffic system capacity, ATFM, network operations management.	180
16	**Risk and Safety Modelling in Civil Aviation**	Risk and safety are considered the most important operational characteristics of civil aviation. Usually, they refer to the potential occurrence of air traffic accidents which might result in loss of life, damage to infrastructure and third party property damage. Consequently, they have been regarded as externalities in addition to other adverse effects such as noise, air pollution, land-use, water/soil pollution, waste, and congestion. This lecture deals with a review of part of the research on risk and safety modelling in civil aviation. In such a context, the basic (generic) concepts and definitions of risk, safety and their evaluation are described. A review of the research is focused on four categories of methods/models for risk and safety assessment: causal for aircraft and ATC/ATM operations, collision risk, human factor error and third-party risk. The review is carried out with respect to their purpose, problems, recommendations and relation to new technologies.	45

No.	Lecture title	Learning objectives (Abstract)	Duration (minutes)
17	**Causal methods/models for the ATC/ATM operations**	Causal methods/models establish the theoretical framework of causes that might lead to certain events (e.g. flight delays, aircraft accidents). These methods/models can be qualitative or quantitative. The former provide a diagrammatic or hierarchical description of the factors that might cause events. They are useful for improving understanding of causes of accidents and proposing preventive interventions. The later estimate the probability of occurrence of each cause. They might be restricted to pure statistical analysis based on the available data or combine these data with expert judgment on the accident causes. Course will provide overview of the following methods: Fault Tree Analysis, Event Tree Analyses, Bayesian Belief Networks, Bow Ties, Petri Nets, etc. Overview is carried out with respect to methods/models purpose, problems, recommendations and relation to new technologies.	90
18	**Agent-based modelling of ATM Safety**	The FAA and EUROCONTROL, together with a number of European Air Navigation Service Providers (ANSPs) and NASA, have worked to evaluate and progress of promising safety research areas that can aid real operational ATM safety and safety assurance. Motivated by the increased safety risk assessment challenges posed by NEXTGEN and SESAR developments they identified Agent-based modelling as promising technique. The lecture will cover reasons for usage of agent-based modelling, detailed modelling steps and finally examples of usage.	45-90
19	**Experimental methods**	Experiments are a common and very useful part of scientific methods as they allow gathering experimental evidence that allow answering a research question or refusing/confirming a hypothesis. Experiments are often costly in effort and time, especially when human participants are involved, and proper planning is necessary to obtain the evidence sought in support of the research question. The tutorial will cover the following topics: • Formulating research question and hypothesis • Observations, longitudinal studies and experiments • Dependent and independent variables • Correlation and causality, Granger causality • Measurement Scales and Distributions (continuous and concrete, examples of distributions) • Population metrics, sampling methods and sample size • Categories of validity • Statistical power • Factorial design • Sequence effects, counterbalancing, latin-square design • Ethical guidelines and participant consent • Experimental design in practice: limitations and considerations Three short exercises, building on each other, will help applying the above concepts.	180
20	**The air transport value chain**	The air transport value chain: aircraft manufacturers, leasing companies, infrastructure providers (airports, air navigation services, communications), ground handlers, airlines, global distribution systems, travel agents, freight forwarders, etc.; Economic relationships between stakeholders involved; The nature of demand for airports and air navigation services, arising from inherently heterogeneous transport demand, accommodated by different airline business models: full-service network carriers, low-fare carriers, business aviation, charters, all-cargo carriers, etc.; Cost and revenue structures of airlines, airports and air navigation service providers.	75-90
21	**Introductory airport economics**	The lecture will give some basic ideas on cost structure, revenue structure and profitability of airports in general, as well as of different airport types. This should help understanding the "objective function" of an airport, and sheds some more light upon relationship between airports and airlines. Importance and sources and of non-aeronautical airport revenues will be specifically addressed.	60-75
22	**Basics of airfield and airspace modelling**	To discuss modelling and models as a planning, design and operation tool. Role of an "engineer". Systems approach and analysis. Systems analysis process structure. Why models for evaluation of alternatives. Model building. Models used in (air) transport. An example of a well-accepted airfield and airspace capacity model.	60-90
23	**Introduction to airfield and airspace simulation modelling**	To discuss basic advantages and possible shortcomings of simulation models. Basics of Monte Carlo simulation. Stochastic processes and variables. Structure of simulation models. Illustrative generic example of an airfield/airspace model.	45-60

