

SafeOPS Communication, Dissemination and Exploitation Report

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SafeOPS

FROM PREDICTION TO DECISION SUPPORT - STRENGTHENING SAFE AND SCALABLE ATM SERVICES THROUGH AUTOMATED RISK ANALYTICS BASED ON OPERATIONAL DATA FROM AVIATION STAKEHOLDERS

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Abstract

This deliverable concludes the Communication, Dissemination and Exploitation (CDE) actions of SafeOPS. It covers the actions that were taken during the project, following the strategy and proposed actions in SafeOPS Communication, Dissemination and Exploitation Plan. It compares, where possible, the planned against achieved actions, based on the Key Performance Indicators and Success Criteria. Additionally, it describes the initially not planned CDE actions, that emerged throughout the project duration as joint efforts with SESAR Exploratory Research Projects on similar topics.

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1 Introduction

The project's communication, dissemination, and exploitation report (D5.2) is the second and final deliverable of WP5 - Communication and dissemination. The objective of work package 5 was to create awareness of the project evolution, objectives, and results among the relevant communities.

The project communication, dissemination, and exploitation plan (D5.1) set up the guidelines to achieve these objectives, identifying the relevant communities and fora, the most suitable communication channels to address them and the appropriate communication actions together with a schedule of activities. This report (D5.2) aims to analyse the completed tasks, audiences reached, and communication actions taken along the duration of the project.

The communication and dissemination of the actions and results of SafeOPS were organised around an understanding of target audiences, and a coordinated plan, taking into consideration the objectives of work package 5:

- Raising awareness of the project activities and their added value to stakeholders and researchers.
- Receiving direct and independent input from external entities, researchers and agencies that may enrich the quality of the project.
- Promote the exploitation of the project results both in the pre-industrial and scientific domains to further guide research activities.

This strategy covered the 24 months of the project. This deliverable provides an overview of the results obtained regarding these communication and dissemination activities and provides an indication of possible exploitation routes.

The SafeOPS CDE activities are and will still be ongoing after the end of the project, in the aim of further disseminating the results and lessons learned from the project.

2 CDE Schedule

This document is intended as an addition to Deliverable 5.1 [1] at the project's end, evaluating a complete list of the actions taken.

This section provides a tabular overview of all CDE actions of SafeOPS in Table 1. The later sections describe these actions in more detail and evaluate them according to the respective Key Performance Indicators, defined in SafeOPS' CDE Plan - Deliverable 5.1. [1]. Not all CDE actions have KPIs defined in the CDE. Some actions emerged from joint efforts of a group of similar oriented Exploratory Research Projects, which were not planned at the beginning of the project.

Table 1 CDE Schedule Overview

Month	Audience (Geo)	Tool / Event	Actions	Link
2021.01	Consortium + SESAR	Internal	Kick-off meeting	N/A
2021.02	Worldwide	Website	First version of the website developed and public	https://safeops.eu
2021.02	Worldwide	LinkedIn	LinkedIn post by partners on website available	https://www.linkedin.com/posts/the-innaxis-foundation-%26-research-institute-safeops-safeops-sesar-activity-6840946589847060480-DZgI?utm_source=share&utm_medium=member_desktop
2021.03	Worldwide	Email	SafeOPS featured in SESAR E-NEWS	https://cdn.flxml.eu/r-2fb1ebfa98983c0451df05afe37ca516172f8b1a79147e18
2021.03	Worldwide	Website	SafeOPS project of the month interview and project featured in SESAR website	https://www.sesarju.eu/news/ai-boosting-safety-and-resilience-aviation
2021.04	Worldwide	LinkedIn	LinkedIn post on SafeOPS interview featured in SESAR website	https://www.linkedin.com/posts/sesar-joint-undertaking-ai-boosting-safety-and-resilience-in-aviation-activity-6777899821329063936-bTil?utm_source=share&utm_medium=member_desktop https://www.linkedin.com/posts/paula-lopez-catala-ai-boosting-safety-and-resilience-in-aviation-activity-6778018702001610752-rRq0?utm_source=share&utm_medium=member_desktop
2021.04-06	Worldwide	Blog post	Publication of blogpost in DataScience.aero featuring SafeOPS	https://datascience.aero/safe-resilient-ai/

Month	Audience (Geo)	Tool / Event	Actions	Link
2021.04-06	Worldwide	LinkedIn	LinkedIn post by Innaxis on blogpost about SafeOPS	https://www.linkedin.com/posts/the-innaxis-foundation-%26-research-institute-safe-and-resilient-ai-datascienceaero-activity-6810165938327957506-1vTU?utm_source=share&utm_medium=member_desktop
2021.06	Europe	Conference	SAFE360 Conference by EASA. Consortium to attend	https://www.easa.europa.eu/en/newsroom-and-events/events/safe-360deg-safety-aviation-forum-europe-2021
2021.06-07	Associated Partners and Partner Projects (as defined in section 2.2.1 and 2.2.2)	Associated Partner Workshop #1	Present results from D2.1 [2] Discuss further strategic orientation of SafeOPS Coordinate research actions with partner project	https://www.linkedin.com/posts/the-innaxis-foundation-%26-research-institute-safeops-safeops-sesar-activity-6840946589847060480-DZgI?utm_source=share&utm_medium=member_desktop
2021.10	Europe (Spain)	Conference	World ATM Congress. Consortium to attend	https://www.worldatmcongress.org/home
2021.12	Europe	Event	SESAR Innovation Days. Consortium to attend.	https://www.sesarju.eu/SIDs2021
2021.12	Europe	Event.	SESAR Innovation Days. Poster and videos submitted	https://innaxis-comm.s3.eu-central-1.amazonaws.com/SafeOPS/SafeOPS+Poster.pdf https://vimeo.com/649566354 https://vimeo.com/649566354
2022.02	Associated Partners and Partner Projects (as defined in section 2.2.1 and 2.2.2)	Associated Partner Workshop #2	Present results from D3.1 [3] and preliminary results from D4.1 [4], which will be (with D2.1 [2] discussed in workshop #1) the scientific results also presented in the Intermediate Review. Discuss further strategic orientation of SafeOPS Coordinate research actions with partner project	Appendix B.2
2022.02	Worldwide	LinkedIn	LinkedIn post on workshop	https://www.linkedin.com/posts/the-innaxis-foundation-%26-research-institute-safeops-activity-6912737560423211009-fRAP?utm_source=share&utm_medium=member_desktop

