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Content list

1 Summary

1.1 Synopsis

This document is part of the OSCAR project (Open ScienCe Aeronautic & Air Transport Research). The main aim of the OSCAR project is to pave the way for open science in the European Aeronautic and Air Transport (AAT) research landscape. For more information on the project its WPs, deliverables and results please see the OSCAR project proposal or the other documents of the project available at the official website of the project: https://oscar-h2020.eu/.

This deliverable D4.1 presents the results of the analysis of the currently (2020-07-13) available results of WP2 and WP3 and in particular of deliverables D2.1, D2.3, D3.1 and D3.2. For a visual representation of the dependency graph, please see Figure 1.

D4.1 focuses mainly on challenges, legal and contractual constraints and opportunities for implementing open science in the European AAT research landscape. Key challenges, key opportunities and derived key recommendations for action have been identified. They are addressing the OSCAR project consortium, aiming to strategically align the OSCAR project and provide an information base for further decisions. Also, first tentative recommendations towards implementation of Open Science within the AAT research community are given.

This document has the following five sections:

- Section 2 gives an overview over the OSCAR project and its main goals and its structure. The sub-section 2.4 is dedicated specifically to work package 4 (WP4) which is dealing with the development and implementation of the OSCAR open science code of conduct.
- Section 3 summarises the contents of work package WP2 and WP3 and highlights the main conclusions and key results of each corresponding deliverable D2.1, D2.3, D3.1 and D3.2.
- Section 4 presents the identified key challenges and key opportunities, the key recommendations for action derived from the results of WP2 and WP3 with focus on the legal and contractual framework of the implementation of open science in the European AAT research landscape.
- Section 5 addresses the problem of delay of the deliverable D4.1 and shows critically the quality of the analysis.

1.2 Objective and background

The objective of the deliverable at hand is to analyse the work performed and results achieved in WP2 and WP3 as of 2020-07-13. The objective is to identify key challenges, key opportunities and derive concrete key actions and implementation paths to foster the open science code of conduct in the European AAT community. By analysing the work and results of WP2 and WP3, we can align the OSCAR project more precisely with its main goal that is to show how open science can be integrated into European AAT research projects in the future. The deliverable D4.1 is an important step for the ongoing project process particularly for the development of the pilot version of the open science code of conduct (D4.3) as well as for the planned simulated integration of the code of conduct into selected European pilot projects (WP5).

1.3 Key results and conclusions

The European aeronautic and air transport (AAT) research landscape is rather complex. D2.1 provides an overview of different networks, events and stakeholders which constitute the European AAT landscape as it developed since decades.

Open science is a rapidly evolving. Especially software tools and platforms, such as the *European open science Cloud (EOSC)* (European Commission 2020), are developing quickly. The wide range of products and the speed of innovation in the open science area can be seen at the one hand as a signal that open science is becoming increasingly important. However, the large number of platforms can also appear confusing to newcomers and produce a barrier to entry the world of open science.

OSCAR offers support to the AAT community for these platforms and tools, e.g. by highlighting which platforms can be of use to AAT community within the research process cycle, with strong focus on engineering, physics, material science, chemistry etc. The AAT landscape can possibly profit from platforms like *Zenodo* (Zenodo 2020), the *EOSC* (European Commission 2020), the *re3data* search engine (Registry of research data repositories 2020), the *arXiv* (arXiv 2020) or *Materials Cloud* (Material Cloud 2020) for materials science.

The analysis of existing consortium agreement models (CAMs) shows that open science is implicitly relevant in five widely used CAMs (D2.3). Implicit relevance of open science means that there is no explicit mention of open science, nevertheless the analysis showed that important categories of open science are de facto relevant (mentioned) in the five analysed CAMs. In this context, the term “category” is simply a synonym for the word “concept”, “topic” or “term”.

The analysis shows that open science and currently used CAMs are compatible at least in principle. Four categories of open science are particularly prominent in the analysed CAMs: *open source software, open data, copyright and licensing*, *intellectual property, ethics and responsibility*. Digitalisation and open science enforce each other. However, does not identify the category of digitalisation to be implicitly relevant in the CAMs. This could be a blind spot of the main stakeholders in the European AAT sector which should be addressed. Open science should not only be fostered in the context of CAM development, but also in the Rules of Participation (RfP) and the Grant Agreement Models (GAM), on which the CAMs are based. Currently only the one of the many categories of open science is directly addressed in the GAM namely the subcategory open access.

A bibliographic analysis of publications related to the AAT sector between 2015 and 2019 revealed that only about 20% of publications are published in open access (D3.1), but these OA publications are more visible in terms of citation rates – even in the AAT sector.

The OSCAR consortium planned to organise an event to engage in a fruitful discussion with selected AAT stakeholders (D3.2). Amongst other events, ILA2020 which was considered as one of the most promising events for OSCAR purposes.

However, due to the COVID-19 pandemic ILA2020 (as many other events) was cancelled, the 10th EASN conference will be organized as a purely virtual conference. The OSCAR consortium modified the plans accordingly.

1.4 Key actions and next steps

Based on the analysis at hand OSCAR consortium suggests the following key actions:

- The communication strategy must emphasise that open science is a pluralistic whole with many aspects and *not* just open access, which is only one of the facets of open science.

- Sub-categories of open science are already of major importance for the AAT community as e.g. open data, open source, open methodology, ethics and responsibility etc. It has to be shown to the AAT community multiple, flexible and easy paths of opening up their research processes. In that sense, there's a need to demonstrate many intermediate levels between complete secrecy (non-disclosure) and complete openness.
- In practise, the AAT research community needs a set of rules (e.g. flexible opt-in, opt-out or hybrid models for applying open science principles and practices in research projects). In addition, further incentives should be created respectively made visible.
- Best practices in the AAT and open science community have to be pointed out in order to promote the awareness and attractiveness of open science.
- Also, major pain points and doubts of the AAT community regarding open science need to be addressed, while the benefits of open science for the AAT community shall be shown clearly. This should be done by fact sheets, user stories, FAQ and templates that deals with facts and misconceptions of open science and its relation to related but different topics like patents, IPR, IP management and RRI.

2 Overview of the OSCAR project

2.1 Project description

The transport sector is a fast-growing sector of Europe and is associated with a wide range of economic and societal benefits – acting as a catalyst of technology transfer to many fields of mainly industrial application and vice versa taking up technologies from other sectors.

Today, the transport sector is confronted with diverse challenges: climate change, CO2 emissions, dependency from fossil fuels, evolving mobility demands, increasing global competition, emergence of new enabling technologies etc.

The transport sector as such is usually categorized by transport modes (car, road transport, rail, maritime, and aeronautics) and is characterised by the production and the operation of transport equipment. Additionally, both production and operation of transport infrastructure, as well as aspects of inter-modality of transport, need to be considered.

In this context, open science is considered as an important and promising opportunity to support the intended performance gain and innovations: “open science, open innovation and open to the world – the so-called 3 O’s – are very likely to impact European innovation performance, growth and international competitiveness” (European Commission 2016b).

Traditional intellectual property rights (IPR) management focuses on keeping intellectual property under lock and key. The basic idea of traditional IPR management is to allow a company to use the competitive advantages gained through secret i.e. non-disclosed research and innovation to gain an advantage over its competitors in the market, via patents and licenses.

One of the basic principles of open science is to open up the scientific process as much as possible and thus to open up the intellectual property associated with the same scientific process. The basic idea of open science is to make knowledge and other intellectual assets freely available to the scientific community and society for reasons of fairness, good scientific practice, reusability and responsibility towards society. It is important to note that even if you share your knowledge freely with the scientific community or with society, you are *not* giving up your copyrights to a creation. The creator retains all her rights to her creation in any case, even if she shares it freely with others, for example by placing it under a free license such as a Creative Commons license (Creative Commons 2020).

It is fair to say, that conventional IPR management and open science are in a state of tension. If traditional IPR management and open science principles are described in generic terms, one could assume or perceive that open science and conventional IPR management contradict each other. Yet, it is important to note that open science and conventional IPR do *not* contradict each other, because they are completely distinct categories. In fact, open science and conventional IPR management can be well harmonized because there are *no logical or conceptual barriers* to this.

For example “while open access to research data […] becomes applicable by default in Horizon 2020, the Commission also recognises that there are good reasons to keep some or even all research data generated in a project closed.” (European Commission 2020c)

The European Commission endorses the principle *as open as possible, as closed as necessary* "and focuses on encouraging sound data management as an essential part of research best practice." (European Commission 2020c)

European AAT research covers the scale of (TRL) from level 1 to level 6 (EARTO 2014). Arguably, the TRLs within a project are important factors influencing how much research can be opened up. The more fundamental research is done, the more this research can be opened up. The more applied industry-related research is done, the less the research process can be opened up. Therefore, for the implementation of open science all aspects of the nature of each individual project needs to be considered.

