



Recommendations for a National Open Science Strategy in Austria

Open Science Network Austria OANA

Working Group "Open Science Strategy"

Version 4: Final translated version including comments and annotations of the public consultation

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The recommendation paper was developed and written by the **OANA** Working Group "Open Science Strategy" from 2018-2020. The Working Group was established by the **OANA** core team on 10 January 2018. The recommendations reflect the experiences and personal opinions of the members of the Working Group.

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Preface

From February 2018 until August 2020, the Open Science Strategy Working Group¹ of the Open Science Network Austria (OANA) developed the "Recommendations for a National Open Science Strategy in Austria".

The recommendations are intended to provide an impetus for further discussion and implementation of Open Science in Austria and to serve as a contribution and basis for a potential national Open Science Strategy to be developed in Austria.

The OANA Open Science Strategy Working Group was established by the OANA core team after the OANA network meeting on January 10, 2018² and developed the recommendations in a two-year process considering many international strategies³. The recommendations build on the diverse expertise of the authors (academia, administration, library and archive, information technology, science policy, funding system, etc.) and reflect their personal experiences and opinions.

A public consultation on the draft of the "Recommendations for a National Open Science Strategy in Austria" took place from 6 March to 19 April 2020, with the participation of numerous more stakeholders, not represented in the Working Group. Their comments and extensive feedback were incorporated into the now available final version of the recommendations.

Many thanks to all those who, through their input and commitment, have made the creation of this document possible!

1. Introduction

Scientific research continues to revolutionise our society. Scientific knowledge owes its robustness and reliability to two principles: the reproducibility of gained insights and the joint determination to turn empirical findings into durable theories. Transparency and communality are not only crucial for research, but also profoundly democratic principles. Digitisation makes these principles mutually beneficial in an innovative way. Scientific research can be reshaped by completely new forms of collaboration and cooperation, while upholding principles of inclusivity and diversity. Scientific knowledge is becoming more transparent and comprehensible in unprecedented ways, opening new possibilities for socio-cultural impact and socio-economic innovation.

Open Science is an umbrella term summarising the numerous initiatives that exist to this end. A look at international activities reveals a broad spectrum ranging from national action plans to institutional strategies for embedding Open Science principles in research and quality management. The present recommendations are based on these national and international initiatives and provide practical advice for their coordinated implementation with regard to strategic developments in research, technology and innovation (RTI) in Austria until 2030. They address all relevant actors in the RTI

¹ <https://oana.at/arbeitsgruppen/ag-open-science-strategie/>

² <https://oana.at/ueber-uns/netzwerktreffen/4-netzwerktreffen-am-1012018/>

³ For further information on the Working Group and the development of these steps, see: <https://oana.at/arbeitsgruppen/ag-open-science-strategie/#c310661>

system, in particular research institutions, research policy, research funding, memory institutions and researchers.

2. What is Open Science?

Free access to knowledge, scientific results, data, methods, publications and relevant infrastructures, as well as the associated opportunities for exchange between researchers, students and the interested public, and (subsequent) use by the latter, are decisive factors for the dissemination and further development of scientific knowledge. Open Science is generally understood as opening up research processes and scientific knowledge. In addition, Open Science acknowledges that it is possible that, for example for ethical, or legal reasons, not all research information can be made openly accessible, and therefore the guiding principle and leading premise should be "as open as possible, as closed as necessary". Digitisation and increasingly networked forms of collaboration entail increased access to, use of, documentation, and evaluation of research methods, significantly increasing the transparency and clarity of scientific decision-making and evaluation processes. Open Science relies on reusable and reproducible findings, some of which are gained in collaborative processes and by means of new participatory forms of knowledge production, and which are accessible to all. The results thus obtained are characterised by improved visibility, comprehensibility and quality, and new research topics and issues can be identified more easily. Open Science also plays a decisive role in research-led teaching by facilitating access to and reusability of materials and accelerating the creation of open educational resources. However, Open Science also entails new ethical and legal challenges, such as issues of data protection and data security, or with regard to alternative exploitation models and licenses.

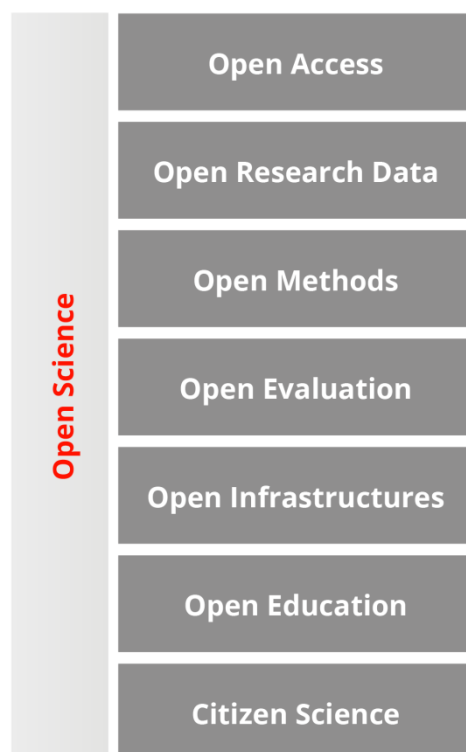


Figure 1: Open Science Elements according to OANA

Prerequisites for a successful implementation of Open Science are the use of digital, collaborative technologies and associated developments in the areas of communication, data production, data storage, and analysis. Furthermore, Open Science requires new, inclusive and transparent governance models, robust research infrastructures and new forms of research evaluation. Work on these and other challenges is already underway. The task now is to coordinate activities to develop a future-oriented, democratic and inclusive science system through Open Science, to support the implementation of responsible research and thus to strengthen trust in and efficiency of the science system. In addition, Open Science acknowledges that it is possible that, for example for ethical or legal reasons, not all research information can be made openly accessible, and therefore the guiding principle and leading premise should be "as open as possible, as closed as necessary".

Openness in science can manifest itself in different ways. The main areas of Open Science identified by OANA are described below.

2.1. Open Access

The term Open Access (OA) stands for unlimited and free access to scientific information via the Internet using open licences. This includes primarily scientific publications, but also data and metadata, source texts and digital copies. OA is associated with making the results of publicly funded research publicly available to all interested parties. Open licences regulate additional rights of subsequent use. The "golden road" describes (often fee-based) measures that rely on OA primary publications, such as OA journals. The "green road" is used to make texts, data or other materials available in online repositories, including those published in so-called "closed access" journals. Other paths, such as the "diamond or platinum road", rely on consortia platforms to enable authors to publish free of charge and readers to access publications openly. In most cases, an open access strategy is the first step in the transformation of the scientific system towards Open Science.

2.2. Open Research Data

Research data that are generated in the course of scientific work (e.g. through digitisation, experiments, measurements, or surveys) are open if they are made freely accessible for subsequent reuse. Research data can be opened unless technical, legal, economic or ethical reasons prevent this. Both research data and metadata should comply with the FAIR principles, i.e. be "findable, accessible, interoperable and reusable"⁴. Institutional, discipline-specific or cross-disciplinary repositories and databases are used for archiving. Open research data support scientific integrity, increase transparency, and enable the reuse of research results.

2.3. Open Methods

Open Methods refer to making scientific methods available. Although the methods section is a central aspect of scientific publications, research results are often not comprehensible in detail and above all not reproducible. The Open Methods approach aims to counteract this.

⁴ Wilkinson, MD et al (2016): The FAIR Guiding Principles for scientific data management and stewardship. In: Scientific Data, Volume 3, Article number: 160018, <https://doi.org/10.1038/sdata.2016.18>

One of the most common examples of Open Methods is the Open Source movement with its aim of making code publicly available and reusable. In addition to transparency and reproducibility, this also enables others to advance method development based on existing code.

Another approach already established in parts of the scientific community is the use of Open Notebooks in which daily research work is publicly documented. Open Workflows (documented and transparent scientific procedures) and Open Annotations (open and collaborative ordering, coding, commenting and keywording of digital content) also count as Open Methods by means of which researchers make their methods accessible, transparent and reusable.

2.4. Open Evaluation

Open Evaluation refers to openness in scientific evaluation in the context of peer review procedures and scientometrics.

Open Peer Review is a generic term for a variety of (partially overlapping) peer review models that are oriented towards the goals of Open Science. Depending on the model, the identity of reviewers and authors may be disclosed, reviews may be published or broader participation in the peer review process enabled.

Open Metrics entail openness of the data, methods and results of bibliometric analyses used for evaluation. With the transparency and reusability of evaluation procedures, new possibilities arise in dealing with the evaluation of scientific findings, e.g. by introducing new evaluation methods such as Altmetrics⁵. In this context, research documentation systems and their accessibility are also of great importance.

2.5. Open Infrastructures

Open Infrastructures support research and teaching as open and reusable systems. This means that these infrastructures use open source software, and that the data and content created by and in the systems (e.g. metadata, metrics, user contributions) are published under an open license and made available via open interfaces (Open APIs). Furthermore, Open Infrastructures follow open standards. This makes migration from one system to another much easier and avoids lock-in effects. Another important criterion is that the governance of Open Infrastructures provides for an explicit right of the community to have a say. This includes both appropriate opportunities for community input and involvement in decision-making and governance processes.