No.	Lecture title	Learning objectives (Abstract)	Duration (minutes)
24	**Making best use of airport airside capacity**	Important question for busy airports is how to achieve the best use of the existing resources before building new ones. Various solutions to increase utilization of available airport airside capacity are discussed - research results and success with implementing them in practice. Procedural and technological improvements are covered (changes in separation standards, innovative procedure design, etc.), as well as contribution of collaborative decision making (A-CDM, APOC, TAM concepts). Also, an overview of the latest SESAR solutions implementation in Key feature – High performing airport operations is given, pointing out an urgency to consider more closely issue of airport airside capacity.	90
25	**Demand characteristics related to airport planning**	Demand at an airport is typically characterized by (more or less pronounced) hourly, daily and/or monthly variations. Concentration of traffic throughout the year (seasonality) and throughout the day (due to number of factors) is of high importance for balanced airport "supply side" planning (runways, taxiways, aprons and terminals). As for the daily traffic patterns – special attention is given to the difference between O-D and hub airports, i.e. airside capacity sensitivity to concentration of aircraft into waves. Wave-system significantly burdens airport resources requiring higher throughput during relatively short time. Apart from traffic patterns, other demand characteristics of importance for reliable airside planning (balancing between runway system and terminal complex) are discussed.	60-90

Figure 1. Catalogue of lectures

SESAR Engage KTN – Summer school, 9-13 September 2019, Belgrade

Please fill in this form using the total of up to 10 Xs to state your preferences, putting no more than 3 Xs in any individual preference box.