Month	Audience (Geo)	Tool / Event	Actions	Link
2022.03	Worldwide	Website	Update website to connect with new stakeholders to join the associated partner workshops	https://safeops.eu/
2022.05	Italy	Conference / Article	Contributed paper [5] and presentation to the XII meeting of the Italian Society of Ergonomics (SIE XII)	http://www.societadiergonomia.it/wp-content/uploads/2014/07/Quaderno-Congresso-SIE-2022-ISBN-def_20220929.pdf
2022.06	Worldwide	Social Media (SESAR & SafeOPS)	Promote scheduling of upcoming Associated Partner Workshop and invite interested Stakeholders	https://www.linkedin.com/posts/the-innaxis-foundation-%26-research-institute_safeops-teaserm4-activity-6950010898178568192-WSuO?utm_source=share&utm_medium=member_desktop
2022.07 (T0+18)	Associated Partners and Partner Projects (as defined in section 2.2.1 and 2.2.2)	Associated Partner Workshop #3	Present results from D3.2 [6], D3.3 [7] and D4.2 [8] Discuss further strategic orientation of SafeOPS Coordinate research actions with partner project	Appendix B.3
2022.06-07	Worldwide	LinkedIn	LinkedIn post sharing the public information on the associated partners workshop	https://www.linkedin.com/posts/activity-6966325179085942784-s8E0?utm_source=share&utm_medium=member_desktop
2022.09	Worldwide	Social Media (SESAR & SafeOPS)	Promote scheduling of upcoming Associated Partner Workshop and invite interested Stakeholders	https://www.linkedin.com/posts/the-innaxis-foundation-%26-research-institute_safeops-activity-7001877267215716352-Utx1?utm_source=share&utm_medium=member_desktop
2022.08	Worldwide	Article	CORDIS -Science Communication Article	https://cordis.europa.eu/article/id/442205-integrating-predictive-ai-into-air-traffic-management-workflows
2022.09.18-22	USA / Worldwide	Paper	Digital Avionics System Conference (DASC) 2022. Paper [9] on D4.1 [4] results	https://ieeexplore.ieee.org/document/9925848/authors#authors https://innaxis-comm.s3.eu-central-1.amazonaws.com/SafeOPS/Time_in_Advance_Go_Around_Predictions_for_Decision_Support_in_Air_Traffic_Management_v2.pdf

Month	Audience (Geo)	Tool / Event	Actions	Link
2022.10.18-21	Europe / Worldwide	Conference	EASN Conference: Presentation / Paper on Evaluation of Safety/Resilience impact of AI based decision support. Paper WIP	https://vimeo.com/768631174
2022.11.02-04	Europe / Worldwide	Event	RPAS and AI in Aviation Dissemination Event. Presentation of SafeOPS Results Demonstrating SafeOPS Simulation Environment	https://static.wixstatic.com/media/7cab8a_948d6728dd1a40cc94d722f155a29672~mv2.png/v1/fill/w_740,h_1047,al_c,q_90,usm_0.66_1.00_0.01,enc_auto/7cab8a_948d6728dd1a40cc94d722f155a29672~mv2.png
2022.22	Europe / Worldwide	Brochure	RPAS and AI brochure with all projects [10].	https://innaxis-comm.s3.eu-central-1.amazonaws.com/SafeOPS/Invircat+Glossy+Report+final_web.pdf
2022.11	Europe / Worldwide	Article	Article about RPAS event	https://www.unmannedairspace.info/la-test-news-and-information/sesar-rpas-and-ai-research-projects-publish-material-from-final-dissemination-event/
2022.11	Europe / Worldwide	Article / newsletter	Article and newsletter about RPAS event	https://www.foxatm.com/blog/weekly-review-177-2022-november
2022.11	Europe / Worldwide	White paper	White paper within the RPAS event context with all projects [11]	https://innaxis-comm.s3.eu-central-1.amazonaws.com/SafeOPS/Sesar+-+white+paper.pdf
2022.12.20 (T0+ 24)	Associated Partners and Partner Projects (as defined in section 2.2.1 and 2.2.2)	Associated Partner Workshop #4	Present results from D2.2 [12] and D2.3 [13] Present overall scientific work of SafeOPS and get final feedback to include in Final Project Report	Appendix B.4
2022.22.21	Worldwide	LinkedIn	LinkedIn post sharing the public information on the associated partners workshop	https://www.linkedin.com/posts/the-innaxis-foundation-%26-research-institute-safeops-activity-7001877267215716352-Utx1?utm_source=share&utm_medium=member_desktop
2022.12	Europe / Worldwide	Event	SIDS 2022: consortium to attend	https://www.sesarju.eu/SIDS2022
2022.12	Europe / Worldwide	Event	SIDS 2022: 2 posters on SafeOPS D2.2 [12]	https://innaxis-comm.s3.eu-central-1.amazonaws.com/SafeOPS/SID_Poster_38_SafeOPS.pdf https://innaxis-comm.s3.eu-central-1.amazonaws.com/SafeOPS/SIDs_poster_23+final.pdf

Month	Audience (Geo)	Tool / Event	Actions	Link
2022.12	Worldwide	LinkedIn	LinkedIn post featuring the SIDS poster session.	https://www.linkedin.com/feed/update/urn:li:activity:7005983566283030528
2022.12	Europe / Worldwide	Event	SafeOPS Contribution to Brochure	https://www.sesarju.eu/sites/default/files/2022-12/2022.3624_SESAR_MG0722621ENC_002_Proof%205_0.pdf
2022.12.06-08	Europe / Worldwide	Event	SafeOPS Participation in Panel Discussion on AI	https://www.flickr.com/photos/sesarju/52551905080/in/album-72177720304299581/
2022.12	Europe / Worldwide	LinkedIn	LinkedIn post: SIDS summary	https://www.linkedin.com/feed/update/urn:li:activity:7006962832646778880/
2022.12	Worldwide	Blog post	Blogpost on datascience.aero featuring SafeOPS	https://datascience.aero/efficiency-versus-resilience/
2022.12	Worldwide	LinkedIn	LinkedIn post sharing the datascience.aero blogpost	https://www.linkedin.com/posts/the-innaxis-foundation-%26-research-institute_efficiency-versus-resilience-datascienceaero-activity-7008422091184062464-sQvv?utm_source=share&utm_medium=member_desktop

3 Communication activities

The following section details the communication actions of SafeOPS and measures them, where defined in the CDE Plan [1], against the success criteria.

3.1 SafeOPS.eu Summary

[Safeops.eu](https://safeops.eu) is the SafeOPS project's web presence. The website collects all information on the project, including publications, deliverables, workshop and event dates. The website has been updated continuously with new content on the project, news, new deliverables and publications. The main communication and dissemination material has been included on the website and made available for everyone to visit and download.

