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ALBATROSS

THE MOST ENERGY EFFICIENT FLYING BIRD

This Final Report on Dissemination and Communication Activities is part of a project that has received funding from the SESAR3 Joint Undertaking under grant agreement No 101017678 under European Union's Horizon 2020 research and innovation programme.

Abstract

ALBATROSS aims at reducing the overall CO_2 footprint of aviation by bringing together multiple disciplines and partners of the aviation branch to demonstrate the potential of fuel consumption reduction already today. To do so several solutions are combined to work together in complete gate-to-gate scenarios that have been demonstrated across Europe.

This document reports on the Dissemination and Communication activities of the Project. Events and activities performed during the project phases are summarised and evaluated against the goals of the Project's Communication and Dissemination strategy as laid down in the initial and final Dissemination and Communication Plans.

This includes a review of targeted activities (conferences, scientific publications) as well as transversal ones (webpages, social media, workshops). Exploitation opportunities in view of the Project's maturities are also described, and lessons learned are extracted

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1 Introduction

1.1 Background

The success and impact of a project such as ALBATROSS also depends on the effectiveness of the communicative actions. Increasing the ALBATROSS project visibility and recognition serves to educate the general public, to inform experts in the field and to attract future research, academic and industrial partners as well as policy makers for further development.

Consequently, in addition to the technical research works of the ALBATROSS project, activities are also planned to address the need to disseminate and exploit the project's results and to communicate about the project's ideas and its findings during the period of the grant. Dissemination activities have to be carried out over the whole project lifetime. The task's activities run until two months before the initially planned project end and do continuously generate results. Instead of focussing on a strict dissemination of project results at the end of the project also intermediate results have to be communicated as soon as available.

Consideration is also given to potential activities that could follow on after the closure of the project to maximize the impact of the research that is being funded. This includes the integration of the of the demonstrated procedures, the implementation of collaborations established in the live trials in every day's operations on European skies. Many of the solutions are near to mature in a sense of stand-alone solutions. Their combination helps to identify the real potential of fuel saving in gate-to-gate scenarios. The identified added value in terms of emissions reduction helps decision makers to justify possible adjustments in current procedures and structures.

1.2 Purpose and Structure of the Document

In order to align all Dissemination, Exploitation and Communication activities within the Project, all partners of the consortium engage(d) in WP 5 within the Work Breakdown Structure. This Task has produced initial and final versions of the Dissemination and Communication Plan [2], [3], based on the draft Dissemination and Communication strategy presented in Annex I to ALBATROSS's Grant Agreement [4].

The purpose of this document then is to review the activities performed according to the Dissemination and Communication plan and to finalise the sketch of the Exploitation strategy – at the TRL of the project, there are not so much concrete Exploitation measures and more opportunities; these are explained in chapter 2 along with the Communication and Dissemination objectives. Chapter 3 gives a chronological listing of all CDE activities already performed or scheduled for the remainder of the Project.

In chapter 4 the targeted Dissemination activities are analysed in more detail, while chapter 5 deals with the transversal ones. The evaluation of the performed activities, including lessons learned, can be found in chapter 6. Finally, chapter 7 lists all Project publications.

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1.3 Acronyms

The following table contains a list of acronyms used in this report

Acronym	Meaning
ACI	Airports Council International
AEC	Aerospace Europe Conference
AIAA	American Institute for Aeronautics and Astronautics
ANSP	Air Navigation Service Provider
AG	Aktiengesellschaft (Public Limited Company)
ATM	Air Traffic Management
CEAS	Council of the European Aerospace Societies
CMS	Content Management System
CO	Confidential
COVID-19	Coronavirus Disease 2019
D<no.>	Deliverable <no.>
DLRK	Deutscher Luft- und Raumfahrtkongress (German Aerospace Congress)
EASA	European Union Aviation Safety Agency
EBAA	European Business Aviation Association
EC	European Commission
EU	European Union
EUR	European [Region]
EUROCAE	European Organisation for Civil Aviation Equipment
FAA	[U.S.] Federal Aviation Administration
GDPR	General Data Protection Regulation
H2020	Horizon 2020
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
ICAS	International Council of Aeronautical Sciences
ICRAT	International Conference for Research in Air Transportation
IPR	Intellectual Property Rights
M<no.>	[project] Month <no.>
MDPI	Multidisciplinary Digital Publishing Institute [open access publisher]
MET	Meteorology, meteorological
MIT	Massachusetts Institute of Technology

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MS	Milestone
PBN	Performance-Based Navigation
Q<no.>	Quarter <no.>
RAD	Route Availability Document
SEPHER	Project to product and to store green energy for on ground CNS facilities
SES	Single European Sky
SESAR	Single European Sky ATM Research
SID	SESAR Innovation Days
SJU	SESAR Joint Undertaking
TBD	to be determined
TMA	Terminal Manoeuvring Area
TRL	Technology Readiness Level
WP	Work Package

Table 1: Acronyms in this report

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2 Communication, Dissemination and Exploitation Objectives

ALBATROSS payed special attention to the effective Communication and Dissemination of the most relevant outcomes and reports to the public. ALBATROSS focussed in particular on strengthening the confidence of supervisory authorities, operational staff and management by providing additional environmental performance evidence from the analysis based on the performance assessment approach. To this end, efficient links to relevant European and international research and innovation activities comprising SESAR projects and solutions relevant for ALBATROSS were maintained by regular teleconferences / direct involvement via participation in external experts' Advisory Board and stakeholder consultation workshops.

The project had the following communication and dissemination goals:

- Showcase results to the ATM industry stakeholders through open day type activities, and through professional fora like the World ATM Congress or SESAR Innovation Days.
- Inform publicly about ALBATROSS's developments, their applicability and potential benefits for operations and the environment, targeting both experts in the field and the general public, at European and international level.
- Facilitate the transfer of the results to further mature the developed approach.

2.1 Communication

2.1.1 Communication Objectives and strategy

Communication towards all aviation stakeholders, with particular attention to European citizens, was an essential activity in ALBATROSS. Dissemination activities within the aviation community aim(ed) to secure that ALBATROSS's results reach all interested stakeholders and target organisations, fostering their interest into the Project and allowing their recommendations to be taken into account during the project and possible follow-up work.

Communication ensure(d) the involvement of operational stakeholders through workshops, Advisory Board participation and other communication actions to gather their inputs to the ALBATROSS work plan and to propose (post-project) measures to advance the TRL of the developed Solution and the identification of the necessary technological and regulatory enablers.

Key stakeholders were identified according to their interest and influence. For each group of stakeholders, specific means of Communication were developed, e.g. participation in the Advisory Board (group of external experts), participation in the stakeholder consultation workshops.

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2.1.2 Targeted audiences

Target	How can they benefit from the project	Objectives and expected feedback
General Public	Get information on activities. Reduce environmental input for everyone.	Public awareness. Especially in groups dealing with pollution or noise issues.
Interested Public	Find out more aviation related implications touched by ALBATROSS.	Spread information in own communities. (Students, online networks,…)
Airline Costumers	Increase consciousness.	Conscious choice of airlines.
Worldwide auditory	Get to know more about European initiatives.	Start similar activities.

Table 2: Communications target audiences

2.1.3 Communication channels

Channel	Link	Information to be shared
Project Website	https:\\www.sesar-albatross.eu	• Project deliverables • Project news • Communication tools, e.g. brochures, flyers, videos. • Etc.
SESAR Twitter account	SESAR 3 JUEU (@SESAR_JU) / Twitter	• Photographs taken at project meetings • Brochures/flyers • Etc.
DLR Twitter account	Deutsches Zentrum für Luft- und Raumfahrt e.V.: Ihr Unternehmen | LinkedIn	• Retweet
Airbus Twitter account	Airbus (@Airbus) / Twitter	• Retweet
Eurocontrol Twitter account	EUROCONTROL (@eurocontrol) / Twitter	• Retweet
SESAR JU LinkedIn Account	SESAR 3 Joint Undertaking: Übersicht | LinkedIn	• Posts on ALBATROSS • Posts on Events

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Channel	Link	Information to be shared
		• Posts on videos produced
Linked In Accounts of PJ Member (M. Nurisso, M. Gerber, J. Scheiderer, and many other)	multiple	• Several retweets, likes and posts highlighting project related posts
AIRBUS online Articles	www.airbus.com/newsroom	• 4 articles • 1 Press release
SESAR JU Website	https://www.sesarju.eu/news	•
AIRBUS summit on sustainability and aviation' s decarbonisation	Sept 2021	• Summit
World ATM Congress **Madrid**	SESAR walking tours and theatre presentations	• Oct. 26th - 28th 2021
World ATM Congress **Madrid**	SESAR walking tours and theatre presentations	• Jun. 21st - 23rd 2022
Connecting Europe Days (CED) **Lyon**	ALBATROSS Presence together with SJU	• Jun. 28th 2022
conference presentation **ICAS Stockholm**	Title: The ALBATROSS Project – A European Initiative to Reduce Aviation's Carbon Dioxide Emissions in Large Scale	• Sept. 04th - 09th 2022
Towards Sustainable Aviation Summit (TSAS) **Toulouse**	Presentation Title: A European Initiative to Reduce Aviation's Carbon Dioxide Emissions in Large Scale	• Oct. 18th- 20th 2022
Airspace World 2023 **Geneva**	Theatre presentations	• Mar. 08th - 10th 2023

Table 3: Communication channels

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2.2 Dissemination

2.2.1 Dissemination Objectives and strategy

ALBATROSS pays special attention to the effective dissemination of the most relevant outcomes and reports to the public. ALBATROSS focuses in particular on strengthening the confidence of supervisory authorities, operational staff and management by providing additional environmental performance evidence from the analysis based on the performance assessment approach. To this end, efficient links to relevant European and international research and innovation activities comprising SESAR projects and solutions relevant for ALBATROSS are maintained by regular teleconferences / direct involvement via participation in external experts' Advisory board and stakeholder consultation workshops.

The project has the following communication and dissemination goals:

- Showcase results to the ATM industry stakeholders through open day type activities, and through professional fora like the World ATM Congress, SESAR Innovation Days or Airspace World.
- Inform publicly about ALBATROSS's developments, their applicability and potential benefits for operations and the environment, targeting both experts in the field and the general public, at European and international level.
- Facilitate the transfer of the results into Industrial application to further use the developed approaches.

