D5.24 Engage 2 Open Science Strategy

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Abstract

This document presents the initial strategic plan for the implementation of Open Science within the Engage 2 project. This strategy is based on the main Open Science (OS) principles described in the OSCAR OS Code of Conduct and is expected to act as an internal guideline and practical framework for the Engage 2 consortium, leading to the development of Deliverables D5.25: Engage 2 Open Science - interim report (M26) and D5.6: Engage 2 Open Science (M45). This is a living document, expected to evolve and update the specifications during the Engage 2 lifespan, in line with the evolution of Task 5.6 and the overall progress of the project, leading to the submission of Deliverables 5.25 and 5.6.

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Copyright Statement

Engage 2

THE SESAR 3 KNOWLEDGE TRANSFER NETWORK

Engage 2

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List of Acronyms

Acronym	Description
AAT	Aeronautics and Air Transport
APC	Article Processing Charges
ATM	air traffic management
CC	Creative Commons

DMP	Data Management Plan
DOI	Digital Object Identifier
ECTL	EUROCONTROL
EOSC	European Open Science Cloud
H2020	Horizon 2020 research programme
IPR	Intellectual Property Rights
KTN	Knowledge Transfer Network
OER	Open Educational Resources
OS	Open Science
OSCAR	Open Science Aeronautics and Air Transport Research
PID	Persistent Identifier
S3JU	SESAR 3 Joint Undertaking
SC	Scientific Committee
SESAR	Single European Sky ATM Research

1 Introduction

Engage 2 aims inter alia to bridge the gap between industry and academia, investigate the future of air traffic management (ATM) including the needed skills, as well as inspire and support the next generation of aviation professionals in facing the challenges of the digital era. By forging strong alliances between research and operational implementation, Engage 2 will foster cross-fertilisation of knowledge by drawing from other disciplines and encouraging innovative, future-oriented, and unconventional research within the domain of ATM.

In the frame of bridging existing gaps between industry and academia in ATM, as well as considering the overall great importance of Open Science for supporting the intended European performance gain and growth, Engage 2 puts in place a dedicated task, namely Task 5.6: Implementation of Open Science, that aims at building on the experience of the OSCAR H2020 project[3], which addressed the current perception, acceptance and implementation of Open Science in the field of European Aeronautics and Air Transport (AAT) research, by developing a Code of Conduct with specific pathways of implementation. Within Engage 2 Task 5.6, the OSCAR Code of Conduct[4] will be prudently applied and evaluated, so as to examine potential issues when attempting to follow it step-by-step, as well as identify any existing gaps, barriers and bottlenecks when implementing Open Science in general. Concurrently, supplementary actions will be also identified and performed by the Engage 2 consortium, such as dedicated surveys and questionnaires, to further facilitate the production of final concrete recommendations on the improvement of future processes and methodologies, and the development of innovative solutions for open science implementation.

It is worth noting that practicing Open Science has a wide range of benefits that have been identified and reported. The OSCAR Code of Conduct elaborates the ones that are relevant, but not limited, to AAT research. Herein, Open Science primarily leads to 1) greater impact, visibility, and citation rates, 2) knowledge transfer and innovation, 3) trust-building culture and increased partnerships especially for start-ups, 4) efficient academic research due to having more access to data, methods, results and publications, and 5) increased transparency promoting higher levels of trust between research/governmental institutions and the citizen leading to equal opportunities, democracy and human rights. Consequently, and in addition to the above, incorporating Open Science practices in Engage 2, by following the H2020 OSCAR Code of Conduct for Open Science, is expected to bring significant impacts and numerous benefits to the project, including:

- ✓ Publications available in open access regime will result in a more efficient and broad dissemination, as well as, being freely available to the general public, which will help us reach a bigger impact in terms of communication of results. In addition, they will surely get more media coverage through sharing information on social media and mainstream media outlets, enabling not only better science communication, but also attracting the interest of industry and general public and eventually, supporting citizen science.

[3] https://oscar-h2020.eu/

[4] OSCAR H2020 (2021), D4.5: OSCAR Open Science code of conduct, Final V1.0. Available here.

- ✓ As such, Open Science practices will increase the expected impact of the project and will contribute to achieving higher quality of science by increasing credibility of research outputs.
- ✓ The research effectiveness will be significantly improved by preventing duplication, contributing to research integrity and excellence.