2.6. Open Education

Open Education follows the principle of making education publicly available on the Internet, free of charge, so that potentially all members of society can benefit. This requires, as a first step, appropriate teaching and learning materials, the free use, processing and further distribution of which is ensured by free licenses that regulate the further use of the material. The Open Educational Resources (OER) label covers a wide variety of formats, such as complete courses, course materials

⁵ <http://altmetrics.org/manifesto/>

or assignments, textbooks, videos or application programmes, and other tools, materials or techniques used to support knowledge acquisition.

2.7. Citizen Science

Citizen Science aims at the active involvement of individuals and groups, non-researchers and the interested public in scientific research projects. The spectrum is broad: Citizen Scientists may formulate research questions, report observations, carry out measurements, analyse data, evaluate, or write publications. Compliance with scientific criteria is a prerequisite for this. This enables innovative approaches to research questions, creates new insights and puts the dialogue between science and society on a broader footing.

Open Science measures facilitate the involvement of Citizen Scientists in research projects. For some projects, free access to research data and publications is just as important as the use of open source hardware and software. Citizen Science also promotes openness by making methods and tools publicly available where possible.

3. Framework Conditions

The national and international political framework is decisive for the development of national Open Science strategies. They have to be accompanied by framework requirements for infrastructures, incentive systems and qualifications, some of which have yet to be created for the successful implementation of Open Science in Austria.

3.1. Democratisation and Access to Knowledge

Publicly funded knowledge should be as openly accessible as possible. Unfortunately, current practice is based on long established but questionable payment systems for often outdated service offerings. Payment barriers set up by commercial service providers such as scientific publishers are problematic because they place a double burden on public budgets: firstly, in the financing of research itself and secondly, in the provision of access. They also have an exclusionary effect: while researchers working at public research institutions often have access to a very large number of scientific content (e.g. via bundle subscriptions from scientific publishers), all other interested parties who are not employed at these institutions find it considerably more difficult to use these information resources. Open Access in particular and Open Science in general brings the ideal of generally accessible scientific knowledge closer by decoupling the reuse of scientific output from individual and institutional financial resources.

3.2. Scientific Cultures and Incentive Systems

Despite growing criticism of journal-based-metrics, such as the impact factor, high-impact journals still play a central role in scientific careers⁶. One aim of the recommendations for an Open Science

⁶ Fleck, C (2013): Impact Factor Fetishism. In: European Journal of Sociology 54 (2), 327-356, <https://doi.org/10.1017/S0003975613000167>

Strategy is to discontinue the "publish or perish" regime towards greater transparency of evaluation criteria for researchers and research proposals⁷. This will make it possible to reflect Open Science practices in academic careers (e.g. Open Access publications or data sets, reviewer activities, Citizen Science). At the same time, researchers benefit from open access to publications and data and achieve greater international visibility⁸.

3.3. Infrastructural Requirements and Standards

Open Science should ideally be based on sustainable Open Infrastructures with community governance (community-controlled, community-driven). This includes systems that ensure data access according to the FAIR principles, that offer a central interface to support researchers, a national platform as a multiplier for full OA publishing and data reuse, and open citation systems/machine-readable data catalogues. Open Infrastructures help to avoid lock-in effects. Public research institutions and libraries ensure visibility and access to general repositories. Public research information systems also improve the transparency of the research and funding landscape. In the context of a diverse infrastructure, the financing of sustainable Open Infrastructures beyond project funds is of particular importance. This can be achieved, for instance, by forming dedicated consortia between universities and non-university research institutions and by using existing networks. Guidelines for Open Infrastructures can be found in the form of the *Good Practice Principles for Scholarly Communication Services* of SPARC and COAR⁹ as well as the recommendations of SCOSS (Global Sustainability Coalition for Open Science Services)¹⁰ and comparable initiatives such as Invest in Open Infrastructure (IOI)¹¹. Another important dimension of Open Science concerns the interlinking of public data sources – Open Government Data (such as registry data) – and scientific data and methods. The demand for access to public data is based on the need for evidence-based policy.

FAIR Data Principles

The "FAIR Data Principles"¹² ("Findable, Accessible, Interoperable, Reusable") formulate principles that are intended to allow for research data and its metadata to be sustainable and reusable. To make data effectively reusable for humans and machines, meaningful metadata, persistent identifiers, and unique licenses are required. FAIR Data are not necessarily completely open; they may be accessible to a limited extent, but their central feature is an exact description. Research data infrastructures should also implement their services according to those principles.

⁷ Examples of what this can look like in practice: <https://sfdora.org/good-practices/funders/>

⁸ Eysenbach, G (2006): Citation Advantage of Open Access Articles. In: PLoS Biol 4(5): e157. <https://doi.org/10.1371/journal.pbio.0040157>

⁹ <https://sparcopen.org/our-work/good-practice-principles-for-scholarly-communication-services/>

¹⁰ <http://scoss.org/>

¹¹ <https://investinopen.org/>

¹² <https://www.nature.com/articles/sdata201618>

3.4. Skills and Training

The EU Commission's Expert Group on Education and Skills under Open Science¹³ identifies the following key competences for Open Science:

1. Publishing Open Access
2. Production, management and curation of Open Research Data
3. Interdisciplinarity and understanding of ethical and legal frameworks
4. Design and implementation of Citizen Science projects.

Internationally, various organisations offer training courses on this subject, e.g. FosterOS¹⁴, OS MOOC¹⁵ or OS Handbook¹⁶. They follow a "train the trainers" principle to achieve a multiplication of efforts. The goal is to train basic Open Science skills from the very start of scientific education and at pre-doc or post-doc level at the latest. This is done by implementing appropriate modules into existing curricula. In particular, the development of data skills and the understanding of ethical, legal and social aspects of research practice are promoted.

3.5. Legal and Ethical Aspects of Open Science Implementation

Open Science touches upon three legal matters: copyright, privacy and licensing. This includes questions about opening up data, as well as questions about the disclosure of contracts and costs for services of scientific communication. Furthermore, aspects of data security are of key importance, particularly in the case of infrastructures for long-term archiving and data processing. In any case it is essential to ensure that the advantages resulting from the transfer/reuse of research data are reconciled with the right of individuals to informational self-determination. Depending on the sensitivity of the data in question, researchers – in close communication with their research communities – must ensure an appropriate level of granularity when publishing data.

The Austrian Research Organisation Act ("Forschungsorganisationsgesetz") (§2d Abs. 2 Z 3¹⁷), for example, allows scientific institutions to apply for and use registry data, provided that they observe a number of requirements (data protection impact assessment¹⁸, prohibition of discrimination, logging of accesses, etc.).

Copyright law in turn provides a basic framework for the open exploitation of research results: in line with prevailing legal norms in Germany, a so-called "secondary exploitation right of authors of scientific contributions" was adopted in Austria in 2015 which regulates the secondary publication of texts in an OA mode (green OA)¹⁹. However, the topic of licensing and exploitation in the context of Open Science has not yet been sufficiently interpreted legally, and there is still not enough legal certainty in Austria regarding the alignment of open licences and the reuse of research results. With regard to ethical aspects, e.g. transparency, access to knowledge, inclusivity, the guarantee of

¹³ https://ec.europa.eu/research/openscience/pdf/os_skills_wgreport_final.pdf

¹⁴ <https://www.fosteropenscience.eu/>

¹⁵ <https://opensciencemooc.eu/>

¹⁶ <https://open-science-training-handbook.gitbook.io/book/>

¹⁷ <https://www.ris.bka.gv.at/GeltendeFassung.wxe?Abfrage=Bundesnormen&Gesetzesnummer=10009514>

¹⁸ https://www.parlament.gv.at/PAKT/VHG/XXVI/I/I_00068/fnameorig_686468.html

¹⁹ <https://www.jusline.at/gesetz/urhg/paragraf/37a>

verifiability and the responsibility of scholars towards society, Open Access certainly functions as a bridging principle.

3.6. Monitoring and Compliance

Many aspects of Open Science are already part of national research policies and the governance of research organisations e.g. in the form of rules of good scientific practice and research data management policies. Ideally, Open Science and good (and lived) scientific practice overlap. However, institutional policies are faced with the problem that they cannot always be enforced effectively. In this respect, funding organisations can intervene more effectively by interpreting compliance with the rules of good scientific practice in a way that privileges principles of Open Science. The fulfilment of corresponding conditions can then be linked to the payment of project funds. In any case, open research information systems are a basic prerequisite to enable both monitoring and compliance.