An important means, which ensures not only feedback from the interest groups but also their interaction with each other, is the conduction of stakeholder consultation workshops. Two of these have been organised:

- The first stakeholder consultation workshop, scheduled for October/November 2021, presented the methodology, concept and approach to be used in this project. Feedback of the stakeholders on these items have been complemented with ideas on how to incentivise the further development and eventual implementation of the concept identified to minimise the environmental impact during complete gate-to-gate scenarios. The feedback gathered from stakeholders was used to finalise the approach, the dissemination plan, the incentives options and the methodology.
- The second stakeholder workshop took place in October 2022 and presented the project results and the impact analysis of environmental benefits as well as potential impact to other performance scheme indicators. The incentives options retained from the first stakeholder workshop and their estimated impact were reviewed and discussed. It was elaborated how the implementation decisions could be accelerated, how incentives and other potential measures could support that acceleration. The status of standardisation and regulation activities and possible additional elements identified by the project requiring further work with standardisation and regulation bodies were explained.
- Further activities had been driven and organised by the different project partner. They significantly contributed to the dissemination activities. The first major event was an airbus summit on sustainable aviation taking place end of September 2021. This event was a great

opportunity to lead a green commercial AFR flight from CDG to Toulouse for which environmental gains are calculated and analysed in details. Albatross was presented as one of the major activities to take further steps to bring Airbus zero-emission ambition into life.

2.2.2 Targeted audiences

Target	How can they benefit from the project	Objectives and expected feedback
European Decision Makers	Information about what is possible with state-of-the-art technology	Enabling Procedures and Principles for further daily use
Aviation OEM's	What needs can be derived for Aviation industry	New developments.
ANSP's	What procedures turn out to be environmentally friendly and easy to apply.	Adaption of standard procedures.
Airlines	Where to save emissions and fuel. Increase consciousness.	Adaption of standard procedures. Conscious choice of airlines.
Pilots	Where to save emissions and fuel.	Increase Awareness.
General Public	Get information on activities. Reduce environmental input for everyone.	Public awareness. Especially in groups dealing with pollution or noise issues.
Interested Public	Find out more aviation related implications touched by Albatross.	Spread information in own communities. (Students, online networks, …)
Worldwide auditory	Get to know more about European initiatives.	Start similar activities.

Table 4: dissemination target audiences

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2.2.3 Dissemination channels

Channel	Link	Information to be shared
DLR FLugBlatt	No web presence	1 article
DLR Twitter account	Deutsches Zentrum für Luft- und Raumfahrt e.V.: Ihr Unternehmen | LinkedIn	Retweet
Partners Social Media accounts	As mentioned above	As mentioned above
Airbus News	Newsroom | Airbus	4 articles
ICAS	ICAS - International Council of the Aeronautical Sciences - Home	Paper/ proceeding
TSAS	Home - Towards Sustainable Aviation Summit 2022 (3af-tsas.com)	Paper/ proceeding
SciTech	AIAA SciTech Forum and Exposition | AIAA	Paper/ proceeding
EuroGNC	EuroGNC 2022: Home (dglr.de)	Paper/ proceeding
DLRK	DLRK2022: Aktuell (dglr.de)	Paper/ proceeding

Table 5: Dissemination channels (general)

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Scientific papers/presentations	Title	Date
Conference presentation **Euro GNC Berlin**	Paper "Engine Thrust Model Determination from Large Operational Flight Data Base"	May 3rd- 5th 2021
Akademischer Aviatik Zürich, **ETH Zürich**	Increasing the efficiency of airline flight operations with next-generation cockpit functions	Oct. 26th 2021
Conference presentation **ICAS Stockholm**	Title: The ALBATROSS Project – A European Initiative to Reduce Aviation's Carbon Dioxide Emissions in Large Scale	Sept. 04th- 09th 2022
Conference presentation **DLRK 2022, Dresden**	Paper "Aerodynamic Model Adjustment for an Accurate Flight Performance Representation Using a Large Operational Flight Data Base"	Sept. 27th- 29th 2022
Towards Sustainable Aviation Summit Toulouse	Collaborative European wide efforts for more sustainable aviation in the very large scale demonstration project ALBATROSS	Oct. 18th- 20th 2022
AIAA SciTech, Maryland	Paper "A smart data approach to determine an aircraft performance model from an operational flight data base"	Jan. 23rd- 27th 2023

Table 6: Scientific papers, publications and presentations

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Event	Location	Date
Workshop on dynamic RAD	Workshop with externals from AIRBUS, DSNA, EC and Air France	Jul. 1st 2021
AIRBUS summit on sustainability and aviation' s decarbonisation	Event at Toulouse, Arrival of a green commercial flight with press and media on board	Sept. 2021
Advisory board workshop	Presentation of current project status to AB – collection of inputs	Oct. 2021
World ATM Congress	SESAR walking tours and theatre presentations	Oct. 26th- 28th 2021
World ATM Congress	SESAR walking tours and theatre presentations	Jun. 21st-23rd 2022
Connecting Europe Days (CED)	ALBATROSS Presence together with SJU	Jun. 28th 2022
ICAS Stockholm	Conference Presentation	Sep. 04th- 09th 2022
Stakeholder workshop **Amsterdam**	Workshop for Evaluations, Recommendations and Roadmap; with external experts and advisory board	Oct. 25th- 26th 2022
Lufthansa Group ATM Community Workshop, Frankfurt	Workshop	Nov. 28th 2022
3rd FABEC Vertical Flight Efficiency (VFE) Workshop	Workshop and presentation	Dec. 07th 2022
SESAR Innovation Days	Conference with exhibition, networking and other activities (poster etc…)	Dec. 05th- 08th 2022
Project Workshop Geneva	Project Status meeting, Project representation at Airspace World with networking activities	Mar. 8th 2023
Exchange with SWISS/ DLR/ Thales	Dissemination of project results, enabling cooperation for further projects	Apr. 13th 2023

Event	Location	Date
Final Dissemination Workshop Braunschweig	Present project results and coordinate all partners for a common way of communication on those results, identify future chances for cooperation and follow-ups	May 03rd- 04th 2023
DGLR Workshop on flight mechanics and flight guidance	Dissemination of project results for scientific community	May 23rd- 24th 2023

Table 7: Dissemination conferences and workshops

2.3 Exploitation Opportunities

Exploitation of the project results requires appropriate **IPR Management**. This has been defined in the Consortium Agreement agreed between the consortium partners. Background knowledge of the individual partners has been clearly identified and recorded when the agreement was concluded. The Consortium Agreement envisions fair conditions for the uses of foreground and background knowledge and IPR even beyond the duration of the ALBATROSS project so as to facilitate their further use in internal and external follow-up activities including commercial exploitation.

The maturity assessment of the ALBATROSS Solutions shows fulfilment of Technology Readiness Level. It was therefore strongly recommended to continue the activities in follow-up projects, especially as the continued involvement of pilots, ATC controllers, scientists and experts from authorities by means of workshops gives confidence in the feasibility of the concept and relevance of the results. This recommendation is in support of the following **Exploitation opportunities** identified:

- ANSP's
    - Technical improvements are expected to support the operational implementation of Dynamic RAD concept.
    - Additional live trials are expected by interested ANSPs before the technical improvements will be implemented
    - Further development of the PBN-to-xLS concept. Derive concrete measures from the airspace users, ATC and other stakeholders. (e.g. local communities).
    - Improve the flight efficiency of procedures.
- airline partners
    - direct use of findings in daily flight operations, leading to fuel use and noise reductions
    - Derive concrete measures for the optimization of ATM

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- Further identify possible efficiency effects at Stockholm Arlanda and/or other airports. Use these results to enhance operation overall (in terms of increased fuel efficiency), for example in discussions with local ANSPs (concept proofing).
- To evaluate the interest to be equipped with the different evaluated functions
- Apply the analysis methodology to other exercises, namely EXE-06B
- Perform optimized arrivals into CDG, in particular as part of EXE-01
- Identify actions that will allow for full adoption of single-engine taxiing at departure
- Deploy the pilot-assistance tools to all fleet and crew
- Further development of Sustainable Taxiing CONOPS using a Sustainable Taxi Vehicle
- Create acceptance of green taxiing operations
- Updated Sustainable Taxi Vehicles available for purchase/exploitation by interested 3rd parties
- Updated Sustainable Taxi Vehicle form the base for next-generation zero-emission vehicles being developed in collaboration with sector partners for both narrow body and wide body aircraft

- all partners
  - contributions to regulatory changes, e.g. EUROCAE WG-85 “4D Navigation”
- research partners
  - further internal & external research activities with partners from industry, research organisations and academia
  - Rely on the proved functionalities to further mature the system implementing new functions / aircraft types
- airborne industry
  - further development and integration of new FMS functionality for new FMS product line

ALBATROSS showcases available solutions to make flying more energy efficient, with SWISS and DLR demonstrating energy optimised continuous descent approaches in Zurich, using DYNCAT’s analysis of the state of the art and the initial concept as input for the ALBATROSS experiment design.

3 Schedule of activities

The following table lists all Communication and Dissemination activities of the ALBATROSS project in chronological order, as performed or scheduled to be performed at the time of submission of the present report. For information on the original planning and its updates please refer to the Initial (D5.1 [2]) and Final (D5.2 [3]) Dissemination and Communication Plans.

Title	Subject	Date	Place
Kick-off meeting of ALBATROSS project	Presentation of project high-level objectives and key messages; familiarisation with SJU communications	Jan. 29th 2021	Webex hosted by SJU
New VLD Project ALBATROSS	Presentation of project's objectives in SESAR context	Jan 2021	CORDIS
SESAR project webpage	Presentation of project's objectives in SESAR context	Feb. 2021	https://www.sesarju.eu/projects/albatross
announcement on project start (e-news#1)	Information about project's initiation and objectives	Feb. 22nd 2021	SESAR e-news; shared via LinkedIn and Twitter
VLD Project ALBATROSS	Information about project's initiation and objectives	Feb 24nd, 2021	Twitter SJU account
'new project' presentation	Information about project's initiation and objectives	Mar. 5th, 2021	DLR Flight Systems internal magazine ("FlugBlatt")
Conference Presentation and Paper EURO GNC Paper	Paper "Engine Thrust Model Determination from Large Operational Flight Data Base"	May 3rd -5th 2021	Euro GNC

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Title	Subject	Date	Place
project webpage	Initial version of official ALBATROSS homepage	Jun. 15th 2021	https://www.sesar-albatross.eu
e-news#2; general project presentation	Interview with project leader on objectives, challenges and activities of ALBATROSS	Jun. 21st 2021	SESAR e-news; shared via LinkedIn and Twitter
Workshop on dynamic RAD	Workshop with externals from AIRBUS, DSNA, EC and Air France	Jul. 1st 2021	Online – Webex
AIRBUS summit on sustainability and aviation' s decarbonisation	Event at Toulouse, Arrival of a green commercial flight with press and media on board	Sept. 21st - 22nd 2021	Digital and in situ
AIRBUS summit livestream	Recorded livestream of the online event made available	Sept. 21st,22nd 2021	AIRBUS website: https://www.airbus.com/en/newsroom/events/airbus-summit-2021
Press Release	Airbus and Partners target more energy efficient flights	Sept. 21st 2021	AIRBUS website: https://www.airbus.com/en/newsroom/press-releases/2021-09-airbus-and-partners-target-more-energy-efficient-flights
ALBATROSS SAGA PART I	Online Article	Sept 21st 2021	AIRBUS website: https://www.airbus.com/en/newsroom/news/2021-09-seeking-the-most-energy-efficient-flight-episode-1-albatross