When implementing open science in European AAT research in general, reasonable compromises between closing and opening the respective project contents must be found. In doing so, special attention must be paid to the respective TRL of the respective project, because TLRs provides a good interface base to decide where, how and when which assets can be opened.

The OSCAR project aims to resolve this perceived tension between open science and traditional IPR management in the AAT research sector and to harmoniously integrate both approaches. OSCAR addresses the issue of the current perception, acceptance, and implementation of open science in the field of European AAT research.

The main goal of the OSCAR project is to initiate and deliver optimized open science opt-in, opt-out or hybrid models for the European AAT research landscape. This requires an in-depth understanding of open science (principles, application, and benefits) as well as of the structure of the European AAT landscape. It also requires convincing stakeholders of open science and to guide them through the integration of open science in their daily research work beyond single European projects.

2.2 Project structure

In order to realize the main goal and the related sub-goals of OSCAR, it is necessary to have (1) detailed understanding of the level of awareness and acceptance of open science in AAT research, (2) to develop and adapt implementation approaches for open science and (3) to evaluate those approaches. While these three objectives provide tools and practical information to implement open science in AAT research projects it is also necessary to raise the motivation to implement open science within the AAT research community.

- **Objective 1, WP2, WP3**: An assessment of the development of open science in European AAT projects since the beginning of FP7, i.e. FP7 and Horizon 2020, considering also the AAT related JTIs Clean Sky and SESAR. To some extent, projects, which relate at least partly with core AAT research, have been considered. The assessment shall have been based on:
  - a statistical analysis of estimated 1500+ collaborative research respectively CSA projects. It should have revealed factors facilitating respectively hampering the acceptance of open science approaches;
  - an intense consultation phase with researchers and administrative or legal staff from industry (IND) including SME, research organisations (REC), universities and academia research (HES) to gather comprehensive first-hand experience about awareness of open science as such, perceived benefits and drawbacks of the idea and potentially concrete examples.

- However, during the implementation of OSCAR legal constraints prevented accessing the needed EU eCORDA database, thus the statistical analysis had to be replaced by other means in order to identify suitable target projects.

- **Objective 2, WP4**: Objective 2 is to develop an open science code of conduct that is tailored to the needs of the European AAT research landscape. This includes analysing current legal constraints and opportunities as well as implementation approaches of open science into the European AAT research landscape.
- **Objective 3, WP5**: Objective 3 is to test the (interim) results in the course of WP4, to finalise recommendations targeting legal aspects and to validate the related open science code of conduct by simulating the application of the code of conduct in pilot project cases.
- **Objective 4, WP6**: Objectives 1 to 3 will contribute to increase of the implementation of open science in the European AAT research landscape. However, to achieve the ambitious goal of OSCAR, the acceptance of the idea as such, as well as open science code of conduct is crucial. Different complementary communication measures will be conducted to maximise the intended acceptance of and support for open science in AAT research landscape.

2.3 Project steps

OSCAR achieves its goals in three consecutive steps:

2.3.1 Step 1: Information and opinion gathering

As a first step, the OSCAR consortium analysed the European AAT research landscape with respect to the awareness and the perception of open science. We have focused on collaborative research projects (FP7: Level 1 and Level 2, Horizon 2020: Research and Innovation Actions, Innovation Actions) and Coordination and Support Actions as most common instruments in AAT research. As mentioned before, the intended statistical analysis could not be performed (no access to eCORDA) thus another approach on based of the professional experiences of the consortium members had to be developed.

In AAT, most research consortia consist of:

- Industry (IND incl. SME; from OEMs and the whole supply chain, represented by the IMG4 group);
- Research establishments (REC, represented by EREA);
- Academia research (HES, represented by EASN);
- In some cases, other types of partners as e.g. public bodies (PUB).

Some project consortia allows to distinguish between more research driven and more application driven projects, although there will be a level of uncertainty. There is also some tendency to associate lower TRL with the Framework Programmes and being driven by REC and/or HES. Vice versa higher TRL may be associated with some projects in Clean Sky with more emphasize in the role of IND, which might affect the degree of openness.

One main concern about open science and open access in particular is less the concept itself rather than the way it is implemented by the European Commission through the Rules for Participation (RfP). First, in HORIZON 2020 there is no differentiation of the IPR and open access rules with reference to the TRL or the nature of projects and there are no specific rules applicable to public or

private partnerships as well and it will probably remain so in HORIZON EUROPE. Currently, there is one single regime that apply to all situations, even where the difficulty of conciliate openness and projects with industrial partners is greatest. To minimize this difficulty, with the objective of better acceptability and understanding of the open science approach, it would be necessary to be able to apply slightly different and adapted open science rules, depending on the type of project. Secondly, rules applicable to open data are unclear especially about the types of tools or platforms to manage and share research content openly and freely. It creates uncertainty and reluctance to share data.

One of the aims of OSCAR is to offer suggestions for more exact and diversified guidelines on how to implement IPR rules in coherence with open science.

The taxonomy of ACARE mentions in total 12 technical fields as Flight Physics, Aero-structures, Propulsion etc. which need to be dealt with in order to achieve the FlightPath 2050 goals. During FP7 the European Commission introduced the first elements of open science – namely open access and later the open data pilot. Open access became mandatory in Horizon 2020, while open data remains a pre-set option, but consortia may opt out.

Since the beginning of FP7 respectively Clean Sky estimated 1500+ AAT research projects have been started. Considering the publication of calls and the usual project duration there are likely permanently 100 to 200 collaborative projects running in parallel. One can expect that clustering of projects by technical field and by other indicators provide sub-groups of sufficient size for statistical analysis of the acceptance of open science. The primary focus was on the timely evolution open science by cluster, which turned out to be not feasible.

WP3 uses the services of WP6 (Networking, Dissemination & Exploitation) in order to spread publishable results to the research community and to attract project consortia for cooperation with OSCAR. The OSCAR consortium will select about 20 target projects, which agree to contribute to OSCAR within the framework of a non-disclosure agreement (NDA). Consortia will be interviewed on their experience with and expectations of open science in general, and how to implement open science in concrete projects. Practical hands-on experience will reveal opportunities and drawbacks. In addition, projects dealing with other transport modes, inter-modality and projects affecting indirectly AAT research shall be considered. WP3 will both address researchers executing these projects and administrative staff, i.e. representatives of the legal and the financial departments. Practical experience confirms – especially in medium and large organisations – the different points of view of researchers and administrative staff.

2.3.2 Step 2: Development of a preliminary code of conduct and considerations of legal constraints

WP4 mainly deals with the development of the OSCAR open science code of conduct. In this second step, we are iteratively developing the methodology and conceptual framework for the open science code of conduct as well as the open science code of conduct itself. Step 1 so far (2020-07-13) gave insights into the level of understanding and acceptance of open science, its potential perceived conflicts with IPR within the AAT research projects. Step 1 also showed some important aspects of the open science community, i.e. plurality of platforms, data formats, practices, its dynamic development etc. These early outcomes are a good information base to build the further development of our open science code of conduct on.

One early outcome of WP4 will be an overview of the legal and contractual framework regarding open science and IPR in European AAT research projects. This overview will address rights and obligations related to open science in conjunction aspects of IPR protection and competitiveness. Current grant agreement (GA) and CAMs deal – amongst other – with IPR protection issues. Thus, a practical implementation of open science should address those CAMs and should demonstrate compatibility of open science and conventional contracts in the project context. It shall be emphasized that the OSCAR consortium is *not* mandated to change these models. We may provide recommendations only on how open science and the open science code of conduct can be harmonised with conventional contractual practices within the European AAT research landscape. The remaining calls in Horizon 2020 and the preparation of FP9 together with the time schedule of OSCAR indicate that efforts should be spent on FP9.

The main goal of WP4 is to arrive at a short, clear and easy to use open science code of conduct for the European AAT research community. This open science code of conduct will be tailored for the implementation in European AAT research projects by addressing the specific requirements of the AAT field.

In **WP2** current CAMs regarding their compatibility with open science have been systematically analysed. The analysis showed that CAMs are indeed compatible with open science. For more information on this analysis, please refer to deliverable D2.3.

OSCAR is developing the first open science of conduct in the field of AAT research. The code of conduct aims to be short, clear and easy to use with all European AAT research projects. It should help researchers and engineers to integrate open science in their daily work. Also, recommendations and guidelines on how to implement open science when reasonable shall be developed.

2.3.3 Step 3: Demonstration & validation

WP5 dealing with **Demonstration and Validation of the OSCAR open science code of conduct in Pilot Projects** is closely interacting with WP4 in order to feedback first experiences with interim WP4 results gathered in pilot projects. The iterative process will start with H2020 projects running at that time in which the application of the draft open science code of conduct will be simulated. OSCAR aims to answer the questions: Which impact of both the deliberation on the legal framework and on the code of conduct will be expected? Which suggestions will seem to be acceptable, which objections – be it regarding contractual aspects or regarding practical application – will come up? WP5 provides these answers to WP4 in order to develop more mature versions of the code of conduct and of a set of recommendations for future CAMs. Once the partners agree on an acceptable level of maturity, OSCAR aims at a test implementation in at least one suitable project, ideally in one of each category of RIA, IA, CSA. To achieve this ambitious goal the support of the European Commission will likely be needed, i.e. to identify such project(s) at an early stage of preparation.