This report is a preliminary document setting the strategy to be applied within Engage 2, towards successfully incorporating and implementing the Open Science practices as directed in the H2020 OSCAR Open Science code of conduct, and whilst following the relevant OSCAR step-by-step guide. This Open Science strategy is expected to gain precision and be further updated and improved throughout the project implementation and in line with the evolution of Task 5.6, leading to the development of more mature versions of the Engage 2 Open Science implementation via the submission of Deliverables D5.25: Engage 2 Open Science - interim report (in M26) and D5.6: Engage 2 Open Science (in M45). The Interim and final conclusions and recommendations resulting from this activity, will also be reported therein.

The following section of this document delves into the specific Open Science practices that are planned to take place within Engage 2. Open Science practices to be implemented are described, emphasising on open data implementation.

2 Open Science Practices for Engage 2

Open Science is the way we conduct and communicate about scientific work. As stated in the OSCAR Code of Conduct for Open Science, there are still discussions on a common definition of Open Science. However, the overall goal which is widely accepted, is to make the conducted scientific process of any research study, as open as possible to as many people as possible, including its hypotheses, inputs, generated data, methods used, outputs, results, publications, peer reviews, etc.

As Open Science is quite a new phenomenon within the scientific realm, there are different approaches to classifying its principles, levels and practices. One widely used approach is through the classification according to certain principles, practices, characteristics and indicators, and this document presents these practices and describes by what means they can be applied within Engage 2.

Engage 2 puts in place a dedicated task, namely Task 5.6, for implementing Open Science, specifically by following the OSCAR Code of Conduct which will be implemented and assessed within the Engage 2 project, as a real pilot case. The main objective of the OSCAR Code of Conduct is to promote the ethos of open scientific practices, as well as a culture of openness and transparency throughout research and scientific collaboration. It, thus, proposes specific ethical values, standards, practices, and principles, in a concrete and tangible manner, as well as invites all relevant actors, such as researchers and scientists, to voluntarily put them into practice, by providing a specific template on implementing Open Science. This task will be led by EASN-TIS, also involved as partner in the H2020 OSCAR project.

Precisely, the Open Science practices elaborated in the OSCAR Code of Conduct, will be prudently realized throughout Engage 2, by following the general step-by-step OSCAR suggested guidelines for their successful execution. In addition to the implementation of these practices, Engage 2 will perform supplementary actions dedicated to the wider promotion (i.e., outside of Engage 2) of Open Science principles:

- Promotion of Open Science Alliance for ATM, see section 2.2.2 for more details,
- Collection of requirements on Open Data, Code and Methodology from Engage 2 participants and wider ATM community, through dedicated surveys,
- Promotion of Open Science principles and OSCAR Code of Conduct within Engage 2 sponsored Ph.Ds and catalyst funding projects,
- Promotion of Open Science principles and OSCAR Code of Conduct at all Engage 2 organised workshops (offering participation in Open Science Alliance) and summer schools (tutorials on benefits of Open Science and resources available through Open Science Alliance).
- Creation of dedicated section in EngageWiki for collection of Open Data, Open Code and Open Publications (only those with permanent identifier, i.e., DOI),
- Collection of feedback on implementation of Open Science principles in the ATM from participants in Engage 2 events.

Ultimately, by implementation of the OSCAR Code of Conduct, and by performing the actions listed above, conclusions will be drawn on the implementation of Open Science principles in the ATM, parts of which would look at whether the intended balance between Open Science and IPR protection is in fact effectively achieved, as claimed in the OSCAR Code of Conduct, or if certain barriers, gaps and bottlenecks, as well as common misconceptions, are still apparent when implementing Open Science.

The OSCAR Open Science Code of Conduct itself will also be evaluated so as to identify any potential issues when following its step-by-step guidelines. and accordingly, propose improvements for future application. These actions, feedback received and conclusions will be further described in the Interim Report (Deliverable D5.25).Consequently, final concrete recommendations will be produced and be presented in the final Engage 2 report on Open Science (D5.26). These will be widely shared and communicated with SESAR3 projects that are willing to collaborate with Engage 2, as well as with relevant stakeholders, organisations and units such as, but not limited to, EUROCONTROL's Performance Review Unit and the Performance Review Commission, etc. This should facilitate achieving a better understanding of the existing open science landscape and current perception of Open Science, allow sharing valuable lessons learned, and ultimately pave the way towards improving and possibly speeding up the ATM research processes through the establishment and promotion of the Open Science Alliance community fostering the development of innovative solutions for open science implementation, in a collaborative and transparent way.