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Title	Subject	Date	Place
ALBATROSS SAGA PART II	Online Article	Sept. 28th 2021	AIRBUS website: Seeking the most energy efficient flight – Episode 2 : Flight Trajectory – Innovation – Airbus
ALBATROSS SAGA PART III	Online Article	Oct. 06th 2021	AIRBUS website: Seeking the most efficient flight – Episode 3: Sustainable Aviation Fuels (SAF) – Innovation – Airbus
ALBATROSS SAGA PART IV	Online Article	Oct. 12th 2021	AIRBUS website: Seeking the most efficient flight – Episode 4 : sustainable taxiing on ground – Innovation – Airbus
Increasing the efficiency of airline flight operations with next-generation cockpit functions	Academic Presentation	Oct. 26th 2021	Akademischer Aviatikverein Zürich, ETH Zürich
World ATM Congress	SESAR walking tours and theatre presentations	Oct. 26th- 28th 2021	Madrid
ALBATROSS Official Videoclip	Information on ALBATROSS Project Idea and the demonstration flight CDG-TLS	Oct. 2021	Madrid WAC Online (Youtube) https://www.youtube.com/watch?v=nFsr87aliaM&t=28s
Advisory board workshop	Presentation of current project status to AB – collection of inputs	Nov. 16th 2021	Online and at AIRBUS Saint-Nazaire site in Toulouse

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Title	Subject	Date	Place
LFPG ESSA G2G Preparation Workshop	Workshop of Stakeholder in the area of Air Navigation and Airspace Control	Jan. 19th 2022	Online and at Eurocontrol Site at Brussels
Workshop on Green Deal and SESAR	Workshop of Stakeholder in the area of Air Navigation and Airspace Control	Jan. 11th 2022	Hosted by DSNA
Results and Findings DREAMS and DYNCAT	Workshop of linked project with participation of ALBATROSS project partners	Jan. 26th 2022	Online
Schiphol invests in vehicles to taxi aircraft sustainably	Schiphol e-news	Feb. 18th 2022	Schiphol newsroom
e-news#3 **Behind the scenes: measuring the environmental performance of SESAR Solutions**	KPI's (Key Performance Indicators)	Feb. 24th 2022	SESAR e-news; SESAR Homepage
Inter project coordination ALBATROSS AEON	Presentation of progresses and findings	Apr. 13th 2022	Online meeting
Engine Thrust Model Determination and Analysis using a Large Operational Flight Data Base	Journal publication	May 4th 2022	CEAS Aeronautical Journal https://doi.org/10.1007/s13272-022-00625-y
Engine Thrust Model Determination from Large Operational Flight Data Base	Publication and Conference Presentation	May 3rd- 5th 2022	Euro GNC, Berlin Engine Thrust Model Determination from Large Operational Flight Data Base (ceas.org)

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Title	Subject	Date	Place
World ATM Congress 2022	Panel Discussion	Jun. 21st- 23rd 2022	Madrid
Video	Interviews from WAC 2022	Jun. 21st- 23rd 2022	SESAR Joint Undertaking | ALBATROSS - The most energy-efficient flying bird (sesarju.eu)
Connecting Europe Days	ALBATROSS participation	Jun. 28th- 30th	Lyon
THE ALBATROSS PROJECT – A EUROPEAN INITIATIVE TO REDUCE AVIATION'S CARBON DIOXIDE EMISSIONS IN LARGE SCALE	Publication and Conference Presentation	Sept. 04th- 9th 2022	33rd International Council of Aerospace Sciences (ICAS), Stockholm
Aerodynamic Model Adjustment for an Accurate Flight Performance Representation Using a Large Operational Flight Data Base	Publication and Conference Presentation	Sept. 27th-29th 2022	Deutscher Luft und Raumfahrt Kongress (DLRK), Dresden
THE ALBATROSS PROJECT – A EUROPEAN INITIATIVE FOR MORE ENVIRONMENT-FRIENDLY FLIGHT OPERATIONS	Publication and Conference Presentation	Oct. 18th-20th 2022	Towards Sustainable Aviation Summit, Toulouse
e-news #4 **How to create optimal eco-efficient flights**	CONOPS (Concept of Operations)	Oct. 19th 2022	SESAR e-news; SESAR Homepage
Advisory Board Meeting	Project advances and actual status presentation	Oct. 25th- 26th 2022	Amsterdam Airport

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Title	Subject	Date	Place
ATM – A/C Optimization for Idle Thrust ApproachesSESAR Projects DYNCAT and ALBATROSS	Presentation at Aircraft Operator ATM Community Workshop	Nov. 28th 2022	Frankfurt
ALBATROSS FLIGHT **Using SAF**	Demonstrational Flight with Press Participation	Nov. 30th 2022	Toulouse-Munich
e-news #5 **En route to greener air traffic management**	Project Overview SESAR activities containing ALBATROSS Information	Dec. 3rd 2022	SESAR e-news; SESAR Homepage
Optimum Management of Aircraft Energy Stateduring Descent and Approach	Presentation at 3rd FABEC Vertical Flight Efficiency workshop	Dec. 7th 2022	Nice
AI based analytics of Frankfurt TMA leading to an airspace geometry change	Presentation at 3rd FABEC Vertical Flight Efficiency workshop	Dec. 7th 2022	Nice
Aviation sector starts follow-up sustainable taxiing tests at Schiphol	Status of Polderbaan preparations and sustainable taxiing	Dec. 7th 2022	Schiphol online newsroom
e-news #6 **SESAR partners move ahead with sustainable taxiing tests at Schiphol**	Sustainable Taxi in Schiphol	Dec. 20th 2022	SESAR e-news; SESAR Homepage

Title	Subject	Date	Place
ALBATROSS, À LA RECHERCHE DE LA PERFORMANCE ENVIRONNEMENTALE DES VOLS	Publication on ALBATROSS related work	Dec. 2022	DSNA Internal Journal Quoi de neuf sur les grand programmes.
Engine thrust model determination and analysis using a large operational flight database.	Journal Publication	Dec. 2022	CEAS Journal
A smart data approach to determine an aircraft performance model from an operational flight data base	Conference paper	Jan. 23rd- 27th 2023	AIAA SciTech, Maryland
ALBATROSS delivering flight efficient operation	Presentation at Airspace World 2023	Mar. 07th- 10th 2023	Geneva
SESAR Award Ceremony	Peoples Choice Award for ALBATROSS	Mar. 07th- 10th 2023	Geneva
Project Workshop	Teamworkshop	Mar. 07th- 10th 2023	Geneva
e-news #7 **2023 Digital European Sky awards announced!**	SESAR Digital European Sky Awards	Mar. 09th 2023	SESAR e-news; SESAR Homepage
e-news #8 **From ALBATROSS to HERON: Europe at the forefront of innovation**	Article about HERON in relation to ALBATROSS	Mar. 27th, 2023	SESAR e-news; SESAR Homepage

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Title	Subject	Date	Place
Aerodynamic model adjustment for an accurate flight performance representation using a large operational flight data base	Journal Publication	Apr. 20th 2023	CEAS Journal Aerodynamic model adjustment for an accurate flight performance representation using a large operational flight data base | SpringerLink
e-news #9	Presentation of Gate2Gate examples – dynamic RAD	2023	submitted to SJU communication officer
e-news #10	Presentation of Exercises, Summary of the actions (WP3)	2023	in review
Press release by DLR	Press release on the project and the DLR contribution after Project End	May 2023	In preparation
Final Dissemination Workshop	Present project results and coordinate all partners for a common way of communication on those results, identify future chances for cooperation and follow-ups	May 03rd-04th 2023	Braunschweig, DLR Facility
Journal paper	DLR's project results – emphasis LNAS flight trials in ALBATROSS context	2023 - 2024	In preparation
Conference Participation	Final Project Results	2023 -2024	In preparation, SESAR Innovation Days

Table 8: Schedule of Communication and Dissemination Activities

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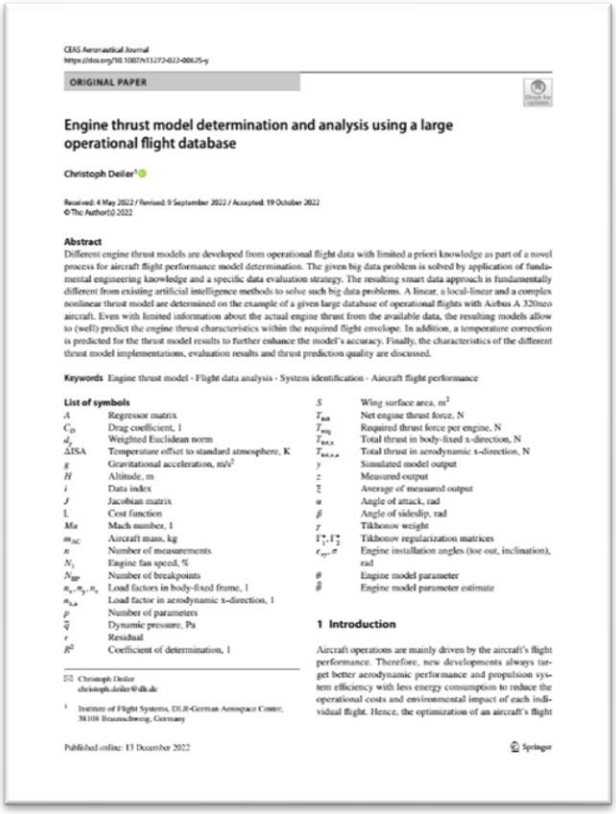
4 Targeted Dissemination activities

4.1 Journal papers (peer reviewed)



CEAS Aeronautical Journal
https://doi.org/10.1007/s13272-022-00625-y

ORIGINAL PAPER

Engine thrust model determination and analysis using a large operational flight database

Christoph Deiler[1]

Received: 4 May 2022 / Revised: 9 September 2022 / Accepted: 19 October 2022

Abstract
Different engine thrust models are developed from operational flight data with limited a priori knowledge as part of a novel process for aircraft flight performance model determination. The given big data problem is solved by application of fundamental engineering knowledge and a specific data evaluation strategy. The resulting smart data approach is fundamentally different from existing artificial intelligence methods to solve such big data problems. A linear, a local-linear and a complex nonlinear thrust model are determined on the example of a given large database of operational flights with Airbus A 320neo aircraft. Even with limited information about the actual engine thrust from the available data, the resulting models allow to (well) predict the engine thrust characteristics within the required flight envelope. In addition, a temperature correction is predicted for the thrust model results to further enhance the model's accuracy. Finally, the characteristics of the different thrust model implementations, evaluation results and thrust prediction quality are discussed.