2.4 Objectives and tasks of OSCAR WP4, legal and contractual constraints and the OSCAR code of conduct

The focus of WP4 is the development of the OSCAR open science code of conduct for the European AAT research projects and its implementation into legal frameworks in the EU project landscape. WP4 consists of 5 Tasks and corresponding deliverables.

2.4.1 T4.1 Analysis of WP2 and WP3 results to identify state of the art, challenges, legal and contractual constraints and opportunities for implementing Open Science in AAT research (TL Fraunhofer IRB, M6 – M10)

In work packages WP2 and WP3 preliminary information on existing practices of and opinions on the application of open science in the European AAT research was systematically collected. In this task T4.1, the OSCAR consortium analysed the results of WP2 and WP3 as of 2020-07-13 with focus on the following aspects:

- Legal and contractual constraints for implementing open science in European AAT research landscape;
- Challenges for implementing open science in the European AAT research landscape;
- Opportunities for implementing open science in European AAT research landscape.

Based on the results of the analysis done in this task we derived measures to (a) implement open science in in the European AAT research landscape in general and (b) to tailor the development of the open science code of conduct in particular.

Deliverable D4.1 aggregates the results of D2.1, D2.3, D3.1 and D3.2 and derives key challenges, key opportunities as well as key actions for the implementation of open science in general and the open science code of conduct in particular.

The analysis performed in D4.1 supports and informs the roadmap delivered with D4.2. The task T4.1 and the corresponding deliverable D4.1 strongly depended on the results of WP2 and WP3. The results from WP2 and WP3 were available later than planned. For more information on the delays, please see the documents of WP2 and WP3. Due to these delays, the activities in task T.41 took place not only from month 6 to month 10 as planned but from month 6 to month 19. Because of these delays, the Deliverables D4.1 could also only be completed with a delay. Please see section 5 *Quality* for more information.

2.4.2 T4.2 Methodology & framework for the OSCAR code of conduct (TL Fraunhofer IRB, M8 – M11)

Based on

1. the analysis from T4.1,
2. the roadmapping workshop in Paris in November 2019 with ONERA, SAFRAN on the legal and contractual constraints and opportunities and
3. on a literature research on the theory and development of codes of conduct

the OSCAR consortium developed a road map and conceptual framework for the OSCAR open science code of conduct. This roadmap includes a detailed work breakdown structure, a Gantt chart and a maintenance and update pattern for the code of conduct (see D4.2).

The finalisation of deliverable D4.2 depended on the finalisation of deliverable D4.1 that was delayed due to delays in WP2 and WP3. Please see section 2.4.1 *Analysis of WP2 and WP3* above and section 5 *Quality*.

An early initial draft version of the code of conduct was created by December 2019. This early draft of the code of conduct was given to the whole OSCAR consortium to give feedback and improve it.

The results of this task are delivered with deliverable *D4.2: Roadmap to Code of Conduct (including maintenance workflow).*

2.4.3 T4.3 Iterative preparation of the OSCAR Code of Conduct and simulated application in pilot cases (TL Fraunhofer IRB, M12 – M18)

Based on T4.1 and T4.2 the first version of the code of conduct will be available at the end of July 2020. The OSCAR consortium understands this code of conduct as a living document and this first version will be continuously and iteratively improved in the further course of the project together with all project partners. Fraunhofer IRB will incorporate new information and insights generated during the project into new versions of the code of conduct. The development of additional information material will be considered like:

- Specifics of knowledge generation and research projects in the AAT sector;
- Development of auxiliary information to enable the AAT community to implement open science and its advantages (like faster innovation cycles) in their research projects;
- User stories regarding potential implementation patterns of open science in the AAT sector and
- Fact sheets on the relation of IP and responsible research innovation (RRI) and open science.

It is planned to simulate the application of the open science code of conduct in selected pilot case projects. The simulation process envisaged consists of adapting existing documents stemming from the project context on a trial basis so that they contain or reference the open science code of conduct. Alternatively, we will obtain the relevant information via a short survey using the findings from this short simulation to further optimise the code of conduct.

The final version of the code of conduct, which will be available towards the end of the project, will be a tailored open science code of conduct that is short, clear and easy to use.

To communicate the our open science code of conduct appropriate measurement like input to the general communication strategy and a dissemination plan (see WP6) will be developed along the way in close cooperation with activities in WP5 and WP6.

Some early results of this task will be delivered with deliverable *D4.3: First version of the Oscar Code of Conduct*.

2.4.4 T4.4 Preliminary integration of the OSCAR Code of Conduct in established Consortium Agreement models (TL Fraunhofer IRB, M14 – M16)

Consortium agreements (CAs) are legally binding contracts between all members of the consortium concerned that are essential in all European projects. These documents regulate the mutual work and exchange between the project partners with focus on confidentiality, protection of background and foreground IP in a given project. CAs concretizes the more generic rules of the respective GA. WP4.4 demonstrates exemplary how CA models may take the code of conduct into account grant agreement. Consortium agreement models (CAMs) are contract templates that a project consortium can use to simplify the contract preparation.

At the time the OSCAR project proposal was written, it was planned to incorporate the open science code of conduct into existing CAMs. Initially the following two subtasks were planned:

- ST4.4.1 Selection of pilot cases (RIA, IA, CSA): here adequate pilot case agreement models should have been selected by comprehensible criteria.
- ST4.4.2 draft modification of CA models: The CA should have been modified. The adopted agreement models should have been tested and reviewed by members of the forum.

During the project, this approach proved to be politically and organizationally unfeasible thus requiring an alternative approach.

All CAMs base on the work of legal services throughout the whole European research landscape (e.g. IMG4, DESCA, etc.) and far beyond the AAT research community, outlining the "translation" of Rules for Participation and Model Grant Agreements to the fully internal agreement of consortium partners in a concrete project. Considering this independence of all CAMs (and all working groups developing CAMs) from Commission Services, the OSCAR consortium suggests providing recommendations to the Commission Services which may be taken into account when updating participation rules respectively Model Grant Agreements. The CAMs are expected to be updated according to the Open Science constraints given with Horizon Europe Model Grant Agreements.

While the approach addresses European policy issues, the second activity works on level of concrete projects. Here, the applicability of the OSCAR Code of Conduct is simulated to understand the potential implementation of OS in concrete cases and the resulting impact.

Additional information material like fact sheets, FAQ, etc. that are incorporated into the general OSCAR communication strategy to promote and disseminate the code of conduct in the AAT community (see WP6).

The results of this task will be delivered with deliverable *D4.4: Modified Consortium Agreement Models*.

2.4.5 T4.5 Finalization of the OSCAR Code of Conduct V.1.0 and the modified Consortium Agreement models on basis of WP5 results (TL INCAS, M24 – M28)

By incorporating the feedback and insights from all the other activities within the OSCAR project including legal advice, the final version of the open science code of conduct will be prepared by Fraunhofer IRB. The code of conduct will then be communicated and disseminated according to our general communication strategy developed in WP6. The results of this task will be presented in deliverable *D4.5: Final version of the Oscar Code of Conduct.*

The result of D4.3 is the first pilot case version of the open science code of conduct for the AAT research sector. The pilot case version is one precondition for WP5. In addition, D4.3 includes the simulated application of the code of conduct in EU projects.

D4.4. will demonstrate how the integration of the open science code of conduct into Consortium Agreement Models could look like. This is done in two steps: first, the CAMs most relevant to European AAT research are identified and the code of conduct is adopted by customizing the CAM. As mentioned above, OSACR will not intervene in the CA maintenance process but provide results of the analyses to the Commission Services.

The result of D4.5 represents the main objective of the work package to provide an applicable open science code of conduct for future European research projects in the AAT sector.

2.5 Relevance and contribution of this deliverable to the objectives of OSCAR

The purpose of deliverable D4.1 at hand is to present the results of the overall analysis of all results and work performed so far in work packages WP2 and WP3. Please see Figure 1 for a visual representation of the dependency graph of D4.1.

The main goal of the OSCAR project is to foster open science and to facilitate the implementation of open science into the European (AAT) research landscape. To achieve this goal, the OSCAR team develops tailored open science opt-in, opt-out or hybrid application models and deliver them to the stakeholders in the fields of AAT.

Therefore, we analysed the status of open science in European AAT research landscape (deliverable D2.1) and in particularly we analysed existing CAMs (deliverable D2.3). We analysed bibliographically open the AAT sector and their current main publication topics. We are also trying to engage in mutual exchanges with key stakeholders to harmonise our approach (deliverable D3.2).

Deliverable D4.1 gives a condensed overview of the identified key results, the key challenges, key opportunities of the analyses and the key actions derived from those analyses. Thus, Deliverable D4.1 establishes an information base needed to provide first recommendations to external stakeholders including the European Commission.