The Engage 2 consortium expects that following the Open Science principles and practices will bring significant impact in the long term to the aviation research and education domain. To this end, the OSCAR Code of Conduct for Open Science is further studied for implementation alleys throughout the project's duration, by following the practices highlighted therein as much as possible, while trying to find different solutions and implementation pathways. The principles for open sharing of research outputs within Engage 2 will be based on the following:

2.1 Open Access

This practice makes publications freely accessible to as many people as possible, leading to increased visibility of research results (Suber 2012; Eve 2014). This is implemented in different ways of open access publications, including:

- **Diamond open access:** Diamond or platinum open access means that the publication is published in an open access journal. The publisher does not require article processing charges (APC) nor do they ask the readers to pay. Therefore, these journals or publishers are often financed by third-party funds and donations. There are two such open access journals with which the European ATM community is collaborating are: The Journal of Open Aviation Science (JOAS)[5], and the European Journal of Transport and Infrastructure Research (EJTIR)[6]. The former is a new initiative, which is requiring open data and code for publication, while the latter journal is hosting the SESAR Innovation Days 2023 Special issue.
- **Gold open access:** Gold open access means that publications of scientific work are directly published in an open access journal, open access monography or regular journals that allow open access publications. There exist different ways of how the publications are financed. The most common way is the article processing charges (APCs), which are paid by the author or through financing agreements between the publisher and author's institution. Other financing options can be sponsoring, sale of printed versions, support from communities, institutions, or organisations (open-access.net 2020). In the case of EU research projects, the European

[5] https://journals.open.tudelft.nl/joas

[6] https://journals.open.tudelft.nl/ejtir/index

Commission offers to reimburse costs for open access publication. The cost should be mentioned when submitting the proposal (Fuchs and Sandoval 2013).

- **Green open access publications:** Green open access is the additional publication of scientific work on an institutional repository (open-access.net 2020) like arXiv.org (2021) or a private website, also known as self-archiving. This enables the authors to share their article without having to pay an APC (Sherpa Romeo, 2020), sometimes an embargo period is applied (i.e., delay to self-publication requested by the publisher). Further, an earlier version of the article (e.g., submitted one, prior to review) can be self-published immediately.

According to Article 17 of the Grant Agreement, the beneficiaries of any Horizon Europe programme must ensure open access to peer-reviewed scientific publications relating to their results. Engage 2 will commit to granting open access to all scientific peer-reviewed publications and will follow an approach to maximise the open access policy to ensure that research outcomes, even though limited, are freely accessible. All publications within Engage 2 will be at least **Green Open access** and the relevant publication DOIs will be hosted on the **knowledge hub (the wiki)**. Green open access publications are usually scientific publications that are published in an institutional repository or a private website, also known as self-archiving. In the case of Engage 2, the already existing wiki[7] will be utilised as an additional means to publish green open access publications. Other platforms, such as arxiv.org (2021) or bioRxiv.org (2021), for preprint green publications will also be explored to further share publications. The Engage 2 wiki will collect the links to open access publications (with permanent identifier, DOI) from all interested researchers in the ATM domain, especially those working on SESAR 3 projects. The wiki will have a dedicated space for these and will develop the process for adding the external (to Engage 2) publications.

The management process of research outputs will ensure that the research outputs that will be generated over the course of the project will be FAIR. The acronym FAIR identifies the main features that the project research data must have to be findable, accessible, interoperable and reusable, allowing thus for maximum knowledge circulation and return of investment. (Further details can be found in the forthcoming D1.2 Data Management Plan).

2.2 Open Data

Practicing open data refers to making the project data as freely accessible as possible, leading to increased quality of research by enabling independent validation, verification and reproducibility of research results. The Engage 2 partners commit to making the research data as open as possible while taking confidentiality and IPR protection into account, following the principle “as open as possible, as closed as necessary”, with the emphasis on the promotion of open access to data. Permanent links to relevant open data sets will be listed in the wiki, in line with the Data Management Plan (Task 1.2) that will be drafted at the beginning of the project and implemented under the coordination of Deep Blue. The consortium will provide mechanisms and services for registration, deposit, retention, and preservation of research data assets in support of current and future access, during and after the completion of Engage 2. The permanent identification (i.e., DOI) is chosen to avoid possibility of broken links from the websites or databases that do not have these assurances. As there are now several European platforms that offers such services for free (e.g., Zenodo, see below). The Data Management

[7] https://wikiengagektn.com/

Plan will describe the types of data that the project will generate, store, and re-use as well as specify how this data will be handled, shared and preserved during and after the project. It will also specify the tools and instruments (software, models, algorithms) needed to validate the results.

