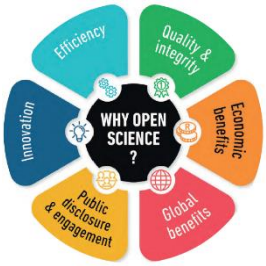

6. Open Science Diplomacy

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FIGURE: Why Open Science? Graphic for University of Cape Town, Gaelen Pinnock, CC-BY-SA-4.0

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Executive Summary

Following the call by EU Commissioner for research, science and innovation Carlos Moedas for "Open Science, Open Innovation, and Open to the World" in 2015, the case investigates applications and implications of Open Science for science diplomacy.

Open Science is the idea that scientific knowledge of all kinds should be openly shared as early as it is practical in the research process. The international Open Science movement strives to improve accessibility to and reusability of research and takes the opportunity to renegotiate the social roles and responsibilities of publicly funded research. The umbrella term of Open Science covers open access to publications, open research data and methods, open source software, open infrastructures, open educational resources, open evaluation, and citizen science. There are already many initiatives and programmes supporting the Open Science approach. Most recently various funders came together acting as the so-called "cOAlitionS" to implement Open Access by 2021 and to encourage new business models for sustainable scholarly communication. Moreover, with the European Open Science Cloud Europe is striving to lead Open Science to new frontiers.

Commissioner Moedas has outlined the leading role of Europe in the implementation of Open Science within the RRI (Responsible Research and Innovation) framework for research and innovation funding. In his "Three O" (Open Science, Open Innovation, Open to the World) approach, he has defined a set of priorities to make Europe a stronger global actor through science and collaboration, thus implying core aspects of science diplomacy. It is therefore vital to explore opportunities offered by Open Science, particularly open data and open access, to the provision of scientific advice to foreign policy. How can Open Science be exploited for decision-making support, knowledge resources and science diplomacy governance frameworks? How is the European Open Science strategy perceived and can thus be harnessed for foreign policy?

How could science diplomacy and Open Science mutually benefit from each other, while the modus operandi of the global science system is facing fundamental changes?

Key findings

This case study examines thus the Open Science policy arena as potential site for science diplomacy. Document analysis, participatory observation as well as qualitative interviews with Open Science stakeholders (scientists, administrators, funders, policy makers, etc) focused on European issues of internationalization of Open Access to scholarly publications and infrastructures for Open Research Data. Plan S - a strategy to promote Open Access to scholarly publications supported by many European and international research funding and policy actors - and the European Open Science Cloud EOSC – a virtual environment for research data, provide interesting grounds for more detailed investigations in that matter.

The central finding is that Open Science Diplomacy can be considered today mostly as international political cooperation for the advancement of the transition towards Open Science, even though Science Diplomacy is not a term commonly used in the global Open Science arena. However, the impact of changes in the international science system on foreign relations is in some cases already tangible – e.g. in the creation of international partnerships for the promotion and coordination of Open Access publishing or in the exchange of Open Research Data.

On the other hand, Open Science has only marginally been used for science advice in foreign relations until now. Their potential link was reflected in most case interviews as "non-existent", "un-anticipated", but "interesting" and "improvable". This potential – for

example to tackle societal challenges efficiently across borders - has not been harnessed yet in diplomatic contexts, even though research policy makers and Open Science advocates are aware of it and start to promote it.

Challenges

- Governance of international Open Science activities in the public sector varies highly and can hardly be generalised.
- International stakeholder landscapes have changed profoundly in the last 30 years, towards a broad variety of advocacy actors and policy implementing organisations (such as funders and research organisations) with the increased involvement of publishing and content service industries, however many cross-border activities rely on informal and personal relationships.
- The European Open Science priorities are under benevolent international observation, commitments are increasing, however the tendency to implementation is still cautious.
- Open Science is very rarely on the diplomatic agenda, and science diplomacy is only marginally used for the orchestration and coordination of Open Science, even though Open Science advocates would welcome more involvement of foreign policy actors.
- Even pressing issues, like the international coordination of standards and legal frameworks for the exchange of data ("data diplomacy"), as well as new opportunities for innovation are not yet discussed in the light of Open Science developments.
- Rare involvement of diplomatic institutions, such as embassies, is mostly triggered by local advocates, such as library consortia, and is often not sustainable.

Key Recommendations

- The European Union and the European Member States as well as associated countries should put Open Science on the agenda for international scientific cooperation to tackle societal challenges, define missions and realise the UN Sustainable Development Goals (SDGs).
- Foreign policy actors need tailored information about Open Science in the form of case studies, best practice reports, etc. in order to understand the potential both for their needs and for the advancement of international scientific cooperation and innovation.
- Open Science actors could benefit from diplomatic skills for multi-national, multi-stakeholder negotiations, when the right interfaces are in place to translate needs into coherent sets of policies, monitoring measures, etc. Mainstreaming Open Science and aligning it with multi-level interests, national priorities and international policies does not only require strong leadership and sophisticated negotiation and communication strategies, but most importantly a holistic overview about major trends and international developments.

1. Introduction– Open Science Diplomacy

Open Science is the idea that scientific knowledge of all kinds should be openly shared as early as is practical in the research process. Open Science is an international movement comprising of Open Access to scholarly publications and data, Open Methods and Open Source, Open Education, Open Evaluation, and Citizen Science, all of which are in some way or another dependent on dedicated infrastructures, relevant measures for assessment and specific skill sets. As an international science policy arena it emerged around 2012, mainly driven by European Union research policies, but also pushed by the OECD and the G7. Open Science shows

- few institutionalized rules and procedures,
- heterogeneous actors,
- a domination by domain-specific priorities,
- the building on long-standing grassroots and bottom-up engagement,
- and the potential to changing the modus operandi of the global science system.

There is no such thing as Open Science Diplomacy, it is rather an auxiliary hypothesis guiding this case study. As a hypothetical term Open Science Diplomacy condenses a prominent EU science policy strategy – and its underlying paradigms – into an investigative instrument: "Open Science, Open Innovation and Open to the World"[1]. Open Science Diplomacy could be defined as international political cooperation for the advancement of the transition towards Open Science. As Research Commissioner Moedas stated: "As part of my own commitment to make European research open to the world, I will continue to develop EU science diplomacy at every opportunity, engaging with new countries and ensuring that science in Europe contributes as much to peace as it does to prosperity"[2]. Open Science Diplomacy delineates in this case not just scientific cooperation across borders, but the foreign policy dimension of this cooperation dedicated to open research practices. "Open to the World" could mean that European Science diplomacy should enhance the external dimension of European science and innovation policies, share EU values, visions and priorities, and achieve the SDGs[3]. However, it could also mean that Europe is sharing its achievements too fast and too wide, if not based on strong international partnerships, as some fear. Against this backdrop, this case study identifies and analyses applications and implications of Open Science in science diplomacy and vice versa.

Neither the term Open Science nor the term Science Diplomacy come with universally accepted definitions[4]. Regarding both concepts, there is room to see what is actually happening and what values and practices are at play. Commonly, Open Science is connoted with: Increasing the availability of knowledge as a public good, typically adhering to

[1] European Commission (2016): Open Science, Open Innovation and Open to the World. Luxembourg: Publications Office of the European Union.

[2] Moedas, C. (2016): Science Diplomacy in the European Union. In: Science & Diplomacy, 5(1). Retrieved from: http://www.sciencediplomacy.org/perspective/2016/science-diplomacy-in-european-union as accessed 01 June 2019.

[3] Slaus, I., H. Wallace, K. Cuhls, M. Gual Soler (2017): 3.3 Science Diplomacy. In: Directorate-General for Research and Innovation & European Commission (ed.): The RISE Report—"Europe´s future: Open Innovation, Open Science, Open to the World", pp. 106–118. Retrieved from: http://ec.europa.eu/research/openvision/pdf/publications/ki0217113enn.pdf as accessed on 01 June 2019.

[4] For Open Science see debate here: Bosman, J., B. Kramer (2017, March 26): Defining Open Science Definitions. I&M / I&O 2.0. Retrieved from: https://im2punt0.wordpress.com/2017/03/27/defining-open-science-definitions/ as accessed 01 June 2019. For Science Diplomacy see here: Gluckman, P. D., V. C. Turekian, R.W. Grimes, T. Kishi (2017): Science diplomacy: A pragmatic perspective from the inside. In: Science & Diplomacy. 6(4), pp 1–13.; López de San Román, A., S. Schunz (2018): Understanding European Union Science Diplomacy. JCMS: Journal of Common Market Studies, 56(2), pp. 247–266.; S4D4C (2019): S4D4C's Madrid Declaration on Science Diplomacy published. Retrieved from: http://www.s4d4c.eu as accessed 01 June 2019.

principles such as accessibility, transparency, reproducibility, and re-usability included in some combination. Many other terms are being used synonymously with Open Science, such as Open Research, Open Scholarship, Science 2.0, and eScience[5]. There are no reports or articles available on the relation of Open Science and Science diplomacy, if at all, we find similar constellations in scholarly literature on Open Innovation Diplomacy[6] or Data Diplomacy[7]. Openness is considered in regard to diplomacy mostly as opposite to secrecy[8], and sometimes referred to in the context of "public diplomacy"[9]. However, we do find events, that thematise the relationship of Open Science and diplomacy, like the 2019 CODATA conference in Beijing, which is co-hosting a high-level policy event with the title: "Implementing Open Research Data Policy and Practice"[10], directed to international research policy makers and representatives of the research systems.

In the decade up to 2019 Europe has expanded its science, technology and innovation (STI) agenda with the concept of Responsible Research and Innovation (RRI) towards considering RRI dimensions such as ethics, gender equality, open access, science education, public engagement, governance throughout the entire research and innovation process[11]. The Open Science Agenda builds on these dimensions, and should add answers and solutions to the following issues

- Europe is too "rarely succeeding in getting research results to market. Technologies developed in Europe are most of the time commercialised elsewhere.
- Although Europe generates more scientific output than any other region in the world, in some areas we fall behind on the very best science. At the same time, there is a revolution happening in the way science works. Every part of the scientific method is becoming an open, collaborative and participative process.
- Europe punches below its weight in international science and science diplomacy. Our collective scientific importance should be matched by a more active voice in global debates."[12]

In his approach to EU science diplomacy Commissioner Moedas outlined the leading role of Europe in the implementation of Open Science within the RRI framework for research and innovation funding, and the potential of Europe becoming a role model of Open Science. It is thus vital to explore opportunities offered by Open Science, particularly open data and open access, to the provision of scientific advice to foreign policy and vice versa.

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[5] Open Science MOOC. Retrieved from: https://opensciencemooc.eu/ as accessed 01 June 2019.

[6] Carayannis, E. G., D.F.J. Campbell (2011): Open Innovation Diplomacy and a 21st Century Fractal Research, Education and Innovation (FREIE) Ecosystem: Building on the Quadruple and Quintuple Helix Innovation Concepts and the "Mode 3" Knowledge Production System. Journal of the Knowledge Economy, 2(3), pp. 327–372. https://doi.org/10.1007/s13132-011-0058-3

[7] Boyd, A., J. Gatewood, S. Thorson, T.D. Bowman (2019): Data Diplomacy. In: Science & Diplomacy, 8(1). Retrieved from: http://sciencediplomacy.org/article/2019/data-diplomacy as accessed 01 June 2019.

[8] Wichowski, A. (2015): 'Secrecy is for losers': Why diplomats should embrace openness to protect national security. In: Digital diplomacy theory and practice, Routledge New York, NY, pp. 52–70.

[9] Melissen, J. (2005): The new public diplomacy: Between theory and practice. In: The new public diplomacy, Springer, pp. 3–27.

[10] CODATA Conference 2019. Retrieved from: http://www.codata.org/ as accessed 01 June 2019.