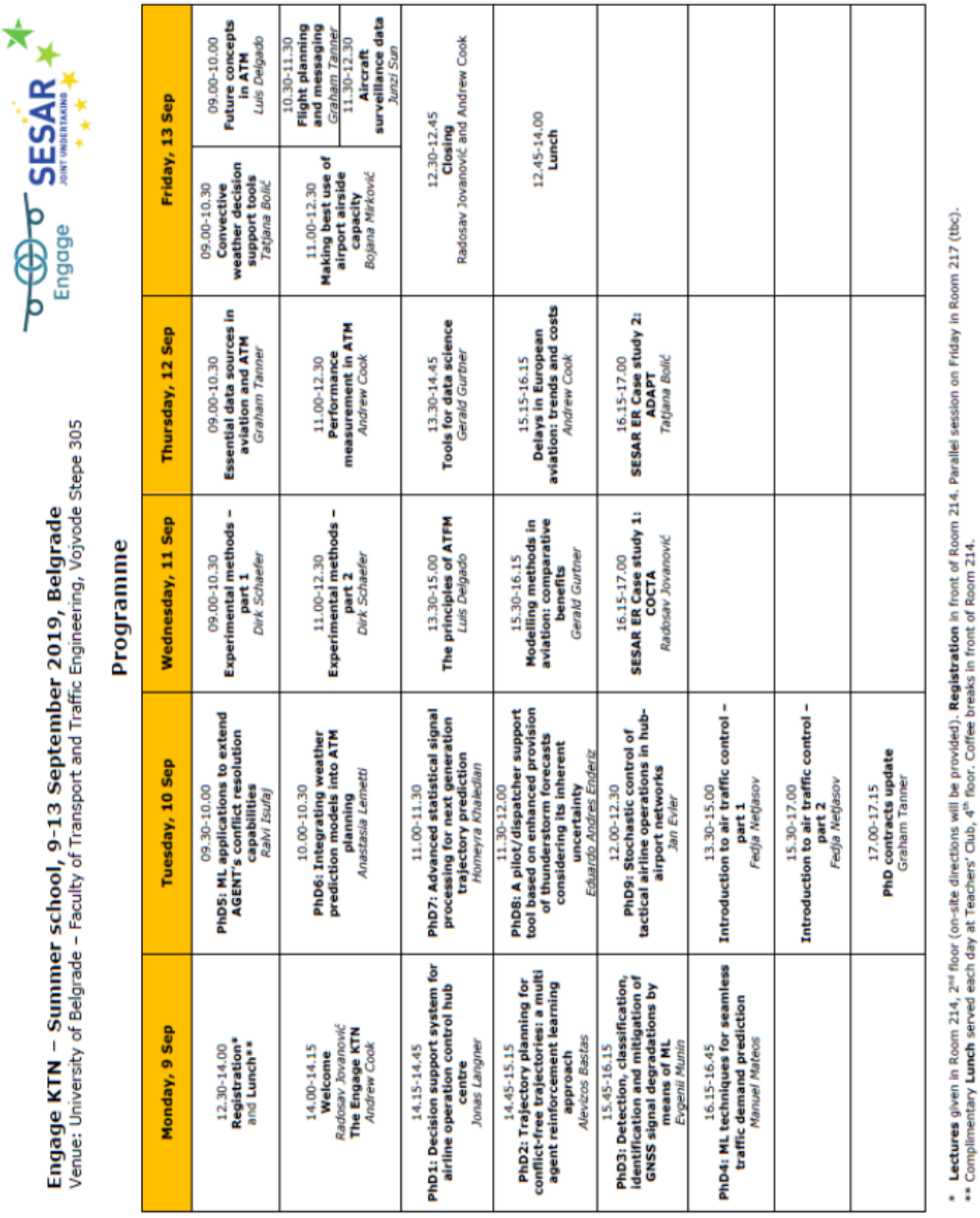
Supervisor:	

No.	Lecture title	Preference box
1	The principles of air traffic flow management	
2	An introduction to flight planning and ATM messaging	
3	Performance measurement in ATM	
4	Delays in European aviation: trends and costs	
5	Essential data sources in aviation and ATM	
6	Modelling methods in aviation: comparative benefits	
7	Tools for data science	
8	Future concepts in ATM	
9	Convective weather decision support tools for ATM, with ATM basics	
10	Financing air navigation services	
11	ATM and airlines' operations in volcanic ash	
12	Survey design	
13	Analysis of survey data	
14	The door to door perspective	
15	Introduction to Air Traffic Control	
16	Risk and Safety Modelling in Civil Aviation	
17	Causal methods/models for the ATC/ATM operations	
18	Agent-based modelling of ATM Safety	
19	Experimental methods	
20	The air transport value chain	
21	Introductory airport economics	
22	Basics of airfield and airspace modelling	
23	Introduction to airfield and airspace simulation modelling	
24	Making best use of airport airside capacity	
25	Demand characteristics related to airport planning	

Figure 2. Lecture preference form

2.2 Delivering the 2019 programme

The programme (Figure 3) kicked off on Monday, 9th September 2019, with presentations of four Engage-funded PhDs. The PhD session continued on Tuesday morning with the five remaining PhD presentations. Each PhD presentation was followed by lively Q&A session, with questions coming both from colleague PhD students and from senior Engage researchers. It should be noted that each Engage PhD has an Engage mentor assigned and that PhD candidates and their mentors were introduced to each other during the summer school.