4. International and National Initiatives

In the international RTI policy arena, Open Science is established as an important cross-cutting issue. In 2017, the G7 science ministers signed a memorandum²⁰ on the international coordination of the development of infrastructures for Open Research. Several leading charities and private sponsors – such as the Wellcome Trust or the Gates Foundation – initiated the Open Research Funders Group (ORFG) and put Open Science policies in place²¹. OECD²² and UNESCO²³ are producing reports on open and inclusive cooperation in science and research and are calling for better political and legal frameworks for the implementation of Open Science. In the USA, for example, the National Institutes of Health (NIH; OA mandate since 2008) and the National Science Foundation (NSF) follow the White House Memorandum of 2013 by developing and implementing policies for Open Science²⁴. Asian and African countries are increasingly participating in Open Science activities, mobilising numerous bottom-up initiatives and developing Open Access strategies, while some are already implementing Open Access mandates²⁵. South American Open Access developments and the focus on collaborative platforms date back to the 1990s. In the meantime, the model of interoperable public infrastructures has also been successfully exported to other regions (e.g. South Africa²⁶).

²⁰ <http://www.g7.utoronto.ca/science/2017-science-communique.html>

²¹ <http://www.orfg.org/>

²² Dai, Q., Shin, E., & Smith, C. (2018): Open and inclusive collaboration in science: A framework. In: OECD Science, Technology and Industry Working Papers, No. 2018/07, OECD Publishing, Paris, <https://doi.org/10.1787/2dbff737-en>

²³ UNESCO reports: <http://www.unesco.org/new/en/communication-and-information/access-to-knowledge/open-access-to-scientific-information/> See also: Towards a UNESCO Recommendation on Open Science, <https://en.unesco.org/science-sustainable-future/open-science/consultation> And: <https://en.unesco.org/news/unesco-mobilizes-122-countries-promote-open-science-and-reinforced-cooperation-face-covid-19>

²⁴ National Academies of Sciences (2018): Office of Science and Technology Policy 2013 Memorandum: Increasing Access to the Results of Federally Funded Scientific Research. <https://www.ncbi.nlm.nih.gov/books/NBK525415/>

²⁵ Innovation Policy Platform, Open science country notes:

<https://www.innovationpolicyplatform.org/www.innovationpolicyplatform.org/content/open-science-country-notes/index.html> and UNESCO Global Open Access Portal: <http://www.unesco.org/new/en/communication-and-information/portals-and-platforms/goap/access-by-region/asia-and-the-pacific/> See also for instance: AOSP (African Open Science Platform): <http://africanopenscience.org.za/>

²⁶ <https://www.assaf.org.za/index.php/programmes/scholarly-publishing-programme/open-access-scielo-south-africa>

4.1. Open Science in the European Union

At the European level, various trend-setting initiatives have been and are being implemented for the various sub-areas of Open Science²⁷. In 2019, the European Union adopted the recast of Directive (EU) 2019/1024²⁸ on Open Data and the re-use of Public Sector Information (PSI). The extended scope of the Open Data and PSI Directive now includes not only data from public companies but also research data that has been financed by public funds and made publicly accessible via an institutional or thematic archive. With regard to compliance with appropriate safeguards, the Open Data and PSI Directive also refers to the principle "as open as possible, as closed as necessary". The Amsterdam Call for Action on Open Science²⁹ was already submitted to the European Council in 2016. The European Commission has already been working on the topic of Open Science for several years and has set the following priorities:

Horizon 2020/Horizon Europe: In its function as a research funding body, the European Commission has anchored Open Access to publications and Open Data in the eighth EU Research Framework Programme (Horizon 2020)³⁰. Open Access to publications is mandatory. As a rule, research data must also be opened: all EU-funded research projects are required to draw up a data management plan. However, an "opt out" is possible according to the principle "as open as possible, as closed as necessary", e.g. if sensitive data is involved. Horizon 2020 has also funded projects and infrastructures specifically related to Open Science, such as OpenAIRE³¹, OPERAS³² or FOSTER³³. For the next research framework programme (Horizon Europe, from 2021), Open Science is planned as a "modus operandi", which means that the current conditions will remain in place and in some cases will be further expanded.

European Research Area ERA: Priority 5 of the European Research Area is dedicated to the propagation of Open Access and Open Data under the banner of "optimal circulation of knowledge". The European Commission's recommendations on "Access to and preservation of scientific information"³⁴, were revised in 2018. Austria has included some relevant measures in the Austrian ERA Roadmap: strengthening the technology transfer between research and industry, further development of copyright law to this end, and the development of a national Open Access strategy³⁵. Open Science is likely to be taken up further in the forthcoming revision of the ERA.

²⁷ SPARC Europe & Digital Curation Centre (2019): An Analysis of Open Science Policies in Europe v4. Zenodo, <https://doi.org/10.5281/zenodo.3379705>

²⁸ Directive (EU) 2019/1024 of the European Parliament and of the Council of 20 June 2019 on open data and the re-use of public sector information. PE/28/2019/REV/1 OJ L 172, 26.6.2019, p. 56–83 ELI: <http://data.europa.eu/eli/dir/2019/1024/oj>

²⁹ <https://www.government.nl/documents/reports/2016/04/04/amsterdam-call-for-action-on-open-science>

³⁰ https://ec.europa.eu/research/participants/docs/h2020-funding-guide/cross-cutting-issues/open-access-dissemination_en.htm

³¹ <https://www.openaire.eu/>

³² <https://operas.hypotheses.org/>

³³ <https://www.fosteropenscience.eu/>

³⁴ Commission Recommendation (EU) 2018/790 of 25 April 2018 on access to and preservation of scientific information C/2018/2375: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32018H0790>

³⁵ Federal Ministry of Science, Research and Economy 2016: Austrian ERA Roadmap, p. 38 f. <https://era.gv.at/object/document/2581>

Expert groups: In recent years, the European Commission has set up expert groups on a wide range of Open Science topics, which have produced important recommendations, e.g. on reward systems³⁶, metrics³⁷, the future of publishing³⁸, and more. In a Mutual Learning Exercise, representatives of the EU member states discussed the challenges of the transition to Open Science³⁹. The Open Science Policy Platform (OSPP), which was appointed from 2016 to 2020 and had an advisory function, should also be highlighted. The group acted as a platform for representing the interests and concerns of the European RTI⁴⁰. Its final report provides practical commitments for implementations, followed by a perspective from each group on the major outstanding blockers to progress and possible next steps and a vision for moving beyond Open Science to create a shared research knowledge system by 2030.

European Open Science Cloud: As a common infrastructure for research data, the European Open Science Cloud (EOSC) was launched on 23 November 2018 in Vienna⁴¹. The goals of the EOSC include

- FAIR data initially within the EU, unless prevented by copyright, data protection or security issues
- Compliance with the FAIR Data principles in data curation, taking into account interdisciplinary, technical, and legal standards
- Training of data stewards
- Development of data skills through training programmes and reward systems
- Mandatory research data management in research institutions

Case studies: Implementation of Open Science in France and the Netherlands

Some EU member states such as Finland⁴², the Netherlands, Ireland⁴³, France⁴⁴, and Portugal⁴⁵ have developed national strategies for the implementation of Open Science or are working on such strategies. The aim of these is both to make knowledge generation more transparent, sustainable, and reproducible, and to increase the value added to and from research. The Open Science strategies of France and the Netherlands are presented below as examples:

³⁶ https://ec.europa.eu/research/openscience/index.cfm?pg=rewards_wg

³⁷ https://ec.europa.eu/research/openscience/index.cfm?pg=altmetrics_eg

³⁸ <https://op.europa.eu/en/publication-detail/-/publication/464477b3-2559-11e9-8d04-01aa75ed71a1>

³⁹ <https://rio.jrc.ec.europa.eu/en/policy-support-facility/mle-open-science-altmetrics-and-rewards>

⁴⁰ <https://ec.europa.eu/research/openscience/index.cfm?pg=open-science-policy-platform#>

⁴¹ <https://eosc-launch.eu/home/>

⁴² https://avointiede.fi/master-7rqtwti-lfuznrqfbx3l2.eu-4.platformsh.site/sites/default/files/2020-01/julistus2020_1.pdf

⁴³ http://norf-ireland.net/wp-content/uploads/2019/07/NORF_Framework_10_July_2019-2.pdf

⁴⁴ <https://www.ouvri.lascience.fr/open-science/>

⁴⁵ <http://www.ciencia-aberta.pt/>

France⁴⁶

- Creation of an Open Science Fund and an Open Publishing System to disseminate innovative forms of publication such as preprints, open peer review, etc.; publications/data from publicly funded projects must be Open Access and FAIR
- Research data to be made openly accessible to open up new scientific perspectives; creation of the position of Chief Data Officer in the Ministry of Education and Science; data management plans as part of calls for projects
- Development and training of individual Open Science skills, preferably at postgraduate level, and development of training modules; participation in international OS landscape
- Republique Numerique: legal establishment of rules for the reuse of research results

Netherlands⁴⁷

- Open Access for all publicly funded publications by 2020; networking and cooperation with Open Access pioneers in the EU; OA policy at the level of institutions and disciplines
- Preparation of research data and methods for their optimal reuse according to FAIR guidelines; long-term archiving of data with appropriate (existing, international) technical standards and procedures; data for research evaluation (e.g. citations) publicly available
- OA as part of the science reward system; adaptation of the existing system towards OA; moving away from the existing "publish or perish" system; OS criteria in evaluation schemes for researchers and research proposals
- Creation of a "clearing house" for OA and disciplinary strategies
- Creation of data stewards, at some universities one per faculty (often PhD students)
- Award of specific grants for innovative Open Science projects

4.2. Open Science in Austria

Several successful Open Science initiatives and activities have been in place in Austria since the early 2010s. These focus primarily on Open Access to scientific publications, Open Research Data and Citizen Science⁴⁸.