[11] Grunwald, A. (2014): The hermeneutic side of responsible research and innovation. In: Journal of Responsible Innovation, 1(3), pp. 274–291.
Owen, R., P. Macnaghten, J. Stilgoe (2012): Responsible research and innovation: From science in society to science for society, with society. In: Science and public policy, 39(6), pp. 751–760.
Randle, S., J. Youtie, D. Guston, B. Hawthorn, C. Newfield, P. Shapira, …N.F. Pidgeon (2012): A trans-Atlantic conversation on responsible innovation and responsible governance.
Flink, T., D. Kaldewey (2018): The new production of legitimacy: STI policy discourses beyond the contract metaphor. In: Research Policy, 47(1), pp. 14–22. https://doi.org/10.1016/j.respol.2017.09.008

[12] Moedas, C., Directorate-General for Research and Innovation (European Commission) (2016): Open innovation, open science, open to the world. Retrieved from: https://op.europa.eu/en/publication-detail/-/publication/3213b335-1cbc-11e6-ba9a-01aa75ed71a1 as accessed 01 June 2019.

How can Open Science be exploited for decision-making support, knowledge resources and science diplomacy governance frameworks? How are RRI and in particular Open Science perceived by non-European partners and can thus be harnessed for EU foreign policy? What requirements of foreign policy interventions for Open Science?

These questions might open up a horizontal division into 1) a content/procedural perspective: how can/does Open Science help foreign policy-making, and 2) a thematic perspective: Open Science as topic of foreign policy (though those perspectives might be overlapping to some extent). Contrasting those dimensions enriched our investigation both in the study of documents and in interviews with experts.

1.1 Methodology

We have approached these questions with a qualitative research methodology consisting of a mix of desk-based document analysis, narrative expert interviews and participant observation completed between June 2018 and June 2019. Document analysis was focusing on EU strategy and policy documents as well as policy and scholarly discussion of member and associated states, as well as international discourse on the state of transition towards Open Science. This research was furthermore guided by insights gathered from the authors role as expert and rapporteur in the Horizon 2020 Policy Support Facility Mutual Learning Exercise on Open Science: Altmetrics and Rewards (2017-2018)[13], as well as her role as active member of the Open Science Network Austria[14]. A set of 23 semi-structured interviews were carried out face-to-face or via telephone from October 2018 to June 2019. Interview partners come from diverse backgrounds, from science policy, research, infrastructures to international organisations. Some of them add an extra-European perspective for instance from Moldova, Argentina, or India. However, finding interview partners was not easy, especially persons from the fields of diplomacy of foreign relations were either too busy or in their own opinion "not knowledgeable enough" about Open Science to be available for an interview – from 23 interviews only 3 persons have a traditional diplomatic background. Nevertheless, 5 others explicitly follow an international cooperation agenda for science, but would not call themselves science diplomats, even though they concede that their international work might cross the Royal Society definitions of science diplomacy[15]. Two other interview partners represented the European Commission, with a focus on Plan S and the European Open Science Cloud.

[13] European Commission (2018): MLE on Open Science—Altmetrics and Rewards—RIO - H2020 PSF. Retrieved from RIO - H2020 PSF website: https://rio.jrc.ec.europa.eu/en/policy-support-facility/mle-open-science-altmetrics-and-rewards as accessed 01 June 2019.

[14] Open Science Network Austria. Retrieved from: https://www.oana.at as accessed 01 June 2019.

[15] Royal Society (2010): New frontiers in science diplomacy: Navigating the changing balance of power. Science Policy Centre London.

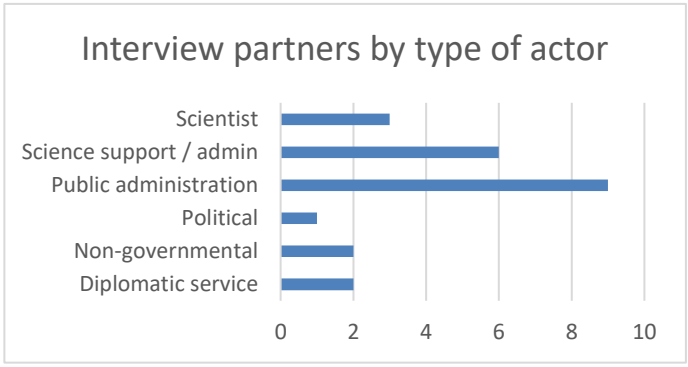

Figure 1: Interview partners by type of actor

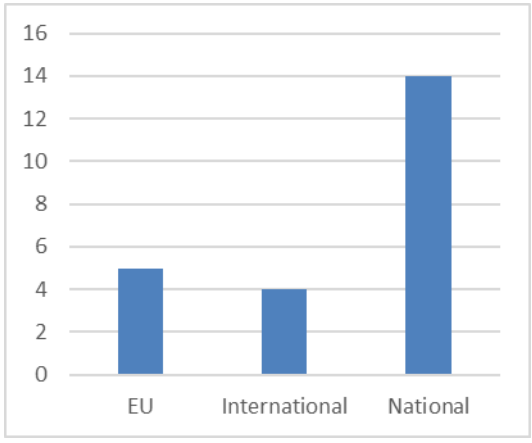

Figure 2: Governance level of interview partners' Open Science activities

In addition, both authors of the report attended conferences, workshops, and meetings dedicated to Open Science, where they could perform participant observations and take notes of informal conversations.

To illustrate the different levels of national and international negotiations on Open Science, we chose to include a recurring excursus to the situation in the Netherlands – authored by Ewert J. Aukes from the S4D4C partner University of Twente.

Figure 3: Wordcloud of topics in interviews

1.2 Background of the case: Open Science as a policy arena

Scholarly research practices are currently changing in fundamental ways and bring about new forms and qualities of interactions within society around the globe. Increasingly, researchers utilize online platforms and tools, produce digitally, share and reuse data and educational materials, and communicate via social media and mobile ICT. There are now innumerable possibilities of producing and sharing knowledge. The Open Science movement is based on the idea that scientific knowledge of all kinds should be openly shared as early as is practical in the research process. By demanding maximum transparency and shareability in knowledge production and transfer as well as the participation of (all) relevant stakeholders in the scientific process, Open Science strives to increase:

- reproducibility and accountability
- reusability and innovation (in its broadest sense)
- collaboration and societal participation respecting diversity, fairness and social responsibility.

It is important to emphasize that Open Science does not only focus on knowledge artefacts, research outputs, and technological affordances. It is first and foremost about social practices, thus the norms and values for organising research in society[16].

Open Science principles are currently discussed on a global scale by governments, funders, research-performing organizations and individual researchers. There is hope that with opening the publicly funded STI system and enhanced international collaboration societal and environmental challenges can be better tackled and scientific knowledge can become robust enough to be rapidly mobilized and reusable. This broad debate tackles the social function of publicly funded research and the current state of research systems in general. Thus, Open Science provides an opportunity to renegotiate the social roles of science, their links to inclusive growth, societal well-being, education and industry and to ask how multi-level agendas and interests can best be converged. Furthermore, the debate on Open Science sheds light on new developments of international scientific cooperation and coordination.

The European Union has embraced Open Science as a means to tackle multiple issues since 2015. "Open Science has the potential to increase the quality, impact and benefits of science and to accelerate advancement of knowledge by making it more reliable, more efficient and accurate, better understandable by society and responsive to societal challenges, and has the potential to enable growth and innovation through reuse of scientific results by all stakeholders at all levels of society, and ultimately contribute to growth and competitiveness of Europe." – European Union Competitiveness Council, 2016[17]

In Europe – mainly driven by a) the Open Access requirements in Horizon 2020, the framework programme for Research and Innovation and b) the European Research Area ERA roadmaps – there are many initiatives: several Member States have already adopted or prepared national Open Science Plans (f.i. NL, SE, FI, PT, FR); Member States and Associated Countries are working together in the European Research Area Committees (ERAC) in furthering the advancement of Open Science and Innovation and ERA implementation (priority of an open labour market for researchers and priority of optimal circulation and transfer of scientific knowledge), and are discussing how best to align various other EU policies and treaties with the implementation of Open Science. Since Europe is facing diverging velocities in the implementation of Open Science both within

[16] Smith, M. L., R. Seward (2017): Openness as social praxis. In: First Monday, 22(4).

[17] European Union Competitiveness Council, 2016. Retrieved from: https://www.consilium.europa.eu/en/meetings/compet/2016/05/26-27/ as accessed 01 June 2019.

research communities and research and education policies, the international perspective might help to align cross-cutting issues and core driving aspects of Open Science along differences of European science governance.

Open Science has become an international policy effort: the 2016 Amsterdam Call for Action[18] (at the Netherlands' EU presidency on 4 and 5 April 2016) set out the following objectives: to provide **open access for scientific publications** by 2020, to make **open research data** and data stewardship the default approach for publicly funded research, to develop **new assessment and reward systems**, and to **align policies internationally** and **exchange best practices**. By 2017 G7 science ministers have signed a memorandum on international coordination of the development of incentives and infrastructures for Open Research. Placing science and innovation at the heart of the political agenda, G7 countries aim at **inclusive growth** and **social innovation**. They promote balancing regulation and incentives of Open Science to **increase productivity** and social impact[19]. Several leading charities and private funders have initiated the Open Research Funders Group ORFG[20]. OECD[21] and UNESCO[22] are producing reports on Open and Inclusive Collaboration in Science and are calling for **better policies and legal frameworks** for the conduct of Open Science. In the USA, the NIH (OA mandate since 2008), NSF, etc. are following the 2013 White House memorandum by developing and implementing Open Science policies[23]. Asian, South American and African countries are increasingly engaging in Open Science activities, mobilising multiple bottom-up initiatives, developing Open Access strategies, while some are already enforcing OA mandates[24].

2. Open Science Governance: What are the questions for international cooperation and science diplomacy?

Dynamics in the development of international science and policy have also come along with conspicuous changes in the stakeholder landscape over the last 30 years. Today, we see a broad variety of advocacy actors and policy implementing organisations (such as funders and research organisations) with the increased involvement of publishing and content service industries, while many cross-border activities still rely on informal and personal relationships as our interview partners recount. This is no different in the Open Science arena. However, what the Open Access movement has dramatically unmasked since the early years 2000s is the imbalanced and costly system of scholarly publishing and the global power corporate gatekeepers and scoring mechanisms, such as the Journal Impact

[18] Amsterdam Call For Action for Open Science. Retrieved from: https://www.government.nl/documents/reports/2016/04/04/amsterdam-call-for-action-on-open-science as accessed 01 June 2019.

[19] G7 Expert Group on Open Science. Retrieved from: http://www.g8.utoronto.ca/science/2017-annex4-open-science.html as accessed 01 June 2019.

[20] Open Research Funders Group. Retrieved from: http://www.orfg.org/ as accessed 01 June 2019.

[21] Dai, Q., E. Shin, C. Smith (2018): Open and inclusive collaboration in science: A framework. https://doi.org/10.1787/2dbff737-en

[22] UNESCO reports. Retrieved from: http://www.unesco.org/new/en/communication-and-information/access-to-knowledge/open-access-to-scientific-information/ as accessed 01 June 2019.

[23] National Academies of Sciences, E., Affairs, P. and G., Information, B. on R. D. and, & Enterprise, C. on T. an O. S. (2018): Office of Science and Technology Policy 2013 Memorandum: Increasing Access to the Results of Federally Funded Scientific Research. Retrieved from: https://www.ncbi.nlm.nih.gov/books/NBK525415/ as accessed 01 June 2019.

[24] Innovation Policy Platform: Open science country notes. Retrieved from: https://www.innovationpolicyplatform.org/www.innovationpolicyplatform.org/content/open-science-country-notes/index.html as accessed 01 June 2019.; UNESCO Global Open Access Portal. Retrieved from: http://www.unesco.org/new/en/communication-and-information/portals-and-platforms/goap/access-by-region/asia-and-the-pacific/ as accessed 01 June 2019.

Factor, which are evidently biased and inadequate to measure scientific performance, as well as the power of their gatekeepers in the publishing industry[25].