Keywords Engine thrust model · Flight data analysis · System identification · Aircraft flight performance

List of symbols

A	Regressor matrix
C_D	Drag coefficient, 1
d_i	Weighted Euclidean norm
ΔISA	Temperature offset to standard atmosphere, K
g	Gravitational acceleration, m/s²
H	Altitude, m
i	Data index
J	Jacobian matrix
L	Cost function
Ma	Mach number, 1
m_{AC}	Aircraft mass, kg
n	Number of measurements
N_1	Engine fan speed, %
N_{BP}	Number of breakpoints
n_x, n_y, n_z	Load factors in body-fixed frame, 1
$n_{x,a}$	Load factor in aerodynamic x-direction, 1
p	Number of parameters
$\bar{q}$	Dynamic pressure, Pa
r	Residual
R^2	Coefficient of determination, 1
S	Wing surface area, m²
T_{net}	Net engine thrust force, N
T_{req}	Required thrust force per engine, N
$T_{bx,b}$	Total thrust in body-fixed x-direction, N
$T_{bx,a}$	Total thrust in aerodynamic x-direction, N
y	Simulated model output
z	Measured output
$\bar{z}$	Average of measured output
α	Angle of attack, rad
β	Angle of sideslip, rad
γ	Tikhonov weight
Γ_1^*, Γ_2^*	Tikhonov regularization matrices
ε_{in}, σ	Engine installation angles (toe out, inclination), rad
θ	Engine model parameter
$\hat{\theta}$	Engine model parameter estimate

1 Introduction

Aircraft operations are mainly driven by the aircraft's flight performance. Therefore, new developments always target better aerodynamic performance and propulsion system efficiency with less energy consumption to reduce the operational costs and environmental impact of each individual flight. Hence, the optimization of an aircraft's flight

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Abstract: Different engine thrust models are developed from operational flight data with limited a priori knowledge as part of a novel process for aircraft flight performance model determination. The given big data problem is solved by application of fundamental engineering knowledge and a specific data evaluation strategy. The resulting smart data approach is fundamentally different from existing artificial intelligence methods to solve such big data problems. A linear, a local-linear and a complex nonlinear thrust model are determined on the example of a given large database of operational flights with Airbus A 320neo aircraft. Even with limited information about the actual engine thrust from the available data, the resulting models allow to (well) predict the engine thrust characteristics within the required flight envelope. In addition, a temperature correction is predicted for the thrust model results to further enhance the model's accuracy. Finally, the characteristics of the different thrust model implementations, evaluation results and thrust prediction quality are discussed.

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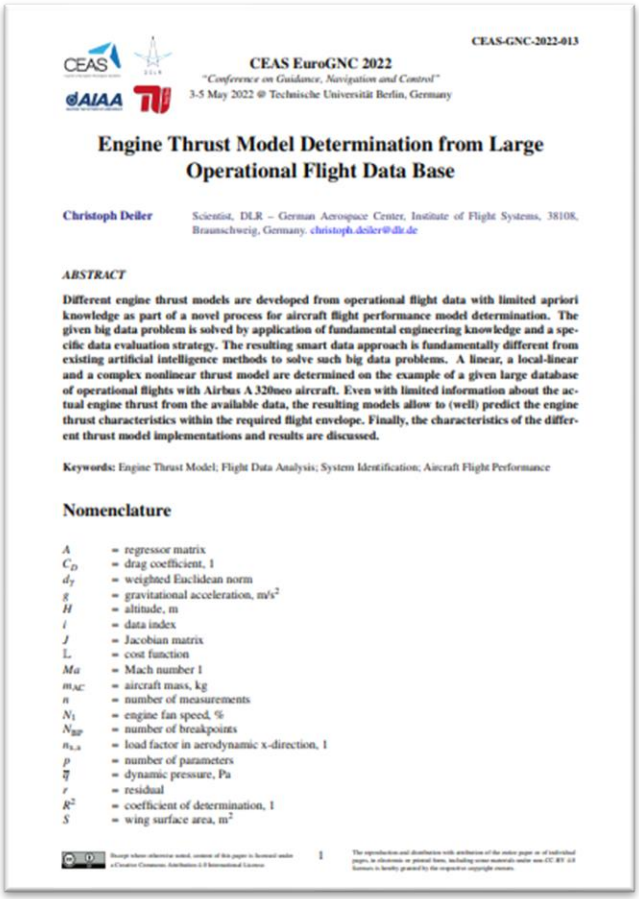

CEAS-GNC-2022-013

CEAS EuroGNC 2022
"Conference on Guidance, Navigation and Control"
3-5 May 2022 @ Technische Universität Berlin, Germany

Engine Thrust Model Determination from Large Operational Flight Data Base

Christoph Deiler Scientist, DLR – German Aerospace Center, Institute of Flight Systems, 38108, Braunschweig, Germany. christoph.deiler@dlr.de

ABSTRACT

Different engine thrust models are developed from operational flight data with limited apriori knowledge as part of a novel process for aircraft flight performance model determination. The given big data problem is solved by application of fundamental engineering knowledge and a specific data evaluation strategy. The resulting smart data approach is fundamentally different from existing artificial intelligence methods to solve such big data problems. A linear, a local-linear and a complex nonlinear thrust model are determined on the example of a given large database of operational flights with Airbus A320neo aircraft. Even with limited information about the actual engine thrust from the available data, the resulting models allow to (well) predict the engine thrust characteristics within the required flight envelope. Finally, the characteristics of the different thrust model implementations and results are discussed.

Keywords: Engine Thrust Model; Flight Data Analysis; System Identification; Aircraft Flight Performance

Nomenclature

A	=	regressor matrix
C_D	=	drag coefficient, 1
d_Y	=	weighted Euclidean norm
g	=	gravitational acceleration, m/s^2
H	=	altitude, m
i	=	data index
J	=	Jacobian matrix
L	=	cost function
Ma	=	Mach number 1
m_{AC}	=	aircraft mass, kg
n	=	number of measurements
N_1	=	engine fan speed, %
N_{BP}	=	number of breakpoints
$n_{x,a}$	=	load factor in aerodynamic x-direction, 1
p	=	number of parameters
$\bar{q}$	=	dynamic pressure, Pa
r	=	residual
R^2	=	coefficient of determination, 1
S	=	wing surface area, m^2

Abstract: A novel process to determine an aircraft performance model from operational fight data with limited a priori knowledge is developed. The given big data problem is solved by application of fundamental engineering knowledge and a specific data evaluation strategy. The resulting smart data approach is fundamentally different from existing deep learning methods to solve such big data problems. A given aerodynamic model is updated to represent the characteristics of an Airbus A320neo aircraft based on a given large database of operational fights. The updated aerodynamic model implementation for one specific flap/slat configuration is exemplarily compared to the information available from fight data and the results are discussed in terms of model quality.

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Co-funded by the European Union

A Smart Data Approach to Determine an Aircraft Performance Model From an Operational Flight Data Base

Christoph Deiler*
DLR (German Aerospace Center), Braunschweig, 38108, Germany

High-quality flight performance models are essential for the reliable prediction of the aircraft flight trajectory and accurate flight planning. An innovative process to determine an aircraft performance model from operational flight data with limited a priori knowledge is developed to target this goal. The given big data problem is solved by application of fundamental engineering knowledge and a specific data evaluation strategy. The resulting smart data approach is fundamentally different from existing artificial intelligence methods or other data analysis strategies to solve such big data problems. An a priori given aerodynamic model is updated to express the characteristics of an Airbus A320neo aircraft on the example of a given large database of operational flights; after the successful determination of an engine thrust model formulation based on the same flight data. The updated aerodynamic models for the different flap/slat configurations are compared to the information available from flight data and the results are discussed in terms of model quality. Finally, the model is validated with a dynamic simulation for an example flight data set.

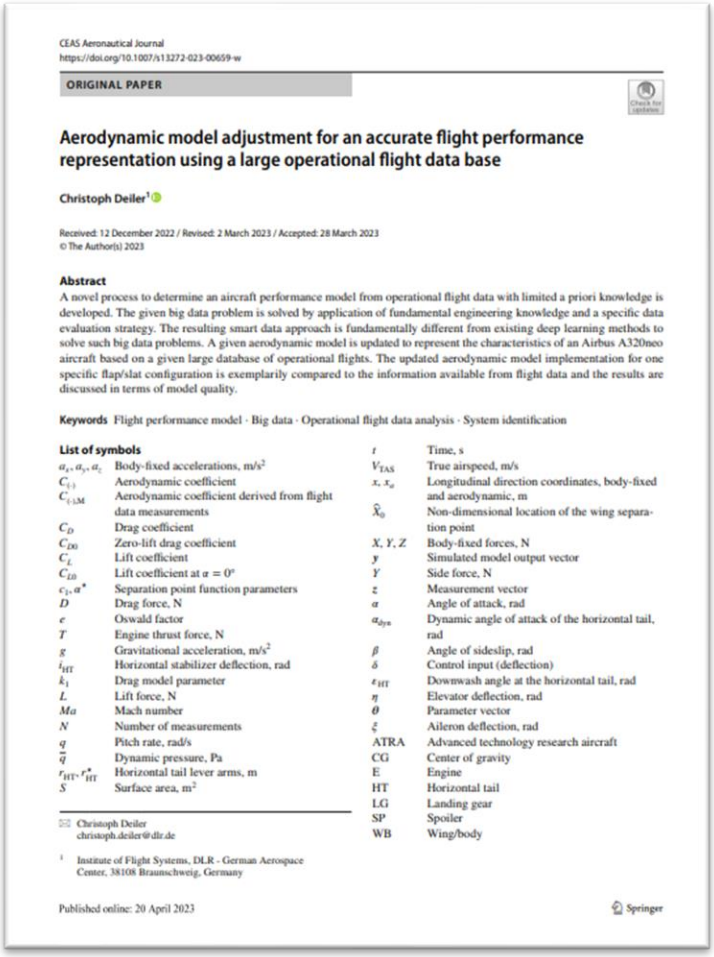
Nomenclature

a_x, a_y, a_z = acceleration in x, y and z direction
$C_{i,j}$ = aerodynamic coefficient
C_D = drag coefficient
C_{D0} = zero-lift drag coefficient
C_L = lift coefficient
C_{L0} = lift coefficient at $\alpha = 0°$
c_1, α^* = separation point function parameters
D = drag force, N
ΔISA = temperature offset to standard atmosphere, K
e = Oswald factor
f = nonlinear function
g = gravitational acceleration, m/s²
i_{HT} = horizontal stabilizer deflection, rad
k_1 = drag model parameter
L = lift force, N
M = pitching moment, Nm
Ma = Mach number
m_{AC} = aircraft mass, kg
N = number of measurements
n = load factor
N_1 = engine fan speed, %
$n_{x,a}, n_{z,a}$ = longitudinal and vertical load factor in aerodynamic frame
P_{corr} = engine thrust correction parameter
q = pitch rate, rad/s
$\bar{q}$ = dynamic pressure, Pa
r_{HT}, r_{HT}^* = horizontal tail lever arms, m
S = surface area, m²

*Research Scientist, Institute of Flight Systems, Lilienthalplatz 7, Braunschweig, 38108, Germany

Abstract: Different engine thrust models are developed from operational flight data with limited apriori knowledge as part of a novel process for aircraft flight performance model determination. The given big data problem is solved by application of fundamental engineering knowledge and a specific data evaluation strategy. The resulting smart data approach is fundamentally different from existing artificial intelligence methods to solve such big data problems. A linear, a local-linear and a complex nonlinear thrust model are determined on the example of a given large database of operational flights with Airbus A 320neo aircraft. Even with limited information about the actual engine thrust from the available data, the resulting models allow to (well) predict the engine thrust characteristics within the required flight envelope. Finally, the characteristics of the different thrust model implementations and results are discussed.