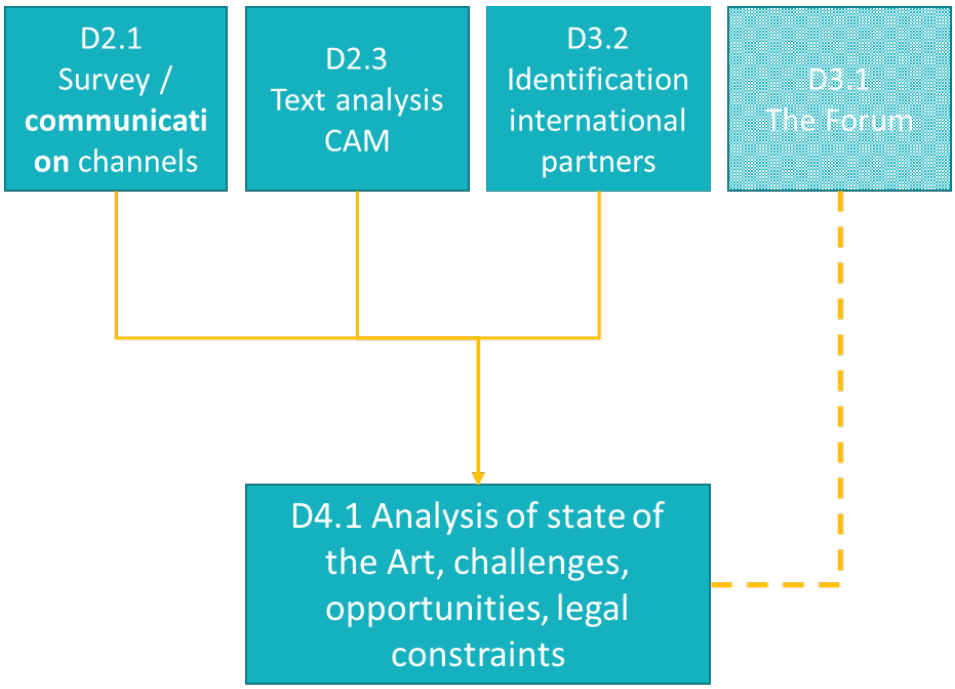


Figure 1: Deliverable dependency graph of deliverable D4.1

3 Approach and procedure

3.1 Work performed

The goal of the task T4.1 associated with the deliverable D4.1 at hand was to analyse the findings of WP2 and WP3 and to identify key challenges, key opportunities and key actions with focus on identifying legal and contractual constraints for the implementation of open science. In the first step we analysed all available results of WP2 and WP3 so far (2020-07-13) and focused on the deliverables D2.1, D2.3, D.31, D3.2. We analysed, flittered and sorted their core statements.

In the second step, overarching key challenges and key opportunities have been identified feeding the identification of further fields of action and recommendations.

In parallel to these analysis activities, a workshop was organised and conducted by Fraunhofer IRB in November 2019 with the project members Fraunhofer IRB, ONERA and SAFRAN to examine the legal and contractual framework conditions of the code of conduct in more detail.

3.2 Further input

As mentioned before, we build in this deliverable on the results of D2.1, D2.3, D3.1 and D3.2. These are summarised in the following sections. For a visual representation of the dependency graph of the deliverable D4.1 at hand, please see Figure 1. For more information on the various different outputs, please see the respective deliverables.

In the following sections, we will present the key results and findings of each individual deliverable.

3.2.1 Key results of D2.1

The main objective of the deliverable D2.1 is to give an overview over the main stakeholders of the AAT research landscape and to identify the most important stakeholders for the OSCAR project. The deliverable D2.1 ensures to address the right stakeholders by giving a full spectrum of the stakeholders and by highlighting the main associations, clusters and hubs of the European AAT research landscape.

The overview of the spectrum of the European AAT research landscape in turn can then be used to establish appropriate communication channels. These communication channels are particularly important for the survey performed in the context of T2.2. by accounting for the interests, constraints and sensitivities of each of these groups as well as for the derivation of challenges and opportunities in the AAT research landscape.

Deliverable D2.1 provides the following key results:

1. The map of the landscape of European AAT research landscape we developed can be seen as rather comprehensive. With the exception of SMEs, all major organisations could be adequately represented. Communication channels were successfully established. Comprehensive visual representation (map) of the major stakeholder of the European AAT research landscape was done.
2. Comprehensive list of point of contacts and a respective communication channel matrix was created.

3. Open science is developing and evolving dynamically and rapidly within the EU research landscape. This adds another aspect, or dimension, to this project that was not regarded that dominant prior to this analysis: time.
4. There is an impressive number of open science platforms. Some rather generic while other focus on a specific niche. Furthermore, it is noticeable that the open science environment presents itself very fractured and heterogeneous and often the interlinkage between open science topics is missing. It appears reasonable that a balanced and sustainable concept has to be found to allow easy and efficient access to both, breadth and depth of knowledge.
5. The official web presence of the European Union (EU website at ec.europa.eu), respectively of the European Commission (CORDIS), apparently do not explicitly support the dissemination and exploitation of open science achievements from EC-funded projects. Even for projects, which had been particularly acknowledged and praised for their valuable free and open contributions to aviation research, no reference could be found in these repositories.

The stakeholder map of the European AAT research landscape, the comprehensive list of point of contacts and a respective communication channel matrix are an effective tool for further communication and further development of the communication strategy for our code of conduct.

Because of the rapid rate of change of open science in the European research landscape, one should keep close eye on the current developments with an emphasis on possible open science platforms.

3.2.2 Key results of D2.3

The objective of deliverable D2.3 was to establish an information foundation on which the OSCAR consortium can base the upcoming OSCAR strategies. Whether and to which extend open science is already relevant in the European AAT research landscape? Whether or not are the current CAMs and open science are compatible with each other? A big part of the current AAT research landscape are five commonly used CAMs: DESCA-2020, IMG4-2020, Clean Sky 2, EUCAR and MCARD-2020. The open science code of conduct to be developed during the OSCAR project has to be in harmony with those CAMs as much as possible. Therefore, in deliverable D2.3 Fraunhofer IRB analysed to what extend open science is already relevant in the commonly used CAMs. The leading and interrelated questions of deliverable D2.3 are:

- Is open science compatible with current CAMs?
- Is open science already relevant in the CAMs?
- Depending on the answer, to which extend is open science a topic in the CAMs?

To answer these questions, Fraunhofer IRB analysed the five aforementioned widely used CAMs. We selected these CAMs because those are the most prominent and relevant in the European AAT research landscape. We also had a dissemination document from MCARD, which we included in our analysis as an additional data point.

In order to be able to perform the analyses and in order to answer the above questions, the following working definition has been considered as relevant:

> **Definition**: If more than half (50%) of the important categories of open science occur significantly frequent in the CAMs, then open science is implicitly relevant in the CAMs.

The word "category" is simply a synonym for the words “concept”, “topic” or “term”. The null hypothesis H0 and alternative hypothesis H1 were:

H0: Open science is not implicitly relevant in the CAMs.

H1: Open science is implicitly relevant in the CAMs.

The methodology of the analysis to test these hypotheses includes performing a multivariate content analysis (Blasius and Baur 2014) which is a combination of qualitative and quantitative content analysis (Mayring 2014). Multivariate content analysis is a well-established, scientific method of empirical social science for objective information retrieval.

The analysis was comprised of two main steps. *The first step* was to perform a theoretical background analysis in combination with an automatic topic modelling (Jurafsky 2019) of open science to determine the important categories of open science. The result of this step were 18 important categories of open science. *The second step* was to analyse the content of the CAMs (a) qualitatively and (b) quantitatively. For details, please see source deliverable D2.3.

Our statistical analysis has shown that 9 out of 18 the predetermined categories of open science occur significantly more often in the five CAMs than expected ((p < .05) (Fisher’s exact test).

Therefore, more than half (50%) of the important categories of open science occur significantly more frequent in the CAMs (see Table 1). Hence, it can be concluded that the alternative hypothesis, that “open science is implicitly relevant in the CAMs”, is probably true. This in turn means (a) that open science is indeed already relevant in the given CAMs and (b) Open science and the CAMs are compatible in principle. For a detailed statistical analysis, see deliverable D2.3 chapter 5.4.

Table 1: Frequent open science categories

Frequent open science categories in the given CAMs	
#	**Category**
C4	Closed / Non-Disclosure / Confidentiality / Privacy / Restrictions / Limits
C5	Public / Society / Community
C7	Patent / Intellectual Property
C8	Knowledge / Knowledge transfer
C10	Data
C13	Quality / Interoperability / Standards / Practices / Best practices / Sustainability / Re-use / Transparency / Verifiability / Falsifiability / Visibility
C14	Ethics / Fairness / Equality / Responsibility
C16	Copyright / Licensing
C18	Software / Source Code

Noteworthy is the category *digitalisation*, which does not seem to be particularly relevant in the investigated CAMs. The reasons for this result could be manifold (see for detailed explanation deliverable D2.3 chapter 6). The categories, like *Intellectual property* and *Copyright/ Licensing* are relatively prominent, which is not surprising, considering that CAMs are legal documents.