Since 2008 – the launch of the Open Access Pilot in FP7 - Europe has established a broad catalogue of measures to initiate, adopt and further promote a systematic and paradigmatic shift towards collaboration, sharing and sustainability in publicly funded research: starting from Open Access to Publications and Research Data in the current Framework Programme Horizon 2020, building necessary infrastructures following the vision of an European Open Science Cloud, and envisioning more openness in evaluation and hiring procedures[26], as well as building the foundations for skills and competencies for the next Framework Programme. In the proposal for Horizon Europe, Open Science is again a major cross-cutting principle: "Fostering Open Science and ensuring visibility to the public and open access to scientific publications and research data, including appropriate exceptions" in included in the objectives for Horizon Europe. There are mandatory open access (to publications and data) rules foreseen, as well as the need to develop adequate "incentives or obligations to adhere to Open Science practices" while listing several rewarding mechanisms for "promoting the adoption of Open Science practices, responsible R&I" [27]. However, there are several aspects that still have to be sorted out and detailed in the coming years, like aligning principles of FAIR data sharing with intellectual property regulation and exploitation opportunities, broadening Open Access to other forms of research output, requiring institutions to assume responsibility and introduce adequate open policies, and introducing responsible, new-generation metrics for assessing output and both scientific and societal impact[28].

Open Science and Science Diplomacy: where there is a will, there is a way?

With all those activities, Europe is indeed at the international forefront of implementing Open Science in public funding schemes. The European Commission acts as role-model for European member states and associated countries – as observations as well as interview partners confirm. On the other hand, the European Union constantly works on enlarging their international research cooperation. Even though receiving European funding entails adhering to the open access standards for publications and data, it does not mean that these necessary conditions are discussed as part of the science cooperation agenda. Moreover, the Open Science strategy seems to be not as closely linked to the science diplomacy agenda, as originally intended. How can Open Science help to develop S&T leadership as well as strengthen regional as well as global relationships? How exactly Open Science could form the basic "infrastructure" for "Open Innovation" and "**Open to the World**", these questions were left unanswered, since the report of the RISE group and the book on the three Os were published in 2016[29]. Even in those reports concrete proposals for the linking of Open Science and Science diplomacy are missing. Neither the cooperation

[25] Hicks, D., P. Wouters, L. Waltman, S. De Rijcke, I. Rafols (2015): Bibliometrics: the Leiden Manifesto for research metrics. In: Nature News, 520(7548), p. 429.

[26] Working Group on Rewards under Open Science (2017): Evaluation of Research Careers fully acknowledging Open Science Practices. European Commission.

[27] For relevant excerpts of the agreed texts of proposal and regulation of Horizon Europe in April 2019, see this statement by SPARC, retrieved from: https://sparceurope.org/open-science-essential-for-new-horizon-europe-funding-programme/ as accessed 01 June 2019.

[28] Burgelman, J. C. (2017): European Perspectives on Open Science Policy. Policy gehalten auf der SA-EU Science Workshop, Johannesburg. Retrieved from: https://www.slideshare.net/AfricanOpenSciencePlatform/european-perspectives-on-open-science-policyjc-burgelman as accessed 01 June 2019.

[29] Directorate-General for Research and Innovation (2017): Europe's future: Open innovation, open science, open to the world. Reflections of the Research, Innovation and Science Policy Experts (RISE) High Level Group. Brussels: European Commission.;
European Commission (2016): Open Science, Open Innovation and Open to the World. Luxembourg: Publications Office of the European Union.

among Member States for the orchestration of Open Access activities, nor the external relations necessary for a global coordination were further outlined, even though the main emphasis was put on **global collaboration and mobility**. Openness in this regard means that "researchers and innovators are able to work together smoothly with colleagues worldwide and where researchers, scientific **knowledge and technology circulate** as freely as possible"[30], and join forces to tackle scientific and global challenges: "Science is and must remain 'Open to the World' as a matter of necessity (it cannot be otherwise in a globalised world), as a matter of quality (we need **access to the best knowledge worldwide**) and as a **contribution to progress** (investing in research makes sense in human, social and economic terms)."[31], said Carlos Moedas in a speech at the World Science Forum 2017 on the World Science Day for Peace and Development in Jordan, at the advent of the signature of Jordan to PRIMA, the Partnership for Research and Innovation in the Mediterranean Area.

A central finding of this case study is that the link between Science diplomacy and Open Science activities is barely acknowledgeable. Science diplomacy is not a common term in the realms of global Open Science. Nevertheless, a lot of things are going on – on the frontstage and the backstage of international political cooperation for the advancement of the transition towards Open Science. Whereas the European Union has focused in the last decade more on a European agenda and the alignment of approaches for Open Access and Open Data, the orchestration of international science policies towards a transition to Open Access requires other strategies and needs to build sustainable structures, as here traditional publishing business models and knowledge markets are disrupted. Stakeholders from research, policy and industry are sorting out their positions and new relationships around the implementation of Plan S, a framework for the regulation of publishing practices for publicly funded research, which will be described in more detail in the chapters to follow[32].

Whereas Plan S coordination has already triggered some specific international cooperation of science and diplomacy, other areas of Open Science, such as Open Data or Open Educational Resources have not yet reached their diplomatic dimensions, even though they are discussed on international level. From the interviews we learn that **policy stakeholders are still sceptical**. While we see commitment everywhere in the world and stakeholders are urgently seeking to improve the sustainability of STI systems and to distribute access to its benefits more equally, such activities and recommendations are often met with scepticism by policy makers, as there is a lack of reliable evidence to support the narratives of opportunities and benefits through Open Science, especially of socio-economic benefits[33]. So, one major issue in the internationalization of Open Science currently is to get policy-makers, funders, researchers and industry together to produce this evidence, another issue it to comprehend the potential for STI leadership, on regional and global scale. We need to better understand how the tree Os actually work together and profit or limit each other. Furthermore, investment into Open Science is an inherently international effort that requires not only global thinking but also international exchanges of best practices for governance or alignment of policies. This is of great importance to

[30] European Commission (2016): Open Science, Open Innovation and Open to the World. Luxembourg: Publications Office of the European Union, p. 68.

[31] Moedas, Carlos: speech 2017. Retrieved from: https://ec.europa.eu/commission/commissioners/2014-2019/moedas/blog/open-world-aspects-wp_en as accessed 01 June 2019.

[32] On 4 September 2018, the cOAlition S published a strategy aimed at further advancing and accelerating Open Access to scholarly publications. Research results funded with public money must be published in Open Access journals or repositories accessible to the general public from 2021. Plan S defines the framework conditions under which publications must be published. See for further information: https://www.coalition-s.org/ as accessed 01 June 2019.

[33] Ali-Khan, S. E., A. Jean, E. MacDonald, E.R. Gold (2018): Defining Success in Open Science. MNI open research, 2.

tackle the most frequently brought up issue of **reciprocity**. As one interview partner put it: "If we go too fast, if we give away our know-how for free without the warranty of reciprocity, we are naïve."[34] This quote illustrates the dilemma of the collaborative and the competitive ends of global science.

In Chapter 4 the sections on "De-facto Governance" will explain in more detail the governance challenges arising in two interlinked areas: the coordination of Open Access policies on a global scale and the opening of research infrastructures to better collaboration and open access to research data. With the example of two European-led initiatives, i.e. Plan S and the European Open Science Cloud, we illustrate both issues of governance and cooperation and some international perspectives on Europe's efforts. Before, we summarise how the international Open Access movement was introduced to Dutch science policy stakeholders and turned into a national agenda.

2.1 Excursus 1: Open Science governance arrangements in the Netherlands (Ewert Aukes, Jan 2019)

2.1.1 From international movement to domestic policy change

Depending on who you ask in the Netherlands, the roots of Open Science date back to different times. While there is an argument to make that modern-day science practices, e.g. scientific publication dominated by international commercial publishing houses, are much more closed now than they were before, the Dutch Science Organization (NWO), the Netherlands' largest research funding organization, has presented a timeline which contains many of the significant events that are mentioned by many of the people interviewed (Figure 1).[35]

[34] Interview 22, October 2018.

[35] The Dutch knowledge hub on all things OA, www.openaccess.nl/nl/in-nederland/stand-van-zaken, presents a slightly different timeline. It ranges from 2011 until now and unsurprisingly focuses on OA news that is applicable to the Dutch academic context. Some of the events feature in both the timelines of NWO and openaccess.nl, some figure exclusively in either of the two. The information on the Big Deals of the Dutch academic sector with the large academic publishing houses for the section below is taken mainly from the openaccess.nl timeline.

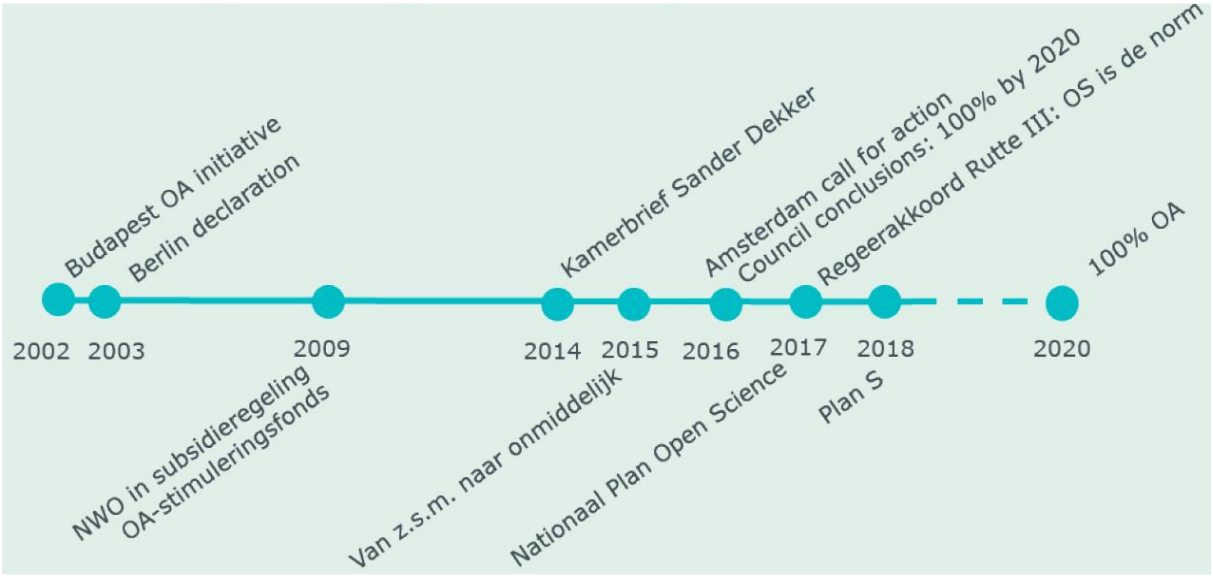

Figure 4: History of Open Science in the Netherlands (source: presentation president NWO).

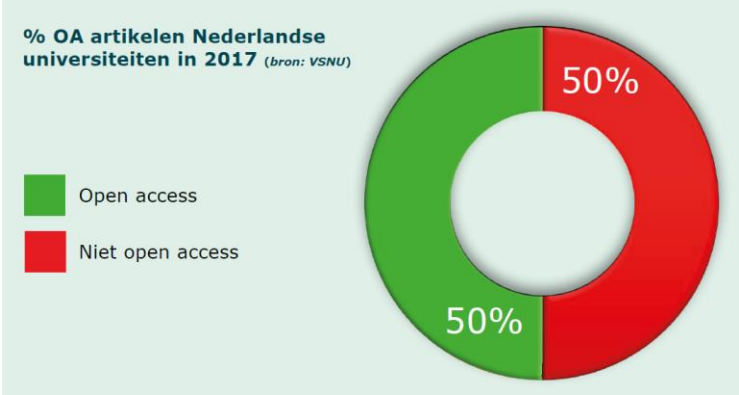

Figure 5: Share of Dutch scientific publications published in Open Access outlets in 2017 (source: presentation president NWO).

First science policy ideas to open up scientific publications to a larger public already surfaced in the early 2000's with the Budapest Open Access Initiative and the Berlin Declaration on Open Access to Knowledge in the Sciences and Humanities. According to NWO, the first Dutch impact of the Open Science movement effectuated in 2009, when NWO began funding Open Access (OA) publications: a maximum of 5000€ was available per NWO-funded project for publications in scientific, peer reviewed OA journals.[36] The recent history of Open Science in the Netherlands begins with a much-reported letter to the Parliament by then undersecretary of education, culture and science Dekker stating that the public funding of research in the Netherlands calls for OA publication of all research. This goal was to be achieved by 2024.[37] An often-mentioned event and even judged a pivotal year by some was the year 2016. Not only did the Dutch

[36] Due to the age of the fund, NWO does not have official webpages with descriptions of this fund available. The only trace I found of this is on a blog on OA: Marijke van der Ploeg (21 March 2010): Open Access fonds NOW. Retrieved from: https://marijke-anyway.blogspot.com/2010/03/open-access-fonds-nwo.html as accessed 01 June 2019.