High-quality flight performance models are essential for the reliable prediction of the aircraft flight trajectory and accurate flight planning. An innovative process to determine an aircraft performance model from operational flight data with limited a priori knowledge is developed to target this goal. The given big data problem is solved by application of fundamental engineering knowledge and a specific data evaluation strategy. The resulting smart data approach is fundamentally different from existing artificial intelligence methods or other data analysis strategies to solve such big data problems. An a priori given aerodynamic model is updated to express the characteristics of an Airbus A320neo aircraft on the example of a given large database of operational flights; after the successful determination of an engine thrust model formulation based on the same flight data. The updated aerodynamic models for the different flap/slat configurations are compared to the information available from flight data and the results are discussed in terms of model quality. Finally, the model is validated with a dynamic simulation for an example flight data set.



CEAS Aeronautical Journal
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ORIGINAL PAPER

Aerodynamic model adjustment for an accurate flight performance representation using a large operational flight data base

Christoph Deiler[1]

Received: 12 December 2022 / Revised: 2 March 2023 / Accepted: 28 March 2023
© The Author(s) 2023

Abstract
A novel process to determine an aircraft performance model from operational flight data with limited a priori knowledge is developed. The given big data problem is solved by application of fundamental engineering knowledge and a specific data evaluation strategy. The resulting smart data approach is fundamentally different from existing deep learning methods to solve such big data problems. A given aerodynamic model is updated to represent the characteristics of an Airbus A320neo aircraft based on a given large database of operational flights. The updated aerodynamic model implementation for one specific flap/slat configuration is exemplarily compared to the information available from flight data and the results are discussed in terms of model quality.

Keywords Flight performance model · Big data · Operational flight data analysis · System identification

List of symbols

a_x, a_y, a_z	Body-fixed accelerations, m/s²
$C_{(\cdot)}$	Aerodynamic coefficient
$C_{(\cdot),M}$	Aerodynamic coefficient derived from flight data measurements
C_D	Drag coefficient
C_{D0}	Zero-lift drag coefficient
C_L	Lift coefficient
C_{L0}	Lift coefficient at $\alpha = 0°$
c_1, α^*	Separation point function parameters
D	Drag force, N
e	Oswald factor
T	Engine thrust force, N
g	Gravitational acceleration, m/s²
i_{HT}	Horizontal stabilizer deflection, rad
k_1	Drag model parameter
L	Lift force, N
Ma	Mach number
N	Number of measurements
q	Pitch rate, rad/s
$\bar{q}$	Dynamic pressure, Pa
r_{HT}, r^*_{HT}	Horizontal tail lever arms, m
S	Surface area, m²
t	Time, s
V_{TAS}	True airspeed, m/s
x, x_a	Longitudinal direction coordinates, body-fixed and aerodynamic, m
$\hat{x}_0$	Non-dimensional location of the wing separation point
X, Y, Z	Body-fixed forces, N
$\mathbf{y}$	Simulated model output vector
Y	Side force, N
$\mathbf{z}$	Measurement vector
α	Angle of attack, rad
α_{dyn}	Dynamic angle of attack of the horizontal tail, rad
β	Angle of sideslip, rad
δ	Control input (deflection)
ϵ_{HT}	Downwash angle at the horizontal tail, rad
η	Elevator deflection, rad
$\boldsymbol{\theta}$	Parameter vector
ξ	Aileron deflection, rad
ATRA	Advanced technology research aircraft
CG	Center of gravity
E	Engine
HT	Horizontal tail
LG	Landing gear
SP	Spoiler
WB	Wing/body

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Abstract: A novel process to determine an aircraft performance model from operational flight data with limited a priori knowledge is developed. The given big data problem is solved by application of fundamental engineering knowledge and a specific data evaluation strategy. The resulting smart data approach is fundamentally different from existing deep learning methods to solve such big data problems. A given aerodynamic model is updated to represent the characteristics of an Airbus A320neo aircraft based on a given large database of operational flights. The updated aerodynamic model implementation for one specific flap/slat configuration is exemplarily compared to the information available from flight data and the results are discussed in terms of model quality.

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4.2 Conference participation

In the Initial Dissemination and Communication Plan (D5.1 [2]), participation in international conferences was planned. Due to COVID-19, not all conferences were held as expected, and furthermore the travel abroad and/or to certain countries was restricted, so that the original planning was voided.

Still, two further conference presentations could be held. All included a paper in the respective proceedings as well as an oral presentation. The availability of the papers is generally limited to the conference participants due to copyright reasons, in order not to block the usage of the material for journal papers.

Nevertheless, the project results will be investigated in the future and further publications after the official and of the project based on the outcomes are very likely.

ICAS bi-annually holds an international conference attended by international research organisations, academia, industry and service providers including ANSPs. In 2022, it took place in Stockholm, Sweden, from 4th – 9th September, ideally suited to present the approach and summary results from the project. With initial results available at the time of the call for papers and further findings at the time of submission of the peer-reviewed paper, the actual presentation could draw also on the results from the real-time and noise simulations.

The talk was placed under the general heading of „Operations Optimisation" in the session 14.3 "Operations and Sustainment" with other presentations on operational and regulatory possibilities to decrease aviation's environmental impact, and there was ample response from the audience with questions and feedback.

https://www.icas.org/ICAS_ARCHIVE/ICAS2022/data/preview/ICAS2022_0328.htm

33RD CONGRESS
OF THE INTERNATIONAL COUNCIL
OF THE AERONAUTICAL SCIENCES
STOCKHOLM, SWEDEN, 4-9 SEPTEMBER, 2022

ICAS 2022 SWEDEN

THE ALBATROSS PROJECT – A EUROPEAN INITIATIVE TO REDUCE AVIATION'S CARBON DIOXIDE EMISSIONS IN LARGE SCALE

F. Sachs[1], F. Abdelmoula[1], D. Vechtel[1]

[1]DLR (German Aerospace Center), Institute of Flight Systems

Abstract

Aviation is seeking further ways to reduce its environmental footprint. To showcase currently still hidden potentials for fuel saving multiple European actors from different fields come together to implement a solution for the most efficient flight regarding state-of-the-art aircraft, airspace and ground infrastructure. Collaboration of all stakeholder is the key to seek benefits and make them permanent. Those acting parties are in particular Pilots, Air Navigation and Service Providers, Network Managers, Airport Operators, System Developers, Airlines and Airframers. This paper presents the approach of the ALBATROSS project. ALBATROSS is a 2-year very large scale SESAR[1] demonstration (VLD). The project participants work together to identify the potential for fuel savings and to demonstrate them in a large European-wide scale. The overall objective of the ALBATROSS project is to define and demonstrate operational solutions and processes allowing greener flights, minimising the environmental impact of aviation while maximising flight efficiency. This is done by a series of live trials and the comparison of the results with historical flight data. The feasibility of operating such flights in various operating environments, with fuel consumption as close as possible compared to the theoretical optimum and as low as possible compared to the average fuel consumption observed historically will be demonstrated. For the sake of comparability, the investigations are conducted for similar aircraft types operating on the chosen city-pairs under similar operational conditions.

Keywords: emission reduction, efficient flight, fuel saving, very large demonstration, gate to gate

[1] Single European Sky ATM Research Programme

1

Abstract: Aviation is seeking further ways to reduce its environmental footprint. To showcase currently still hidden potentials for fuel saving multiple European actors from different fields come together to implement a solution for the most efficient flight regarding state-of-the-art aircraft, airspace and ground infrastructure. Collaboration of all stakeholder is the key to seek benefits and make them permanent. Those acting parties are in particular Pilots, Air Navigation and Service Providers, Network Managers, Airport Operators, System Developers, Airlines and Airframers. This paper presents the approach of the ALBATROSS project. ALBATROSS is a 2-year very large scale SESAR1 demonstration (VLD). The project participants work together to identify the potential for fuel savings and to demonstrate them in a large European-wide scale. The overall objective of the ALBATROSS project is to define and demonstrate operational solutions and processes allowing greener flights, minimising the environmental impact of aviation while maximising flight efficiency. This is done by a series of live trials and the comparison of the results with historical flight data. The feasibility of operating such flights in various operating environments, with fuel consumption as close as possible compared to the theoretical optimum and as low as possible compared to the average fuel consumption observed historically will be demonstrated. For the sake of comparability, the investigations are conducted for similar aircraft types operating on the chosen city-pairs under similar operational conditions.

The Towards Sustainable Aviation Summit (TSAS) is a conference addressing aircraft design and operations to increase aviation sustainability. It is organised by the French 3AF (Association Aéronautique et Astronautique de France, French Aerospace Association). TSAS 2022 took place in Toulouse from 18th to 20th October 2022, with participants from Canada, US, UK and the EU.

THE ALBATROSS PROJECT – A EUROPEAN INITIATIVE FOR MORE ENVIRONMENT-FRIENDLY FLIGHT OPERATIONS

F. Bischer*, F. Abdemeulai*

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Abstract

The project ALBATROSS unites multiple initiatives from relevant stakeholder of commercial aviation to demon- strate in a European scale the current potentials to save emissions in the normal every days operations. All parties are working together in multiple exercises. Each one has the potential to reduce emissions and each one has already passed the phase of experimental research. ALBATROSS as a Very Large Demonstration (VLD) seeks answers to the key question how all those activities can be streamlined and what can be the overall benefit. In this paper the methodology of ALBATROSS is highlighted and insights in several exercises are given. Since the number of exercises is high a special focus is put on one exemplary exercise, which is con- ducted by SWISS and DLR and demonstrates the use of the LNAS-system to follow fuel efficient trajectories in the approach phase from top of descent down to the stabilization altitude.