A dedicated space in the Engage 2 **wiki** will be used for access to publications and research data, which will be open to the wider ATM research community, accompanied with the process on how to add pertinent links to the wiki, especially for those coming outside the Engage 2. In addition, the **European Open Science Cloud[8] (EOSC)** can be recommended for hosting and processing research data, Zenodo[9] for hosting/publication, and the **Open Research Europe[10] open access publishing platform** for the publication of research stemming from Horizon Europe funding across all subject areas.

Making data findable: A specific metadata template, will be defined, to describe, discover, and trace existing data collected by the project and the data that will be generated by it over the next years. The templates will be sent and filled out by the data owners/data providers and saved in the Engage 2 repository. Afterwards a metadata fiche, for each Engage 2 data collection will be made publicly accessible through trusted repositories.

Making data accessible: All project results (data, scientific publications) will be openly accessible. Specifically, in the cases where data is fully open, the project will make it available and deposited in **a data repository** at the same time as a publication. In some specific cases, non-public research data could be archived at the repository using a restricted access option.

Making data interoperable: All data sets will be described using standard descriptive metadata, such as Dublin Core and DataCite Metadata Schema to ensure metadata interoperability for indexing and discoverability. All relevant documentation explaining codebooks, users' manuals, data collection procedures and analysis will be made available along with the data to guarantee intelligibility, reproducibility and the validation of the project findings.

Increase data re-use: Engage 2 distributes the shareable data by adopting licences that allow re-use of the data and of the data sets in their entirety by other scholars and stakeholders. The data sets are made available, unless otherwise stated, under Creative Commons (CC) by 4.0 or CC0 upon each dataset final contents. In general, data are made openly available as underlying data necessary to validate the research results immediately at the time of publication of public reports and scientific papers. Data are given full citations from official project publications and websites, and they are made available through institutional or public data repositories compliant with **OpenAIRE[11]** requirements.

▪ 2.2.1. Engage KTN lessons learned

Even though just started, Engage 2 aims at continuing various strands of work performed by the previous project, Engage KTN. Open data access is one of the work strands, and the Engage KTN collected the information on what are the most important research enablers, based on the lessons

[8] https://eosc-portal.eu/

[9] https://zenodo.org/

[10] https://open-research-europe.ec.europa.eu/

[11] https://www.openaire.eu/

learned during the project. One of the most cited ones was the data availability. The data availability has been recognised by different stakeholders as a bottleneck in SESAR's exploratory research (ER). The data is usually difficult to acquire, and is often subject to non-disclosure agreements, often requiring that the same dataset cannot be used in multiple projects. As such, it presents a "barrier to improving experimental comparability across projects". Engage KTN collected opinions of many projects and PhDs students, where one of the findings was that they spend approximately 6 to 12 months (sometimes more) in acquiring and then consolidating and cleaning the data. This observation was a recurring theme in the thematic challenge workshops organised by Engage KTN.

The data required in ER is composed of different types, the exact requirements varying across the projects. "Some of the data can be obtained freely (e.g. from the relatively new, and extensive, EUROCONTROL R&D data archive[12], launched at the 2020 Engage summer school; ADS-B data from the OpenSky Network[13]), some need to be paid for (e.g. schedule data, passenger itineraries and fares), and some need to be acquired from multiple sources if a greater geographical area is being researched (e.g. MET lightning or radar observations, public transit schedules), which complicates and prolongs data acquisition". As frequently some sort of licensing and non-disclosure agreement is required, the input data is prevented from being shared. Depending on the specificities of the licensing/agreements, sometimes the results of the research can be shared. However, if the input data cannot be shared, then achieving comparability and reproducibility becomes close to impossible.

A couple of solutions for better data access for ER projects were proposed at the end of Engage KTN:

- Creation and application of non-disclosure agreements regarding the acceptable form of sharing of confidential (or subject to GDPR) information by the data owners, having in mind that for the research results to be validated and/or reproducible, the sharing of input data is required.

- Creation of a framework to share ATM-relevant data (including MET and multimodal data), to afford easier access without having multiple agreements in place, which would require the provision of centralised licensing for certain ATM and commercial data (and/or the creation of synthetic datasets for the ATM community).