Engage KTN – Summer school, 9-13 September 2019, Belgrade
Venue: University of Belgrade – Faculty of Transport and Traffic Engineering, Vojvode Stepe 305

Programme

Monday, 9 Sep	Tuesday, 10 Sep	Wednesday, 11 Sep	Thursday, 12 Sep	Friday, 13 Sep
12.30-14.00 **Registration*** and **Lunch****	09.30-10.00 **PhD5: ML applications to extend AGENT's conflict resolution capabilities** *Ralvi Isufaj*	09.00-10.30 **Experimental methods - part 1** *Dirk Schaefer*	09.00-10.30 **Essential data sources in aviation and ATM** *Graham Tanner*	09.00-10.00 **Future concepts in ATM** *Luis Delgado*
14.00-14.15 **Welcome** *Radosav Jovanović* **The Engage KTN** *Andrew Cook*	10.00-10.30 **PhD6: Integrating weather prediction models into ATM planning** *Anastasia Lemetti*	11.00-12.30 **Experimental methods - part 2** *Dirk Schaefer*	11.00-12.30 **Performance measurement in ATM** *Andrew Cook*	10.30-11.30 **Flight planning and messaging** *Graham Tanner*
14.15-14.45 **PhD1: Decision support system for airline operation control hub centre** *Jonas Langner*	11.00-11.30 **PhD7: Advanced statistical signal processing for next generation trajectory prediction** *Homeyra Khaledian*	13.30-15.00 **The principles of ATFM** *Luis Delgado*	13.30-14.45 **Tools for data science** *Gerald Gurtner*	11.30-12.30 **Aircraft surveillance data** *Junzi Sun*
14.45-15.15 **PhD2: Trajectory planning for conflict-free trajectories: a multi agent reinforcement learning approach** *Alevizos Bastas*	11.30-12.00 **PhD8: A pilot/dispatcher support tool based on enhanced provision of thunderstorm forecasts considering its inherent uncertainty** *Eduardo Andres Enderiz*	15.30-16.15 **Modelling methods in aviation: comparative benefits** *Gerald Gurtner*	15.15-16.15 **Delays in European aviation: trends and costs** *Andrew Cook*	11.00-12.30 **Making best use of airport airside capacity** *Bojana Mirković*
15.45-16.15 **PhD3: Detection, classification, identification and mitigation of GNSS signal degradations by means of ML** *Evgenii Munin*	12.00-12.30 **PhD9: Stochastic control of tactical airline operations in hub-airport networks** *Jan Evler*	16.15-17.00 **SESAR ER Case study 1: COCTA** *Radosav Jovanović*	16.15-17.00 **SESAR ER Case study 2: ADAPT** *Tatjana Bolić*	12.30-12.45 **Closing** Radosav Jovanović and Andrew Cook
16.15-16.45 **PhD4: ML techniques for seamless traffic demand prediction** *Manuel Mateos*	13.30-15.00 **Introduction to air traffic control - part 1** *Fedja Netjasov*			12.45-14.00 **Lunch**
	15.30-17.00 **Introduction to air traffic control - part 2** *Fedja Netjasov*			
	17.00-17.15 **PhD contracts update** Graham Tanner			

* **Lectures** given in Room 214, 2nd floor (on-site directions will be provided). **Registration** in front of Room 214. Parallel session on Friday in Room 217 (tbc).
** Complimentary **Lunch** served each day at Teachers' Club, 4th floor. Coffee breaks in front of Room 214.

Figure 3. Final summer school programme

The programme continued with tutorials on key ATC/ATM concepts and research methodologies. Two SESAR ER case studies were presented too: the Jane's 2019 ATC Innovation award-winning project COCTA, and the ongoing ER project ADAPT. It should be noted that it was attempted to have the presentation of another SESAR ER (and Jane's 2018 Enabling Technology Award-winning) project – RETINA – at the summer school. Following the initial contact in early July, it unfortunately turned out that neither the RETINA project coordinator nor the potential substitute presenters were available during the summer school week.

Specifically, during the opening and closing sessions, but also where relevant throughout the PhD presentations and tutorials, references have been made to relevant Engage thematic challenges and forthcoming workshops, to relevant catalyst-funded projects, as well as to the SESAR Innovation Days conference.

All summer school tutorial slides were made available to participants on a dedicated password-protected page of the Engage website.