Keywords

Keyword A; Keyword B; Keyword C

1. MOTIVATION

Environmental friendly and efficient flight operations are currently of greatest interest regarding the pre- dominant global developments. Due to effects on climate change each evitable ton of CO_2-emission should be saved and due to war implications of Russia and its consequences for international energy markets the prices of fuel are rising. The motivation on environmental, economical and political side to reduce fuel burn is high and may even increase in the near future. ALBATROSS main ambition is to form the forces of aviation stakeholders from very different fields to showcase the overall benefits of a concerted action. The ALBATROSS participants are composed of Pilots, Air Navigation and Service Providers, Network Managers, Airport Operators, System De- velopers and Airframers. Within the 2-year very large scale demonstration these stakeholders collab- orate conducting multiple live trial demonstrations. Where ever possible the live trials are combined in clusters to ge- be able to evaluate the complex inter-dependencies of the single measurements for fuel usage reduction. The objective is to get a clearer view of the overall gate to gate operations searching for sources of fuel/CO2 waste. This includes prede- parture, departure, climb, cruise, descent, arrival and ground operations for taxiing and parking.

2. METHODOLOGY

From the overall projects perspective there are two main challenges to generate relevant and reliable data from the flight trial evaluations. First of all a unique concept of operations (CONOPS) must be tai- lored for ALBATROSS to structure the multiple efforts and to fulfill clear procedures that might become recommendations for commercial aviation procedure standards after the project. The CONOPS also found the basement for the planning and coordination of the live trials. For the definition of the CONOPS and the organization of the live trial dedicated work packages are formed. The second major task on project level is to guarantee comparability for the measured results. For this purpose the work package performance analysis deals with different methods to structure, normalize and analyze the data gathered in the exercises. Furthermore a list of key performance indicators is defined to trace the impact of the single measurements during different phases of flight and concerning to their environmental effects.

The backbone of the ALBATROSS evaluations and considerations is a concept of three types of flight which are essential to structure demonstrations and analysis. Those are:

- Optimum Flight (OF)
- Baseline Flight (BF)

1

Abstract: The project ALBATROSS unites multiple initiatives from relevant stakeholder of commercial aviation to demonstrate in a European scale the current potentials to save emissions in the normal every days operations. All parties are working together in multiple exercises. Each one has the potential to reduce emissions and each one has already passed the phase of experimental research. ALBATROSS as a Very Large Demonstration (VLD) seeks answers to the key question how all those activities can be streamlined and what can be the overall benefit. In this paper the methodology of ALBATROSS is highlighted and insights in several exercises are given. Since the number of exercises is high a special focus is put on one exemplary exercise, which is conducted by SWISS and DLR and demonstrates the use of the LNAS-system to follow fuel efficient trajectories in the approach phase from top of descent down to the stabilization altitude.

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4.3 Project workshops

Name	Topic	Date
Kick- off meeting, Webex	Project Start	Jan. 29th 2021
F2F Workshop, Toulouse	Intermediate project coordination	Nov. 16th- 17th 2021
F2F meeting/ workshop, Madrid	Intermediate project coordination	Jun. 21st 2022
WP 5 Communication/ Dissemination, Amsterdam	Intermediate project coordination	Oct. 25th- 26th 2022
F2F @Airspace World, Geneva	Intermediate project coordination	Mar. 08th 2023
Final Dissemination workshop, Braunschweig	Final gathering of project partners / summary / dissemination / AB-feedback	May 03rd- 04th 2023

Table 9: List of project workshops

4.4 Coordination workshops with external activities

The success of ALBATROSS's concept depends on its coordination with ongoing activities, both within and outside the SESAR world. Consequently, numerous workshops for coordination and information sharing were held in cooperation with other projects, organisations and initiatives.

On 7 December 2021, the Functional Airspace Block Europe Central (FABEC) held an expert workshop on vertical flight efficiency (VFE). The workshop was attended by representatives from several European ANSPs and Airlines. During the workshop, the project's approach were presented. There was sufficient interest in the ALBATROSS approach so that the Project was invited to present its findings in the next annual workshop.

Thus SWISS was able to present the ALBATROSS project at the third FABEC VFE Workshop on 7th December 2022 in Nice. Various airlines (Air France, Lufthansa, SWISS, Easyjet, Ryanair, Wizzair) were represented at this workshop, as well as several ANSPs (Skeyes, DFS) and organisations such as Eurocontrol and FABEC. This workshop was particularly valuable because it enabled a direct exchange between SMEs and decision-makers (Head of Sustainability Eurocontrol, Director FABEC). Many airlines pointed out the importance of better data exchange between ATC and aircraft, especially regarding DTG. It was also emphasised how important it is to only define ATC constraints for the definition of approach procedures that do not generate any undesired side effects. At this 3rd VFE workshop, a high degree of coherence was observed in the identification of causes, tasks and ongoing projects to improve the VFE.

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Several coordination meetings were held with other SESAR projects, specifically on 11th Mar 2021 with DYNCAT, on 16th Mar 2021 with DYNCAT and AEON and on 26th Jan 2022 with DREAMS and DYNCAT. During those workshops, approach, preliminary and eventually final results of DYNCAT were presented with the goal of informing about scope and aspects, coordinating efforts, and finding synergies.

While the coordination meeting with AEON has failed to identify significant common ground, findings from DYNCAT are exploited in the very large-scale demonstration (VLD), ALBATROSS, which is showcasing available solutions to make flying more energy efficient. As part of ALBATROSS, DYNCAT project partners SWISS and DLR demonstrate energy optimised continuous descent approaches in Zurich. In particular, DYNCAT's analysis of the state of the art and the initial concept have served as input for the ALBATROSS experiment design. DREAMS, DYNCAT and ALBATROSS have mutually increased the respective understanding of energy-optimised approaches; DLR has used the knowledge in the development of flight envelopes for approaches with increased glideslope for different aircraft types, weights and weather conditions. DREAMS partners have demonstrated approaches with increased glideslope (3.5 – 4.49°) in flight test.

4.5 SESAR e-News

The SESAR e-News are a monthly newsletter published by SESAR (3) JU Communications and read by a broad audience of aviation stakeholders.

For ALBATROSS, already six articles have been submitted and published, detailing the project approach and following its progress and achievements. The first one announced the project start and the project idea and the second focusses on the project leaders' view on objectives and challenges. Further articles contain interviews and background information on project and SESAR activities. Project experiences from project partner the e.g. Schiphol or DSNA were published in articles on the internet or in internal journals. The article dates and topics are listed in the table below.

At the time being of this report creation further e-news are prepared to be published in the final phase of the project.

The e-News articles were also shared by the Project's participants via Twitter and LinkedIn.

Date	Topic
Feb. 22nd 2021	"ALBATROSS, the most energy-efficient flying bird" https://www.sesarju.eu/news/albatross-most-energy-efficient-flying-bird
Jun. 21st 2021	ALBATROSS: Joining forces to further reduce aviations environmental impact https://www.sesarju.eu/news/albatross-joining-forces-further-reduce-aviations-environmental-impact
Sep. 23rd 2021	Flight trials on energy-efficient flying kick-off https://www.sesarju.eu/news/flight-trials-energy-efficient-flying-kick
Feb. 24th 2022	Behind the scenes: measuring the environmental performance of SESAR Solutions https://www.sesarju.eu/news/behind-scenes-measuring-environmental-performance-sesar-solutions
Oct. 19th 2022	How to create optimal eco-efficient flights https://www.sesarju.eu/news/how-create-optimal-eco-efficient-flights
Dec. 20th 2022	SESAR partners move ahead with sustainable taxiing tests at Schiphol https://www.sesarju.eu/news/sesar-partners-move-ahead-sustainable-taxiing-tests-schiphol
Mar. 27th 2023	From ALBATROSS to HERON: Europe at the forefront of innovation https://www.sesarju.eu/news/albatross-heron-europe-forefront-innovation
Prevision May 2023	Flight Trials – Conduction and final results
Prevision May 2023	Dynamic rad – Application in European Airspace and outcomes

Table 10: List of SESAR e-News issues

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4.6 Other presentations

Other targeted presentations, often via online communication, were held to inform stakeholders about the project, gain partners for the Advisory Board, and interest partners for follow-up and Exploitation activities.

Next to the presentations driven directly by the project several participants used the opportunity to prepare presentations of their experiences gained in the project to perform presentations in the context of ALBATROSS.

Generally, those presentations are all listed in the table of communication activities. Examples are the presentation on the “Optimum Management of the Aircraft Energy State” at the 3rd FABEC Vertical Flight efficiency workshop in Nice as well as the contributions to the same event on “AI based analytics of Frankfurt TMA leading to an airspace geometry change”.

In an earlier phase of the project a presentation on “Increasing the efficiency of airline flight operations with next-generation cockpit functions” had been given at the ETH Zürich.

4.7 Final dissemination event

The final Dissemination workshop addressed all interested parties from the SESAR 3 JU, regulators and ANSPs including the Advisory Board, airport and air traffic authorities, project managers from related SESAR and other projects, the pilot and air traffic controller community. It has been an event with the possibility to take part in person, held on 3rd and 4th May 2023 at the DLR, Braunschweig / Germany.

Representatives of all relevant and addressed stakeholders participated as guests. These includes representatives of SJU, airlines, ANSP’S, OEM’s, NM’s and research.

The event took place at the DLR facility in Braunschweig. Online participation was also possible for the two days of the event and used by further members of the Advisory Board, SESAR3 JU and interested stakeholders.

In place the participants had the opportunity to visit the DLR Flight Experiments department and the AVES flight simulation center.

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5 Transversal communication activities

In the beginning of the project the initial Communication and Dissemination Plan (D5.1) has been created and approved. The project's website *www.sesar-albatross.eu* was launched, several project participants communicated the project on their websites and social media channels. The website is constantly updated and news are published regularly on a dedicated subpage.

Regarding **communication activities**, which needed not wait for the Project's first results but had already an intrinsic value in informing about the existence of the Project and its intentions, the following target audiences and activities were identified:

towards the general public, the sponsors and all stakeholders

- a website providing up-to-date information on the Project's objectives, status and (intermediate) outcomes. The website promotes Project related events such as Project workshops or conferences. It also allows downloading all public access Project reports.
- support to the SESAR 3 JU to publish institutional brochures, newsletters, posting news on the SESAR 3 JU website, prepare dedicated meetings and events (and join them if requested)
- promotional material (videos, posters) and regular updates on the research partners' news blogs / social media accounts on the project's achievements
- regular updates on the research partners' news blogs / social media accounts
- press releases for key steps and achievements, directed towards national media of the partners and international media (Aviation Today, Aviation Week, ATM magazine, …)

towards the ATM community including regulators, ASNPs, controllers' and pilots' organisations

- demonstrations of the proposed tool at the implementation site to air and ground users who could potentially benefit from its use as part of a workshop informing on the project's progress
- participation SESAR Innovation Days
- indirect multiplication of the knowledge on the ALBATROSS Solutions through the considerable number of active airline pilots and air traffic controllers employed in the project for evaluation purposes
- specific Communication actions were identified as needed for critical points of the Solution implementation, including after successful validation exercises, to maximise the awareness of the Solution and the necessary steps to achieve its benefits in practice

towards the scientific community including potential partners for follow-up research and innovation

- all of the above measures include the scientific community as their target. Furthermore, the participation in scientific conferences serves the Communication aspect in addition to the Dissemination activity. The lessons learnt from the project will be shared with external bodies that support and/or drive the international standardisation

In February 2021 the project was already awarded as project of the month.