⁴⁶ https://libereurope.eu/wp-content/uploads/2018/07/SO_A4_2018_05-EN_print.pdf

⁴⁷ <https://repository.tudelft.nl/islandora/object/uuid:9e9fa82e-06c1-4d0d-9e20-5620259a6c65?collection=research>

⁴⁸ An overview of national Open Science activities can be found on the OANA website at the following link: <https://oana.at/nationale-aktivitaeten/>

In 2012, the Open Science Network Austria (OANA – then called "Open Access Network Austria") was founded by Universities Austria (Österreichische Universitätenkonferenz uniko) and the Austrian Science Fund (FWF). The network is a think tank on the topic of Open Science, which, among other things, formulates recommendations on elements of Open Science in Austria within the framework of working groups. In 2016, the OANA Working Group "National Strategy" published the "Recommendations for the Implementation of Open Access in Austria"⁴⁹, with the leading objective of 100% Open Access to scientific publications in 2025. 16 recommendations were formulated which were to lead to a coordinated transition to Open Access in Austria in the years to come. Many of the steps which had already been initiated earlier were made concrete in the recommendation paper and further necessary coordination measures were identified.

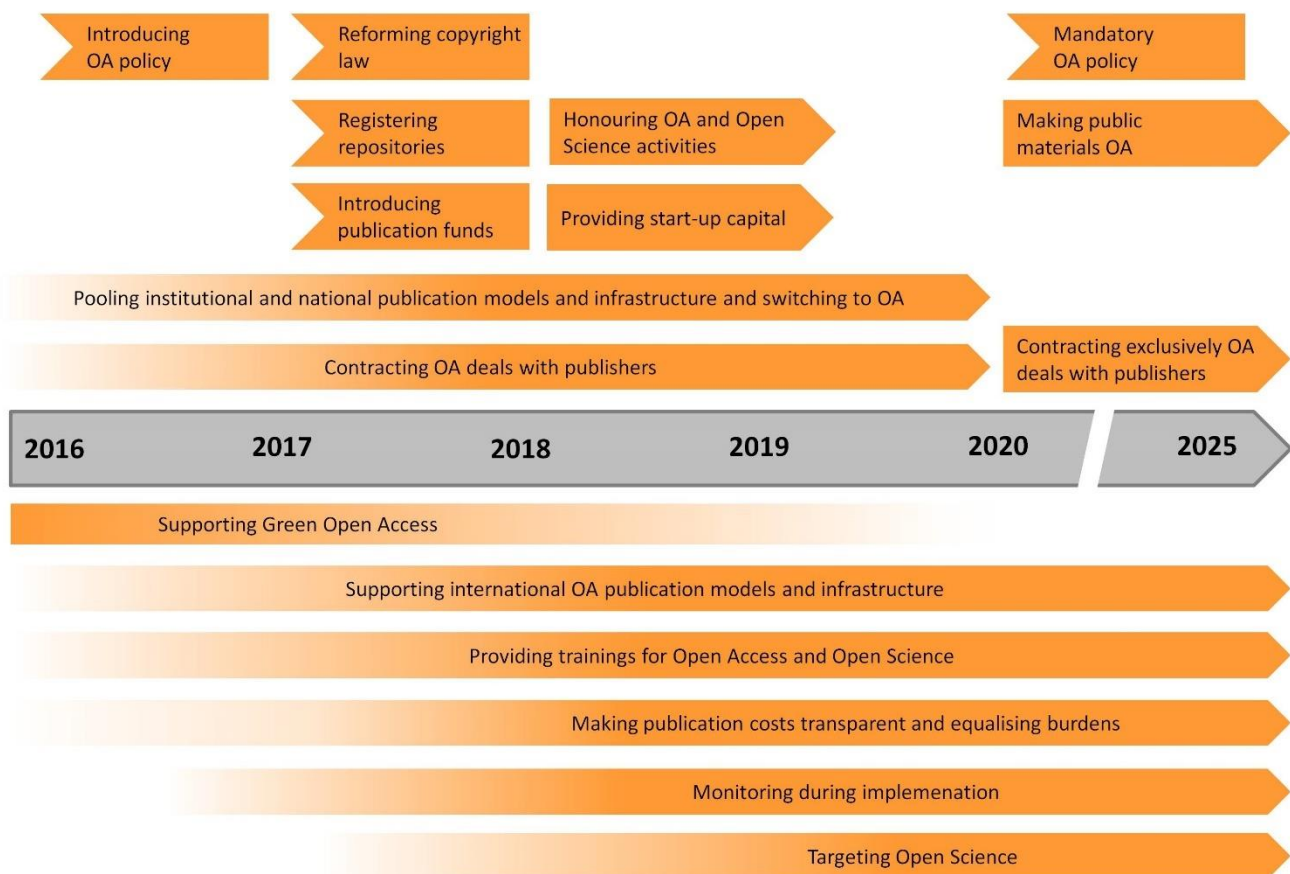


Figure 2: National Strategy Expert Group of Open Access Network Austria: Recommendations for the implementation of Open Access in Austria (2016); <https://doi.org/10.5281/zenodo.51799>

⁴⁹ Expert Group "National Strategy" of the Open Access Network Austria (OANA) & Universities Austria (uniko). (2016). Empfehlungen für die Umsetzung von Open Access in Österreich. Zenodo. <http://doi.org/10.5281/zenodo.51799>

In 2016, the OANA Working Group "Open Access and Scholarly Communication" published a paper on the future of scientific communication that has attracted worldwide attention, the so called "Vienna Principles"⁵⁰. This paper defines 12 principles as cornerstones for a future system of scholarly communication. This framework is internationally used as a basis for strategy and policy development, as well as a framework for projects and initiatives implementing Open Science.

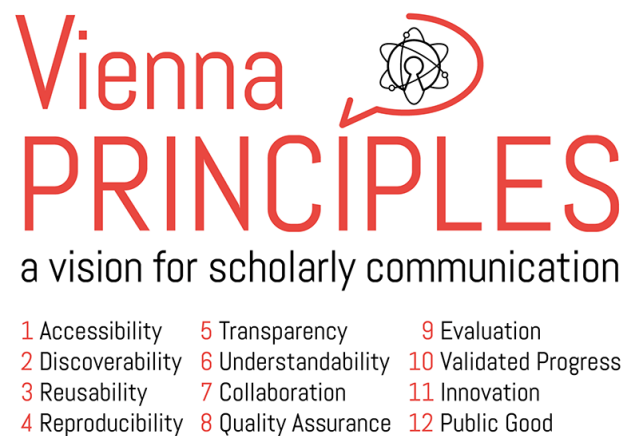


Figure 3: <https://viennaprinciples.org/>

In 2014, the Austrian Academic Library Consortium (KEMÖ)⁵¹ was one of the first national library consortia worldwide to negotiate an Open Access publishing agreement, which it accomplished in cooperation with the Austrian Science Fund (FWF). There are currently eleven Open Access agreements with scientific publishers in place, which promote free access to scientific publications in Austria and are listed in the international ESAC Agreement Registry⁵². Further Open Access agreements with publishers are currently being negotiated. Since 2017, Open Access activities have also been supported by the Austrian Transition to Open Access (AT2OA) project⁵³, in which working groups are developing analyses and concepts for the practical implementation of the transition to Open Access in Austria (successor project AT2OA2 until 2024). Further, in 2016, the RepManNet⁵⁴, a forum for repository managers from Austrian institutions, who deal with issues related to the archiving of scientific publications and research data, was founded. There is also a coordinated approach throughout Austria in the promotion of alternative publication formats and platforms⁵⁵ such as the Open Library of Humanities⁵⁶, the Directory of Open Access Journals (DOAJ)⁵⁷, Open Knowledge Maps⁵⁸, Online Library and Publication Platform (OAPEN)⁵⁹ and SciPost⁶⁰.