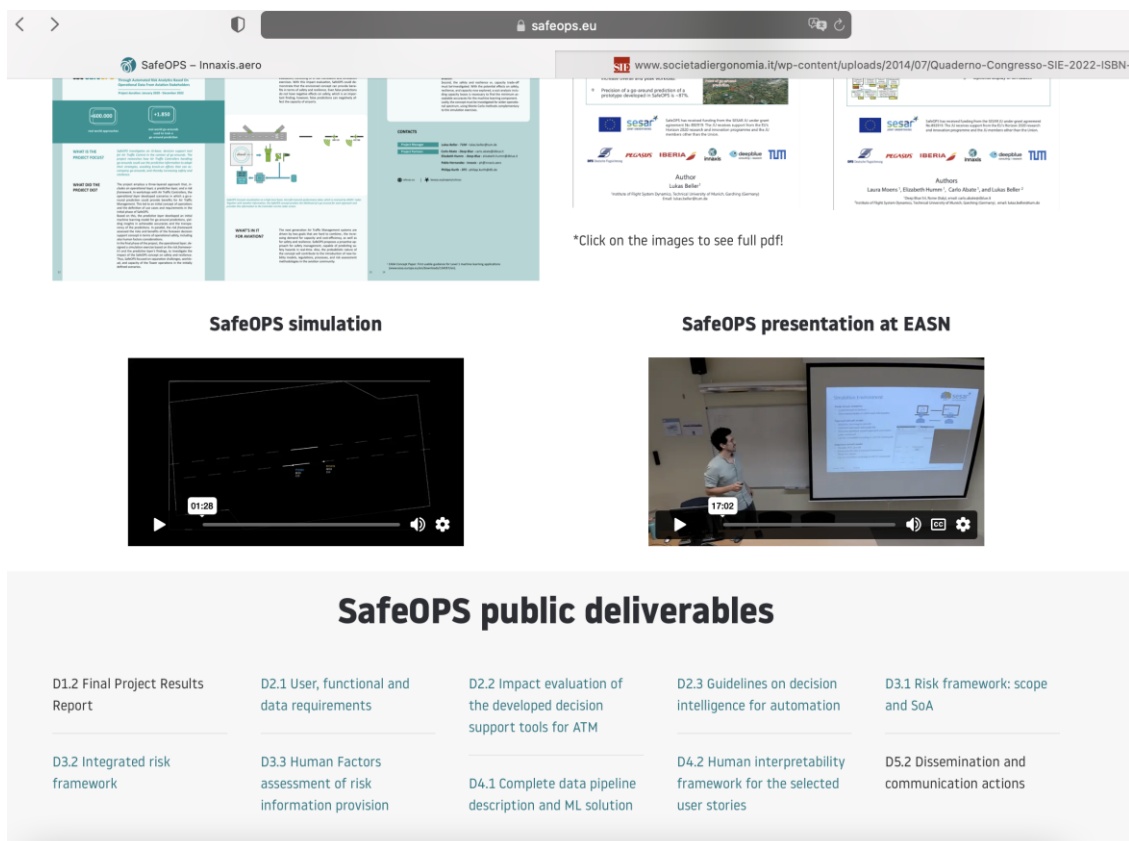


Figure 1. SafeOPS.eu example showing uploaded video material and Deliverables for download

Key Performance Indicators and Success Criteria

SafeOPS website was launched in January 2021, but Google Analytics was set up in December 2021 due to incompatibilities with the Innaxis website, where it is integrated.

Approximately 800 users have visited the SafeOPS website since December 2021 (see Figure 2). Most of them, almost 80%, are new visitors and around 23% are returning visitors.

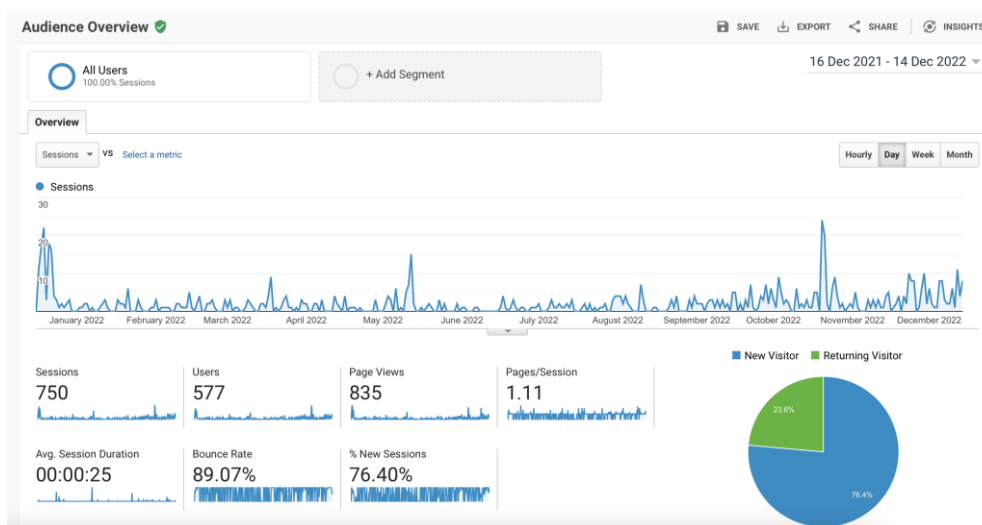


Figure 2. Analytic Evaluation of SafeOPS.eu

Page views provide the total number of pages viewed. Repeated views of a single page are counted. The SafeOPS website counts on over 800 page views.

The peaks that can be found on Figure 2, are the most website visited days, and they meet other significant dates on the communication and dissemination report, such as a LinkedIn post, a blogpost, or a meeting, both internal and external.

The page views of the website are short of the 2000/year defined success criteria. The website will still be promoted in the last weeks of the project and also after it has finished, with the final deliverables and results.

Table 2 KPI Webpage

Medium	KPI	Success Criteria
Project website	800 visitors/year	NOK; 2000 visitors/year

3.2 Social Media Summary

The main social media channel used for SafeOPS has been LinkedIn. Through the posts, there has been a great reach on the content shared by SafeOPS consortium. With an average of 500 impressions per post, and over 1000 impressions in the most successful posts, LinkedIn has proven to be an effective communication and dissemination tool of SafeOPS project. SafeOPS has also been mentioned on Innaxis' and DeepBlue's Twitter accounts, specially at RPAS event.

At the end of the project, SafeOPS wrote 20 LinkedIn Posts, related to the project, and shared by the consortium. There are more post where SafeOPS has been mentioned, by other companies or accounts, but they own those statistics so the numbers could not be added on this report.

SafeOPS does not have its own LinkedIn account (see Deliverable D5.1 [1] for more information), since building the amount of followers, the beneficiaries' accounts already have is difficult for a two years

project. All posts are shared by the consortium, including the hash tag: [#SafeOPS](#). This hash tag allows LinkedIn users to filter content related to the project when it's included in the post text.

The main contributing LinkedIn Accounts are:

- [Innaxis](#)
- [DeepBlue](#)
- [Lukas Beller](#)
- [Caro Abate](#)

and some key posts are listed in Table 3.

Table 3 Key Social Media Posts

Post	Impression	Reactions
Associated Partner Workshop 1	400	8
SafeOPS Promo	360	6
RPAS&AI	400	10
Simulation Exercise Video Preview	1300	21

Key Performance Indicator and Success Criteria

Table 4 KPI social media

Medium	KPI	Success Criteria
LinkedIn	20 posts(from Jan. 21 – Nov. 22)	OK; 10 posts / year

3.3 SESAR Newsletter / E-news

SafeOPS contributed to the SESAR E-News with a project of the month article:

- Project of the month: <https://www.sesarju.eu/news/ai-boosting-safety-and-resilience-aviation>
- E-News: <https://cdn.flxml.eu/r-2fb1ebfa98983c0451df05afe37ca516172f8b1a79147e18>

Additionally, the RPAS & AI event, discussed in section 4.2.2, was featured on the SJUs website:

- <https://www.sesarju.eu/node/4217>

KPI and Success Criteria

No quantifiable KPI has been designed for the SESAR Newsletter / Project of the month interview, as it is not in the project's ability to measure. However, contributing to and using the SJU's communication channel was part of the project's communication strategy.

3.4 Blog Posts

Two blog posts have been published at datascience.aero by SafeOPS. The first one was published in June 2021 and written by Paula Lopez and the second one was published in December 2022 and co-authored by Pablo Hernández and Lukas Beller. The evaluation can be found in Table 5. A third post has only been published one day before writing this deliverable, so the KPI for the third post is not evaluated.