Based on the findings of D2.3, paths arise on how to implement of open science in the European AAT research landscape, especially regarding the identified important categories (C7) intellectual property, (C10) open data, (C14) ethics and responsibility and (C18) open source software (see D2.3 chapter 5.4). The OSCAR project should also focus on the key driver of open science namely digitalisation, which enables principles and paradigms of open science to be feasible in the first place. In deliverable D2.3, we conclude with the following four recommendations:

1. Intellectual property (management) (IPM) is part of CAMs with the rights and obligations of the individual consortium partners in the project. IP management also determines when and by whom which results may be shared, disseminated or exploited. It is important to address the topic of IP adequately in the development of the code of conduct, as well as in the communication strategy, in order to limit potential sources of conflict as far as possible, especially preventing the false belief that open science excludes IP or vice versa.
2. The category *ethics and responsibility* represents one aspect of the policy agenda of the responsible research and innovation (RRI) as well as open access. Thus, the inclusion of this category is indispensable, and the OSCAR project should emphasize the integration of existing guidelines and best practices of RRI at the interface with open science.
3. The analysis shows that the category *open data* and *open source* are well known to the AAT community. This fact can be used for further actions in the project lifecycle, especially to build a bridge to the overarching catchall category *open science*. Furthermore, it will be useful to take advantage of the strong connection of open data to open access. One approach could be to show best practices of open source or open data projects and try to adapt them to the AAT research landscape. In general, the EU efforts in this area should be made more visible to the community, such as the EOSC) (European Commission 2020) project.
4. Even if digitisation is not prominently mentioned in the CAMs, it is essential for the open science movement, because it makes open science possible in the first place. This connection should be made visible for the AAT research landscape. We strongly belief that open science can only be successfully implemented if the right incentive systems are in place. It is also important to have clear rules and guided instructions to implement open science. In this sense, we are pretty much in agreement with what Eva Méndez from the European Commission is proposing (Méndez 2019).

3.2.3 Key results of D3.1

The results of deliverable D3.1 reflects the picture of the predominant challenge of competition between nations (see also WP2), especially between the US and China. A further finding was that the AAT sector is currently increasingly addressing issues such as air pollution, which also addresses the currently very important topic of climate protection. Here, there the AAT sector shows tentative signs of efforts to open up to the public and the scientific community.

A further finding of D3.1 stems from the bibliographic analysis of publications from 2015-2019. On the one hand, only about 20% of publications are published in open access. On the other hand, it is also evident that open access publications are more visible, derived from their citation rates. In detail, it turns out that journals are published more often in open access than, for example, proceedings.

3.2.4 Key results of D3.2

The main aim of the work related to deliverable D3.2 was to identify and engage in a fruitful discussion on open science with key international partners of the European AAT research landscape. The initial approach was to organise an internet-based forum using the ARCPORT® platform to discuss in an open community the issue of open science in the AAT landscape, approaches towards implementation of open science, objections and chances. This approach did

not find the intended acceptance of the AAT research community resulting in a lack of feedback about perception, knowledge and the valuation of open science.

As a consequence, the OSCAR consortium decided to intensify its participation in aviation related events as e.g. ILA 2020 in Berlin or the 10th EASN conference in Salerno to run this discussion process over a long period of time, to spread information about open science and to receive feedback from the AAT research community. The OSCAR consortium compiled a comprehensive list of the best possible events and corresponding activities. Due to the COVID-19 pandemic all intended events have been cancelled and it is not clear at the present time (2020-07-13) whether at all or when the other events will take place.

The current situation so far – a dramatic economic situation of the whole AAT sector both in production (OSCAR focus) and operation (BE OPEN focuses on operation in several transport modes) – and the no more existing availability of established physical communication channels required to find again another concept to engage the interest of key stakeholders of AAT in open science. One could argue that both the economic as well as the climate crisis fosters significantly more openness. Here, supporting evidence is needed.

OSCAR will participate in the virtual EASN conference (former 10th EASN conference at Salerno) with a dedicated session on open science. However, the effectiveness of this approach is not yet clear, be it because of the economically and ecologically complex situation mentioned above or because of the level of acceptance of the concepts of virtual conference

4 Challenges, opportunities and recommendation for action

In the following sub-sections, the conclusions and key results with regard to the challenges and opportunities for open science in the AAT field derived from the results and analysis of the deliverables (D2.1, D2.3, D3.1, and D3.2) are described. Additionally, recommendations for actions both for the project and beyond are given. Also, the legal and contractual framework of the open science code of conduct is elaborated. This topic was developed at the internal OSCAR project roadmapping workshop in November 2019 with the partners Fraunhofer IRB, ONERA and SAFRAN on the legal framework of the code of conduct.

4.1 Results and analysis of our workshop on the legal and contractual constraints of a code of conduct

In addition to the roadmapping activities at the beginning of the project, Fraunhofer IRB also organised and conducted a workshop together with ONERA (Marie-Claire Coët, Cécile André) SAFRAN (Valérie Hachette) and Fraunhofer IRB (Tina Klages, Martin Maga) in Paris on 2019-11-21. The title of the workshop was *Workshop on the legal aspects of an open science code of conduct for the implementation of open science in the European AAT research*.

The goal of the workshop was to get a clear understanding of:

1. The legal situation regarding CAM) and code of conducts (CC) and
2. The key steps for designing and communicating a code of conduct.

The leading questions were:

1. What is the legal status of the consortium agreement model and what could be the legal status of the open science code of conduct?
2. What is a sound legal way of integrating the open science code of conduct into the CAMs?
3. What are the key (legal) challenges and opportunities?
4. How could a general roadmap to an open science code of conduct look like?
5. How could we communicate deliberately our code of conduct to our stakeholders?

The first two question were discussed by a moderated in depth round table discussion in which we looked at the individual legal documents and worked out their context and relations (see also Figure 2). We determined the following important facts:

1. There are already EU Commission guidelines on open access that can be enforced.
2. It is important to foresee the upcoming new Horizon Europe Framework Programme that provides for further applicable rules to open access and will include a definition of open science.
3. In contrast to purely scientific data, some technical data (like specific material design) may need to remain closed.
4. We need a clear understanding of what should be open by default and what are the possible exceptions.
5. There are prevalent concerns about openness in the industry in particularly to safeguard their investments and their competitiveness.
6. H2020 is subject to a regulation that provides potentially binding rules regarding open access (Open Research Data Pilot (ORD)).

7. Rules for Participation (RfP) are exemplified in detail by Model Grand Agreement (MGA) between the EC and the coordinator.
8. The EU Commission provides an Annotated Model Grand Agreement (AMGA) as well with some guidelines included on each provision.
9. The MGA is exemplified in details by a Consortium Agreement (Model) CA that is executed between the beneficiaries.
10. The Clean Sky (or equivalent network) could potentially be a good candidate to display that open science topics can be implemented in harmony with traditional consortium agreements, because IMG is relatively progressive.

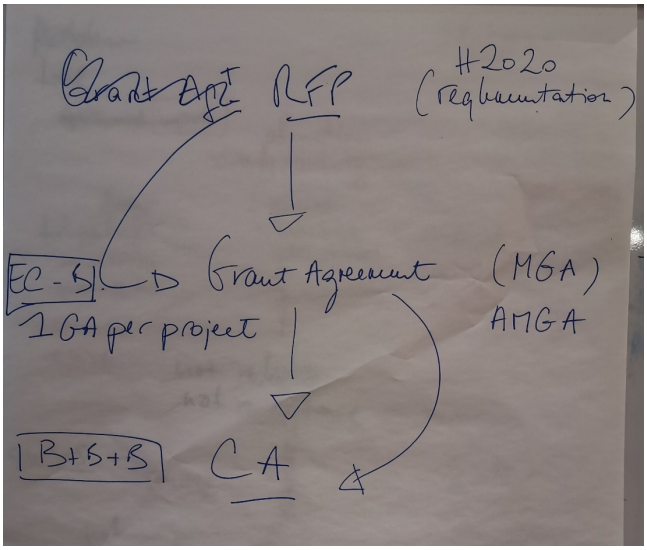


Figure 2: Legal structure and relations of consortium agreement models

After discussing the legal and contractual context and framework of CAMs, in the second part of the workshop the focus was put on challenges and opportunities.

One method of situation analysis is the *problem and solution tree analysis* by Anyaegbunam et al. (Anyaegbunam, Mefalopulos, and Moetsabi 2004). This method helps to identifying the key challenges and opportunities within a project. In the problem (black) and solution (red) tree session of the workshop, we answered the following questions regarding the open science code of conduct:

1. What is the main problem?
2. What are the direct and indirect causes of the main problem?
3. What are the direct and indirect effects of the main problem?