2.2.2. Way forward

As can be seen above, the open data is an important research enabler, for which SESAR's ER projects identified important points that needed improvement. Engage 2 aims to help the betterment of open data availability by supporting the creation of an open data framework. SESAR 3 JU's Scientific Committee (SC) established the open data task force to further explore opportunities and overcoming of the barriers. Engage 2 and the SC agreed to collaborate on this topic. As a first step in this collaboration, the Engage 2 consortium prepared a **survey questionnaire** to be sent to relevant stakeholders, including participants and coordinators of past and running SESAR projects, to gather the information on the main **challenges, needs, gaps, and possible pathways towards promoting the practice of open data within the aviation research and education domain.** The survey has been

[12] https://www.eurocontrol.int/dashboard/rnd-data-archive

[13] https://opensky-network.org/

launched and shared with the relevant recipients in March 2024. The preparation of the survey was led by UoW. Topics and concerns related to accessibility/inaccessibility are included, including: 1. Data that is currently in use that is free and accessible (under what conditions); 2. data that researchers and industry are paying for to gain access; 3. data that are not available; 4. other existing barriers; 5. opportunities and benefits of making data more accessible; etc. The survey results will be shared with SJC, as well as with ECTL, PRU, PRC, etc.

This will further feed into the creation of a framework for ATM related data and code (see next section) sharing and availability that will be further implemented in the pilot case of Engage 2 KTN. Moreover, Engage 2 will get in touch with projects that have successfully applied Open Science in the previous SESAR call, to collect best practices and include them in the recommendations/results to be developed in the frame of the project.

The second step of the SC and Engage 2 collaboration consists in promotion of **Open Science Alliance for ATM,** an initiative, still very loosely structured, currently involving Engage 2, SC, EUROCONTROL PRC and OpenSky Network, but is open to the entire ATM research community. The goal of the alliance is to promote the adoption and application of Open Science principles in the ATM Research. The roadmap towards the alliance is described in (Bolic at al., 2023). The survey questionnaire is also enquiring for respondents willing to join Open Science Alliance for ATM, in order to create a vibrant community focused on Open access to data and strengthening reproducibility and quality of European ATM research.

The alliance initiative grew around the need for the Open data access but is tightly linked with all other Open Science principles described in this chapter. As such, this initiative has a potential of being the means with which the Open Science principles are spread to the wider ATM community and the lessons learned taken on-board and implemented, within Engage2 and outside of it.

The Open data sources will be promoted to the PhD students and catalyst funded projects, as will the Open Science Alliance for ATM community and its resources.

○ 2.3 Open Source

Open-source practice refers to making as much source code of the developed software as accessible and available as possible. Code sharing facilitates research reproducibility and reuse of the existing code source, in addition to building trust and generation of research at a faster pace. Moreover, open source reduces unnecessary software creations, which in turn, saves research funds and effort. Any software developed within Engage 2, will be open-source and will be freely accessible, modifiable, distributable, and re-useable. To achieve this, the Engage 2 consortium will publish the source code in open access repositories such as GitLab (GitLab 2021), GitHub (GitHub2 2021), Bitbucket (Atlassian 2021) or SourceForge (SourceForge 2021) In addition, the source code will be placed under open license, such as the MIT license (Open Source Initiative 2021b). The Engage 2 consortium will distribute the shareable data by adopting **licenses** that allow re-use of the data and/or the source codes and data sets in their entirety by other scholars and stakeholders. The Engage 2 wiki, as the online platform developed as an accessible meta-source of research data, will host or link (whenever possible) to existing and past projects, documents, published papers, videos, and software code to ensure Open

Science practice as a whole, including open source practice. This will include data on PhD theses supported by Engage and Engage 2 as well as material from summer schools, workshops and webinars.

2.4 Open Methodology

This practice involves being transparent by describing and sharing the methods used throughout the project design and implementation, including the hypotheses development. Engage 2 will commit to keeping its methodology and its outputs to be as open as possible, by documenting the methods used and publishing them together with the results achieved, as open access publications. The Engage 2 methods, research designs and hypotheses, will be described as explicitly, clearly, concretely, and transparently as possible. Engage 2 will also consider publishing any research notes via the open notebook approach, as well as pre-registering any hypotheses and/or research designs or methods, where relevant, in Open Science Framework, As Predicted, or the registered report format. The Open Methodology practice will also be introduced and promoted to the PhD students involved in the project activities. Upon interaction with the students on this subject, Engage 2 will subsequently report on how many of the students have already used this practice, as well as whether they encountered any barriers (and if so, what kind).

Moreover, Engage 2 will exploit and apply the methodology developed and applied by Deep Blue in several EU-funded projects ((see projects SKILL-UP, SKILLFUL, HAIKU, etc..) aimed at, among others, defining the workforce profiles (job roles) called by the future trends and scenarios, and fostering synergies between educational institutions and labour market. This directly showcases the benefits of implementing open methodology by having access to an already established methodology, using it, and reproducing it in different but related projects.