3 Participants

The summer school was attended by 30 participants from 14 countries (see Figure 4). 42 applications from 16 countries were received in total, of which 38 were accepted on a first come, first served basis for postgraduate students studying for an ATM-/aviation-/aeronautical-related topic or those working in the industry. With cancellations, a total of 30 participants took part. The largest number of participants came from Spain (7), followed by Serbia (4), Germany and the Netherlands (3 each), Belgium, France and Greece (2 each), and Bulgaria, Italy, Norway, Singapore, Sweden, Turkey and UK (1 each). The participants included nine Engage PhD candidates and 21 other postgraduate students and practitioners (of which two researchers are involved in Engage catalyst-funded projects).

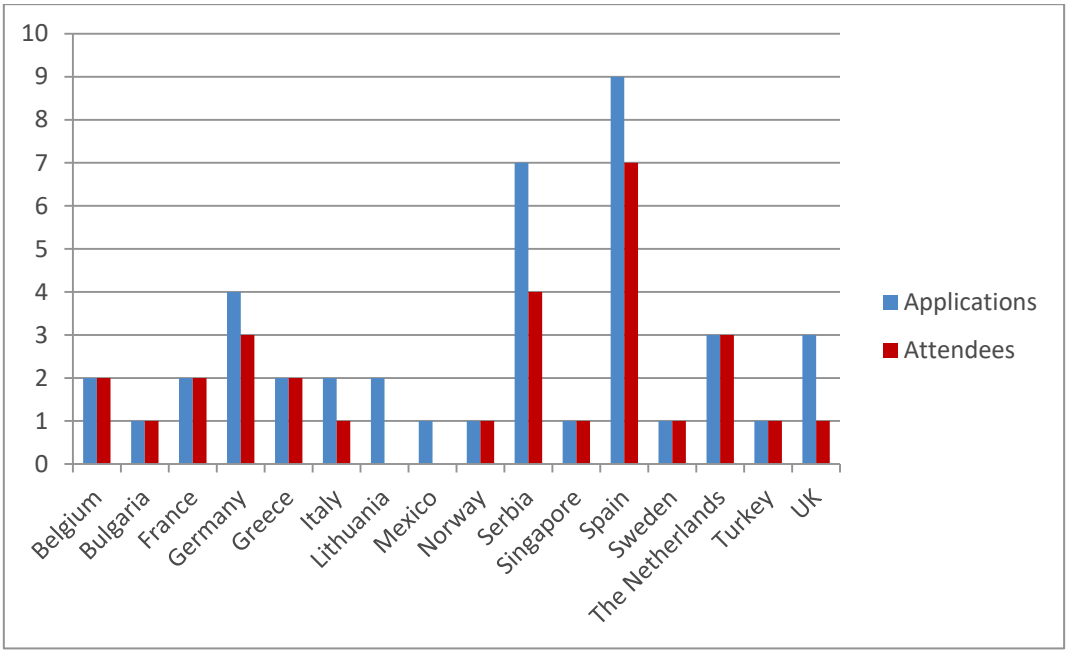


Figure 4. Participants' countries of residence

Figure 5 shows that three-quarters of participants were PhD students, with most of the others being current or recent MSc students. The four non-student participants are all involved in various SESAR-funded projects.

The summer school also raised interest in several European ANSPs, with three applications received and accepted. However, two of these places were subsequently cancelled due to unforeseen work commitments of the applicants. Limited industry involvement was to be expected given that the

programme focused on ATM tutorials and methodological aspects (reflecting the early stage of the Engage PhDs).