Describing the solution tree requires transforming the problems and to answering the following questions:

1. Wat is the main solution?
2. What are the goals and activities for the main solution?
3. What are the results and impacts of the main solution?

Identifying key challenges and opportunities for a functional open science code of conduct (see Figure 3) the OSCAR code of conduct should be:

- Short
- Address the man pains and fears of the community
- Communicated in a strategic way
- Visually appealing
- Customizable to default contracts and
- Adaptable to new legal inputs from the EU Commission.

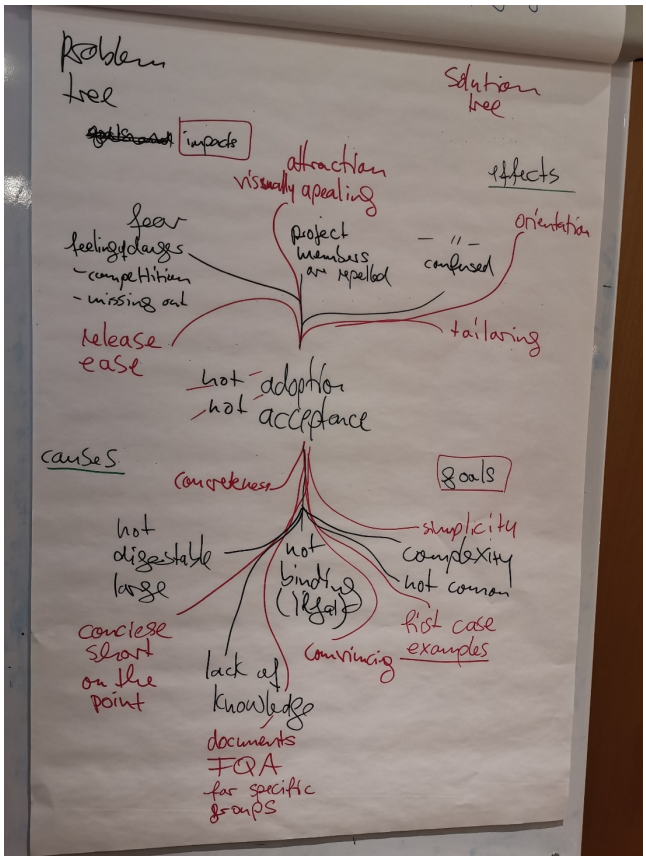


Figure 3: Problem tree (black) and solution tree (red)

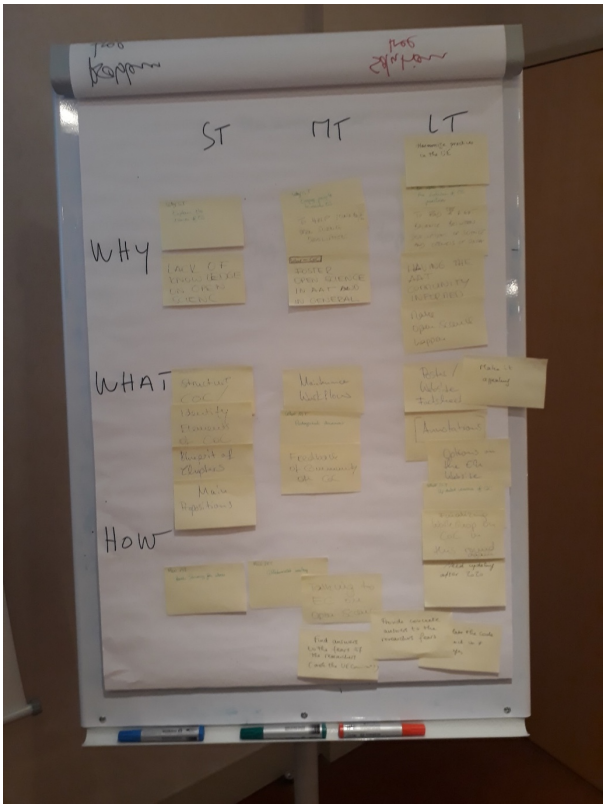
In the last session of the workshop, the following questions have been discussed:

1. How could a general roadmap to an open science code of conduct look like?
2. How to communicate deliberately the developed code of conduct to the identified stakeholders?

The goal of this session of the workshop was to design a roadmap that lays out the key steps to develop an open science code of conduct. To develop a roadmap we answered the following three questions:

1. What is the current state?
2. What is the desired future state?
3. What are the key fields of action to develop an open science code of conduct?
4. What are the key objects of our actions to develop an open science code of conduct?
5. What are the time frames to develop an open science code of conduct?

We used a combination of the Cambridge roadmapping method (Phaal 2020) and the GRIP (Piirainen 2015) method (see also Ohshiro, Watahiki, and Saeki 2003; 2005).



We identified the following key steps and objectives for the short-, mid- and long-term. The results can be seen in Figure 4 and Table 2.

Figure 4: Sketch of the roadmap to code of conduct

General roadmap to code of conduct			
	Short-term	**Mid-term**	**Long-term**
Why	We need to get an understanding of what a CC could look like	Adoption to external needs and constraints	• Projects need to know the benefits of OS and a OS CC • Foster OS in general
What	• Basic structure of OS CC • Main propositions • Core Elements	• Maintenance and continous integration workflow • Find early adopters	Poster, Annotations, Guidline, How To, EU Website Integration
How	Early feedback on early drafts	• Find answers to the fears of the community • Talk to the European Commission	• Finalising feedback rounds • Final workshop

Table 2: General roadmap to code of conduct

The Consortium Agreement (CA) is linked to the Grant Agreement (GA) (see also deliverable D4.2), which implement the Rules for Participation (RfP). The GA and the RfP address the concept of open science only implicitly by only mentioning one of the sub-concepts of open science namely open access. See for detailed information the latest version 5.2 of the Annotated Model Grant Agreement Article 29 “DISSEMINATION OF RESULTS — OPEN ACCESS — VISIBILITY OF EU FUNDING” and the Rules for Participation (REGULATION (EU) No 1290/2013 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 11 December 2013) Article 43 “Exploitation and dissemination of results”.

Open science is as of 2020-07-13 not a concept on which beneficiaries have to commit under the RfP. The H2020 RfP does not address the concept of open science in general but only one sub-concept of open science namely open access. To our knowledge, same holds for the MGA and the AMGA. In view of this, it is no surprise that there is no explicit mention of open science in the CAMs as well.

A code of conduct itself is a document that per se does not establish a legal obligation that can be enforced or sanctioned in case of non-compliance. It must therefore be clarified in the further course of the project (primarily in the forthcoming deliverable D4.3) how the implementation of the code of conduct could take place in the existing legal framework and the individual research project.

4.2 Key challenges

The AAT field is considered to be very competitive and there is a significant risk awareness that own essential know-how could be stolen. Another fear is the risk of innovative knowledge migrating to China. In general, the engineering research sector presents itself as a conservative and restrictive milieu, in which the protection of one's own IP is central. This can be deduced from the strong industry proximity in research projects[1].

This theme is also indicated by the current low level of open access publication (only about 20%), although the open access topic has been massively promoted politically since 2003. Furthermore, there seems to be still a need for clarification of the distinction between open access and open science. There is also a need to promote other facets of open science that are most likely of genuine interest to the AAT sector, such as open data, open source, open methodology. Yet, according to the surveys carried out, open science for the AAT sector is viewed very critically by the community.

As outlined in D2.1, open science is evolving constantly and dynamically. On the one hand, this dynamic evolution increases the likelihood of tools and paradigms being created that are of potential use for the AAT community. On the other hand, this dynamic evolution of open science poses the challenge of maintaining an overview and making well-founded decisions. For those in the AAT community who want to connect with the open science community this could be a major obstacle.

As has already been mentioned several times, the perception that open science contradict conventional IPR is common. This is, however, a misconception and has to be discussed in the community in order to counteract a general rejection of open science, based on misconceptions.

The surveys of the OSCAR project reflected well that the interviewees are already interested in open science, especially in unhindered access to information and data, but on the other hand that they themselves are not prepared to act according to the open science mentality. There is still a great need to develop the culture and mindset of open science within the European AAT research landscape.

Apart from the unjustified perception that open science is associated to uncontrolled disclosure of all knowledge or IP, participants of the OSCAR surveys believe that in order to implement open science, more time and thus resources must be planned into the project's budget when doing open science. This could very well be the case, especially at the beginning of implementing open science in your project. In this sense, the demand for more time and resources is reasonable and the potential additional expenditure is most likely related to the need to comply with EU quality standards such as the FAIR principles and the maintenance of metadata to make the information accessible in the long term. Furthermore, participants expressed the need for more support from central offices and a platform for sharing project experiences with the public.

The participants of the OSCAR surveys would like to see greater transparency from whom the results come from and whether they have already been verified in the open science community, for example through a rating system. This demand from the AAT community is in turn a good opportunity to further promote open peer review and open methodology, which would counteract precisely these concerns.