In September 2021 the communications campaign was accelerated by the AIRBUS summit. ALBATROSS was presented as a priority activity to showcase several solutions to reduce the aviation's environmental impact. Decarbonisation of aviation was one of the key messages of the summit. Stakeholders from industry and science and the general public were invited to join the event in place or online. The livestream was worldwide available and might be downloaded as recording.

As special event for the summit a first ALBATROSS flight was organised from Paris CDG to Toulouse TLS. This flight was already optimised according to some of the ALBATROSS criteria and a certain reduction of fuel burn could be reported. The flight to the summit caused a considerable media echo, which increased the public awareness of the ALBATROSS project.

AIRBUS also launched a media campaign for ALBATROSS topics consisting of several publications around the airbus summit. The articles focussed on the possibility to make the most efficient flight within the project ALBATROSS, the optimum 4D-trajectory, the use of sustainable aviation fuels (SAF) and the support of ground-based infrastructure as sustainable towing vehicles.

Those articles were launched each week for a period of 4 weeks. Thanks to the huge visibility and impact factor of the AIRBUS website the publications were broadcasted to a wide audience.

For the World ATM Congress in Madrid 2021 DSNA, Air France and AIRBUS produced a video describing the idea behind ALBATROSS and the methods used. It references the practical example of the first ALBATROSS flight CDG-TLS.

In November 2022 a special press event took place. An A350 flew on an optimized trajectory from Toulouse to Munich using Sustainable Aviation fuels (SAF). Several articles appeared in social media and on the internet.

The project had been present at several international events also in 2022. High visibility was achieved by the attendance of the World ATM Congress in Madrid 2022. ALBATROSS was presented in a dedicated panel discussion on a separate stage. The attendance of a qualified audience was given and the event was framed by several interviews published on the internet. Next to the World ATM Congress ALBATROSS was also present at the Connecting Europe Days the FABEC Vertical Flight Efficiency workshop and the Aircraft Operator ATM Community Workshop.

Several coordination meetings with other projects took place. Those were a meeting with the DYNCAT consortium and a meeting with AEON project participants. Project internal workshops were also organized and conducted. Eurocontrol organized an online workshop on the ideas of dynamic RAD on July 1st 2021 and AIRBUS and DLR organized a hybrid meeting Face to Face and online at the Saint Martin site in Toulouse (16th – 17th Nov. 2021). At this meeting Advisory Board Members were informed about the project progress. Three Advisory Board Member joined the meeting physically and six further Advisory Board Member online.

The project had a vital exchange with the AEON project in April 2022 as well as with the project DREAMS in January 2022. In October 2022 the Advisory Board had the opportunity to participate at a dedicated face-to-face meeting in Amsterdam.

During the first year of the project a TV clip on ALBATROSS was produced and broadcasted by France 3 TV. In that clip some ALBATROSS principles are explained and the further way for CO2 reduction is sketched.

For the scientific community some work has been performed. Martin Gerber (SWISS) had a presentation at the ETH Zürich on next generation cockpit functions also presenting the ALBATROSS ideas and combining those topics. DLR submitted a paper to Euro GNC that is related to the DLR work share in ALBATROSS. The title is “Engine Thrust Model Determination from Large Operational Flight Data Base”.

In Summer 2022 the project and the activities to reduce carbon dioxide emissions were presented in Stockholm on the 33rd ICAS (International council of the aeronautical sciences) conference. In addition to this the ALBATROSS approach was also presented in Toulouse at the Towards Sustainable Aviation Summit TSAS 2022. Scientific work on ALBATROSS related topics was also presented at Euro GNC (guidance navigation and control) in Berlin, at DLRK Deutscher Luft- und Raumfahrt Kongress in Dresden as well as in the journal of CEAS (Council of European Aerospace Societies)

The ALBATROSS project was shortlisted in the VLD category for the SESAR Digital European Sky Awards and also received the People’s Choice Award.

Most of the news published by the consortium or partner can be found on the ALBATROSS home page. The links lead to the websites where they had been originally published.

Thanks to the contribution of many partners on their social media channels the ALBATROSS e-news and any kind of news could be shared in a way that the reach of the ALBATROSS news could be increased. Thanks to the popularity of distinct partners of the ALBATROSS consortium and of the SJU the impact of such shared articles is comparatively high.

5.1 Banner, Logos, Keywords

A banner image for the project has been designed. It is depicted in Figure 1. The copyright is owned by the ALBATROSS consortium.

Figure 1: Project banner for use on the internet

The following **keywords** apply to the project and suitable subset of them can be used in Communication metadata (including hashtags): most efficient flight, zero fuel waste, decarbonization, dynamic RAD, sustainable taxi, Green Flight, Optimum Flight, Reference Flight, energy management, PBN-to-xLS, descent profile optimization, Continuous Climb, idle factor optimizer, Gate-to-Gate, CO2 savings, sustainable ground power, aircraft performance, sustainable aviation fuels, time-based-operations, 4D-trajectory

5.2 Project websites

A **website** providing up-to-date information on the Project's objectives, status and (intermediate) outcomes has been established. It promotes Project related events such as Project workshops or conferences and allows downloading all public access project reports and publications after their acceptance by the SESAR 3 JU or the editors, respectively.

In order to maximise visibility and facilitate finding information on the Project, several web addresses are established:

- the SESAR 3 JU page for ALBATROSS (https://www.sesarju.eu/projects/albatross);
- the European commission page for DYNCAT (https://cordis.europa.eu/project/id/101017678);
- the sesar-albatross.eu domain (https://www.sesar-albatross.eu/) linking to the ALBATROSS site at DLR;
- the **main ALBATROSS site** hosted at DLR (https://www.dlr.de/ft/albatross)

For practical and legal reasons, the main project website is hosted at DLR under https://www.dlr.de/ft/albatross. The domain http://www.sesar-albatross.eu/ has been registered and leads directly to the DLR site. The SESAR Project webpage (https://www.sesarju.eu/projects/albatross) provides an overview of the Project including a link to the specific project website (https://www.sesar-albatross.eu/).

All public Deliverables, once accepted, are available for download from CORDIS and the main site.

Figure 2: Screenshot of ALBATROSS Project website

The SESAR 3 Joint Undertaking hosts an overview website as well. This SESAR project webpage (https://www.sesarju.eu/projects/albatross) highlights the project's goals and links relevant e-News articles (see Figure 3).

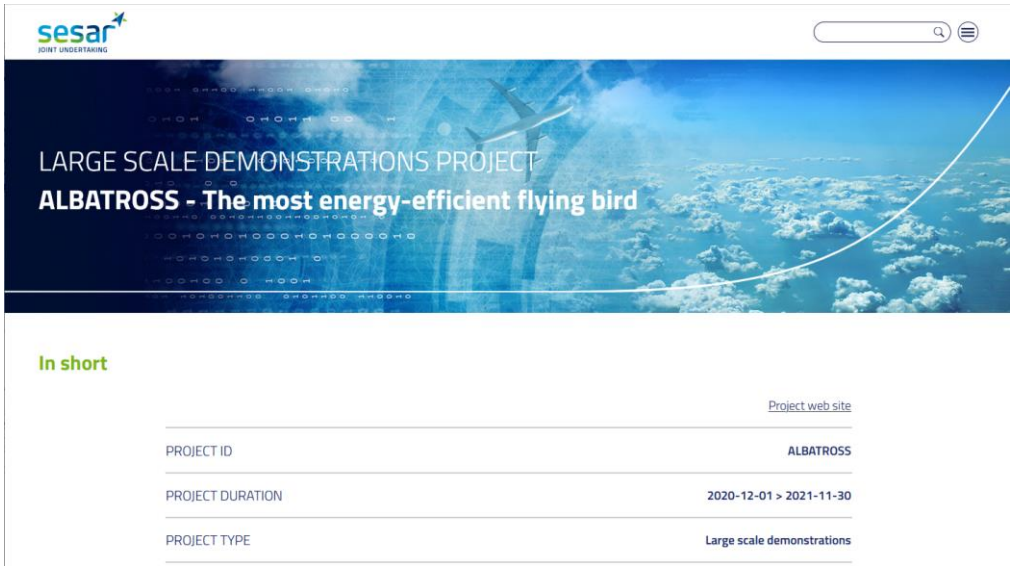

Figure 3: Screenshots of ALBATROSS Project webpage at SESAR 3 JU

5.3 Social media

Creating awareness and outreach is supported by the use of social media. In accordance with the beneficiaries' internal communication rules, the consortium therefore has not set up dedicated accounts for the project but used the participants' (both coordinator's and project partners') established Twitter and LinkedIn accounts for updates on major achievements, links to reports of general interest, the conduction and outcome of stakeholder workshops and other topics. Posts also drew attention to new content published elsewhere, e.g. by SESAR 3 JU communications or on the project website.

The events listed are typical triggers for social media messages. DLR for instance used the Twitter accounts 'DLR_de' and 'DLR_en' with 102,999 / 39,583 followers, respectively, and the LinkedIn account with 73,516 followers at the project start. The noteworthy advantage compared to a project account is that the established accounts of the participants already cover a wide range of the aviation community.