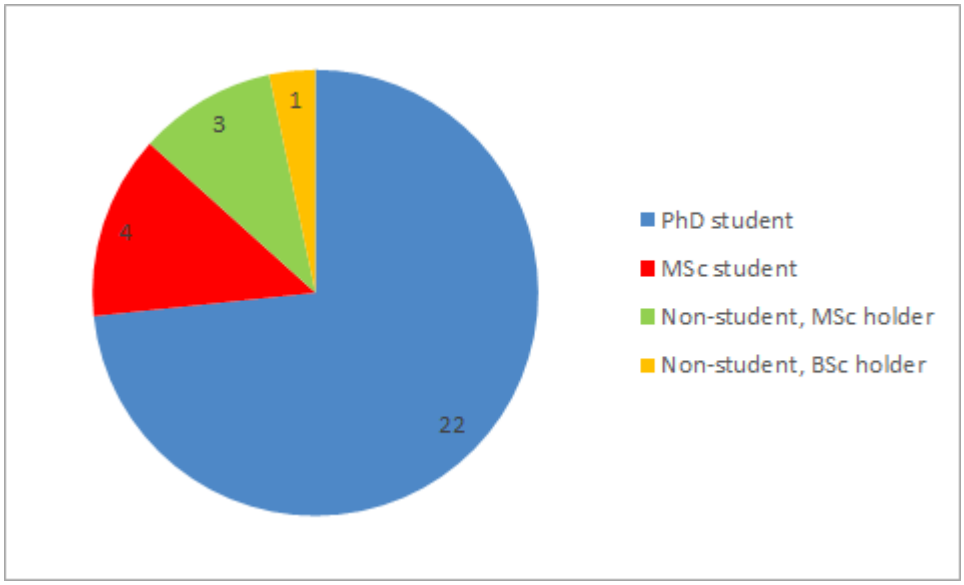


Figure 5. Educational level of participants

Figure 6 illustrates the varied educational background of summer school participants. It suggests that almost half of them had some kind of aviation background (aerospace engineering, air transport and traffic engineering, aeronautical engineering or aviation management). Six participants had a background in computer science or informatics, and a fifth with other engineering background (industrial, electrical, civil, space or maritime).