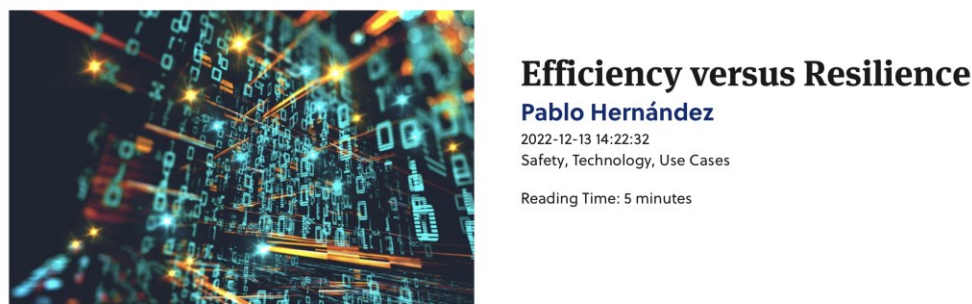
The first posts, shown in Figure 3, covers [safe and resilient AI](#):



Air Traffic Management (ATM) provides a highly safe framework for aircraft to fly thanks to skilled controllers who operate robust systems. However, ATM can still improve in terms of operational efficiency while maintaining its current safety levels, as Eurocontrol reported in the last [ATM cost-](#)

Figure 3. SafeOPS first blog post

The second post, shown in Figure 4, covers [efficiency vs. resilience in ATM](#):



How Predictive Risk Information Could Influence the Trade-off in ATM

The next generation Air Traffic Management (ATM) systems are pushed more and more towards

Figure 4. SafeOPS second blog post

The third post covers [Innaxis' experience and impressions from the SESAR Innovation Days 2022](#)



SESAR Innovation Days 2022

Paula Lopez

2022-12-19 16:40:16

Events, Safety

Reading Time: 3 minutes

The 17th SESAR Innovation Days took place this past December 5-8 in Budapest. After two years of

Figure 5: SafeOPS third blog post

KPI and Success Criteria

Table 5 KPI Blogs as of December 2022

Medium	KPI	Success Criteria
Blogpost 1	120 views	OK; 50 viewers/post
Blogpost 2	50 views	OK; 50 viewers/post

3.5 Cordis Communication Article

SafeOPS, in a joint effort with a science communicator from the EC, produced a short article on SafeOPS, which is available at [CORDIS](#). The article is also featured in the [SJUs'/ECs' Results Pack on AI in ATM](#).

KPI and Success Criteria

This action was not planned from the project but originated from EC/SJU activities. Therefore, no KPI has been defined to evaluate the impact from a projects' perspective, but the action contributes to the overall SJU/EC communication.

3.6 Associated Partner Workshops Summary

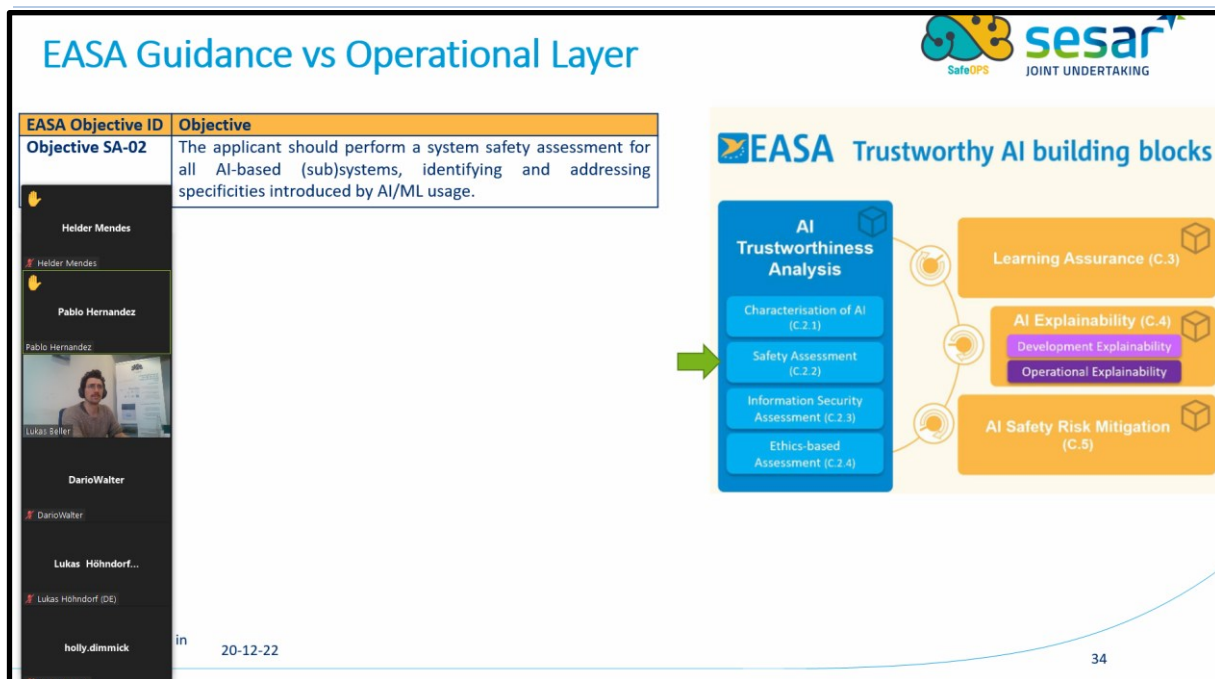
SafeOPS intended a transparent approach for stakeholders that are not part of the consortium but express interest in the work of SafeOPS. Thus, we offer associated partnerships for these parties. Associated partners are able to provide input to the project approach, feedback on the employed techniques and general recommendations. An overview, also regarding the KPIs is presented in Table 7.

Table 6 provides an example for an agenda of the second workshop. In general, all workshops have been structured similarly. We present our results to the audience and have a dedicated Q&A session per presented result. At the end of the workshop, we additionally planned a project outlook and

discussion for the future project evolvement. A visual impression of the workshops is provided in Figure 6.

Table 6 Example of an agenda from Workshop 2

Time	Topic	Presenter
15min	Introduction + general context of project	Lukas Beller (TUM)
30min	Risk Framework - Results and current work	Carlo Abate (DeepBlue)
15min	Q&A	
30min	Predictive Layer - State of current work	Pablo Hernandez (INX)
15min	Q&A	
30min	Further Project Outlook + Discussions/Feedback	Lukas Beller (TUM)



EASA Guidance vs Operational Layer

EASA Objective ID	Objective
Objective SA-02	The applicant should perform a system safety assessment for all AI-based (sub)systems, identifying and addressing specificities introduced by AI/ML usage.

EASA Trustworthy AI building blocks

- AI Trustworthiness Analysis**
 - Characterisation of AI (C.2.1)
 - Safety Assessment (C.2.2)
 - Information Security Assessment (C.2.3)
 - Ethics-based Assessment (C.2.4)
- Learning Assurance (C.3)**
- AI Explainability (C.4)**
 - Development Explainability
 - Operational Explainability
- AI Safety Risk Mitigation (C.5)**

Participants: Helder Mendes, Pablo Hernandez, DarioWalter, Lukas Höhndorf..., holly.dimmick

Date: 20-12-22

Page: 34

Figure 6: Associated Partner Workshop 4

KPIs and Success Criteria

The evaluation of all Associated Partner Workshops is summarized in Table 7.