[37] Dekker, S. (2013, 15 November): Open Access van publicaties [Letter to Parliament]. Retrieved from: https://www.tweedekamer.nl/kamerstukken/brieven_regering/detail?id=2013Z22375&did=2013D45933 as accessed 01 June 2019.

government put Open Access high on the European agenda with the Amsterdam call for action during its EU presidency that year, but also the European Council decided that by 2020 100% of European scientific output is to be published OA. A process with a strong impact on the publication of publicly available scientific output were the so-called 'Big Deals' with publishing houses (see Text Box 1). The governmental stimulus to publish scientific output in OA outlets had already led to a 50% share by 2017 (Figure 2). Moreover, early that same year the Dutch National Plan Open Science saw the light of day which is considered a very important framework document for OS in the Netherlands (NWO representative). This plan embodied the commitment of Dutch science and science policy organizations to the 2020 100% OA goal. Besides accounting for what was already going on in terms of Open Science, it stated 14 ambitions in four fields: Full open access to publications, making research data optimally suitable for reuse, Recognition of and rewards for researchers and promoting and supporting Open Science.[38] The implementation of the National Plan Open Science led to the two-year appointment of a National Coordinator Open Science in 2018, a role meant for furthering the realisation of Dutch Open Science ambitions and strengthening the Netherlands' pioneer position on the topic. Later on in 2017, Open Science's momentum was bolstered by the coalition agreement of the newly formed cabinet under PM Rutte stating that Open Science and open access would become the norm in scientific research.[39]

[38] OCW (9 February 2017) National Plan Open Science. doi: 10.4233/uuid:9e9fa82e-06c1-4d0d-9e20-5620259a6c65.

[39] VVD, CDA, D66, ChristenUnie. (2017, 10 October): Vertrouwen in de toekomst: Regeerakkoord 2017 – 2021.

Text box 1

Big Deal negotiations as OA push

As lead actor in the Dutch academic transition towards OA, the Association of Universities in the Netherlands (VSNU) is in charge of negotiations with academic publishing houses. There is an agreement with the government that no new contracts with publishers will be closed that do not include OA provisions. The negotiations take place in cooperation with the Dutch consortium of university libraries and the National library of The Netherlands and has by now yielded the following 'Big Deals':

- Dec 2014: **Springer** deal for 2015 and 2016, no payments for journal subscriptions, but for publication in Springer's approx. 1.500 hybrid journals
- Apr 2015: **Wiley and Sons** agrees to invest in Open Access
- Jul 2015: **SAGE** strikes two-year agreement about OA transition
- Dec 2015: Three-year framework agreement with **Elsevier** on OA publishing
- Feb 2016: OA agreement with **Wiley and Sons**, allowing for OA publication in 1.400 of their journals
- May 2016: From 2017, all articles including an author from a Dutch university will be published OA by the **American Chemical Society** without extra fees
- May 2017: **Cambridge University Press** agrees on OA publication in 339 hybrid journals and 17 fully open journals
- Mar 2018: New agreement with **Springer** allows 2.080 OA published articles per year for four years
- Mar 2018: OA included in new agreement with **Oxford University Press** for the first time
- Jun 2018: OA agreement in contract renewal with Dutch publisher **Wolters Kluwer**
- Jan 2019: articles in **Oxford University Press** journals can be published OA for free for the coming two years

In a meeting organized by NWO at the end of March 2019 to discuss the implication of Plan S and how to prevent detrimental effects, especially for OA publications, several issues were touched upon. Changing the publication rules during the game was seen as the effect of the 100% OA policy with immediate implications for individual scientists. It became clear that the impacts of the 100% OA ambition would differ across the academic demography and would potentially impair mobility of individual scientists. Finally, it can be asked what the Big Deals' foreign policy implications is, given that VSNU, a non-governmental national actor is negotiating those deals with large-scale publishing houses from the Global North which operate on a global scale with commercial interests.

2.2 Contributing to debate on EU level

Gradually, Dutch academic organizations started to link up with the debate on EU level. Of course, Carlos Moedas' '3 O's' had already heaved the topic of Open Science onto the European agenda in 2015. However, once the debate was picking up momentum in the Dutch science policy arena and potential policy objectives began to materialize, Dutch academic organizations such as NWO heeded the necessity of representing the Dutch interests also on a European level. This activity and engagement only grew more intense with the publication of Robert-Jan Smit's 'Plan S' at the end of 2018, which solidified the EC's ambitions with regard to Open Science. Plan S not only presented the opportunity for

the Dutch academic sector of playing a leading role in setting the pace for the development of Open Science in the EU and potentially globally, but also the necessity of weighing in on the debate to ensure the Dutch academic sector would not fall behind on the topic of Open Science. NWO coordinates further Plan S negotiations to ensure a unified Dutch voice. In a way, the European efforts to implement Open Science could also be seen as catching up, as there is already a large role for Open Science in South America, albeit with different mechanisms and routes. Finally, the San Francisco DORA declaration was also mentioned by many interviewees as a significant step towards Open Access which was also ratified by Dutch science policy organizations. Currently, the Dutch science policy organizations are negotiating on different levels to realise Plan S and maximize the share of Open Access published publications in the Netherlands.

3. Stakeholder landscape

Interview partners described the stakeholder landscape and actors involved in the Open Science policy arena.

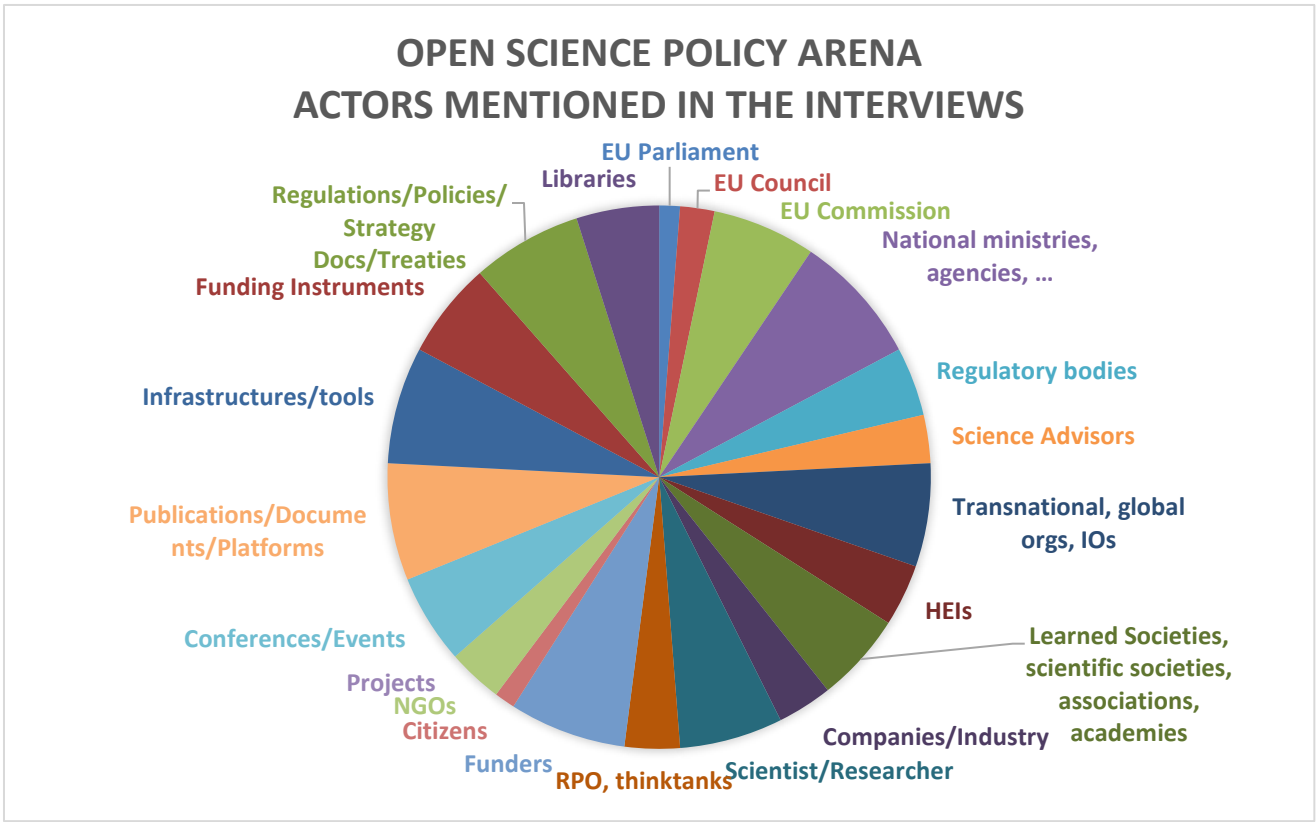

Figure 6: Actors in the Open Science policy arena as mentioned in the interviews. Pie illustrates the distribution of mentions.

Bringing together results from desk research and interviews, the following types of stakeholders are most visibly involved in the international Open Science arena. In the table we describe briefly the activities that were mentioned in the interviews and observed in the case study, which concern Open Science as well as related international or regional cooperative actions.

Type of actor	**description of activities and formats**	**exemplary actors**
Supra-national (science) policy actors	Statements, reports, platforms with description of state of the art, needs analyses, best practices and recommendations. Task forces and working groups.	G7/G8 Science Ministers, OECD, UNESCO, UN, WHO
European (science) policy actors	Policy alignment, regulations (funders) alignment of EU and member states, role models, expert advice, working groups	EU Commission DG Research and Innovation, DG Connect, the European Research Council ERC, ERAC working groups; Open Science Policy Platform; European Competitiveness Council; European Strategy Forum for Research Infrastructures ESFRI, High level expert groups, Science Advisors (SAM)
National-level science policy actors	Working groups (overlapping with ERAC), guidelines or national roadmaps and action plans, research policy and financial and legal frameworks, national research documentation systems	Research, education and innovation ministries and related public services, agencies
Public research funding organisations	Funders are predominately supporting Open Science, except innovation funds, that only rarely and then cautiously implement optional Open Access schemes. The international representatives of European science funders are particularly active, see i.e. Plan S. Policies, guidelines, trainings, international exchanges and coordination (e.g. for transparency of publishing costs)	Science funding agencies, research councils, science academies, or innovation funds Science Europe, Global Research Council
National foreign policy actors /diplomatic services	Event organisation, briefing documents and preparation of negotiations	Delegations in embassies, liaison officers in ministries, science attaches, and dedicated offices, such as the Office of Science and Technology of Austria in Washington OSTA.