⁵⁰ <https://viennaprinciples.org/>

⁵¹ <https://www.konsortien.at/openaccess.asp>

⁵² For an overview of international Open Access contracts, see the Efficiency and Standards for Article Charges ESAC Registry: <https://esac-initiative.org/about/transformative-agreements/agreement-registry/>

⁵³ <http://at2oa.at/>

⁵⁴ <https://ubifo.wordpress.com/netzwerk-repositorienmanagerinnen-repmannet/>

⁵⁵ A complete list can be found on the OANA website under the following link: <https://oana.at/nationale-aktivitaeten/support-von-infrastrukturen/>

⁵⁶ <https://www.openlibhums.org/>

⁵⁷ <https://doaj.org/>

⁵⁸ <https://openknowledgemaps.org/>

⁵⁹ <https://www.oapen.org/home>

⁶⁰ <https://scipost.org/>

Since the publication of the OANA recommendations for Open Access publications, Open Access Policies have been adopted by many research institutions and financial support mechanisms such as publication funds have been implemented⁶¹. Some research institutions also operate institutional repositories, which are in many cases managed by the libraries⁶²

With its Open Access Policy for publications and corresponding funding structures, the Austrian Science Fund (FWF) has been working since 2004 to promote the transition to Open Access for publications⁶³ and achieved a compliance rate of 89% in 2019⁶⁴. Since 2018, the FWF has been a member of cOAlition S⁶⁵, a worldwide association of research funding organisations, that developed Plan S⁶⁶, which aims to accelerate the transition to Open Access in the scientific publishing sector even more rapidly by employing targeted, coordinated measures. Plan S will have a significant influence on the FWF's Open Access Policy in the coming years and will thus give further impetus to Open Access in Austria.

The government programme 2020-2024 of the Austrian Federal Government, which was presented to the public on January 2nd, 2020, contains a clear commitment to Open Access. It states: "The federal government actively supports Plan S for the implementation of Open Access. Subsequently, the principles of Plan S are also to be implemented by all universities and non-university research institutions in Austria"⁶⁷.

The field of Open Research Data is being promoted in Austria by various initiatives and projects. The Higher Education Area Structural Funding Project (Hochschulraum-Strukturmittel, HRSM) e-Infrastructures Austria plus project⁶⁸, the successor project of e-Infrastructures Austria⁶⁹ which was launched in 2014, focused until 2019 on the development of data infrastructures at Austrian universities, data management, institutional repositories and the implementation of measures to raise awareness on FAIR Data at Austrian institutions. Furthermore, domain-specific research infrastructures have been successfully established, such as the Austrian Social Science Data Archive (AUSSDA)⁷⁰ or the Humanities Asset Management System (Geisteswissenschaftliches Asset Management System GAMS)⁷¹. AUSSDA provides infrastructure for social science data as well as services for data archiving and use. GAMS provides infrastructure and tools for the management, publication and long-term archiving of digital resources from disciplines in the humanities. The mission of the "Plattform Registerforschung" (Platform Registry Research)⁷² is to make public

⁶¹ <https://oana.at/ueber-open-science/open-access-ressourcen/>

⁶² See for instance: IIASA (<http://pure.iiasa.ac.at/>), JKUePub (<http://epub.jku.at/>) University of Vienna Phaidra - Permanent Hosting, Archiving and Indexing of Digital Resources and Assets (<https://phaidra.univie.ac.at/>), repositUm (<http://repositum.tuwien.ac.at/>), IST PubRep (<https://repository.ist.ac.at/>), Institutional Repository of the University of Applied Arts (<https://phaidra.bibliothek.uni-ak.ac.at/>), ePUBWU (<http://epub.wu.ac.at/>), Digital Repository KUG-PHAIDRA (<https://phaidra.kug.ac.at/>), Institutional Repository of the University of Art and Design Linz (<https://phaidra.ufg.at/>)

⁶³ <https://www.fwf.ac.at/de/forschungsfoerderung/open-access-policy/open-access-fuer-referierte-publikationen/>

⁶⁴ Kunzmann, M (2020): Austrian Science Fund (FWF) Open Access Compliance Monitoring 2019 (Version 1) [Data set]. Zenodo. <https://zenodo.org/record/3931234#.X32yvGem3dk>

⁶⁵ <https://www.coalition-s.org/>

⁶⁶ <https://www.coalition-s.org/principles-and-implementation/>

⁶⁷ <https://www.bundeskanzleramt.gv.at/bundeskanzleramt/die-bundesregierung/regierungsdokumente.html>

⁶⁸ <https://www.e-infrastructures.at/>

⁶⁹ <https://e-infrastructures.univie.ac.at/>

⁷⁰ <https://aussda.at/en/>

⁷¹ <https://gams.uni-graz.at/archive/objects/context:gams/methods/sdef:Context/get?mode=about>

⁷² <https://www.registerforschung.at/>

registry data accessible to researchers and to help shape the necessary legal and infrastructural framework to enable this.

The Research Data Alliance Austria (RDA-AT)⁷³, the Austrian subgroup of the RDA, forms a network on the topic of research data management and enables the connection between Austrian data management initiatives and international working and interest groups of the RDA. In 2018, the Austrian Open Science Support Group (AOSSG) organised among others the event for the EOSC launch and was the international contact point for topics such as the European Open Science Cloud (EOSC) or FAIR Data. Today the members are actively involved in the work of the EOSC Secretariat⁷⁴.

Since 2019, Open Science has also been given high priority within the focus on "Digitisation" in the Austrian funding stream Higher Education Area Structural Funding Project (Hochschulraum-Strukturmittel, HRSM)⁷⁵. A number of cooperative projects, such as FAIR Data (TU Graz) and collaborative Data Labs (TU Vienna), have started which in the coming years will establish communication channels across institutional boundaries and jointly develop infrastructures and their governance. Past and future HRSM projects form an important basis for the networking of Austrian actors, regardless of their size and resources.

The Austrian Science Fund (FWF) requires a data management plan (DMP) for all projects approved after January 1, 2019. In addition, it expects research data collected and/or analysed in the course of FWF funded projects and which form the basis for research publications to be made openly accessible, provided there are no legal, ethical or technical reasons for not doing so.

In Austria, the topic of Citizen Science is mainly promoted by the Citizen Science Network Austria and the associated platform *Österreich forscht* ("Austria does research")⁷⁶. The network provides a forum for people interested in Citizen Science in Austria, which promotes not only the dialogue between science and society, but also discusses quality criteria for Citizen Science projects. It also offers the possibility of cooperation on specific Citizen Science or Open Science topics in numerous interdisciplinary and inter-institutional working groups⁷⁷, while facilitating exchange with the international Citizen Science community, e.g. by organising the annual Austrian Citizen Science Conference. Furthermore, the Centre for Citizen Science⁷⁸ offers researchers and the interested public information and networking possibilities on Citizen Science, Open Innovation⁷⁹ and Responsible Science. The Centre presents the annual Citizen Science Award⁸⁰, which is intended primarily to support the recruitment of participants for Citizen Science projects. From 2007 to 2019, the research programme Sparkling Science⁸¹, which was funded by the Federal Ministry of Education, Science and Research, provided funding for Citizen Science projects. The FWF's Top

⁷³ <https://www.rd-alliance.org/groups/rda-austria>

⁷⁴ <https://www.eoscsecretariat.eu/>

⁷⁵ BMBWF (2020): Digitale und soziale Transformation. Ausgewählte Digitalisierungsvorhaben an öffentlichen Universitäten 2020 bis 2024.

https://pubshop.bmbwf.gv.at/index.php?article_id=9&sort=title&search%5Btext%5D=digitalisierungsvorhaben&pub=799

⁷⁶ <http://www.citizen-science.at/>

⁷⁷ <https://www.citizen-science.at/netzwerk/arbeitsgruppen>

⁷⁸ <https://www.zentrumfuercitizenscience.at/>

⁷⁹ Information on the national Open Innovation Strategy is available under the following link:

<http://openinnovation.gv.at/wp-content/uploads/2016/08/Open-Innovation-barrierefrei.pdf>

⁸⁰ <https://www.zentrumfuercitizenscience.at/de/award>

⁸¹ <https://www.sparklingsscience.at/>

Citizen Science⁸² programme, which was initiated in 2015 (until 2019 it was implemented in cooperation with the “Österreichischer Austauschdienst” (OeAD – Austrian Exchange Service for international mobility and cooperation) and is a targeted funding opportunity for Austrian Citizen Science projects.

Open Science is also addressed within the framework of the Open Innovation Strategy⁸³, which already contains measures on Open Science, such as building research competence for the application of Open Innovation in science, anchoring incentive mechanisms for research partnerships and anchoring Open Data and Open Access principles in research.

In summary, with the initiatives, activities and contributions presented here, the transition towards Open Science is already underway in Austria. Some of the most important steps of a potential national Open Science Strategy have already been taken: the central actors are known, connected to one another and in dialogue, they are well networked and coordinated internationally, recommendations for an Open Access Strategy have been made and, in many places, appropriate measures and policies have already been designed or implemented. Monitoring measures are being developed in coordination with international partners.