Table 7 Associated Partner Workshops Overview

Workshop #	Participants	Key Performance Indicator	Success Criteria
1	AISA Austrian Airlines EASA Star Alliance	Nr. Participants: 4 75% Industry / 25% Research	NOK Nr. Participants >=5 70% Industry / 30% Research
2	AISA Artimation Austrian Airline EASA (2x) Eurocontrol FARO	Nr. Participants: 6 66% Industry / 33% Research	OK Nr. Participants >=5 70% Industry / 30% Research
3	AISA EASA Eurocontrol DB Fernverkehr Austrian SJU	Nr. Participants: 5 80% Industry / 20% Research	OK Nr. Participants >=5 70% Industry / 30% Research
4	Air Navigation Solutions (ANSL) AISA (ER4 Project) Artimation (ER4 Project) DB Fernverkehr EASA IABG SafeTEAM (Horizon Europe Project)	Nr. Participants: 7 66% Industry / 34% Research	OK Nr. Participants >=5 70% Industry / 30% Research

Minutes

The meeting minutes of the associated partner workshops can be found in Appendix B.

Follow-up actions from the Associated Partner Workshops beyond the project lifespan

The following actions arose from the Workshops, which will not be covered by this deliverable as they lie beyond the project's lifespan.

- SafeOPS is invited to present at a Eurocontrol Safety Team Meeting in March 2023
- SafeOPS will follow-up with the EASA-AI group for discussions on Data Quality Requirements in 2023

4 Dissemination

This section summarizes in Table 8: Dissemination KPIs and Success Criteria Evaluation the dissemination actions of SafeOPS and evaluates them against the KPIs defined in D5.1 - CDE Plan [1]. The details for the dissemination actions are presented in the following subsections.

Dissemination KPIs and Success Criteria

Table 8 Dissemination KPIs and Success Criteria Evaluation

Dissemination channels	KPIs	Success Criteria	Evaluation
External conferences and events	Number of presentations given	3	OK 6 Presentations at Conferences (Not included workshops)
External conferences and events	Attendance at presentations, meetings and other events broken down by target audience	5	OK 8 Conferences attended (not included workshops)
Publication of papers	Number of papers published	2	OK 2 papers published 2 open papers, will be published after the projects end

4.1 Conferences and Publications

This section lists all publication related actions. Table 9 provides an overview of attended conferences as well as the associated actions.

Table 9 Conferences Attended

Title	Type	Audience group	Status
2021 EASA Safe360	Conference	Aviation Stakeholders / Academia	Attended
2021 World ATM Congress	Conference	ATM Stakeholders	Attended
2021 Sesar Innovation Days	Conference	ATM Stakeholders / Academia	Poster Presentation / Video Presentation
2022 Ergonomics contribution to AI design in safety-critical domains	Conference	Academia	Presentation + Paper [5]

Title	Type	Audience group	Status
2022 EASN	Conference	ATM/Aviation Stakeholders Academia	Presentation
2022 DASC	Conference	Academia / Aviation Stakeholders	Presentation + Paper [9]
RPAS and AI in Aviation	Dissemination Event	ATM / Aviation Stakeholders	Presentation + Demonstration + Brochure [10], see section 4.2.2 for details.
2022 Sesar Innovation Days	Conference	ATM/Aviation Stakeholders / Academia	2 Posters , Contribution to white paper [11] Participation In Panel Discussion

4.1.1 Papers

This section provides an overview of the published papers associated with SafeOPS. Note that two paper are not published yet.

Table 10 Overview SafeOPS related papers

Titel	Authors	Presented in/at
Time in Advance Go-Around Predictions for Decision Support in Air Traffic Management IEEE release	Pablo Hernandez, Lukas Beller, Clara Argerich, Phillip Koppitz	Digital Avionics Systems Conference 18.-22. September 2022
Green Open Access version of the paper.		
Ergonomics contribution to AI design in safety-critical domains pp.235	Stefano Bonelli, Matteo Cocchioni, Carlo Abate, Ana Ferreira, Andrea Capaccioli, François Brambati, Anna Giulia Vicario, Nicola Cavagnetto	Congresso nazionale Societa Italiana di Ergonomia e Fattori Umani / L'Ergonomia Gentile per la Salute, la Sicurezza e la Flicita
White Paper: AI in ATM: transparency, explainability, conformance, situation awareness and trust	AISA ; ARTIMATION ; MAHALO ; SAFEOPS ; TAPAS	Sesar Innovation Days 2022

4.1.2 Posters

This section lists the published posters of SafeOPS in Table 11.

Table 11 Overview SafeOPS related Posters

Titel	Authors	Presented at
From Prediction to Decision Support - An investigation in ATM exemplarily for Go-Around Scenarios	Lukas Beller, Carlo Abate and Pablo Hernandez	Sesar Innovation Days 2021
Impact Evaluation Method for an AI-Based Decision Support in Initial Development Stage	Lukas Beller	Sesar Innovation Days 2022
Risk Framework for AI-based predictions in ATM. Modelling the impacts of AI predictions in a Go-Around Scenario.	Lukas Beller, Carlo Abate, Elizabeth Humm and Laura Moens	Sesar Innovation Days 2022

KPI and Success Criteria

No KPIs and Success Criteria were defined for posters.

4.1.3 Others

This section lists other type of publications, like video material released for SafeOPS in Table 12.

Table 12 Overview of Video Publications from SafeOPS

Titel	Authors	Presented in/at
SafeOPS in 5 Minutes	Lukas Beller, Ines Gomez	Safeops.eu
EASN presentation	Lukas Beller	Safeops.eu
Simulation Demonstration	Lukas Beller	Safeops.eu
SID 2022 Impressions	Paula Lopez-Catala	LinkedIn
Ai support in ATM	AISA; ARTIMATION; MAHALO; SAFEOPS; TAPAS	YouTube

KPI and Success Criteria

No KPIs and Success Criteria were defined for video or other publication means.

4.2 Common ER4 Project Activities

All actions listed in this section were not planned in the SafeOPS CDE Plan [1] but emerged from the joint effort, triggered by SJU, once all projects started. Thus, no success criteria were defined for these actions.

4.2.1 ER4 Automation Workshops

The initial joint activity were two workshops of ER4 Project, working on AI/ML – Automation topics, listed in Table 13. Based on these the joint efforts, described in the following subsections, materialized.

Table 13 ER4 Automation Workshops

Workshop #	Participants	Topics	Conclusion
1 3 rd March 21	AISA ; ARTIMATION ; MAHALO ; SAFEOPS ; TAPAS	<ul style="list-style-type: none"> Project Introductions General Discussion on joint activities 	<ul style="list-style-type: none"> White Paper, see section 4.2.3
2 5 th Oct. 21	SINAPSE AISA ; ARTIMATION ; MAHALO ; SAFEOPS ; TAPAS	<ul style="list-style-type: none"> Project Progress Presentation Interactive Discussion on Automation in ATM 	<ul style="list-style-type: none"> Propose common effort on structured approach to provide data for ER-AI projects

Figure 7 shows the participants of the first workshop, whereas Figure 8 illustrates an interactive session of the second workshop.