Charitable organisations and trusts acting as research funders	Policies, guidelines, trainings and capacity building, international exchanges and coordination, lobbying, infrastructures Often role models for science policy makers.	Wellcome Trust, Gates Foundation, Sloan Foundation, Open Society Foundations, … see also the Open Research Funders Group …
Research performing institutions, higher education institutions and their international representatives	Policies, education and capacity building, infrastructures, lobbying, incentives and rewards, conferences … advocacy and engagement level commonly depending on the activities of libraries	League of European Research Universities (LERU), European University Association (EUA), Association of African Universities (AAU),…
Research infrastructure organisations, libraries, archives, and information services, as well as museums (and their international representations)	Research documentation, repositories, infrastructure, technology, governance models, lobbying, training, international exchanges and coordination, negotiation of big deals with publishers in cooperative library consortia. Either strongly advocating, partially involving, sceptically observing, or fully rejecting Open Science developments. Sceptical are mostly cultural heritage institutions as well as specialist archives, which are depending on sparse resources for long term digitization, curation as well as visitor fees/subscriptions.	Among the advocates are the Association of Research Libraries (ARL), LIBER, OpenAIRE, the Council of the Australian University Librarians (CAUL), The Confederation of Open Access Repositories (COAR), REDALYC, GÉANT (pan-European collaboration on e-infrastructure), DARIAH (European research infrastructure).
Learned societies and their international representatives	Running or publishing scientific journals or research databases, conferences, platforms, lobbying	Discipline specific associations, European Citizen Science Association, Global Young Academy, and the International Science Council
Civil society organisations, NGOs, NPOs, or associations, intermediaries	Research, infrastructure, platforms, networking, consulting, statements, briefings, technology, strategic development, international coordination…	Advocating OS: SPARC, Mozilla, Wikimedia, EIFL, African Open Science Platform, Research Data Alliance (RDA), Wikimedia Policy consultants and support: RAND, Lisbon Council (Open Science Monitor)
Publishing and research services industry	Publishing, indexing, competing and developing new Open Science business models	Monograph or journal publishers, repository and research and documentation

	(Gold OA, Article Processing Charges), monitoring, documenting, analysing, lobbying, infrastructure, policies	infrastructure providers, discovery services, conference services, data management and analysis services, such as the Holtzbrinck Group, Elsevier, Frontiers, F1000, …
Individuals	All of the above-mentioned activities. Many of them speaking out, publishing, blogging, teaching about Open Science (pro and con) and networking	Researchers, technology developers or librarians, involved in grassroots' activities, science administration as well as in policy advisory bodies[40]. Moreover, there is a growing community of internationally mobile students and next generation researchers developing and promoting Open Science activities and policies.

Table 1: Actors in the international Open Science arena as mentioned in the interviews and gathered through observation.

The relations between these actors, as well as their roles vary when looking at the respective thematic and geopolitical domains. The common ground, however, is the inherent international cooperative and political character of all the exchanges that were studied and discussed in the interviews. From the research performing organisation in Europe that wants to establish an open access policy and looks to international best practise via its diverse networks to national policy makers, who are creating new STI policies: many of them – even non-European ones[41] - are first and foremost looking at the status quo in European programmes, then turn to compare countries or organisations with similar configurations in the governance of publicly funded science, before they craft their roadmaps or policies. Providing the necessary modular stepping stones, guidelines and role models, has therefore become more and more important in the last years, as was also demonstrated by the Mutual Learning Exercise on Open Science in 2018[42].

Another set of important actors in the Open Science arena are umbrella organisations or international associations of RPOs and libraries. Since libraries or library consortia were among the first advocates of Open Access – because of their insights to the business models of big commercial publishers – they already share a long history of international lobbying for Open Science topics.

> *"Our approach is that we work with library consortia and that's also something that was a little bit strange for previously closed countries, because before they were used to working in environments where they were told what to do, and they didn't need to have any kind of shared governance mechanisms or*

[40] SEE THE LIST OF MEMBERS OF THE OPEN SCIENCE POLICY PLATFORM https://ec.europa.eu/research/openscience/pdf/ospp_nominated_members.pdf #view=fit&pagemode=none OR THE LIST OF AMBASSADORS FOR PLAN S https://www.coalition-s.org/ambassadors/ as accessed 01 June 2019.

[41] With the exception of Latin American and Caribbean Countries that are part of the long term successful and growing Open Access system CLACSO: there are many regional and national initiatives, such as OA journal platforms, publication and data repositories, framed by supportive governmental policies (see SciELO and RedALyC). Here we find growing attention of European Open Science actors, that Europe can learn from these pioneering developments and well as should establish stronger partnerships. CLACSO. Retrieved from: https://www.clacso.org/ as accessed 01 June 2019.

[42] Mayer, K., S. Leonelli, K. Holmberg, F. Miedema (2018): Mutual Learning Exercise: Open Science—Altmetrics and Rewards. European Commission.

> *collective decision-making processes. […] But they learned very fast, since they are seeing their limitations in budgets and at the same time the demand from the research community."*[43]

Library consortia are also highly trusted stakeholders, particularly in countries facing frequent fluctuations in policy making and research institutions. Similarly, large e-infrastructure providers and consortia promoting data sharing can look back at a large knowledge base of international research cooperation. They are thus also among the strong voices in the discourse, building on their diverse experiences of benefits and challenges of data sharing.

When looking for Open Science Diplomacy, namely implementations of the link of Open Science with Science diplomacy as envisioned by Moedas[44] to serve European values and tackle global challenges, then we find that only recently the topic of Open Access and - even more marginally - the topic of Open Data has found its way to both EU and national-level foreign policy bodies. Yet, we have not discovered any formalised or stabilised interactions aside from ad-hoc activities, which would put Open Science on an EU wide foreign policy agenda. We could not find evidence, other than anecdotal, on any substantial involvement of the European External Action Service. Our interview partners reported several cases, where Open Science was mentioned alongside other science or culture-related agenda points in high level diplomatic exchanges (e.g. between EU-Switzerland, EU-Russia, EU-LAC). Furthermore, we heard of some initiatives, such as the initiative for an Open Science Working Group in the Western Balkans[45], or some regional EU Member States embassies' support of Open Science events e.g. in Africa, as was mentioned in an interview. Exchanges with the USA – according to one interview partner – are more frequent, although mostly bi-lateral between EU member states and the USA, but nevertheless not strategically or systematically aligned until now. In 2018 to celebrate 20 years of science and technology agreement between the EU and the US, a workshop brought together policymakers, funders, researchers, and supporters of Open Science to discuss the opportunities and challenges for international cooperation in Open Science and related paradigms:

> *"The international scientific community is now embracing Open Science approaches. In the European Union (EU), Commissioner Carlos Moedas has set three goals for research and innovation policy: Open Innovation, Open Science and Open to the World. In the United States (US), the Federal Crowdsourcing and Citizen Science Act was signed into law in January 2018. But despite such high-level support, more work is needed to understand and measure the value of Open Science policies, and to understand how to foster international cooperation in this area."*[46]

European Union Delegations – it seems – were made aware more systematically on the topic only recently. In an interview, the Open Access special envoy of the European Commission reports that he asked the EU science counsellors assigned to DG Research and Innovation or DG Connect to both create awareness of Plan S in their regions, and to help to prepare the grounds for meetings with responsible policy makers, which we will describe in more detail in the following sections.

[43] Interview 13, 27 June 2019.

[44] Moedas, C. (2016): Science Diplomacy in the European Union. In: Science & Diplomacy, 5(1).

[45] Regional Cooperation Council (2017): Regional Cooperation Council | Working Group on Open Science. Retrieved from: https://www.rcc.int/working_groups/30/working-group-on-open-science as accessed 01 June 2019.

[46] Woodrow Wilson International Center for Scholars (2018): Advancing Open Science in the EU and the US. Retrieved from Wilson Center website: https://www.wilsoncenter.org/event/advancing-open-science-the-eu-and-the-us as accessed 01 June 2019.

While this report was finalised in summer 2019 we were informed about a series of events planned around the 2019 UNESCO World Science Day for Peace in November devoted to Open Science. "Open Science is not only an issue of science being open to the research community, as in "open access" and "open data" but refers to a science open to society." Addressing disparities in accessing and sharing scientific knowledge as well as discussing how Open Science can finally become a "game changer for achieving the Sustainable Development Goals, particularly in Africa, developing countries, and Small Island Developing States (SIDS)" are central aspects mentioned by UNESCO[47]. Furthermore, UNESCO invests in a "global dialogue on Open Science to ensure that Open Science practices meet their potential in bridging the world's STI gaps and enabling sustainable development." At the time the UNESCO Executive Board is discussing a follow-up to several preceding recommendations and strategy documents[48] to foster "UNESCO's normative and standard-setting role" in Open Science and has published a consolidated roadmap for a possible UNESCO Recommendation on Open Science[49].

Around the same time, the United Nations announced to host conferences dedicated to Open Science. The first United Nations Open Science Conference on 19 November 2019 is organized by the UN Dag Hammarskjöld Library in collaboration with the Scholarly Publishing and Academic Resources Coalition (SPARC) [50]. Global Open Science is emphasized as "core enabler of the UN 2030 Agenda". The organisers are assembling representatives of different kinds of initiative, research performing organisations, industry, libraries, policy makers and researchers.

Whether or not this is a paradigm change in international foreign policy making in adopting the Open Science topic remains to be seen, however it can be regarded as important step for the topic to be on the global agenda of Science diplomacy.

[47] UNESCO World Science Day for Peace website 2019. Retrieved from: https://en.unesco.org/commemorations/worldscienceday#theme as accessed 1 November 2019.

[48] UNESCO Recommendation on Science and Scientific researchers, approved by the General Conference at its 39th session in 2017 and the UNESCO Strategy on Open Access to scientific information and research approved by the General Conference in its 36th session in 2011.

[49] UNESCO (2019): Consolidated roadmap for a possible UNESCO Recommendation on open science—UNESCO Digital Library (Nr. 207th Meeting of the Executive Board). Retrieved from the UNESCO Executive Board website: https://unesdoc.unesco.org/ark:/48223/pf0000369699 as accessed 1 November 2019.

[50] Open Science Conference 2019 at UN. Retrieved from: https://research.un.org/conferences/OpenScienceUN as accessed 01 November 2019.

3.1 Excursus 2: Open Science stakeholders in the Netherlands (Ewert Aukes, Jan 2019)

An actor network is useful to show the multitude of actors in the Dutch Open Science policy arena (Figure 3). In the following, we will give a description of those actors that are influencing the national Dutch Open Science debate. We will do so following the multi-level governance structure that is also suggested in Figure 3 starting from the bottom up.

3.1.1 Sub-national level

On a sub-national level, those institutions sit that are most implicated in their daily practices: **Universities**, **Research institutes** and **University libraries**. Of course, this is also the level hosting the actual people who are part of the longstanding grassroots movement for Open Access and those co-shape and carry out the Open Science policies: **knowledge workers** (including scientists, librarians, data managers and curators, …).

3.1.2 National level

The national level is populated with organizations participating in the Open Science policy arena. On the one hand, this includes governmental institutions such as the **Dutch cabinet**, but also the **Ministries of Education, Culture and Science** and **Economic Affairs**. On the other hand, there is a plethora of non-governmental organisations who play different roles in the Open Science policy arena. The most prominent non-governmental actors on this level are the **Dutch Science Organization (NWO)** and the **Association of Dutch Universities (VSNU)**. While VSNU leads the Big Deal Open Access publishing contract negotiations, NWO is the first contact point for all negotiations about Open Science on the European level. This role is possible, because NWO sees itself as a neutral party in the Dutch science policy arena. From that position, it can bring parties and agendas together and make connections that improve scientific cooperation. NWO explicitly does not want to be a coordinator but rather a connector that does not steer on content as a NWO representative explained in the interview. The NWO also stimulates Open Science in the Netherlands and Europe by formulating funding conditions to that effect, such as required data management plans. The **Royal Academy of Science (KNAW)** is also situated on this level and represents the interests of basic sciences. A large part of its work is negotiating the meaning of OS and its elements. KNAW is cautious in picking up swiftly on new developments. Things that have taken a long time to develop should not be changed completely in the blink of an eye, we were told in an interview. Although the