2.5 Open Peer Review

Contrary to traditional peer review process which is blind, or double-blind (meaning that the identify of reviewers and/or authors is hidden from the other party in the process), the open peer review process fosters open and fair communication between parties, as the review is performed on the dedicated open platforms, and the identities of authors and reviewers are known, and can be followed by any interested party. The open peer review will be highly recommended for the project's publications. This process increases the recognition of the reviewers' work as well as the quality of scientific publications. A closed peer review is prone to errors and such a closed process can be exploited to push through certain subjective interests unnoticed. Consequently, the Engage 2 researchers will be encouraged to participate in open peer-review processes. Examples of open peer review journals are: the Journal of Open Aviation Science – JOAS (https://journals.open.tudelft.nl/joas), which is the only available open-access peer-reviewed journal explicitly focused on aviation research and science, as well as others, more generic ones, such as GigaScience (http://www.gigasciencejournal.com/), PeerJ (https://peerj.com/) and F1000 Research (http://f1000research.com/) (Ross-Hellauer 2017; Wikipedia 2020a; AG Open Science 2020), Geoscientific Model Development (https://www.geoscientific-model-development.net/) which is dedicated to Earth sciences, where several SESAR projects working on climate and hazards already published. Furthermore, the Engage 2 partners will be encouraged to use Open Research Europe[14],

[14] Open Research Europe | Open Access ... | Open Research Europe (europa.eu)

which is an innovative open access publishing venue for European Commission-funded researchers across all disciplines, with no author fees, offering rapid publication, open peer review, whilst supporting data deposition and sharing. Last but not least, the Open Peer Review process will be promoted to the PhD students so as to introduce them to this important Open Science practice, report on how many of them have already used it in the past, as well as report any potential barriers they might have experienced.

○ 2.6 Open Educational Resources (OER)

This practice directly makes educational resources, such as learning and teaching material freely accessible to as many people as possible, improving worldwide equal opportunities for education and contributing to a bigger and better-informed scientific community.

Two main strands of Engage 2 involve core activities in relation to education, training, and knowledge.

The existing wiki, developed during Engage KTN, will be updated by providing differentiated access to the resources/information/material for students and professionals. The Engage 2 repository of ATM research containing SESAR ATM research, will be a central knowledge resource and reference centre for researchers. The repository will host (whenever possible) or link to existing and past projects, documents, published papers, videos and software code.

The wiki will further be improved with more advanced search functionality, where researchers may turn to the hub as an accessible meta-source of research data. Engage 2 will also offer opportunities to young scientists and students at MSc and PhD level to access the wiki including relevant training material. New training material will be added to the currently existing basic ATM courses. The new material will consider the findings of a critical review of the state of the art in the field of European ATM education/training, conducted in 2019 in the course of the Engage KTN. Various learning and development resources will be available in the wiki whenever possible, including but not limited to training material, meta-source of research data, data on PhD and Master theses supported by the project, workshops, hackathons, and serious games. This will make the Engage 2 wiki repository the one-stop, go-to source for information: a single European point of entry for ATM knowledge, contributing to the education of more people and indirectly contributing to the advancement of ATM science community, which will in turn lead to an enhanced collaborative effort between academia, industry, and policy makers.

○ 2.7 Citizen Science

Citizen science is when science is conducted together with the citizens. Citizen science is all about being inclusive and about the integration and engagement of the civil society in research projects to make the research life cycle more accessible, transparent and understandable (Gura 2013; Wikipedia 2020b). Several platforms, such as Zooniverse (2021), Citizen Science Association (CSA) (2021), European Citizen Science (ECSA) (2021) or EU-Citizen.Science (2021), will be explored and accordingly exploited to build citizen science, i.e. carry out the project together with non-professional scientists to increase inclusiveness, integration, and engagement of the civil society in Engage 2. This in turn will enhance transparency, accountability and public participation in research, technological innovation and its related public policy formulation.

Also, publications available in open access regime will feed into citizen science as they will attract more media coverage through sharing information on social media and mainstream media outlets enabling not only better science communication but also attracting the interest of industry and the general public and eventually, supporting citizen science.

Engage 2 Open Science practices in a Nutshell

It is no surprise that so many of the Open Sciences practices are interlinked and their applications are interconnected. The Engage 2 consortium intends to implement a wide range of these practices, as much as possible, so as to increase the benefits of Open Science practice.

Table 1 provides a summary of the Open Sciences practices that Engage 2 can immediately and easily implement using already existing platforms, repositories and systems. The table provides a list of the directly workable actions towards practicing Open Science. The main drawback towards practicing open data has already been discussed within the consortium and there is a consensus towards putting efforts together to tackle it through further research and gathering of information on the current status quo about the existing barriers on data accessibility and potential scenarios towards addressing these barriers.