▶ Map	Identify key stakeholders and Open Science champions
Plan	Devise national strategy through consultation with stakeholders
Incentivise	Change reward system to incentivise all aspects of Open Science
Promote	Encourage critical and informed thinking
▶ Support	Participate in international initiatives
▶ Implement	Implement strategy, starting from Open Access
▶ Monitor	Monitor and tackle emerging issues as they arise

Figure 4: Template for a national Open Science strategy, Mutual Learning Exercise Open Science (European Commission 2018) <https://rio.jrc.ec.europa.eu/en/library/mle-open-science-final-report-altmetrics-and-rewards>

⁸² <https://www.fwf.ac.at/de/forschungsfoerderung/fwf-programme/foerderinitiative-top-citizen-science/>

⁸³ <http://openinnovation.gv.at/wp-content/uploads/2016/08/Open-Innovation-barrierefrei.pdf>

5. Recommendations for Open Science in Austria

The successful transition to Open Science is based on maximising the synergies and overall coherence of the many different activities and actors involved. At the national level, these are research performing organisations⁸⁴, memory institutions such as libraries⁸⁵, researchers, as well as research policy and research funding organisations. These actors are called upon to keep an eye on the one hand on the international perspective, including the European framework of Horizon Europe, the ERA Roadmap and the Digital Single Market, and beyond Europe the goals of the UN’s Agenda 2030. On the other hand, a new national RTI strategy with the 2030 horizon is expected for the end of 2020. All corresponding activities need thus to be designed on the basis of measurable goals. In the following, the OANA Working Group proposes target group specific steps to further implement all elements of Open Science in Austria.

Recommendations for Research Performing Organisations					
Short Term	1-2 years	Medium Term	5 years	Long Term	10 years
<ul style="list-style-type: none"> ▶ Develop an Open Science Roadmap as part of the institutional strategy ▶ Define responsibilities and establish a national network of Open Science nodes and contact points ▶ Offer Open Science Training ▶ Establish a contact point for research data management and FAIR Data ▶ Prepare and implement the connection to the European Open Science Cloud (EOSC) 		<ul style="list-style-type: none"> ▶ Integrate Open Science into curricula and further education ▶ Prefer and support Open Infrastructures ▶ Make Open Science activities visible and evaluate them ▶ Expand evaluation processes according to Open Science criteria 		<ul style="list-style-type: none"> ▶ Establish further Open Science criteria in evaluation systems ▶ Establish Open Science as an aspect of the institutional Third Mission 	

⁸⁴ In this context, the term “research institution” includes not only universities and non-university research organisations, such as research departments in memory organisations, but also research infrastructures.

⁸⁵ The term “libraries” also includes research-led archives.

Recommendations for Research Funding Organisations

Short Term	1-2 years	Medium Term	5 years	Long Term	10 years
<ul style="list-style-type: none"> ▶ Develop Open Science funding strategies ▶ Enable experiments through pilot programmes ▶ Expand evaluation processes to include Open Science criteria 		<ul style="list-style-type: none"> ▶ Support and expand review processes in line with Open Science strategies ▶ Evaluate Open Science activities ▶ Further develop programmes in line with Open Science strategies ▶ Support the pooling and opening up of successful infrastructures 		<ul style="list-style-type: none"> ▶ Promote sustainable Open Infrastructures 	

Recommendations for Research Policy

Short Term	1-2 years	Medium Term	5 years	Long Term	10 years
<ul style="list-style-type: none"> ▶ Develop and implement a national Open Science Strategy ▶ Establish an Open Science Monitoring Centre ▶ Establish a clearing house for data protection and copyright issues ▶ Strengthen national Open Science initiatives 		<ul style="list-style-type: none"> ▶ Contribute to the development of a European directive on Open Science ▶ Aim for 100% Open Access by 2025 ▶ Fund sustainable and long-term Open Science infrastructure 		<ul style="list-style-type: none"> ▶ Use transparent evaluation procedures in the assessment of research activities and open metrics 	

Recommendations for Libraries

Short Term	1-2 years	Medium Term	5 years	Long Term	10 years
<ul style="list-style-type: none"> ▶ Negotiate transparent transformative Open Access publishing contracts ▶ Prepare library stocks for the FAIR principles ▶ (Further) develop Open Infrastructures in accordance with international standards ▶ Advice and support for researchers on open licensing ▶ Create Open Access publication funds ▶ Strengthen existing Open Science initiatives 		<ul style="list-style-type: none"> ▶ Foster activities of the Austrian Academic Library Consortium (KEMÖ) to meet the growing Open Science challenges ▶ Focus on 100%-OA contracts to replace transformative agreements ▶ Prepare and implement the connection to EOSC ▶ Publish research data management plans (DMPs) in repositories 		<ul style="list-style-type: none"> ▶ Further develop open publishing and open research infrastructures 	

Recommendations for Researchers

Short Term	1-2 years	Medium Term	5 years	Long Term	10 years
<ul style="list-style-type: none"> ▶ Follow the principle “As open as possible, as closed as necessary” ▶ Use an ORCID ID ▶ Attend Open Science Trainings ▶ Critically review Open Science services 		<ul style="list-style-type: none"> ▶ Network and join grassroots communities ▶ Use and develop discipline-specific metadata standards for research data ▶ Adhere to the FAIR data principles ▶ Establish Open Science policies at the project level 		<ul style="list-style-type: none"> ▶ Use and/or develop open collaborative teaching and research environments 	

5.1. Open Science: Recommendations for Research Performing Organisations

Short Term (1-2 years)

- **Develop an Open Science Roadmap as part of the institutional strategy:** Research Performing Institutions should develop an Open Science strategy which, as a guiding principle, specifies steps and measures for the establishment and implementation of individual Open Science elements. As a roadmap or action plan, the Open Science strategy should be part of the overall institutional strategy or vision and at the same time contribute to increasing the visibility of the Open Science agenda and activities at research institutions. One part of the Open Science strategy can be an Open Access policy. There are already numerous international models and best practices available to guide the design of institutional Open Science strategies⁸⁶. Activities should be regularly evaluated and assessed with regard to their potential for institutional change.
- **Define responsibilities and establish a national network of Open Science nodes and contact points:** Research institutions should appoint contact persons for Open Science agendas and promote national and international networking. Contact points improve both internal and external communication. Responsibilities should be clarified and coordinated at least at management level. This approach is already being implemented very successfully for the Citizen Science domain. Open Science contact persons should be listed on a central, national website.
- **Offer Open Science Training:** Research Performing Institutions should offer training courses for e.g. data management, FAIR Data, Open Access publishing, creating Open Educational Resources and conducting Citizen Science projects. As part of a professionalisation initiative, these training courses should be incentivised, like existing support in writing grant applications or as qualification measures. Priority should be given to the principle "train the trainers".

⁸⁶ E.g. <https://repository.tudelft.nl/islandora/object/uuid%3Af2faff07-408f-4cec-bd87-0919c9e4c26f>; see also <https://www.leru.org/files/LERU-AP24-Open-Science-full-paper.pdf>

- **Establish a contact point for research data management and FAIR Data:** Research institutions should offer or establish a centralised contact point, which provides services and support on topics such as research data management, data management plans and FAIR Data. Furthermore, the contact points could be networked to promote the exchange of information.
- **Prepare and implement the connection to the European Open Science Cloud (EOSC):** Austrian data and data infrastructures are to become part of the European Open Science Cloud (EOSC). Therefore, arrangements should be made at the institutional level to identify Austrian contributions, coordinate them at the national level and prepare them for international networking and participation.

Medium Term (2-5 years)

- **Integrate Open Science into curricula and further education:** Open Science should be included in research education curricula in a suitable manner. Courses on good scientific practice and research integrity should also address the topics of Open Access publishing, data management and curation, the development of Open Educational Resources, but also opening up research through participatory processes (e.g. Citizen Science). More detailed training and certification in Open Science should take place at the pre- or post-doc level at the latest. The development of tailored training modules can be customised on the basis of existing training materials⁸⁷.
- **Prefer and support Open Infrastructures:** Research institutions should be aware of the dangers of lock-in effects through proprietary infrastructures, especially if large parts of the scientific workflow are covered by a few providers. They should therefore give preference to open source alternatives and support Open Infrastructures that offer important disciplinary or cross-disciplinary services (the recommendations of the Sustainability Coalition for Open Science Services SCOSS⁸⁸ are helpful here). Contracts for infrastructures should be transparent and governance should reside with the relevant communities. For the establishment of Open Infrastructures, a strategic networking of research institutions and a bundling of successful Open Infrastructures for operation and maintenance is recommended.
- **Make Open Science activities visible and evaluate them:** Research institutions should make their Open Science policies, activities and actors more visible on their websites, but also through reporting, prizes, awards, etc. Measurable goals of institutional Open Science strategies should be openly evaluated on a regular basis.
- **Expand evaluation processes according to Open Science criteria:** Research institutions should develop measures to change the assessment of performance in teaching and research and sign declarations such as the San Francisco Declaration on Research Assessment (DORA⁸⁹) [see box below]. Similarly, the Hong Kong Principles⁹⁰, the Leiden

⁸⁷ See for instance Foster OS <https://www.fosteropenscience.eu/> OS MOOC <https://opensciencemooc.eu/> and OS Handbook <https://open-science-training-handbook.gitbook.io/book/>

⁸⁸ <https://scoss.org/>

⁸⁹ <https://sfdora.org/>

⁹⁰ <https://wcrif.org/guidance/hong-kong-principles>

Manifesto⁹¹, or the Open Science Career Assessment Matrix (OSCAM⁹²) [see box on page 28] can serve as guidance for the development of measures to broaden perspectives, for instance in appointment procedures, or to promote strategic career development.