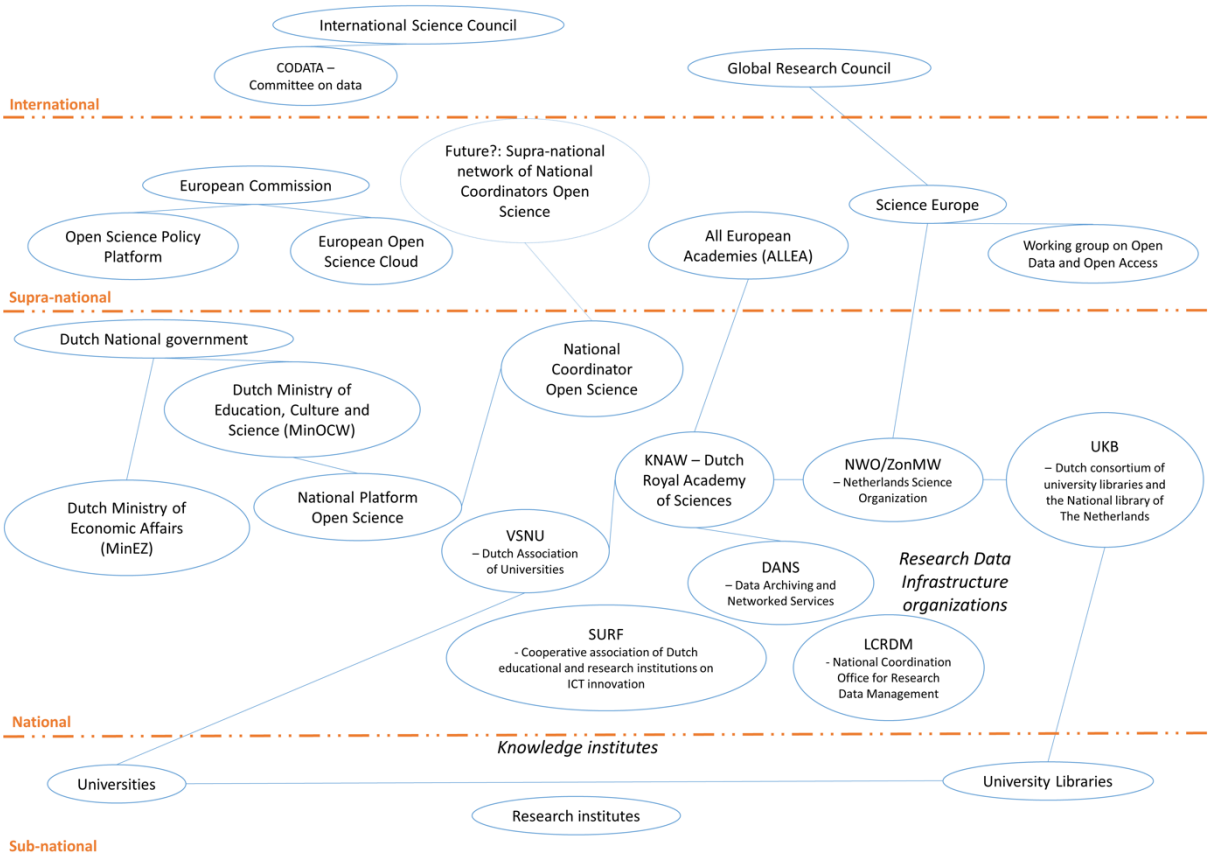

Figure 7: Visualisation of the Dutch actor network on Open Science in a multi-level governance perspective. (Ewert J. Aukes)

Academy is contented with the political activity in the Open Science policy arena, e.g. by Sander Dekker or Robert-Jan Smits, it sees the scientific community as a system of checks and balances that evaluates the feasibility of policy plans. Furthermore, some organizations represent the Dutch science infrastructure as it has developed over the decades. This includes the **Association of University Libraries (UKB),** which represents the interests of all sub-national university libraries as well as the Royal library. It also includes three organizations dealing with scientific data infrastructure. These have broadened possibilities for data sharing over the past decades and figure in the Open Data debate. These data infrastructure organizations are **Data Archiving and Networking Services (DANS)**, the **Cooperative association of Dutch educational and research institutions on ICT innovation (SURF)** and the **National Coordination Office for Research Data Management (LCRDM)**. These data organizations have different origins and are linked to different organizations. DANS is an initiative of NWO and KNAW, while SURF originates in the university context. The overlap in tasks and responsibilities suggests that a closer look at their work may increase the Dutch power in the field of Open Data. Finally, the National Open Science Plan has produced two institutions on the national level: the **National Platform Open Science** and the **National Coordinator Open Science**. The National Platform Open Science connects institutions and organisations in the Netherlands somehow involved with Open Science. By now there are around a dozen participating organizations. The platform is led by a steering group formed by presidents and chairs of Dutch knowledge organizations, which meets twice a year to discuss an agenda prepared

by the platform. The Dutch National Coordinator Open Science is also a member of the European Commission's Open Science Policy Platform (see below). Moreover, in May 2018, the European Council on Competitiveness decided that each EU Member State should have a National Coordinator for Open Science, who in turn should form a network for close interaction and exchange. Such a network would increase the possibility for better coordination of Open Science on EU Member States' level.

3.1.3 European level

The actors on the European level, who link up directly with the National Platform OS and the National Coordinator OS are the Open Science Policy Platform OSPP started by the EC and the European Open Science Cloud initiative (EOSC). For now, there is no unified understanding of what the EOSC will be among Dutch science policy actors. According to a KNAW representative, it is "a set of hardware and software that would allow all scientists to store their data in a fair way". This understanding focuses on the Open Data aspect of OS, but discussions about this are still under way. In any case, the EOSC could have a structuration effect on the national level says a NWO representative. As the appointment of a National Coordinator Open Science is promoted throughout Europe, some actors on the national level also envision a Network of National Coordinators Open Science in the future. Finally, the European level is marked by the branch organizations of the NWO and the KNAW. The NWO is organized in Science Europe, the European level organization representing the interests of science funding organizations. Here, NWO influences discussions in the working groups on Open Data and Open Access. KNAW is organized in All European Academies (ALLEA). In the field of Open Science, ALLEA publishes policy reports, organizes events and supports policy makers in interpreting the risks and promises of Open Science, especially as they are perceived by scientists. An NWO representative recognizes the European Commission as an important driver of Open Science as a policy field.

3.1.4 International level

Finally, Open Science as a science policy issue is not limited to the national or European policy arenas. Also, on the international level, organizations or networks representing the science funders (**Global Research Council**) and the **International Science Council** (with its **CODATA commission**) influence the Dutch Open Science debate.

In general, the national science policy organisations act cooperatively. They share a sense of purpose to implement Open Science in the Netherlands as advantageously as possible. There is even a degree of division of labour with responsibilities on EU negotiations and negotiations with publishers. This does not mean that there is unity in how to approach and implement Open Science in the Netherlands. It is rather an exploration process in which many terms and conditions still need to be negotiated.

4. De-facto governance practices

Before delving into the international dimension of Open Science, we should not forget: first and foremost, at its core Open Science remains a grassroots movement that is very well organised and networked among both local organisations, with a strong focus on local impact, as well as international communities, such as the Open Source or Open Hardware community, with a strong focus on innovation and knowledge commons. "Geek diplomacy"[51] – as the socio-political strategy of such groups are sometimes called – describes the "citizen, grassroots involvement" in scientific and political knowledge production by bridging knowledge divides, building alternative infrastructures and creating spaces for knowledge brokerage. While geek diplomacy and the resulting "Open Science diaspora networks"[52] have been described as offering unique opportunities for global cooperation for peace and sustainability, their potential for Science diplomacy has largely remained untapped by foreign policy makers, some of our interview partners report, even though actors in the field of international development and cooperation are already actively supporting Open Science initiatives[53].

With the ongoing digital transformation come new opportunities of cooperation on a global level: "The information- and technological revolutions are reshaping diplomacy in the twenty-first century. […] Diaspora networks, like nongovernmental organizations, civil society groups, and multinational corporations, are increasingly important and influential actors in international relations. Science diasporas are vital to a new architecture of cooperation that will allow us to invent, create, innovate, and solve problems together."[54] Governance of such networks is very diverse and not generalizable; however, our interview partners suggest that more involvement of foreign policy actors would be appreciated for the global transition towards Open Science.

Science diplomacy is not a term commonly used in the global Open Science Arena. While the concept itself covers most of the observable activities in the implementation and internationalization of Open Science – just without trained diplomats and with only marginal involvement of foreign relation and diplomatic services.

The impact of the internationalization efforts driven both by the communities (libraries, researchers, funders) and increasingly also by policy makers on international relations, however, is in some cases already tangible (cooperation for the global transition to Open Access to publications), and in many others (f.i. research frameworks promoting Open Science, European Open Science Cloud) at least noticeable.

Open Science in Public Policy

Open Science related to international public policy is very different between regions. As has been observed, Open Access policies vary from the collaborative investment in central public platforms (for example Brazil and South Africa cooperate on SciELO since 2013[55]), to the set-up of a highly diversified and domain-specific infrastructure (for example in India

[51] Kera, D. (2015): Open source hardware (OSHW) for open science in the global south: Geek diplomacy? Open Science, p. 133.
[52] See Kera (2015) and Burns (2013): Burns, W. J. (2013): The Potential of Science Diasporas. In: Science & Diplomacy, 2(4).
[53] Chan, L., A. Okune, R. Hillyer, A. Posada, D. Albornoz (2019): Contextualizing openness: Situating open science. University of Ottawa Press.
[54] Burns, W. J. (2013): The Potential of Science Diasporas. In: Science & Diplomacy, 2(4).
[55] Scielo launch Report. Retrieved from: https://www.gov.za/scielo-south-africa-open-access-platform-launch as accessed 01 June 2019.

or China). Whereas Brazil and Russia consider the free access to publicly funded research to be the political responsibility of the public sector authorities, and therefore do not support commercial publishing models, India and China are actively fostering institutional and corporate models. In some regions the focus is on local cooperation, such as Latin America or Europe, or selective cooperation between countries, such as Brazil and South Africa, other regions, such as India, Russia or China "appear to seek global impact, in competition with Western countries, which means for instance, that for them the question of English content and the visibility in international initiatives are of prime importance"[56].

Governance of Open Science activities in the public sector also varies highly and can hardly be generalized. In Europe, only few Member States and associated have adopted a national agenda or roadmap for the transition such as the Netherlands, Finland, France, and recently Ireland[57]. The variety of approaches and velocities is based on the role of the state, whether the state is central in the governance of research, such as in Croatia, Latvia, Slovenia or Italy, or if research institutions are to different degrees autonomous actors, like in Switzerland, Sweden, Austria or the Netherlands, or if the general state governance is largely federated such as in Belgium[58]. Even if it seems easier to implement National Open Access or Open Science plans in smaller countries with centralized governance, such as Latvia, Slovenia, or Croatia, this does not reflect the realities of velocities. An important anchor for the coordination of Open Science within Europe is the European Research Area ERA Roadmap. Based on the Internal Market, in which researchers, scientific knowledge and technology is supposed to circulate freely, Open Science is hoped to flourish too. The Council Conclusions adopted in May 2016 are dedicated to the transition towards an Open Science system (9526/16)[59]. The Standing Working Group on Open Science and Innovation of the European Research Area and Innovation Committee (ERAC - OSI) supports and advises on the development and implementation of policies and initiatives with a particular focus to enhance access to scientific information and circulation of the use of knowledge for research and innovation based on action priority 5 of the ERA Roadmap 2015-2020: implementing Open Access and knowledge transfer policies at national level in order to maximise the dissemination, uptake and exploitation of scientific results. In a report (Dec 2018)[60] the working group published a set of recommendations, including the need to produce better evidence and incentives at the crossroads of bringing Open Science and innovation together.

The country representatives in the Mutual Learning Exercise on Open Science[61] agreed that the most important element in advancing the topic regionally is the presence of informal networks, such as the Open Access Network Austria[62], library consortia used to negotiate

[56] Schöpfel, J. (2015): Learning from the BRICS. Open Access to Scientific Information in Emerging Countries. Retrieved from: https://hal.archives-ouvertes.fr/hal-01586530 as accessed 01 June 2019.

[57] Open Research Plan Ireland. Retrieved from: http://norf-ireland.net/wp-content/uploads/2019/07/NORF_Framework_10_July_2019-2.pdf as accessed 01 August 2019.

[58] Leonelli, S. (2018): Implementing Open Science: Strategies, Experiences and Models (Nr. 4). European Commission.;
Mayer, K., S. Leonelli, K. Holmberg, F. Miedema (2018): Mutual Learning Exercise: Open Science—Altmetrics and Rewards. European Commission.

[59] Council Conclusions May2016. Retrieved from: https://data.consilium.europa.eu/doc/document/ST-9526-2016-INIT/en/pdf as accessed 01 June 2019.

[60] ERAC Standing Working Group on Open Science and Innovation (SWG OSI). (2018): Recommendations on Open Science and Innovation (Nr. 1216/18). Retrieved from EUROPEAN RESEARCH AREA AND INNOVATION COMMITTEE website: http://era.gv.at/object/document/4508 as accessed 01 June 2019.