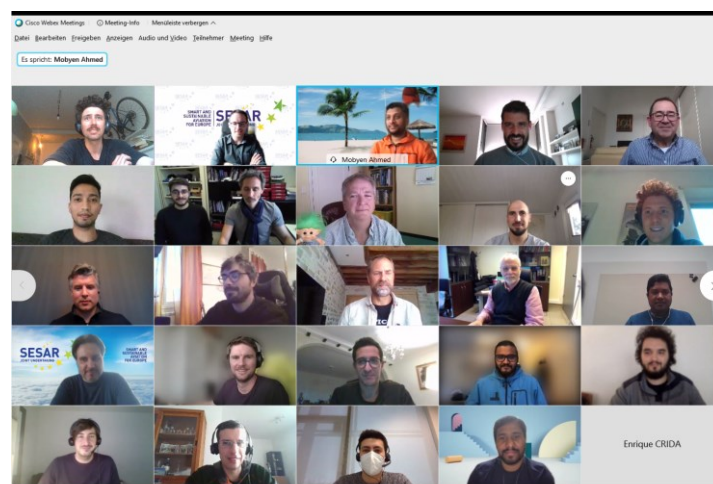


Figure 7: Automation workshop participants

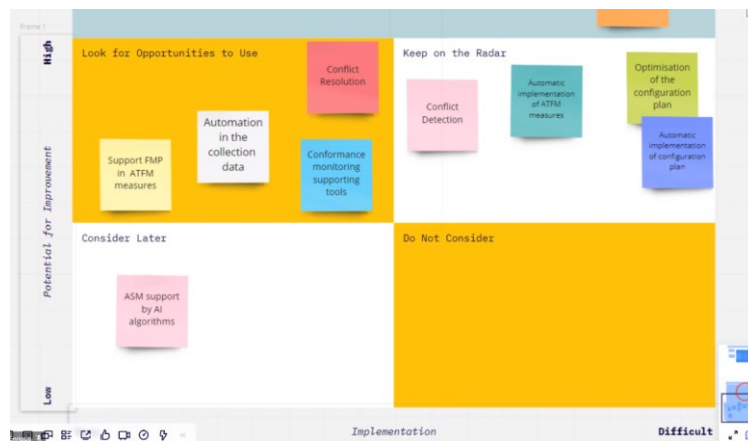


Figure 8 Automation workshop participants and presentation II

4.2.2 RPAS and Ai in Aviation Event Summary

Six exploratory research projects financed by the [SESAR Joint Undertaking](#) programme came together in a **joint event** to present the audience with the latest developments within the SESAR JU framework in two of the most promising aviation topics: **Drones and Artificial Intelligence**.

This in person event took place **in Rome (Italy) on 3-4 November**, bringing together [INVIRCAT](#), [URClearED](#), [SAFELAND](#), [SafeOPS](#), [MAHALO](#) and [ARTIMATION](#), who researched these two topics in the last two years (and a half).

Why these six projects in one joint event?

According to [OPTICS](#) and [OPTICS2](#) projects' analysis - which investigated European aviation research to assess if it is on the right track towards **Flightpath 2050** to provide recommendations to steer EU Aviation Safety and Security research - **Remotely Piloted Aircraft Systems (RPAS) and Artificial Intelligence (AI) explainability** are two of the hottest themes still to be explored in aviation.

This event bundled each topic in a separate day, however for the similar types of stakeholders, the projects teamed up, to organize a joint event.

SafeOPS Contribution

- 45min presentation on project results
- Demonstrator session of the simulation environment
- Project description for brochure

Event Materials

All materials from the event are published on the [Invircat website](#), the SafeOPS related materials can be found below:

- [Agenda](#)
- [Presentation](#)
- [Brochure](#)

KPIs and Success Criteria

Total Participants: 77 (72 without counting SafeOPS members)

Stakeholders (17): Aeronautica Militare, AOPA, DJI, D-Flight, ENAV (2x), EUI, Eurocontrol (3x), HungaroControl, ISA Software (2x), ISDEFE (2x), Leonardo (2x), Menapia, Pegasus Airline (2x), Polish Air Navigation Services Agency, RINA Mission systems (2x), SAAB (2x), Volocopter

Research (9): CIRA (4x), DLR (4x), ENAC (2x), Italian National Research Council, Linköping University, NLR (2x), Sapienza University, SJU, UPC Barcelona

Standardization/Regulation (3): Eurocae, EuroUSC (3x), IFATCA (2x)

This event was not planned from the beginning of the project and therefore, no success criteria have been defined in the CDE Plan [1]. However, given the generated reach, also compared with reach of the Associated Partner Workshops, the RPAS and Ai Joint Dissemination Event has to be considered a major success in terms of communication and dissemination.

4.2.3 White Paper of ER4 Automation

The ER4 Automation Projects produced a joint [White Paper](#) [11], together with a [video](#), introducing the projects. The document summarizes all participating projects as well as their lessons learned and conclusions on AI in ATM. SafeOPS contributed with the project description and the lessons learned section of the document, as illustrated in Figure 9. The white paper was presented at the SIDs 2022 during the AI/Automation Panel, described in the following section.



Figure 9: SafeOPS Contribution to the White Paper

4.2.4 SESAR Innovation Days 2022 Panel On AI/Automation in ATM

SafeOPS participated in the SIDs 2022 Panel Discussion on AI/Automation in ATM, organized by the SJU. The Panel was held on 8th December 2022 in Budapest. The AI/Automation related ER4 projects summarized their project findings and engaged in a discussion with the audience on the future of AI and Automation in Air Traffic Management. Figure 10 shows the panel with the introduction slide of the panellists. Figure 11 shows the audience, as seen from the panel.



Figure 10 SESAR Innovation Days 2022 Panel On AI/Automation in ATM I



Figure 11 SESAR Innovation Days 2022 Panel On AI/Automation in ATM II

5 Exploitation

Table 14 covers the exploitation of the project results, per beneficiary.

Table 14 Exploitation Overview

Title	Type	Audience group
TUM	<ul style="list-style-type: none"> Data fusion algorithms combining different data sources Advanced flight phase detection algorithm (label UAs reliably) Advanced data driven UA prediction Data driven Go-Around prediction Guidelines on Decision Intelligence for Automation 	<ul style="list-style-type: none"> Present state of the art research in lectures of TUM FSD Use gained technical know how for future research / projects (incl. acquisition) in collaboration with end users. A more airline-focus can be researched aimed at applying the research findings to a potential application in the cockpit. As a concrete example, TUM participates in the Horizon Europe Innovation Action SafeTeam. Data management and predictive capabilities will be applied at a higher TRL research including validations with end users. Use gained project management know how for future collaborative projects (incl. acquisition) Use research results in PhD theses of team members
INX	<ul style="list-style-type: none"> Automated data preparation Advanced data driven UA prediction Data driven AI/ML solutions for Go-Around prediction Understand interpretation strategies of AI/ML models Guidelines on Decision Intelligence for Automation 	<ul style="list-style-type: none"> Data management skills, including data preparation, cleaning and merging, together with Machine Learning and predictive analysis experience will support future research on this line of activity. Innaxis is the coordinator of the SafeTeam Innovation Action, funded under the Horizon Europe research programme and targeting TRL6. SafeTeam builds on previous research projects, including SafeOPS, and takes it to higher maturity levels, incorporating the human factors perspective in aviation automation ensuring safety and resilience. The experience in working with operational partners, brings further opportunities for applied research, including but not limited to SESAR3. Innaxis' spin off, DataBeacon, was established to move from applied research into data-driven services responding to the Innaxis' commitment to exploit research results. Opening new marked opportunities in data science as a service. Innaxis holds a long experience in the promotion of data science and AI initiatives in the aviation sector through the organization of workshops and conferences on the topic (e.g. MONDAIS) that will serve as a communication platform to share the most promising results.