Moreover, in the effort to learn from prior experiences in practicing Open Science, the Engage 2 Consortium also considers contacting the projects that successfully applied Open Science in the previous SESAR calls to collect best practices. Once said projects are identified with the support of all Engage 2 partners and project officer, a dedicated questionnaire will be circulated to the projects' coordinators, for gathering valuable insights on their prior experience with implementing Open Science. Namely, Open Science best practices, perceptions and attitudes, lessons learned, potential gaps, barriers and bottlenecks faced, will be addressed. The questionnaire results, will be evaluated and presented in the project's intermediate and final reports on the implementation of Engage 2 Open Science pilot, D5.6: "Engage 2 Open Science". The conclusions and recommendations drawn and produced, will be subsequently widely shared and communicated with SESAR 3 projects that are willing to collaborate with Engage 2, as well as other relevant stakeholders, organisations and units such as but not limited to EUROCONTROL's Performance Review Unit and the Performance Review Commission, etc., within the Open Science Alliance for ATM initiative. This should facilitate learning about the existing open science landscape, exchange on lessons learned, and improve future processes and methodologies, by further encouraging the development of innovative solutions for open science implementation, in a collaborative and transparent way, within ATM research.

Practice	Action
Open Access	At least Green Open access publications (also available on the wiki) , aiming for Diamond Open access. Publication in EJTIR and JOAS journals will be encouraged, where appropriate. Open Research Europe open access publishing platform to be used for the publication of Engage 2 research outputs.
Open Data	Relevant data sets will be linked to data platforms compatible with OpenAIRE on the wiki in line with the Data Management Plan. Engage 2 wiki used for the deposition of and access to publications and research data from Engage 2 and wider ATM research community. European Open Science Cloud (EOSC) will be used for hosting and processing research data. Zenodo and similar platforms will be used for data and notes hosting. Engage 2 survey on Open Data, for identifying main challenges, needs, gaps, and possible pathways towards promoting the practice of open data within the aviation research and education domain. Promotion of this practice to PhD students and catalyst funded projects. Report on usage and feedback.
Open Methodology	The Engage 2 methods and results will be documented and published together, as open access publications. The Engage 2 methods, research designs and hypotheses, where applicable, will be described as explicitly, clearly, concretely and transparently as possible. Promotion of this practice to PhD students to introduce and encourage its use. Report on how many have used it and any barriers experienced.
Open Peer review	Open peer review process is highly recommended for the project's publications. Promotion of this practice to PhD students to introduce and encourage its use. Report on how many have used it and any barriers experienced. Publication in JOAS will be encouraged.
OER	Creative commons license to be utilised for open access publishing and Open Educational Resources. Various development and learning resources like, training material, meta-source of research data, data on PhD and Master theses supported

	by the project, workshops, hackathons, and serious games will be available and accessible through the wiki.
Open data, access, code, OER	The Engage 2 repository will host (whenever possible) or link to existing and past projects, documents, published papers, videos and software code. Participation in and promotion of Open Science Alliance for ATM initiative, aiming at creating a research ecosystem increasing reproducibility of ATM research.
Citizen Science	Several platforms, such as Zooniverse, Citizen Science Association, European Citizen Science (ECSA) or EU-Citizen.Science, will be explored and exploited to build citizen science, i.e. carry out the project together with non-professional scientists to increase inclusiveness, integration, and engagement of the civil society in Engage 2. Also, publications available in open access regime will feed into citizen science as they will attract more media coverage through sharing information on social media and mainstream media outlets enabling not only better science communication, but also attracting the interest of industry and general public and eventually, supporting citizen science.

Table 1: Open Science implementation actions within Engage 2

3 Final Remarks and Conclusions

Engage 2 aims at making scientific outcomes and related data generated over the course of the project, available to any member of an inquiring society, from industrial stakeholders to the general public. As such, Open Science practices will, among others, increase the expected impact of the project and will contribute to releasing higher quality of science by increasing credibility and reproducibility of research outputs. Furthermore, the research effectiveness will be significantly improved by preventing duplication contributing to research integrity and excellence.

The document at hand has been formulated so as to provide a general outline and overview of the consortium's plan towards incorporating the OSCAR code of conduct for Open Science practices within the project and serves to be the initial strategy for this practice. Precisely, it presented the main Open Science practices that are considered for implementation throughout the lifetime of the project, the pathways for their implementation, as well as the main already identified existing bottleneck in relation to open data and the suggested approach to be adapted for addressing it successfully. In parallel, complementary actions are also examined, such as dedicated surveys and questionnaires to be conducted by the Engage 2 partners, for further facilitating the production of concrete recommendations on Open Science. The goal is to understand the existing perception and application of Open Science in ATM and find the respondents willing to join the Open Science Alliance for ATM that would further promote and apply the Open Science principles.