[61] European Commission, Research & Innovation Observatory – Horizon 2020 Policy Support Facility: Mutual Learning Exercise Open Science. Retrieved from: https://rio.jrc.ec.europa.eu/en/policy-support-facility/mle-open-science-altmetrics-and-rewards as accessed 01 June 2019.

[62] Open Science Network Austria. Retrieved from: https://www.oana.at as accessed 01 June 2019.

deals with publishers, or formal transnational networks such as OpenAIRE[63] and even then, the creation or implementation of national roadmaps is not guaranteed.

This results also in who becomes the driving force behind not only the transition to Open Science, but also the international cooperation and coordination of this transition. If there is already a national agenda and a clear implementation plan, actors such as ministries or representative bodies of research organisations engage in transnational exchange on the topic. Without political backing and based more on grass-roots initiatives, international exchange is mainly driven by individual or collective bottom-up action, such as by library consortia. For those actors especially in countries without Open Science activities, the Open Science agenda of the European Commission, and its Framework Programmes Horizon 2020 and Horizon Europe, Plan S and the European Open Science Cloud as well as their other Open Science initiatives, such as the Open Science Policy Platform OSPP are important anchors and role models.

4.1 International alignment of Open Access policies – Plan S and the roles and reactions of funders

Funding organisations, supported by the European Commission and the European Research Council (ERC), are assembling in cOAlition S, which announced to implement a "Plan S" at the ESOF in Toulouse in July 2018. The central principle of the (revised) plan is: "With effect from 2021, all scholarly publications on the results from research funded by public or private grants provided by national, regional and international research councils and funding bodies, must be published in Open Access Journals, on Open Access Platforms, or made immediately available through Open Access Repositories without embargo"[64]. The objective of Plan S is to align international research funding towards coherent Open Access rules. The plan and the procedures for its implementation have been debated among scholars, policy makers, funders, but also publishers since its publication and in the following consultation period.

Among the 10 principles of (the revised) Plan S[65] are the following, which point to the need of international coordination:

- Where applicable, Open Access publication fees are covered by the Funders or universities, not by individual researchers; it is acknowledged that **all scientists should be able to publish their work Open Access** even if their institutions have limited means.
- Funders support the **diversity of business models** for Open Access journals and platforms. When Open Access publication fees are applied, they must be commensurate with the publication services delivered and the structure of such **fees must be transparent to inform the market** and funders potential **standardisation and capping of payments** of fees;
- Funders will develop **robust criteria and requirements for the services** that high-quality Open Access journals, Open Access platforms, and Open Access repositories must provide;
- In cases where high-quality Open Access journals or platforms do not yet exist, the **Funders will, in a coordinated way, provide incentives to establish and support** them when appropriate; support will also be provided for **Open Access infrastructures** where necessary;

[63] OpenAIRE. Retrieved from: https://www.openaire.eu/ as accessed 01 June 2019.

[64] Revised Plan S principles in May 2019. Retrieved from: https://www.coalition-s.org/about/ as accessed 01 June 2019.

[65] cOAlition S. (2018): Plan S implementation guidelines. Retrieved from: https://www.coalition-s.org/principles-and-implementation/ as accessed 01 June 2019.

- Funders do not support the '**hybrid' model** of publishing. However, as a transitional pathway towards full Open Access within a clearly defined timeframe, and only as part of **transformative arrangements**, Funders may contribute to financially supporting such arrangements; The Funders will **monitor compliance and sanction non-compliance**.
- Authors retain copyright of their publication with no restrictions. All publications must be published under an **open license**, preferably the Creative Commons Attribution Licence CC BY.
- Funders encourage governments, universities, research organisations, libraries, academies, and learned societies to **align their strategies, policies, and practices**, notably to ensure **transparency**.
- Funders commit that when assessing research outputs during funding decisions they will **value the intrinsic merit of the work and not consider the publication channel**, its impact factor (or other journal metrics), or the publisher.

There are several dimensions in the plan, which require cohesive planning and strong international cooperation: transparency of costs, coherent catalogue of criteria (e.g. for services required) of eligible OA publishing fees, alignment of criteria for transformative agreements, incentives for creation or fostering of Open Access infrastructures, documentation and monitoring data and tools, far-reaching changes in incentive and reward cultures. Whereas the levels of infrastructure and monitoring do need international cooperation in the creation of the necessary platforms, data bases and tools, they also need new types of governance, which are yet to be determined. Furthermore, the other levels require convincing or nudging research performing organisations, funders as well as higher education institutions to align their policies and strategies, including their hiring strategies with the Plan S principles. There are currently many noteworthy initiatives, from bottom-up pressure to include Open Science criteria in academic job descriptions[66], principles for research integrity[67], to prices for outstanding Open Access activities. Most importantly though is the international coordination of institutions that fund research: "We are committed to implement what is one of the most significant and ambitious changes to the research system and with the final plan now in place we look forward to more funders, from across the world, supporting the transition to full and immediate Open Access by joining and aligning with cOAlition S" says Marc Schiltz, President of Science Europe and co-initiator of Plan S[68].

In 2019 only one quarter of all scholarly literature in the sciences, social sciences and humanities is open access. There are some communities, such as High Energy Physics for example, with an Open Access adoption rate up to 90%[69], but – even though they show the feasibility - they are not representing the general trend. Plan S follows the rationale that it is now up to the funders to increase the adoption rate and to coordination their policies internationally.

"As a matter of fact, the discussion of OA has been going on since 20, even 25 years. This was mainly only driven by the science community. The science community itself – and that is why nothing has happened over the last 25 years – has not been able to transform the system into open access because firstly, they were completely scattered and secondly,

[66] LERU (2019): Open Science and its role in universities: A roadmap for cultural change. Retrieved from: https://www.leru.org/files/LERU-AP24-Open-Science-full-paper.pdf as accessed 01 October 2019.
[67] ALLEA revised version of the European Code of Conduct for Research Integrity. Retrieved from: https://allea.org/code-of-conduct/ as accessed 01 June 2019.
[68] Coalition S press release 31 May 2019. Retrieved from: https://www.coalition-s.org/revised-implementation-guidance/ as accessed 01 October 2019.
[69] Press release of CERN. Retrieved from: https://cerncourier.com/a/a-turning-point-for-open-access-publishing/ as accessed 01 October 2019.

they had to deal with very powerful and big multinational publishing companies that were very cleverly playing the different parties against each other."[70]

By October 2019 Plan S is endorsed by many international organisations in a big wave of support as well as national funding organisations from Europe, such as the Austrian Science Fund, the Academy of Finland, the French National Research Agency, the Polish National Science Centre, the Research Council of Norway, UK Research and Innovation, and many more. It is supported by the European Commission and the European Research Council. Non-European funders and agencies supporting include the Wellcome Trust, the Bill and Melinda Gates Foundation, World Health Organization, the Higher Council for Science and Technology in Jordan, National Science and Technology Council of Zambia amongst others. However, not all of them joined cOAlition S, and some even withdrew their support at a later stage, such as the Swedish Riksbankens Jubileumsfonden or the principal scientific adviser of the Government of India K. VijayRaghavan. The rationale for stepping away from Plan S differ. Jubileumsfonden explains its withdrawal in March 2019 as follows, pointing to the importance of cost transparency as well as the specificities of disciplines: "Our assessment is that the process is too fast to suit humanities and social sciences. This also means that we have left cOAlition S, but we continue to support their ambitions. Jubileumsfonden will continue to work towards an increasingly more Open Science, through funding immediate open access when this is viable, and by declaring all our costs for Open Science from the year 2020." Similarly, the decision of the Chief Science Advisor of India followed after an intensive national consultation period. Likewise, he still assured his intents for collaboration when announcing the withdrawal: "As we move along, I expect there will be overlap in our directions to open-access. However, our directions will be entirely determined by the interests of Indian academia and of India, for which our understanding of and collaboration internationally with groups such as Plan-S is important."[71] The main reasons for revoking Indian collaboration in cOAlition S are given as lack of support of the Indian scientific communities for a fast transition as well as fear of raising costs, if the government has to guarantee the funding for a primarily APC based Open Access business model, and additionally has to build repository infrastructures. Furthermore, in the same interview VijayRaghavan pointed to the need for more fundamental change in the science system, monitoring and rewarding scientific performance: "Publishers and access are important components, but the fundamental issue is what we think is the purpose of science and what the metrics of scientific success are."[72] With India ranking as 5th largest producer of scientific publications by 2018[73], cOAlition S loses a powerful actor in the international knowledge and publication markets[74].

Despite the decision of the Indian coalition partner, Plan S seemed to spur the developments in India from the start: "And then coalition S came […] discussions started in India after a month of the European initiatives with the Indian top science administrators. Particularly our principle scientific advisor, the one who addresses the Prime Minister and the government directly, he took a personal interest in open access for quite some time and he is now going towards making it a pan-India movement, a national-

[70] Interview 1, 7 January 2019.

[71] The Wire (26 October 2019): Interview with K. VijayRaghavan 26 October 2019. Retrieved from: https://thewire.in/the-sciences/an-interview-with-k-vijayraghavan-on-open-access-publishing as accessed 31 October 2019.

[72] Ibid.

[73] Ranking based on Elsevier Scopus data. Retrieved from: https://www.scimagojr.com/countryrank.php?year=2018 as accessed 31 October 2019.

[74] In India funders have enacted Open Access policies since 2014. See: Government of India, Ministry of Science & Technology (2014): DBT and DST Open Access Policy. Policy on Open Access to DBT and DST Funded Research. Retrieved from: http://www.dst.gov.in/sites/default/files/APPROVED%20OPEN%20ACCESS%20POLICY-DBT%26DST%2812.12.2014%29_1.pdf as accessed 31 October 2019.

wide initiative by having negotiations with these Journals, […] and creating a national-wide Open Access policy and infrastructure initiative."[75]

China, on the other hand, backs Plan S, however not by joining cOAlition S, but the Ministry of Science and Technology and two national science libraries issued supporting statements in December 2018. As longstanding Open Access advocates[76] (the Chinese Academy of Sciences CAS signed the Berlin Declaration on Open Access in 2003) and ranking number one in worldwide publication of scientific literature[77], China has particular interest in negotiating access to international publications of Chinese authors, as well as access to international journals of interest for their RPOs: "Therefore, we support libraries of research and educational organisations to actively seek large-scale transformation of their subscription journals to open access journals, where papers by their respective members as corresponding authors [...] should be made immediately open access when published and free of any APC [article-processing] charge."[78] This statement among others[79] shows how China is taking into the costs of access for the 2000 universities and other research performing organisations in the country, and it underlines the necessity of negotiating national deals with publishers. Every move China makes will have a huge impact on the scientific publishing markets, and the current direction pro Open Access (both green and gold) would certainly also support the goals of Plan S to reform the market.

Other funding organisations have been a bit less supportive of Plan S. The US Office of Science and Technology Policy (OSTP) announced that it will not sign Plan S in October 2018. Among several reasons its director explained one major concern in an interview: "One of the things this government will not do is to tell researchers where they have to publish their papers. That is absolutely up to the scholar who's doing the publication."[80] This argument, which is also brought forward by many researchers fearing to lose their scientific freedom, underlines the reluctance to intervene in existing markets. The United States of America are however pursuing their own national Open Science initiatives. With the 2006 Federal Research Public Access Act (FRPAA) publications from publicly funded projects should be made freely accessible no later than six months after publication. Similar objectives are pursued by the 2013 Fair Access to Science and Technology Research Act (FASTR), but FASTR would only affect facilities that spend more than $ 100 million a year on research. Large funders, such as the National Institute of Health NIH which complies since 2008, have since started to develop Open Access strategies and building repositories.

Whereas Argentina's Federal Ministry of Education, Culture, Science and Technology signed the "JOINT COMMUNIQUÉ. XI Joint Steering Committee Meeting of the Bilateral Agreement on Science and Technology between the European Union and Argentina"[81] on 7 June 2019 and announced that it would join cOAlition S as well as promote a regional initiative among

[75] Interview 6, 21 May 2019.

[76] Montgomery, L., X. Ren (2018): Understanding Open Knowledge in China: A Chinese Approach to Openness? In: Cultural Science Journal, 10(1), pp. 17–26.