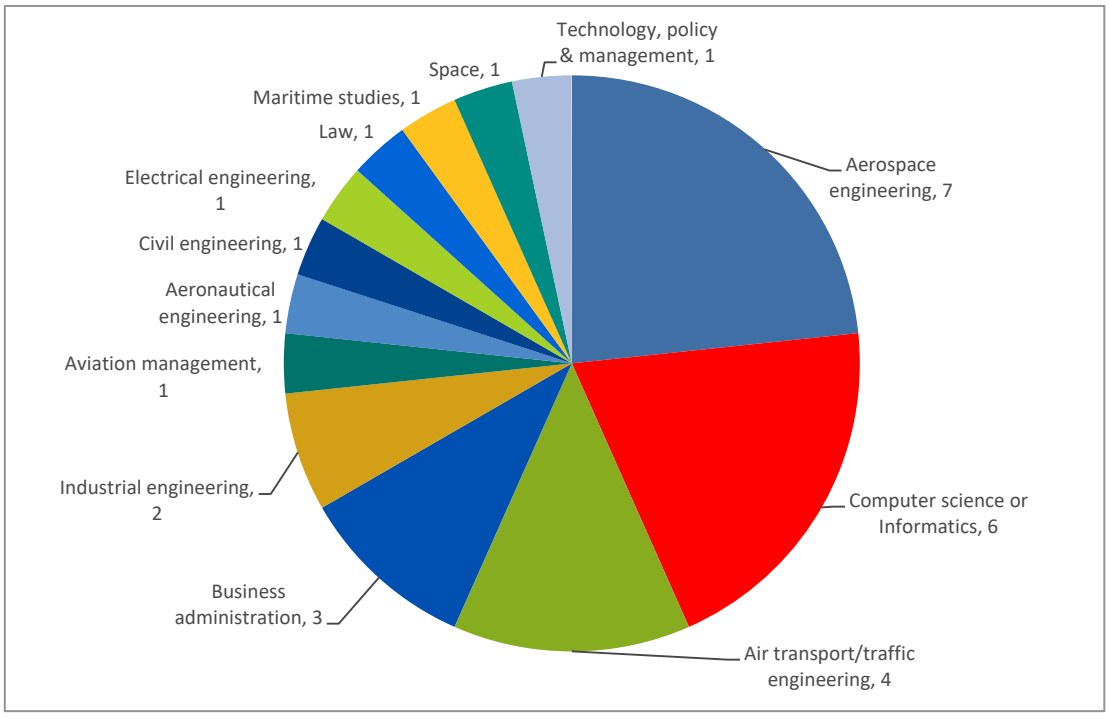


Figure 6. Educational background of participants

Finally, Figure 7 shows the gender structure of participants and applicants, with around two-thirds male and one-third female in both categories.

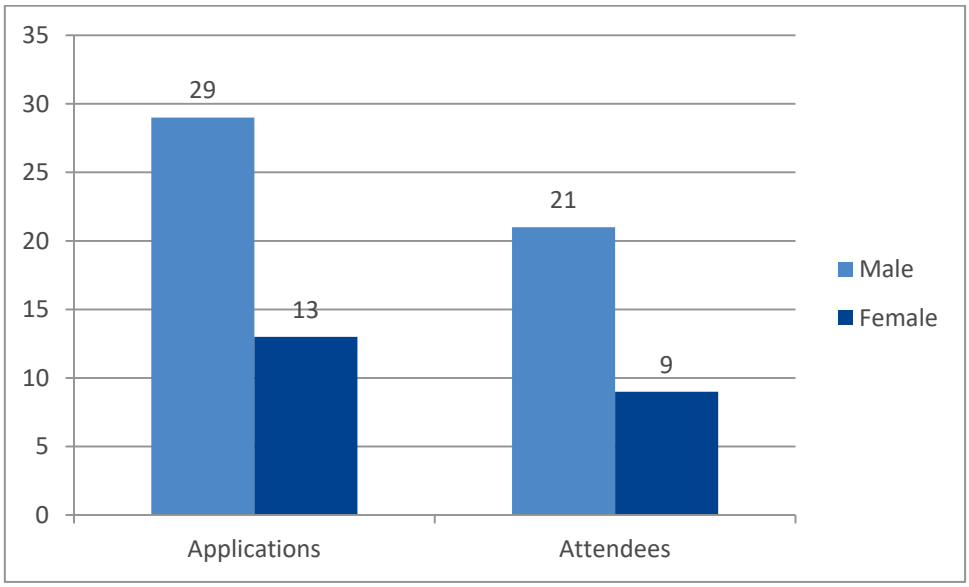


Figure 7. Participants' gender structure

4 Feedback from participants

4.1 Participant feedback

Participants were encouraged to provide feedback, several of which did. Anonymised feedback is shown below.

I just wanted to say a huge thank you to everyone for preparing the Excellent "Engage KTN Summer School 2019, Belgrade".

It was the best opportunity to enhance my knowledge in ATM and meeting the great community in this field. I learned many useful subjects during this week which if I wanted to learn them on my own it would take plenty of time.

First, I learned the concepts of ATM and mathematic tools related to ATM.

Then, the next generation of ATM and also Surveillance data which they were very close to my project

And finally, modeling, performance measurement, and getting familiar with the projects in this field with SESAR solutions and EUROCONTROL.

It was really an honor to see you all.

[Engage PhD student]

Thanks a lot for the brilliant organization of the Engage KTN Summer School I have really learned a lot from it!

I do hope to attend the future trainings on the subject to enrich my knowledge and capacities.

[non-Engage PhD student]

Thank you for the great organization and the inspiring programme. It was nice to visit Belgrade and I am looking forward to the upcoming events and my PhD research.

[Engage PhD student]

Thank you for sharing the slides and for organising a great summer school. There was really a lot of useful information, of which I am still digesting. Also, the venue was great and I hope to visit Belgrade again. You asked during the final day for some feedback to help improve the 2nd edition:

1. I think during the first day, a tour de table of all the participants would have been helpful. This would have made getting to know people a bit quicker and easier, as well as seeing who is doing similar work.