Declaration on Research Assessment (DORA)

The “Declaration on Research Assessment” (DORA) is a global initiative aimed at reducing the reliance on bibliometric indicators (such as publications and citations) in the assessment of research while increasing the use of other criteria. The Declaration contains a number of recommendations for improving research assessment. The DORA Declaration was published in 2012 and is aimed at research funders, publishers, research institutions and researchers. The Declaration has already been signed by more than 1,200 organisations and almost 14,000 researchers around the world. Signing DORA means that organisations must align their practices and procedures with the principles of the Declaration. This means that the publication medium, publisher or journal metrics such as the impact factor should not be used as criteria for assessing scientific performance. Furthermore, in addition to publications, other outputs such as prizes, conference papers, keynote speeches, major research projects, research data, software, codes, preprints, exhibitions, knowledge transfer services, science communication, licenses or patents should also be used as criteria, while the concrete evaluation criteria should always be made transparent.

Long Term (10 years)

- **Establish further Open Science criteria in evaluation systems:** By joining initiatives and/or supporting international declarations such as the DORA Declaration (see Box), research performing institutions are taking visible steps towards Open Science. Appropriate measures to change the assessment of performance in research and teaching should be established as standard operating procedure at research performing institutions and should be evaluated and updated on a regular basis.
- **Establish Open Science as an aspect of the institutional Third Mission:** By opening up research processes and further establishing participatory methods in knowledge generation, research not only becomes more transparent, but in many cases also more comprehensible. By applying these participatory methods, complex scientific topics can be made intelligible to a broader public. This also increases trust in science, while making scientific research more relevant to the wider public. However, this benefit can only be achieved if Open Science initiatives receive appropriate support.

⁹¹ <http://www.leidenmanifesto.org/>

⁹² https://ec.europa.eu/research/openscience/pdf/os_rewards_wgreport_final.pdf

5.2. Open Science: Recommendations for Research Funding Organisations

Short Term (1-2 years)

- **Develop Open Science funding strategies:** Research funding organisations can directly promote the openness of scientific output and processes by introducing policies on Open Science elements⁹³, especially⁹⁴ when these policies are supported by mechanisms such as earmarked funding for infrastructure. For this reason, OANA recommends for all Austrian research funding organisations to first implement an Open Access policy, followed by the development of further policies towards other Open Science elements. To achieve the highest impact, funding bodies should coordinate their criteria for Open Science and join international initiatives.
- **Enable experiments through pilot programmes:** OANA recommends that research funders develop pilot programmes to gain experience in implementing support and incentive measures for Open Science. Such pilots offer the opportunity to try out new measures within a limited timeframe, create best practices and can contribute to the development of robust new funding structures. Already existing examples include the FWF's Open Research Data Pilot⁹⁵ and the FFG's Innovation Laboratories⁹⁶. Such processes should be continuously evaluated and analysed in an international dialogue with other funding agencies.
- **Expand evaluation processes to include Open Science criteria:** New criteria for the evaluation of scientific activities and outputs should be developed and aligned with international initiatives. Research funders should sign relevant declarations such as the San Francisco Declaration on Research Assessment (DORA) or the Leiden Manifesto and align their evaluation criteria, reviews, guidelines and specifications with them⁹⁷.

Medium Term (2-5 years)

- **Support and expand review processes in line with Open Science strategies:** The implementation of Open Science criteria in review processes also requires the training of reviewers. Research funders are therefore encouraged to support reviewers accordingly and inform them in the best possible way about these criteria. Guidelines and information materials from funding agencies can be a suitable means of informing the international scientific community about criteria such as the DORA declaration, and of promoting their dissemination and establishment as a scientific standard. Furthermore, new open review processes for the evaluation of Open Science activities should be considered.
- **Evaluate Open Science activities:** The implementation of Open Science activities by researchers should be evaluated regularly and transparently. This requires the development

⁹³ See *Report of the Expert Group to the European Commission*, p. 46 https://www.eosc-portal.eu/sites/default/files/KI0518070ENN.en_.pdf

⁹⁴ See *Do authors comply when funders enforce open access to research?* <https://www.nature.com/articles/d41586-018-07101-w> or *Putting down roots. Securing the future of open access policies* <http://repository.jisc.ac.uk/6269/10/final-KE-Report-V5.1-20JAN2016.pdf>

⁹⁵ <https://doi.org/10.5281/zenodo.803234>

⁹⁶ <https://www.ffg.at/ALT/Instrumente/Innovationslabor>

⁹⁷ See as an example of good practice <https://sfdora.org/good-practices/funders/>

of measurable goals, such as monitoring the output of Open Access publications or the FAIRness of research data financed by research funding agencies.

- **Further develop programmes in line with Open Science strategies:** Research funding programmes should be reviewed at regular intervals with regard to the respective Open Science strategy and, if necessary, adapted and further developed.
- **Support the pooling and opening up of successful infrastructures:** Successful infrastructures that are well received by scientific communities should be opened up as much as possible through funding mechanisms. Where it makes sense, services and organisations that pursue similar goals should be merged and continued on the basis of transparent governance models.

Long Term (10 years)

- **Promote sustainable Open Infrastructures:** Research funders should participate in the development and establishment of Open Infrastructure in order to ensure the long-term and sustainable openness and accessibility of scientific output. In the area of Open Access, for example, this is already being actively implemented by several Austrian institutions including the FWF through funding of platforms such as OAPEN, Europe PMC and arXiv⁹⁸. Funding agencies should support networking and the creation of alliances for the operation of successful research infrastructures. OANA recommends the development of mechanisms that contribute to the support of research infrastructures independent of project durations, which are implemented nationally and internationally through coordinated action by research funding agencies. Such measures could include the establishment of overhead costs or Open Science flat rates.

5.3. Open Science: Recommendations for Research Policy

Short Term (1-2 years)

- **Develop and implement a national Open Science strategy:** In order to remain a frontrunner in the field of Open Science, Austria should develop a national Open Science strategy as suggested in the "Recommendation (EU) of the Commission 2018/790 of 25 April 2018 on access to and preservation of scientific information"⁹⁹. An action plan for the implementation of Open Science in line with the RTI Strategy 2030 should be created following international models and involving all relevant national stakeholders, networks and initiatives. The development of national measures and objectives of the strategy should be coordinated by a central authority.
- **Establish an Open Science Monitoring Centre:** An agency for the monitoring and evaluation of Open Access publications, research data and Open Educational Resources should be established in Austria, which should operate in conjunction with the Open Science contact points of the research institutions. To this end, already existing,

⁹⁸ <https://www.fwf.ac.at/de/forschungsfoerderung/open-access-policy/open-access-fuer-referierte-publikationen/open-access-publikationsmodelle/>

⁹⁹ <https://eur-lex.europa.eu/legal-content/DE/TXT/HTML/?uri=CELEX:32018H0790&from=EN>

sustainable structures should be commissioned and financially supported. Through evaluation processes datasets can be created, which can be used as a basis for decision processes regarding future measures.

- **Establish a clearing house for data protection and copyright issues:** The OANA Working Group "Legal aspects of Open Science"¹⁰⁰ encourages the creation of a clearing house for legal issues. In Open Science, data protection, copyright, as well as exploitation rights and licensing models are particularly important issues. Individual institutions currently suffer from limited competences in this regard. A central contact point would pool knowledge and services and could act more efficiently.
- **Strengthen national Open Science initiatives:** Initiatives such as the Forum New Media Austria (FNMA) and the Austrian Academic Library Consortium (KEMÖ) should be strengthened, as these initiatives can make valuable contributions to Open Science and provide important impulses for Austrian research policy.

Medium Term (2-5 years)

- **Contribute to the development of a European Union directive on Open Science:** Austria should participate in the development of a European directive on Open Science in order to position its interests in the best possible way.
- **Aim for 100% Open Access by 2025:** Austria is well on its way to implementing the OANA "Recommendations for the Implementation of Open Access in Austria" of 2016. The networking of institutions via the Austrian Academic Library Consortium (KEMÖ) should be further expanded to enable the conclusion of additional Open Access publishing agreements and alternative, non-commercial publication models and infrastructures, both on a national and international basis, should be strengthened. In order to achieve this goal, incentives could be provided to universities for gradually increasing the Open Access quota.
- **Fund sustainable and long-term Open Science infrastructure:** Stable infrastructure is needed in order to be able to conduct sustainable research. In the future, these should not just be funded on a project basis but should also be converted into long-term financing through other instruments, with the added benefit of avoiding lock-in effects. When developing such instruments, however, it should be considered that important infrastructures exist both within and outside of the university sector. A prerequisite for any funding should therefore be that all involved infrastructures are open. It is of central importance to recognise the FAIR data principles, the principle of reusability (open source, open interfaces and licences) and the need for robust community governance, i.e. the involvement of the scientific community in the management of the infrastructures. Funded infrastructures should be evaluated routinely and transparently based on their success and potential to pool resources and needs. In particular, interoperability and synergies with regard to EOSC should be promoted.