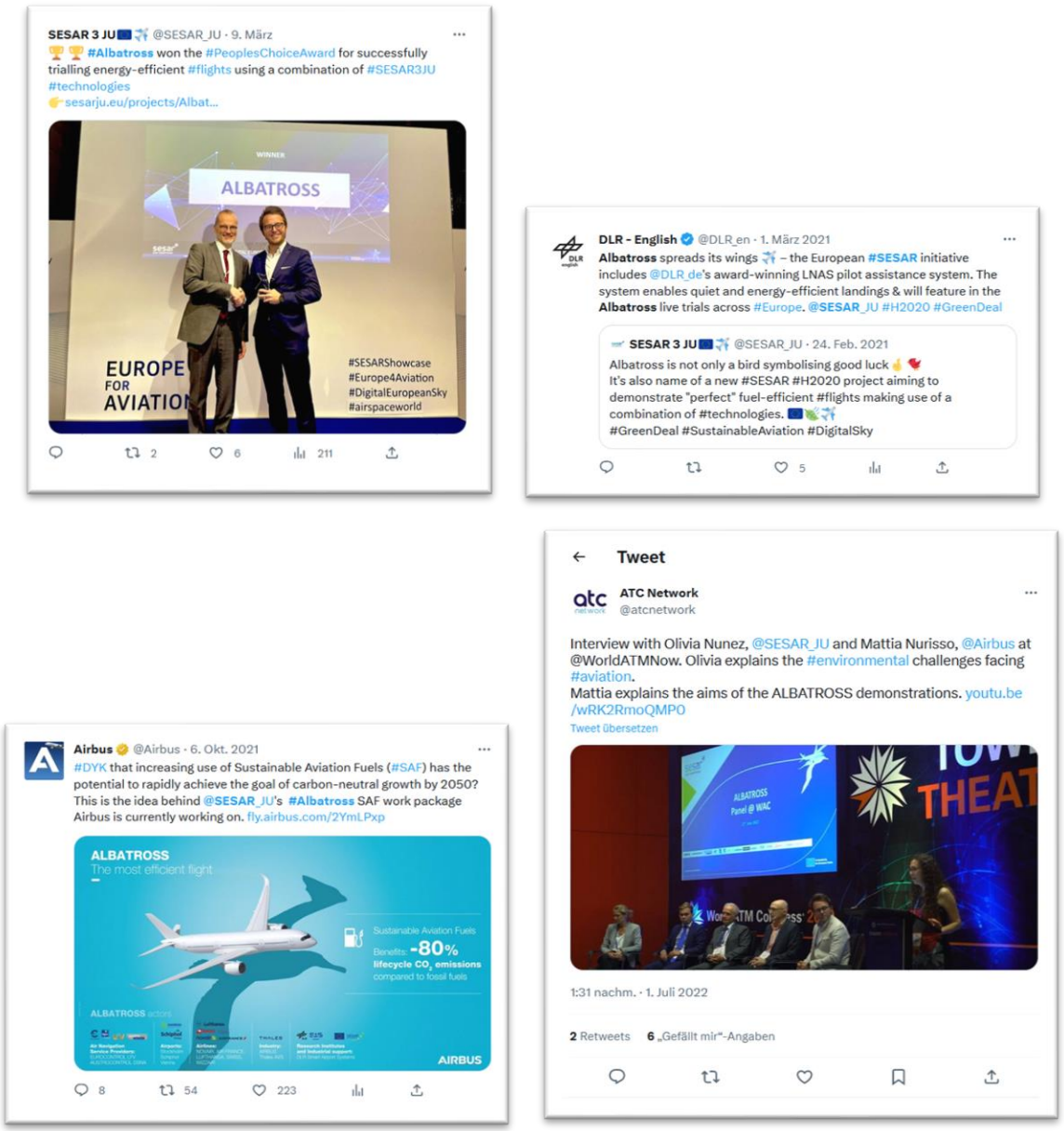

Figure 4: Sample screenshots of ALBATROSS social media content

All Twitter messages associated with ALBATROSS can be seen from the following link: https://twitter.com/search?q=SESAR%20ALBATROSS.

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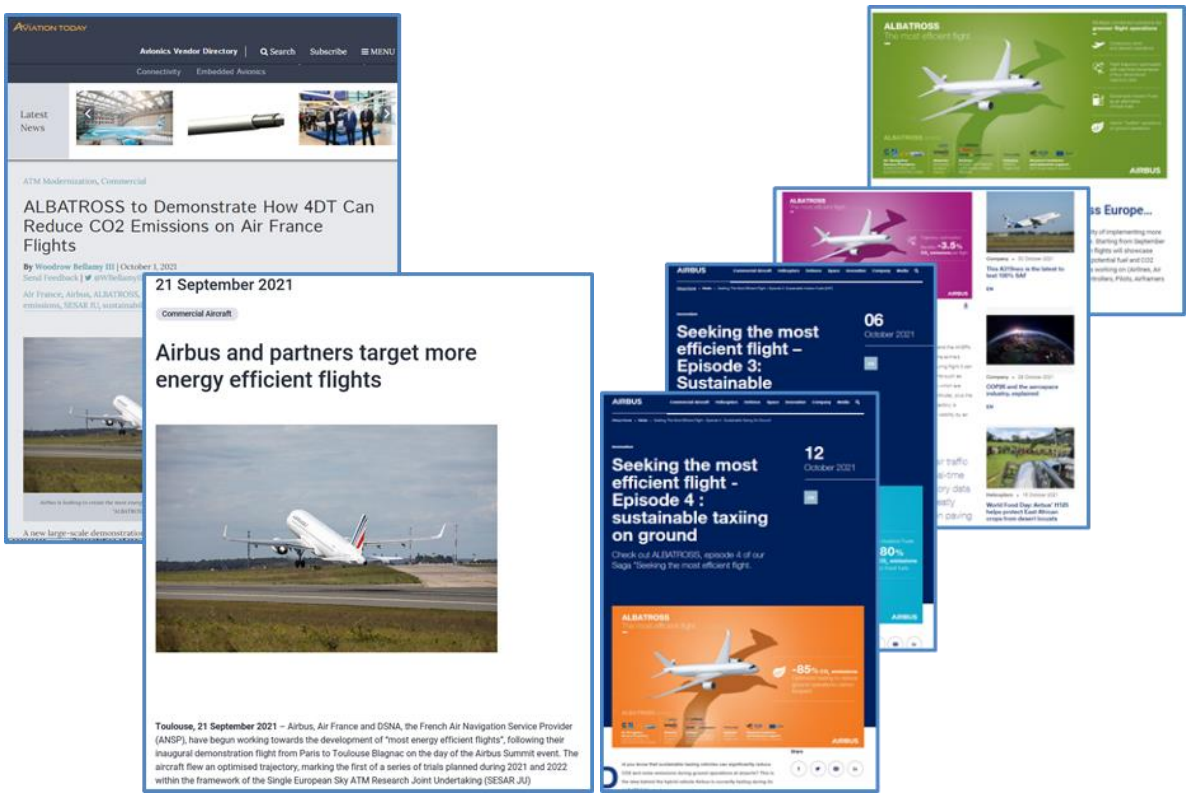
5.4 Press releases and articles

Several press releases were prepared by project participants and shared subsequently, e.g.



Press Release	Date	Link
Airbus: Airbus and partners target more energy efficient flights	Sept. 21st 2021	Airbus and partners target more energy efficient flights | Airbus
Airbus: Seeking the most energy efficient flight- Episode 1: ALBATROSS	Sept. 21st 2021	Seeking the most energy efficient flight - Episode 1 : ALBATROSS | Airbus
Airbus: Seeking the most energy efficient flight- Episode 2: Flight Trajetory	Sept. 28th 2021	Seeking the most energy efficient flight - Episode 2 : Flight Trajectory | Airbus

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Press Release	Date	Link
Aviation Today: ALBATROSS to demonstrate, how 4DT can reduce CO2 Emissions on Air France Flights	Oct. 1st 2021	ALBATROSS to Demonstrate How 4DT Can Reduce CO2 Emissions on Air France Flights - Avionics International (aviationtoday.com)
AerospaceTechReview: Airbus, Air France and DSNA Celebrate Inaugural Demonstration Flight of ALBATROSS Project	Oct. 03rd 2021	Airbus, Air France and DSNA Celebrate Inaugural Demonstration Flight of ALBATROSS Project | Aerospace Tech Review
Airbus: Seeking the most efficient flight- Episode 3: Sustainable Aviation Fuels (SAF)	Oct. 06th 2021	Seeking the most efficient flight – Episode 3: Sustainable Aviation Fuels (SAF) | Airbus
Airbus: Seeking the most efficient flight- Episode 4: sustainable taxiing on ground	Oct. 12th 2021	Seeking the most efficient flight - Episode 4 : sustainable taxiing on ground | Airbus
Aero telegraph: Mit Babyschritten die Emissionen verringern	Oct. 21st 2021	Projekt As: Mit Babyschritten die Emissionen verringern - aeroTELEGRAPH
Behind the scenes: measuring the environmental performance of SESAR Solution	Feb. 24th 2022	SESAR Joint Undertaking | Behind the scenes: measuring the environmental performance of SESAR Solutions (sesarju.eu)
Airbus: HERON project to increase fuel efficiency in aviation takes flight	Mar. 07th 2023	HERON project to increase fuel efficiency in aviation takes flight | Airbus

Table 11: List of Press releases and articles

5.5 Magazines

DLR flugBLATT Feb. 2021

DSNA Dec. 22nd 2022

DLR flugBLATT Mar. 2023

5.6 Promotional videos

The produced videos were shared in press releases and on YouTube and are accessible via the SESAR 3 JU Project website as well.

SESAR JU ALBATROSS Project - YouTube

Inaugural flight of SESAR JU ALBATROSS demonstration - French TV news (France 3 TV) - YouTube

Enabling more energy-efficient flying - interview with SESAR experts - YouTube

Sustainable taxiing tests at Schiphol - ALBATROSS - YouTube

6 Evaluation of performed activities

6.1 Conducted activities

Largely due to COVID-19, several established conferences did not take place or were held online only; additionally, travel abroad and/or to certain countries was restricted for considerable time with virtually no possibility to predict the situation for the actual conference at the time of the call for papers. Still many activities were conducted successfully. Several papers have been presented at national and at international scientific conferences. Moreover, the Project presented its approach in the Airspace World 2023.

Several scientific papers have been published in CEAS Journal, SciTech, ICAS, DLRK, Euro GNC and TSAS. With these scientific publications the Project results have been successfully disseminated towards the scientific community and especially under the SESAR umbrella also towards many ATM stakeholders.

Transversal activities addressing both experts in the field and the general public include the Project's website http://www.sesar-albatross.eu/ (which provides downloads of all public Deliverables after SESAR (3) JU acceptance) and the communication of the Project on several Project participants' websites and social media channels. Four promotional videos have been prepared and are available on YouTube, linked from different origins. Six SESAR e-News articles have been published, with a two more under preparation, and articles placed in corporate magazines, including that of the German airline pilots' and flight engineers' association. Press releases on the project's approach and achievements were made by several partners.

Networking with other projects is an ongoing activity. Three stakeholder workshops have taken place supporting the project activities, with valuable input also from the ALBATROSS Advisory Board, and a final Dissemination workshop open to all interested parties had been conducted on 3rd – 4th May 2023.

Already now the findings from DYNCAT are being fed into ALBATROSS, which is showcasing available solutions to make flying more energy efficient. As part of ALBATROSS, DYNCAT participants SWISS and DLR demonstrate energy optimised continuous descent approaches in Zurich. In particular, DYNCAT's analysis of the state of the art and the initial concept have served as input for the ALBATROSS experiment design.

Presentations of the ALBATROSS approach and results have been and will be given to various audiences, e.g. at the Functional Airspace Block Europe Central (FABEC) expert workshops on vertical flight efficiency, which is attended by representatives from several European ANSPs and Airlines. The feedback received and the results from ALBATROSS (where an Electronic Flight Bag (EFB) application is used instead of the FMS) will need to be considered in successor activities.

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6.2 Lessons learned

Not a new observation but still an important point to remember is that many conferences have a long lead time between the call for papers deadline and the actual conference, meaning results targeting the specific conference's focus and audience may not yet be validated (or even available) when the abstract is due, and thus need to be anticipated. In fact, the choice of a conference to present the final results is strongly influenced by the suitable timing.

The SESAR E-news have a high reader count, which makes them an opportunity to reach a broad audience and a big part of the aviation community.

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