Title	Type	Audience group
Deep Blue	<ul style="list-style-type: none"> Understand interpretation strategies of AI/ML models Risk evaluation model for data driven decision support Integration of risk model in user operations Impact analyses of data driven decision support on ATM operation Guidelines on Decision Intelligence for Automation 	<ul style="list-style-type: none"> Use gained technical know how for future research / projects (incl. acquisition) in collaboration with end users. Synergies with other SESAR projects of the same call made it possible to identify challenges and safety issues that all AI applications in ATM face besides those that are specific of the Go-Around scenario, particularly related to the transparency and explainability of the AI predictions. Apply risk models to calculate the frequency and impact of multiple hazards and evaluate mitigation strategies by quantifying benefits brought by alternative solutions Use the gained know-how in Human Factors aspects of technology acceptance to develop new for consultancies services in aviation and other domains Develop training and consultancy services about the delivery of effective decision-support analytics which take into account Human Factors The understanding of operations and of the needs and pain points of operational partners, brings further opportunities for applied research, including but not limited to SESAR3.
DFS	<ul style="list-style-type: none"> Data driven Go-Around prediction Impact analyses of data driven decision support on ATM operation Guidelines on Decision Intelligence for Automation 	<ul style="list-style-type: none"> Gaining know how in usage of data driven tools for ATM operations
Iberia	<ul style="list-style-type: none"> Safety/Risk Analyses of Operation w.r.t. Go-arounds and UAs Guidelines on Decision Intelligence for Automation 	<ul style="list-style-type: none"> Include findings and analyses in airline FDM program. Explore the possibility to apply the Go-Around predictive capabilities to the cockpit environment supporting pilot safety and operations.
Pegasus	<ul style="list-style-type: none"> Safety/Risk Analyses of Operation w.r.t. Go-arounds and UAs Guidelines on Decision Intelligence for Automation 	<ul style="list-style-type: none"> Include findings and analyses in airline FDM program. Explore the possibility to apply the Go-Around predictive capabilities to the cockpit environment supporting pilot safety and operations.

6 Conclusions and lessons learned

The overall CDE performance of SafeOPS is considered mostly successful, since most defined success criteria are met at the project's end. The project's website and the first Associated Partner workshop were the two activities that did not meet the initially formulated expectations. Regarding the number of participants for the Associated Partner Workshops, an increase can be observed after the first edition. This stems from the advertisement, which was done by the project, as agreed in the Intermediate Review Meeting. The later editions all satisfied the success criteria. The website underperformed most significantly and, even though the project advertised the website in LinkedIn, especially towards the project end, when the final results were available. All other CDE actions were performed, according to the specified expectations of the CDE Plan. Additionally, to the CDE actions, defined with the project start in the CDE Plan, a set of CDE actions emerged from joint efforts of the automation related, exploratory research projects funded by SESAR JU, which balance the underperformance of the project website. Furthermore, more exploitation and communication actions will take place after the end of the project, with the release of pending papers, further widening the project's reach.

Regarding the activities, planned in the CDE plan, LinkedIn and Blogposts provided a good reach, considering the effort spend to produce them, considering that the first blog post received more views than the website in two months and the second post, which was released only a days before this deliverable already has generated as much attention as the website in one month. Also, considering the reach, generated by LinkedIn outperforms the website's reach and especially posts including videos received as much views as the website over one year. Considering all this, it can be concluded that SafeOPS has a great reach among the community and public, however the website might have been received more as a repository for results than a medium to raise awareness in the first place.

Additionally to the planned actions, and as one of the emerging actions, the common ER4 Project activities should be highlighted. With the project starting at the beginning of the Covid-19 period and all meetings / conferences being held virtually until spring/summer 2022, especially the in-person RPAS & AI Event in Rome provided a fruitful basis for dissemination, communication and stakeholder engagement; with a reach far beyond what could be achieved by virtual means. Also, the white paper, joint video and the SJU's AI/Automation Panel at the SIDs, also initially unplanned activities, have been received very well by the audience. Since these actions were performed only a week prior to this deliverable, a definite measure on their impact is however not possible. It can however be concluded, that joining efforts of several projects is a good way to generate reach and also distribute costs for organizing in person events.

After this conclusion it can be said that two lessons have been learnt. On the one hand, that joining forces with similar oriented projects is an action that brings successful results, and that in-person events are more fruitful than webinars or online meetings, so if it is possible, it would be better to prioritize the organization of in-person activities. As it is difficult for one project to generate enough interesting material for 1-2 full days and to justify travel costs for in person events, including budgeted for invited speakers, joining efforts with similar oriented projects is considered a key enabler for good in-person events.

A further lesson learnt for SafeOPS is the lack of professional video production by the project, especially compared to e.g. Mahalo project. As described in section 4.1.3, SafeOPS released several videos, however in self-production, as no dedicated budget for professional/external video creation

was allocated in the cost planning. In future projects, budget should be planned for such purposes, allowing for higher quality video material.

Finally, since SafeOPS started delayed, a dedicated six-month period for CDE actions had to be shifted in the final productive phase of the project. Thus, an overlap with the final results generating and disseminating occurred. Given this circumstance, the project did well, having results ready to present at the RPAS/AI event, however a distinct CDE phase is considered be preferable.

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Appendix A Acronyms

Term	Definition
AI	Artificial Intelligence
ATM	Air Traffic Management
ATCO	Air Traffic Controller
Dx.y	SafeOPS Deliverable x.y (where x = task number, y = deliverable number)
ER4	Sesar Exploratory Research Wave 4
ML	Machine Learning
RPAS	Remotely Piloted Aircraft System
SESAR	Single European Sky ATM Research Programme
S3JU	SESAR3 Joint Undertaking (Agency of the European Commission)
WP	Work Package

Appendix B MoM Associated Partner Workshops

B.1 Workshop #1 13.07.2021

Time	Topic
20 min	Introduction Introduction Tour de Table Introduction to: <ul style="list-style-type: none"> • project Objectives • Work Packages • Phases
15 min	Methodology used in Requirements Definition Phase: <ul style="list-style-type: none"> • User Story • Use Case • Scenario • Workshops
5 min	Q&A no questions
40 min	Results of Requirements Definition Phase <i>Example Scenario:</i> <ul style="list-style-type: none"> • Procedural separation not granted since crossing of missed approach and SID routes over OTT VOR <i>Example Use Case</i> <ul style="list-style-type: none"> • Goal of Scenario/Use Case/User story to gain understanding of actors involved and their actions <i>In total:</i> <ul style="list-style-type: none"> • 7 use cases • 21 user stories • ATCOs want to have a Go Around indication <i>Visualization on TFDPS:</i> <ul style="list-style-type: none"> • Color Coding Schemes • Indication of probabilities <i>Technical problem statement:</i> <ul style="list-style-type: none"> • Many toolboxes available to deal with data cleaning and preparation • Challenges to be expected with new data sets from airlines, feature engineering, data fusion • Accuracy of ML algorithm, binary classification, false positive and negative
15 min	Q&A - Discussion HM: <ul style="list-style-type: none"> • Approach patterns changed during Corona • what data is used: ADS-B, QAR/FDM • focus on pilot induced G/A