[1] For more information about open access in engineering see https://open-access.net/en/open-access-in-individual-disciplines/engineering

In summary, the OSCAR consortium has identified the following challenges:

- Open science is changing constantly and dynamically;
- The AAT community is shaped by competitive thinking or a restrictive mindset;
- Awareness and understanding of open science is limited (only open access is well known);
- There are many misconceptions of the actual relation between open science and intellectual property;
- The AAT community is fearful of losing IP to competitors;
- The AAT community is concerned with additional expeditious when doing open science;
- The AAT community is concerned that open science leads to a loss in quality.

Most of those beliefs, concerns and fears are unjustified, some are legit, all of them have to be addressed.

4.3 Opportunities

Open access is already an integral part of the H2020 program and will remain so in Europe Horizon. The focus on only one partial aspect of open science namely open data can also be expected to play a bigger role in the future.

Deliverable D3.1 showed that higher visibility is generated by open access—even in the AAT sector. Project partners can use this fact to raise their level of visibility in society, economy and politics as well as to present their competence to the public and potential partners.

Transparency vis-à-vis the general public can promote confidence and thus increase the image of the AAT sector, which has recently been negatively affected by for example by the Boeing 737 Max crashes.

Deliverable D2.3 shows that the CAMs implicitly contain open science categories. This means that open science is compatible with current contractual practices, at least in principle. Furthermore, a complete revision of the existing regulations or CAMs are not necessary.

The European AAT research landscape can benefit from the acceleration of innovation cycles due to improved access to open research results, data and the application of common open standards and procedures. A common standardized data model would allow a reduction of the initial project initiation time. Furthermore, communication within the project itself is supported by such open standards and procedures. A good example how open science can not only improve research and innovation cycles but also helping society as a whole are the open science practices during the COVID-19 pandemic. Only by opening up the preliminary results of individual research institutions, it was possible to gain knowledge fast and develop solutions quickly. This in turn is right now helping to save lives. In a competitive and technically very dynamic evolving sector like the AAT, where the project's complexity increases, this could be a solution to handle cost explosions of projects and risk diversification.

In summary, we have identified the following opportunities:

- Open access is **already in the GAM and RfP**;
- Open data could **minimise the time until project partners can work together**;
- Open science is **compatible with the current CAMS (D2.3)**;

- Open science enables **faster research and innovation cycles** and makes scientific communication more easy (faster innovation cycles are needed for example to reduce CO2 emissions fast);
- Open science makes **risk distribution** of cost intensive AAT projects possible (example: COVID-19 research);
- Open access publications are **more visible** than regular publications (this can help to show expertise and find potential project partners);
- **AAT can regain their lost trust** (Boeing 737 Max, CO_2 emissions, etc.).

4.4 Recommendation for action

4.4.1 Information materials open science especially for AAT community

In order to meet the known challenges, one recommendation is to provide the AAT sector with informative materials on all aspects of open science, but especially on those topics that have already emerged from the analyses of WP2 and WP3, such as IPR and open science or the distinction between open access and open science. This includes the creation of an overview of the current open science platforms, tools and paradigms relevant to the AAT sector and the preparation of fact sheets. Furthermore, other aspect of open science should be presented such as open data, open source, open methodology, open standards.

We are continuously taking up, new finding and want to compile a list of frequently asked questions (FAQ) for the AAT community.

We also want to utilize user stories to make the grant themes of open science more tangible by showing exemplary project situations and give example action.

We should emphasis on the relation of IPR and open science. From our results so far and from internal scientific discussions between the partners of the OSCAR consortium, it is clear by now that an appropriate compromise between the IPR management and the new paradigms of open science needs to be achieved.

Open science is the practice of science, where the entire research process from the hypothesis to the publication of the results or the product is opened as much as possible. This means that an opening *only* takes place where it is possible (institutionally, legally, etc.). The individual IPR remains untouched by this practice in any case. The European Commission emphasise this fact with the motto "*as open as possible, as closed as necessary".* (European Commission 2020c)

Furthermore, a scientist who works scientifically according to the principles of open science does not take a greater risk than a scientist who works according to conventional principles, at least not with regard to the default scientific process itself—it could well be argued for the opposite. A risk could only arise from sharing content that is covered by a previously concluded contract such as a non-disclosure contract or a consortium agreement with according passages. Yet, this risk is *not* related to open science per se, but rather to any scientific endeavour within joint research projects.

Of course, there are certain cases where a full opening (disclosure) is not possible—and that is legitimate. However, this is *not* an issue of open science in general, as elaborated above. Rather, the respective non-disclosure contract or other secrecy regulations apply in such cases. This means

that in such cases an opening is excluded in the first place and in a general sense. Open science principles are affected by this just as much as all other principles of openness in general like the fundamental scientific principles of transparency. It is important to make these cases clear without drawing the premature and false conclusion that open science is not applicable in general. In each research projects, a tailored open science strategy can be developed individually, in which conventional IPR management and open science methods are combined successfully.

Because of the often perceived—yet conceptually non-existent—dichotomy between open science and conventional IPR management, particular attention should be paid to this attitude. We should focus on patterns that showcase in which situations open science is and in which situations it is not applicable. Our results so far suggest that a sophisticated communication strategy is needed to address the pain points and gain points of our stakeholders regarding open science.

4.4.2 Best practices for open science

Another way to present open science in an attractive and tangible way is to illustrate the advantages of open science on the basis of best practices from other or related research areas or at best from the AAT sector itself. We should build on the already existing open science best practices and other best practices like RRI as they may already be implicitly implemented in some projects. Above all, it is important to underpin the all the relevant subcategories of open science, such as open data and open source as well as interrelated topics such as IPR and RRI (ethics/SDGs) as D2.3 has shown.

4.4.3 Extension of the communication activities, create incentives and clear rules, provide guidance

In general, it is important that we help the EU and EC to develop a clean and compelling incentives system to support the successful implementation of an open science code of conduct in the European AAT research landscape. We should have a sense of balance and consider the reality of EU projects. The ongoing survey in WP2 will give us more insights into what incentives are most important to our stakeholders. We should extend our communication strategy and make it more concrete. We should coordinate the activities from WP4, WP5 and WP6 to achieve this.

The general theme of our communication strategy should be this: Eva Méndez, chairwoman of the open science Policy Platform (OSPP) (OSPP 2020), gets to the very core of this topic: to implement open science in the European research landscape we need a three level approach. (Méndez 2019) To make open science happen we need the following three actions (Méndez 2019):

1. **Create incentives**: Scientists need suitable incentive structures that motivate them to be more open with their research.
2. **Establish clear rules**: Scientists need clear rules that guides them in the active effort to do open science.
3. **Provide guidance**: Scientists need to be taught how to open up their research according to the principles of open science.

4.4.4 Develop a code of conduct that is easy to use with opt-in, opt-out, or hybrid application models

To make open science more applicable in the AAT sector an open science code of conduct should be designed to be short, clear and easy to use. It should contain the core statements of what open science is and it should be supported by practical examples of application.

Our code of conduct provided a voluntary option to either add the code of conduct to the project consortium agreements between the project partners (opt-in) or to give the possibility to explicitly exclude parts of the code of conduct in safety critical projects (opt-out). It is planned that the our application model will provide templates and short supporting tutorials on how to use the templates.

Our code of conduct is based on the analysis and collection of existing functioning, well-established codes of conducts and best practices and the use of existing definitions and terms. The concrete design of our open science code of conduct is part of deliverable D4.3

4.4.5 Stronger integration of open science in legal documents (like RfP, MGA)

As described above, the focus in the legal program documents of Horizon 2020 is on open access only. We also already stressed that open access is just a subcategory of open science. However, our findings so far suggest that other subcategories such as open source, open data or open standards, open methodology etc. could also be of interest for the AAT field.

In order to give these subcategories of open science more presence, we recommend that open science including all its major aspect should be integrated into the RfP and MAG, for example. The project is aware of the actual efforts to extend the focus in Europe Horizon.

4.4.6 Key actions

In summary, we have derived the following key actions for our internal OSCAR project consortium; we should:

- Develop a **communication strategy** (Fact sheets, User stories, taking into account the COVID-19 pandemic) (in cooperation with WP4, WP5 and WP6);
- Develop **opt-in, opt-out or hybrid model** models (open science code of conduct implementation templates);
- Embrace current **best practices** and already used concepts in AAT and open science;
- Create **incentives for the AAT** community or make them visible;
- Establish **clear rules** (in cooperation with the EC) or make them visible;
- Provide **guidance** for the scientists and the industry partners;
- **Create fact sheets and user stories** on the relation of open science IP and RRI.

5 Quality

5.1 Comparison of planned activities and performed work

The activities for the development of D4.1 did not proceed according to the OSCAR plan, mainly because of delays of WP2 and WP3. At first, requested access to EC databases (eCORDA) was not granted resulting in time consuming efforts to compensate this unavailability of well-structured data. At second, the forum approaches (internet-based forum) didn't provide results as planned, while the new approach using relevant aerospace events for F2F meetings and workshops had to be cancelled due to still ongoing COVID-19 pandemic.