2. An evening event, such as a tour of the city or closing dinner, could have helped further with establishing contacts.

3. I felt that the introductory presentations could have happened on Monday. After, the more technical or specific presentations (such as the PhD topics) could take place. This would allow people coming from the different disciplines to have the necessary background information, before going into more advanced topics.

4. A summer school participation certificate could be a nice gesture, as well as proving useful for those who have to prove attendance to companies/universities.

[non-Engage PhD student]

5 Conclusions and outlook

5.1 Conclusions

This first edition of the Engage summer school was considered successful. A healthy number of applications from a number of European countries and Singapore was attracted. This led to a nicely sized and structured final group of 30 participants, with varied backgrounds and a common, strong interest in air traffic management. The programme itself seemed well-tailored to participants' interests and capabilities. Overall, a solid foundation has been laid for the forthcoming work with Engage PhDs, as well as for future editions of the Engage summer school and other related Engage activities.

5.2 Lessons learned

The format chosen for the first summer school worked well:

1. Involving Engage PhD supervisors in building the programme ensured lecture topics were closely aligned with student requirements;

2. Although primarily aimed at Engage PhDs, the programme proved to be attractive to other PhD/MSc students and young researchers.

Lessons learned organising the first summer school:

1. Publicising the summer school with a near-final programme at the earliest opportunity (over three months' notice was given in this case) helped the target number of bookings (around 30) to be reached in good time;

2. As this was the first summer school, considerable effort was invested in the organisation, preparation of the lecture content, and post-event activities such as processing travel/accommodation expense claims from students eligible for financial support. Although it may be somewhat easier to organise the next two summer schools, the processing of student claims is expected to require a similar amount of effort from the Engage Coordinator;

3. Whilst a complimentary lunch was provided for participants each day, organising additional social activities such as an evening meal or a tour should be considered.

Follow-up activities:

1. It is clear that some of the PhDs have similar requirements for their research, e.g. use of high-resolution trajectories in TMAs and access to passenger itineraries for decision-making tools. Such research requirements could be addressed by Engage through the organisation of targeted technical workshops involving students and experts from within/outside the network. These may be opened to a limited number of other participants (this will be discussed with the SJU during the upcoming Grant Amendment phase);

2. PhD candidates were notified of forthcoming Engage thematic challenge workshops, which align particularly well with their topics of study, and encouraged to attend them.

5.3 Outlook

The second Engage summer school is scheduled to be held in July 2020 at EUROCONTROL's premises in Luxembourg. It will have a stronger focus on the Engage PhDs' technical progress and outputs, as the candidates will by then be nearly half-way through their PhD studies. Consequently, less time will be devoted to tutorials on ATM concepts and research methodologies, with more time devoted to PhDs presenting their more mature work and obtaining targeted feedback from both industry and academia, including from their mentors. Supervisors will be strongly encouraged to attend.

Industry involvement will be encouraged, particularly as expert speakers, to give insights into the operational context, thus building on the previous edition of the summer school. However, it should be noted that given the target number of appx. 30 participants identified as lessons learned, with a full complement of Engage PhD students and supervisors, plus other (e.g. EUROCONTROL-sponsored PhD) students, there may only be a few additional places available for industry *delegates per se*.

6 References

[1] Engage project, 2017. Grant Agreement 783287, Ref. Ares(2017)6114946 - 13/12/2017.

[2] Engage website, 2019. https://engagektn.com/summer-school-2019/.

7 Acronyms

ANSP	Air navigation service provider
ATC	Air traffic control
ATM	Air traffic management
ER	Exploratory Research
KTN	Knowledge Transfer Network
SESAR	Single European Sky ATM research
SJU	SESAR Joint Undertaking
TMA	Terminal manoeuvring area

-END OF DOCUMENT-