All practices mentioned in this document feed into the successful implementation, communication, and dissemination of the four strands of Engage 2. This document is a living document and will be continuously updated throughout the project lifespan, based on its overall progress, performed activities, and produced outcomes/conclusions/recommendations, leading to the development of more mature versions of the Engage 2 Open Science implementation, via the submission of Deliverables D5.25: Engage 2 Open Science - interim report (in M26) and D5.6: Engage 2 Open Science (in M45). Finally, it is provisioned for this initial Open Science strategy to be available in the wiki with the purpose of practicing Open Science.

4 References

AG Open Science. (2020, November 2). Open peer review. AG Open Science (blog). https://ag-openscience.de/open-peer-review/. arXiv.org.

ArXiv.Org e-Print Archive. (2021). https://arxiv.org/. bioRxiv.org.

Atlassian. (2019). Bitbucket. https://bitbucket.ord/product

BioRxiv.Org - the Preprint Server for Biology. https://www.biorxiv.org/.

BOLIC, T., Cook, A.J., Koelle, R., Spinielli, E., Goens, Q., Strohmeier, M., (2023) Roadmap for a European open science alliance for ATM research, SESAR Innovation Days 2023, Seville, Spain, DOI: 10.61009/SID.2023.1.39

CSA. (2021). Citizen Science: Partnering the Public and Professional Scientists. Citizen Science Association. https://citizenscience.org/.

ECSA. (2021). European Citizen Science Association (ECSA) – Engage with Us. https://ecsa.citizen-science.net/

EU-Citizen.Science. (2021). EU-Citizen.Science. https://eu-citizen.science/

Engage KTN. (2022). D3.10 Research and innovation insights.

Eve, M. P. (2014). Open Access and the Humanities: Contexts, Controversies and the Future. Cambridge University Press. https://doi.org/10.1017/CBO9781316161012.

Fuchs, C., & Sandoval, M. (2013). The Diamond Model of Open Access Publishing: Why Policy Makers, Scholars, Universities, Libraries, Labour Unions and the Publishing World Need to Take Non-Commercial, Non-Profit Open Access Serious. TripleC, 11, 428–43. https://doi.org/10.31269/vol11iss2pp428-443

GitHub. (n.d.). GitHub. GitHub. https://github.com/

GitLab. (2016). The first single application for the entire DevOps lifecycle - GitLab. GitLab. https://about.gitlab.com/

Gura, T. (2013). Citizen Science: Amateur Experts. Nature, 496(7444), 259–61. https://doi.org/10.1038/nj7444-259a

OpenAIRE. (2021). OpenAIRE. https://www.openaire.eu/

open-access.net. (2020, October 23). Informationplatform Open Access. Open-Access-Strategien. https://open-access.net/informationen-zu-open-access/open-access-strategien.

Open Source Initiative. (2019). News | Open Source Initiative. Opensource.org. https://opensource.org/

OSCAR project. (2021). D4.5 OSCAR Open Science code of conduct, Final V1.0. Available: https://oscar-h2020.eu/sites/default/files/2021-06/D4.5-Final_version_of_the_OSCAR_Open_Science_Code_of_Conduct_f.pdf

OSF. (2021). Osf.io. Preregistration Open Science Framework Retrieved April 3, 2024, from https://osf.io/prereg

Ross-Hellauer, T. (2017). What Is Open Peer Review? A Systematic Review. F1000Research, 6. https://doi.org/10.12688/f1000research.11369.2

Sherpa Romeo. (2020). Welcome to Sherpa Romeo - v2. Sherpa. https://v2.sherpa.ac.uk/romeo/

SourceForge. (2019, November 24). Sourceforge.net. https://sourceforge.net/

Suber, P. (2012). Open Access. MIT Press Essential Knowledge Series. MIT Press.

Wikipedia. (2020a). Open Peer Review. In Wikipedia. https://en.wikipedia.org/w/index.php?title=Open_peer_review&oldid=983149139.

Wikipedia. (2020b). Citizen Science. In Wikipedia. https://en.wikipedia.org/w/index.php?title=Citizen_science&oldid=983102498

Zenodo. (2021). Zenodo - Research. Shared. https://zenodo.org

Zooniverse. (2021). Zooniverse. https://www.zooniverse.org/