In particular, D4.1 depended directly and critically on the results from the deliverables D2.1, D2.3, D3.1 and D3.2. Please see Figure 1 for the dependency graph of deliverable D4.1.

The work packages tasks, deliverables, their distribution to the project partners and their chronological sequence described in the OSCAR project proposal naturally only represent estimates at the project start. Adjustments and/or delays during the course of large projects like the OSCAR project can occur. During the course of the OSCAR project, unforeseeable changes in the planned work occurred despite the greatest care, due to changing demands and intermediate results. Those adjustments were ipso facto accompanied by a previously unforeseeable additional expenditure (overhead) not only in terms of content, but also in terms of project communication and project management. Adjustments to the content during the project period required additional new project coordination and project management, because both the entire consortium and the individual partners had to reach new agreements and have to coordinate their new efforts.

5.1.1 Reasons for the delay of deliverable D2.3

In case of deliverable D2.3 and the corresponding task T2.3, Fraunhofer IRB and Fraunhofer IFAM were confronted with two different issues:

First, in terms of content, the analysis of the CAMs turned out to be much more difficult, complex and hence time consuming than originally thought. This is due to (a) the fact that legal texts have a special status and (b) the difficulty of analysing those special legal texts in a scientific i.e. objective manner. Fraunhofer IRB had to adjust the initial rather simple analysis approach during the task to address these issues. As a consequence, a much more sophisticated analysis being rather complex and time consuming compared to the initial approach. This affected also the revision process within the consortium, as such a linguistic analysis of documents (here CAMs) required intense discussion of the partners – linguistic analyses are not considered as core AAT knowledge.

Secondly, the lead of D2.3 *Analysis of established CAMs with respect to Open Science related issues* had to be transferred from UPAT to Fraunhofer IRB. The transfer of the D2.3 was decided during the project meetings in Athens in June 24th to 26th 2019 and confirmed in Bucharest on December 12th, 2019 by all project partners. The rationale of this decision was the unrivalled competence of Fraunhofer IRB in the field of linguistic analysis. In that sense, the aeronautics competence of the OSCAR partners had to step back until the discussion of the interim results to provide feedback to D2.3.

5.1.2 Reasons for the delay of the other deliverables

For further information on the reasons of the individual delays of the different deliverables D2.1, D3.1 and D3.2, please see the respective individual deliverables.

5.2 Quality of the results

D4.1 combines and analyses the detailed results of WP2 and WP3, in that sense the results are of high quality, despite of the shortcomings revealed by WP2 and WP3. D4.1 is an excellent information base on which the OSCAR consortium pushes the project forward.

The recommendations for action derived from the analyses are concrete, feasible and directly implementable.

6 Conclusions

In the first place, our analysis is meant to result in recommendations for action for our own OSCAR project consortium. Nevertheless, our conclusion could represent first tentative recommendations that might be interesting for outsiders.

6.1 Conclusions drawn from D2.1

We developed a comprehensive and useful overview map over the spectrum of the European AAT research landscape. This overview map was and is to establish appropriate communication channels. These communication channels are particularly important for the survey performed in the context of T2.2. We have searched various databases and websites and found out that open science is a very fast and dynamic developing field.

6.2 Conclusions drawn from D2.3

We performed a multivariate content analysis (Blasius and Baur 2014) that means a combination of qualitative and quantitative content analysis (Mayring 2014). Multivariate content analysis is a well-established, scientific method of empirical social science for objective information retrieval. Our statistical analysis has shown that 9 out of 18 the predetermined important categories of open science occur significantly more often in the five CAMs than expected ($(p < .05)$ (Fisher's exact test). It can be concluded, that open science is very likely implicitly relevant in the analysed CAMs. This in turn means (a) that open science is indeed already relevant in the given CAMs and (b) open science and the CAMs are compatible in principle.

Important categories in those CAMs are: intellectual property, open data, ethics and responsibility and open source software. We should focus on these categories, because they are already implicitly relevant in the contractual practices. Furthermore, we should stress that digitalisation and open science go hand in hand. Digitisation is an important megatrend, which is also crucial for AAT.

6.3 Conclusions drawn from D3.1

Our bibliographic analysis of publications from 2015-2019 shows that only about 20% of publications in the AAT sector are published in open access. Yet, open access publications are more often downloaded than closed publications, hence open access publication are more visible than closed publications—even in the AAT field. There are indications that the AAT sector is dealing with topics like sustainability lately.

6.4 Conclusions drawn from D3.2

The initial goal of task T3.2 was to engage key stakeholders of the European AAT research landscape in a mutual and fruitful discussion on open science. We initially planned to achieve this by utilizing major physical AAT events like the ILA202 in Berlin. However due to the COVID-19 pandemic all such events are cancelled. We are currently (2020-07-13) working on alternative solutions so achieve our goal to engage key stakeholders in the AAT field in a discussion on open science.

6.5 Open science code of conduct and the legal and contractual constraints

IRB organised and conducted a workshop on the legal and contractual constraints or framework for the open science code of conduct with ONERA and SAFRAN in Paris in November 2019. The

workshop dealt with the roadmapping of the development of the code of conduct. The results of this workshop were the following:

1. A code of conduct is not legally binding per se and this has to be reflected in the application templates we want to ship with the code of conduct.
2. We need to address the major pain points and fears of the AAT community by delivering additional information material like fact sheets.
3. We need to exchange with the policy makers of the European Commission (MAG, RfP) to integrate, disseminate and promote our code of conduct in accordance with established workflows.

6.6 Identified challenges, opportunities and derived key actions for the OSCAR project consortium

6.6.1 Challenges

Analysing the results from WP2 to WP4 we arrived at the following key challenges:

- Open science is dynamically changing, this could potentially pose an obstacle for newcomers to open science, because it is hard to make well-informed decisions if the subject (open science) is constantly in flux.
- Within the AAT community the awareness and understanding of open science is limited. Only one aspect of open science – open access – is widely known.
- The AAT research community seems to be – in relation to the open science community – influenced by competitive thinking. Suitable incentive structures may facilitate the implementation of open science ideas in AAT research.

  Throughout our analysis, we encountered many misconceptions of the actual conceptual relationship between open science and intellectual property and the conventional management of IP. This may support concerns to lose IP to competitors within the AAT community.
- Furthermore, we found the AAT community to be concerned with additional expenses when implementing open science. This concern is at least in parts understandable and may be justified.
- There is also an unjustified concern of the AAT community that open science leads to a loss in quality. This belief is false, yet we have to address this misconception and educate the AAT community on the true benefits of doing open science including the improvements of the research quality.

6.6.2 Opportunities

By analysing all the available results from the work done so far in WP2, WP3 and WP4 the OSCAR consortium identified at the following key opportunities:

- Open access is already present in the GAMs and RfP, this could be an opportunity to extend the concept towards open science. Policy should extend the existing concept of open access and the associated regulations that already exist to include other aspects of open science like open data, open methodology etc.
- The analysis of currently used CAMs shows that open science is – at least as a generic idea – compatible with the existing CAMs.
- The OSCAR strategies the categories of open science in terms of intellectual property, open data, ethics and responsibility and open source software etc. Furthermore, it should be

emphasised that digitalisation is both a key driver for open science but also indicating a crucial megatrend for AAT research.

- Arguably, open science enables faster research and innovation cycles and makes scientific communication easier. It is important to communicate that faster innovation cycles are urgently needed in AAT research in order to be able to meet the major current and future challenges adequately like the urgently needed drastic reduction of CO_2 emissions. We have no more time and need new solutions quickly and this is only possible with open science paradigms.
- Furthermore, open science makes risk distribution of cost intensive AAT projects possible in the first place. This link can be seen for example in the current COVID-19 research. Only because scientists and research organisations are sharing preliminary or early results freely with others it is possible to make fast progress in fighting the pandemic.
- Open access publications are more visible than regular publications. It can be assumed that this contributes to develop individual research networks especially of younger scientists and engineers also in the AAT field.

6.6.3 Key actions

- WP4 provides input to the OSCAR communication strategy (core part of WP6) by preparing fact sheets, user stories etc. and taking also into account the COVID-19 pandemic (and also of its diverse consequences) as a driver for changes.
- Opt-in, opt-out or hybrid application models need to be developed which aim at an as easy as possible implementation of open science codes of conduct. These concepts may be taken up the Commission Services and integrated in the corresponding legal framework.
- Current best practices and already used concepts in AAT as well as in open science are embraced, allowing to refer to already established standards, which is an incentive in its own right.
- Specific incentives for the AAT community shall be considered in the design and the implementation of research programmes. The focus should be put on the benefits and potential gains of open science in practise which shall become more visible in e.g. participation rules.
- Scientists and engineers from both academia and industry demand more information and guidance during the transformation process towards more open science practises in the AAT research landscape. Proximate topics as IPR, IP management and RRI shall be addressed as well.

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