B.2 Workshop #2 07.02.2022

Time	Topic	Presenter	Meeting Notes
10min	Roundtable introduction of participants		
15min	Introduction + general context of project	Lukas Beller (TUM)	Intro to the project in general Recap on D2.1
25min	Risk Framework - Results and current work	Carlo Abate (DeepBlue)	
15min	Q&A		<p>Q: what AIM models in particular will you be using?</p> <p>A: The purpose is to develop a new model that describes in particular the pilot-induced GA, and then to link this models to other critical hazards that are related to the GA operations (either because they are possible outcomes of a GA, or because they can happen during GA), namely:</p> <p>Wake Encounter Runway Incursion / Collision Mid-Air Collision (TMA/En-route) Controlled-flight into terrain</p> <p>All these events are already modelled in AIM and this is one of the reasons why AIM was chosen in the first place</p>
25min	Predictive Layer - State of current work	Pablo Hernandez (INX)	
15min	Q&A		<p>Q: What do you mean for abnormalities</p> <p>A: not in terms of operations, but from a ML point of view. So give a ML model a whole set of approaches, the algorithm detects "outlier" approaches. Maybe there is nothing wrong with them, but they are identified as different compared to the historical data. The algorithm "learns" what is the "normal APP" and detects what deviates from the normal.</p> <p>Q: There are a lot of different aircraft with different performance. IBE and PGT have a fleet of A/C, but these does not exhaust all possibilities, e.g. especially business jets and so on that have very different behavior than commercial flights. How do you deal with these?</p> <p>A: We need to be aware of the limitations of the algorithm and make sure we do not stretch the assumptions to cover situations that cannot be learnt by the algorithm.</p>

			<p>Q: Are you considering other techniques beside CNN that work well with scarcity of data (which might be relevant for GA)?</p> <p>A: we will consider a range of different solutions to see what works better, from linear regression to random forests, etc., especially to consider the huge imbalance between "normal APP" and "GA". One of these techniques is e.g. to create synthetic GA, or to reduce the number of "normal APP", to reduce the imbalance and make the algorithm learn.</p> <p>Q: You don't weight the GA with any kind of risk ?</p> <p>A: No, we only consider whether it is "abnormal" compared to the main trend, and let the model decide what an "abnormal APP" is.</p>
10 min	Validation Approach	Lukas Beller (TUM)	<p>Q: The data you have available, what do they represent in terms of volume or duration of operations?</p> <p>A: FDM- perspective around 200,000 flights, ADS-B: 2 years of operations for each airport, but more could be downloaded, METAR available for every flight we are investigating.</p>
30min	Further Project Outlook + Discussions/Feedback	Lukas Beller (TUM)	<p>BM - in FARO, analysis of impact of extra data on safety of resilience of system (one case study is in GA), we do not include the HF aspect</p> <p>HM - Would be great benefit if you use FDM data, there are already precursors studies on unstable APP, quite documented in UFDM WG B and I think it would improve the analysis you are doing. We can put you in contact with the UFDM members to get more insight on how the analysis was performed.</p>

B.3 Workshop #3 12.07.2022

Time	Topic	Presenter	Minutes
15 min	Introduction + general context of project	Lukas Beller (TUM)	
30 min	ML results for go-around prediction	Pablo Hernandez (INX)	
30 min	Q&A - Discussion		<p>TL: Have you considered the EASA Roadmap for AI in your project</p> <ul style="list-style-type: none"> LB: we are planning a paper on Data Quality Assessment/Requirements based on EASA Guidance Material TL: organizes a conference in 2023 where SafeOPS can be a case study on the Guidance material <p>HM: Why are the FN high</p>

			<ul style="list-style-type: none"> As data set only covers approach performance, ATC included GA are not reliably detected by the ML algorithm
30 min	Interpretability of ML results	Pablo Hernandez (INX)	
30 min	Q&A - Discussion		No questions
15 min	Further Project Outlook + Discussions/Feedback	Lukas Beller (TUM)	

B.4 Workshop #4 20.12.2022

13:00-13:10 Tour de Table

13:10-14:15 LB SafeOPS presentation, No dedicated Q&A but open Questions during Talk

Questions on:

Data

- LH: How was QAR data used?
 - LB: QAR data was used to compare data pipelines developed with ADS-B data
 - PH: We used QAR in data exploration but the tool is intended from the perspective of the ATCO so QAR data would not be available for prediction and so it was not used in training

Machine Learning Results

- DW: Low number of FP is good but how was the model trained to achieve this?
 - LB: From operational perspective low number of FP was the optimum solution.
 - PH: For training we used mainly the precision-recall metric to be optimized. Then based on the initial performance of the model you would be able to adapt the prediction threshold to further adjust the performance but this a manual task
- LH: Are the models trained only for one runway?
 - LB: No. The models were trained at an airport level.
- LH: How is the 10.000 approaches example shown been defined? Is this how the model has been trained?
 - LB/PH: This is just a visualization to better understand the results obtained from the model instead of just relying on the precision/recall percentage results. The development of the solution was done using the typical train/test split of the data
- LH: False positive event?
 - PH: We investigated some of the false positive events but in most cases no clear explanation on the case. Most probably this could be unstable approaches that pilots in the end landed.
- DW: Why is there a capacity decrease at 6NM if we are sure the aircraft is going around?

- LB: The rationale of the ATCO if there is a high likelihood for GA you leave the runway free so the aircraft can follow the standard missed approach and do not need any type of vectoring or instructions
- DW: Do ATCOs don why a fly over the runway if there is an aircraft?
 - LB: Based on our input with the ATCOs this seems to be the case. No ATCO today so not sure if this is always the case.
- DW: How did you handle the imbalanced data problem?
 - PH: We explored different techniques (re-sampling and cost-sensitive models) during the benchmark study. In the end for our case study the one that gave the best results was the oversampling technique called SMOTE.

EASA Guidance/Roadmap

- LH: What are the next steps (after the project ends)?
 - LB: There is a roadmap for AI by EASA and they also published a guidelines for the development of AI/ML solutions. We looked into them at the end of the project and see how our methodology aligned with them as they were published this year.
- LB: Any experience in safety assessment of the performance of the tools? With binary classification is simpler but with other types?
 - HM: The future is for sure in the direction of this type of analysis and maybe promote some meetings with colleagues from their AI team so they are aware of the possible future steps
 - LB: Definitely interested in being in contact with more EASA members. Maybe really interesting for a future planned paper.
- HD: Did you find any resistance from controllers to change their behavior?
 - LB: We had some resistance although interestingly with younger controllers we had much more acceptance with more older ones.
- DW: Are you addressing the ODD?
 - LB: We started looking into it but we did not define specific conditions and re-explore the data set used. This is the next big step
 - LH: You already contacted Constantine which for sure will be a good contact for this theme
- DW: Concepts of Design Assurance for Neural Networks (CoDANN) II
- LH: For future proposals, not sure if you want to go into the development of a product, where you need to work in certification issues.
 - LB: The SJU is very application oriented, with their solution pipeline, so if you are funded for a ML project, you will probably need to look into this type of issues

Spontaneous Presentation on Predictive Layer

- LH & DW were interested in an additional presentation on the machine learning related work