¹⁰⁰ Core team of the Open Science Network Austria (OANA), Working Group "Legal aspects of Open Science" (2019, May 17): Einrichtung einer Clearing-Stelle für Datenschutz- und Urheberrechtsfragen gemeinsam für alle Forschungsinstitutionen. Empfehlungspapier (Version 1.0). Zenodo. <http://doi.org/10.5281/zenodo.2862171>

Long Term (10 years)

- **Use transparent evaluation procedures in the assessment of research activities and open metrics:** National evaluation and application procedures should be open and transparent. Support should be given to adapting academic career models to the criteria of the Open Science Career Assessment Matrix OSCAM [see box below]. Research and teaching at funded institutions should be presented and evaluated in a transparent and open manner.

Open Science Career Assessment Matrix (OS-CAM)

Researchers are the key to the successful implementation of Open Science. The evaluation of researchers cannot be reduced to a single number but must include multidimensional criteria to reflect the full range of their achievements. A much broader evaluation, which also makes reference to Open Science, is therefore urgently needed. The EU Expert Group on Rewards has developed the Open Science Career Assessment Matrix (OA-CAM) for this very purpose as early as 2017¹⁰¹. It covers all career levels, from first stage researcher (R1) of the European Framework for Research Careers to senior positions (R4) and complements or replaces existing assessment systems.

5.4. Open Science: Recommendations for Libraries

Short Term (1-2 years)

- **Negotiate transparent transformative Open Access publishing contracts:** All license agreements with publishers should contain an Open Access component, be cost-neutral and result in authors with an affiliation to an Austrian institution being able to publish Open Access automatically and free of charge. The prices, costs and contractual texts of these transformative Open Access agreements (e.g. Read & Publish agreements) should be made public and registered in international databases such as the ESAC Registry¹⁰² to ensure international comparability.
- **Prepare library stocks for the FAIR principles:** Libraries should check their digital collections and metadata for compliance with the FAIR principles and take steps to prepare and process them accordingly where necessary. Findability, access, interoperability and reuse of collections have always been part of the core business of libraries and in a digitised world should be based on international standards. Many libraries act as contact points for questions about FAIR-Data and should therefore set an example in implementing these principles.
- **(Further) Develop Open Infrastructures in accordance with international standards:** In addition to collections, libraries should also examine the existing institutional infrastructure and adapt it to international standards where necessary. For instance,

¹⁰¹ https://ec.europa.eu/research/openscience/index.cfm?pg=rewards_wg

¹⁰² <https://esac-initiative.org/about/transformative-agreements/agreement-registry/>

publication repositories should be listed in the Directory of Open Access Repositories¹⁰³ and provide interfaces for easy exchange of documents. Research data repositories should aim for international certifications such as those provided by the Core Trust Seal¹⁰⁴.

- **Advice and support for researchers on open licensing:** Researchers often encounter legal issues when publishing scientific output. Libraries can be contact points for questions of this kind and cooperate with the suggested clearing house for data protection and copyright issues (see Recommendations for Research Policy).
- **Create Open Access publication funds:** Open Access publication costs for publishing agreements, alternative publication formats and platforms should be managed centrally at the library within the framework of an Open Access publication fund. The instalment of dedicated publication funds helps to provide an overview of institutional expenditure on Open Access and to ensure continuous monitoring. The gradual reallocation of a growing proportion of the library budget to support the production of open content should be supported.
- **Strengthen existing Open Science initiatives:** Existing forums and networks such as the University Library Forum (UBIFO) and the consortium body for negotiating agreements with large publishing houses, the Austrian Academic Library Consortium (KEMÖ), should be strengthened. For many years now, a cooperative working style has been developed among national academic libraries which among others led to Austria becoming one of the leading nations in the field of Open Access to publications. This frontrunner role should be secured and expanded, towards other aspects of Open Science.

Medium Term (2-5 years)

- **Foster activities of the Austrian Academic Library Consortium (KEMÖ) to meet the growing Open Science challenges:** By negotiating numerous transformative Open Access agreements (e.g. Read & Publish agreements) KEMÖ has helped to establish Austria as an Open Access frontrunner. However, new Open Access business models, the coordinated allocation of funds for alternative publication formats and Open Science platforms mean that KEMÖ's office is confronted with ever evolving and growing challenges. In order to be able to implement Open Access as a standard in publishing throughout Austria, it is therefore essential that the KEMÖ office is adequately staffed and has secure, long-term funding. Longer-term financing models should therefore be developed and implemented in order to maintain Austria's pioneering role in Open Access to publications in the future.
- **Focus on 100%-OA contracts to replace transformative agreements:** The transformation from closed to Open Access should be completed in five years and 100% OA contracts should be negotiated.
- **Prepare and implement the connection to EOSC:** Many libraries will act as contact points at their institutions for contributions to the EOSC and can – as institutional nodes – connect various departments, including IT and research services. The cooperation of libraries with other involved actors should be strengthened to facilitate the connection of Austrian infrastructures or existing networks (e.g. CLARIAH, HRSM projects) to the EOSC, in

¹⁰³ <http://v2.sherpa.ac.uk/opensoar/>

¹⁰⁴ <https://www.coretrustseal.org/>

order to promote and enable the implementation of new services and the development of uniform technical standards (e.g. long-term archiving).

- **Publish research data management plans (DMPs) in repositories:** Data management plans describe (in a machine-readable or human-readable manner) how research data is organised, stored and archived for a particular research project. This information can also be very helpful to other researchers. DMPs contribute to high-quality work and should be securely archived in a repository as part of library services.

Long Term (10 years)

- **Further develop open publishing and open research infrastructures:** Libraries can be a driving force in establishing Open Science standards. In addition to providing Open Access publication funds and managing repositories, libraries can also promote new, innovative Open Access publication models and support open, collaborative working methods (Open Methods) and open teaching (Open Education) by providing Open Infrastructures. Libraries should critically follow Open Science developments and contribute to improving them through concomitant studies.

5.5. Open Science: Recommendations for Researchers

Short Term (1-2 years)

- **Follow the principle "As open as possible, as closed as necessary":** Researchers at all career levels should work as openly as possible, in order to benefit from the advantages of Open Science in their own research practice, but also to keep their research and teaching materials accessible, transparent and reproducible¹⁰⁵. This concerns both research outputs such as publications or research data as well as methods and workflows.
- **Use an ORCID ID:** Researchers should create an ORCID¹⁰⁶ ID (Open Researcher and Contributor ID) to be able to clearly and permanently assign their own research output to themselves. By means of such an identifier, one's own research output is more easily and clearly accessible while the information is always reusable, for instance for submissions and reporting.
- **Attend Open Science trainings:** Scholars should take the opportunity to attend general or tailor-made Open Science trainings.
- **Critically review Open Science services:** Scholars should inform themselves about Open Science services (e.g. Open Access publication models or data services) and critically check the services and conditions of service providers. This applies not just to costs, but also to the openness of the services offered in terms of Open Infrastructures. Researchers should point out missing services (e.g. interfaces or inaccessible metrics), and demand improvements.

¹⁰⁵ For guiding principles see the Vienna Principles and McKiernan, E. et al. (2016): How open science helps researchers succeed. <https://doi.org/10.7554/eLife.16800>

¹⁰⁶ <https://orcid.org/>

Medium Term (2-5 years)

- **Network and join grassroots communities:** Researchers who have had good experiences with Open Science should set a good example by showing how to work according to open standards, and what advantages open practices have for the community in general as well as for each individual. This can be done through courses or working groups, through personal exchange or through bottom-up initiatives set up for this purpose. In Austria, one example for this is the Graz Open Science Initiative¹⁰⁷.
- **Use and develop discipline-specific metadata standards for research data:** Metadata is data about research data which is essential for finding, searching, using and reusing research data. In order to ensure the interpretability and reusability of data, researchers should therefore develop and apply discipline-specific metadata standards¹⁰⁸ in their communities, where these do not yet exist.
- **Adhere to the FAIR data principles:** Research data should be FAIR (“Findable, Accessible, Interoperable, Reusable”) and the FAIR concept should be integral to research data creation processes. Further, data management plans should comply with the FAIR data principles¹⁰⁹ in order to ensure the traceability of data generation as well as data processing, findability and reusability of research data. At the same time, open data management plans help those Researchers who have less experience with the topic and can be used as examples.
- **Establish Open Science policies at the project level:** Research projects should be carried out on the basis of an Open Science policy agreed on by the project partners in the consortium agreement. This may also be part of broader ethical guidelines, RRI and exploitation strategies, and may include data management plans and measures for long-term archiving and availability.

Long Term (10 years)

- **Use and/or develop open collaborative teaching and research environments:** Virtual working platforms that enable collaborative teaching and research activities should be designed to be both open and transparent. Particularly when the entire teaching and research process is supported, including data collection, analysis, interpretation, discussion and publication, control and steering must be in the hands of the scientific communities and the researchers.

¹⁰⁷ https://www.facebook.com/pg/GrazOpenScienceInitiative/about/?ref=page_internal

¹⁰⁸ <http://www.dcc.ac.uk/resources/metadata-standards/list>

¹⁰⁹ <https://www.nature.com/articles/sdata201618>