[77] Tollefson, J. (2018): China declared world's largest producer of scientific articles. In: Nature, 553, pp. 390–390.

[78] Roussi, A. (2018): China backs Plan S. Research Research. Retrieved from: https://www.researchresearch.com/news/article/?articleId=1378740 as accessed 1 June 2019.

[79] Sayer, L. (2019): Open Access in China. Interview with Xiaolin Zhang of the National Science Library. Blog International Science Council. Retrieved from: https://council.science/current/blog/open-access-in-china-interview-with-xiaolin-zhang-of-the-national-science-library as accessed 1 June 2019.

[80] FYI Team. (2019, April 30): An Interview with OSTP Director Kelvin Droegemeier [Blog]. Retrieved from the American Institute of Physics website: https://www.aip.org/fyi/2019/interview-ostp-director-kelvin-droegemeier as accessed 01 June 2019.

[81] Joint Communiqué – XI Joint Steering Committee Meeting of the Bilateral Agreement on Science and Technology between the European Union and Argentina. Retrieved from: https://ec.europa.eu/research/iscp/pdf/policy/ec_rtd_jc-11th-jscm-eu-ar_062019.pdf as accessed 01 October 2019.

Latin American and Caribbean countries, many researchers as well as Open Access advocates in the country are alarmed and are not supporting this decision. They disagree with the implementation guidelines for Plan S, as it "ignores more than 20 years of widespread experience in open-access publishing in many developing nations, as well as Latin America's widespread ethos of free-to-publish and free-to-read research"[82], and they call for the promotion of more globally inclusive open access strongly supporting non-commercial publishing "while improving the quality of editorial processes and keeping their control within the scientific community". In Latin America "Scholarly communications are managed by the scholarly community, with its own journal platforms and repositories, and supported by public funds as part of the public infrastructure needed for research", says Dominique Babini in an interview.[83]

Further learnings from Plan S

Based on these briefly summarized reactions across the world, we see that for funders there are many different approaches and velocities towards open access to scholarly publications[84]. It will require extensive negotiations and international coordination efforts not only of funders, but also of science and research policy to align them so that international publishing markets and cultures of scholarly communication as well as reward and incentive systems can successfully transition towards Open Science. In the interview the European Commission's Special Envoy for Open Access emphasized the role of science counsellors at the EU delegations for the international coordination of Plan S:

"I came out of a meeting with all science counsellors recently, where I trained them about Plan S, so that they know its specifics. We asked them to discuss it with the people in the countries they are located, to see what is going on, to talk with people about Plan S, but also then to come back to me and to advise me what should be done. Also, to organize possible visits, which have already been done, to China, to India, where I met key people, decision makers, to see if they can join Plan S. So now that we have to go global, the role of the science counsellors is essential."[85] The **research and innovation counsellors** in the EU delegations, responsible for promoting STI cooperation between Europe and India and following closely policy dialogues on societal challenges like climate change, clean energy, sustainability or the digital transformation, have so far focused more on the "open to the world" paradigm. They were promoting and supporting access to European research and innovation funding to stakeholders in the respective regions, as well as access to training and mobility programs for researchers. Before the advent of Plan S not Open Science was not on the agenda. Several interview partners confirm the importance of personal engagement in political negotiations for Open Access or more broadly Open Science.

Plan S had another important dimension, though. cOAlition S has not only bundled existing engagement and brought it successfully to the policy arena, it has also – despite the many critics from research and publishing industry – spurred the political discussion in other regions. For many local Open Access advocates it was a **strong sign of support**, especially in countries where policy makers and funders were not aware of the importance of Open Access. Here once again, it is important to engage with the stakeholders already

[82] Debat, H., D. Babini (2019): Plan S: take Latin America's long experience on board. In: Nature, 573, pp. 495–495.
[83] International Science Council: Plan S and Open Access in Latin America: Interview with Dominique Babini. Retrieved from Science Council website: https://council.science/current/blog/plan-s-and-open-access-interview-with-dominique-babini as accessed 01 June 2019.
[84] Further information on funding bodies' OA policies can be gathered f.i. from Sherpa JULIET, ROARMAP and MELIBEA.
[85] Interview 1, 7 January 2019.

active in the field. An interview partner says: "I'm optimistic, and Plan S really attracted attention of researchers and policymakers in other countries, [well], in addition to countries where funders joined Plan S, also in other countries. So, you could really say that's it. It had a global impact. And I guess because it was a real strong statement like "enough is enough and we have to move faster". […] In many countries they are not aware of all technical details of Plan S, but I'm kind of confident that they will gather this knowledge in the process because in the countries where funders joined Coalition S we also have strong library consortia knowledgeable about these issues."[86]

Another interview partner points to an additional, yet less desirable effect Plan S has on the international discourse: "Plan S is for the first time - in the last 17 years that we are playing with the idea of open access, a practical commitment for implementation. […] I think it's really a crucial thing that happened in the last year but also is a bit disappointing, because we have been working on the idea of Open Science as a [broad change] for science towards collaborative, and new open innovation paradigms and then it's like, Plan S appears and all attention is back again in the publication system."[87]

Interestingly, Plan S gets also support from some of the **publishing industry** giants, like Springer Nature, as they share the concern about the complexity of too diverse approaches to Open Access and resulting governance models. In an interview Steven Inchcoombe of Springer Nature remarks: "There are many ways in which open access could be accelerated and its use more widely spread. Plan S outlines a particular approach. Other organizations are pursuing the same goals but not necessarily using the Plan S movement, such as DFG in Germany. Similarly, a very large amount of research being produced in China is published open access, and they've expressed strong support for OA2020 and some support for Plan S, but that doesn't necessarily mean that they will adopt the Plan S principles. Then you have the foundations like the NIH and NSF in the United States that see open access as important but don't want to set aside specific funding to support it and are relying on the continuation of funding from institutional libraries and are therefore more focused on the green open access side. There's a diversity of approaches. Springer Nature is ultimately a service provider to the research community, and the research community needs a more consistent approach so that they know how they're going to be judged, and what funding or policies they're going to be operating under."[88]

So, it seems the publishing industry can also benefit from clear regulations and criteria, common standards and so forth, especially if the industry seeks to re-use openly available knowledge to further develop their services and build their own knowledge bases.

The goal to internationally align Open Access policies has brought about another important issue: what librarians have long criticized was the lack of information about costs and thus impact of Open Access. Since most deals with publishers remained secret, there was no comparison on international level possible. Moreover, all related scientometric information like the number of citations, the reads, etc. remained in the property of the publishers and could only be accessed through yet again expensive interfaces, such as Web of Science or Scopus. Therefore, Plan S can only be successful if it also regulates the monitoring and documentation. International negotiation is one issue, but without creating an accessible evidence base about Open Access developments, it cannot be sustainable, most interview partners agree. There are already invaluable resources for the monitoring and comparison of a range of aspects related to Open Access and other dimensions of Open Science such

[86] Interview 13, 27 June 2019.

[87] Interview 9, 28 May 2019.

[88] International Science Council (2019): Interview with Steven Inchcoombe. Jan 2019. Retrieved from: https://council.science/current/blog/scholarly-publishers-also-need-a-more-consistent-approach-interview-with-steven-inchcoombe-of-springer-nature-on-plan-s-and-open-access as accessed 01 June 2019.

as Open Research Data, like OpenAIRE[89] and PASTEUR4OA[90] for an European perspective, or the Innovation Policy Platform by the OECD and the World Bank[91]; Furthermore there are databases that reflect the current status of open access journals, data repositories or open institutional policies (DOAJ[92], ROARMAP[93], OPEN ACCESS Map[94], SHERPA[95], etc.); Other platforms, that deal with STI metrics dedicated to Open Science, such as the Open Science Monitor[96] or the Federal RePORTER[97] (formerly StarMetrics) have a very specific focus or just a limited perspective due to the limits of indicator sets or available databases, which are not always open and reproducible. Furthermore, there is a growing body of scholarly literature discussing and monitoring the current status of OA[98]. Hence, the evidence base is growing and will be enriched by more and more transparency initiatives, like the one from the European University Association EUA on calculating the money Europe is spending every year on scientific literature[99]. However, it will be important to translate these complex findings to policy makers and science diplomats, so that they can build an understanding of the opportunities but also the limitations of Open Access to scholarly communication on a global scale.

[89] OpenAIRE. Retrieved from: https://www.openaire.eu/ as accessed 01 June 2019.

[90] Pasteur4OA. Retrieved from: http://www.pasteur4oa.eu/home as accessed 01 June 2019.

[91] Summary of international open science policies. Retrieved from: https://www.innovationpolicyplatform.org/www.innovationpolicyplatform.org/content/open-science/index.html as accessed 01 June 2019.

[92] Directory of Open Access journals. Retrieved from: https://doaj.org/ as accessed 01 June 2019.

[93] Register of Open Access repositories. Retrieved from: https://roarmap.eprints.org/ as accessed 01 June 2019.

[94] Open Access Map. Retrieved from: http://www.openaccessmap.org as accessed 01 June 2019.

[95] Sherpa. Retrieved from: https://v2.sherpa.ac.uk/ as accessed 01 June 2019.

[96] Open Science Monitor. Retrieved from: https://ec.europa.eu/info/research-and-innovation/strategy/goals-research-and-innovation-policy/open-science/open-science-monitor_en as accessed 01 June 2019.

[97] US Federal Reporter. Retrieved from: https://federalreporter.nih.gov/ as accessed 01 June 2019.

[98] See Piwowar, H., J. Priem, V. Larivière, J.P. Alperin, L. Matthias, B. Norlander, S. Haustein (2018): The State of OA: A large-scale analysis of the prevalence and impact of Open Access articles. PeerJ, 6, e4375. for overview and analysis.

[99] European University Association EUA (2019): 2019 Big Deals Survey Report. Retrieved from: https://eua.eu/resources/publications/829:2019-big-deals-survey-report.html as accessed 01 June 2019.

4.2 Open Research Infrastructures

At the International Conference for Research Infrastructures 2018[100], Carlos Moedas renewed his vision for science diplomacy: "Research infrastructures are the assets for science diplomacy"[101]. Science policy makers from around the world agreed: Sanja Damjanovic, minister of science in Montenegro, sees research infrastructures as a "route to mitigate tensions in the Balkans, reverse the brain drain and recover the tradition of technology development in Southern and Eastern Europe. The only way to bring back our people is to have a first-class research facility, Damjanovic said."[102] Mikhail Popov, deputy director at the Kurchatov Institute in Moscow noted that "Science collaborations can secure bridges between Russia and the EU."[103] Furthermore, research infrastructures are important pillars of innovation and therefore regarded as a "key [requirement] to compete in a globalised world"[104] by Wolfgang Burtscher, deputy director general for research and innovation at the European Commission. Hence, they have been at the centre of science diplomatic activities since a long time.

Amongst its set of recommendations, the European Open Science Policy Platform points to the necessity to ensure the scholarly **infrastructure is highly interoperable** and that **credit for research contributions is given to all participants in the research cycle**, as well as to ensure that hiring procedures and HR strategies, as well as research evaluation procedures in general reflect Open Science culture[105]. It is those cross-cutting issues which will be the core stepping stones for a successful implementation of Open Science. However, policy makers around the world face a double challenge: "how to increase the visibility and global impact of their scientific output, and how to improve access to scientific and technical information for their research and higher education"[106]. At the core of such deliberations are research infrastructures.

Research infrastructures are providing important resources and services for research communities. With Open Science come several additional requirements for infrastructures, namely that they are as open as possible, f.i. that the software is open sourced and the data and content (e.g. metadata, metrics, user contributions) created by and in the systems are published under an open license and made available online via open interfaces. In addition, open infrastructures follow open standards. This enables, among other things, interoperability and re-usability. A further important criterion is that the governance of open infrastructures provides for an explicit say of the communities attached to it. This includes appropriate opportunities for community input as well as involvement in decision-making processes.

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[100] International Conference for Research Infrastructures 2018. Retrieved from: https://www.icri2018.at/ as accessed 01 June 2019.

[101] Zubaşcu, F. (2018): Are research infrastructures the answer to all our problems? Retrieved from Science|Business website: https://sciencebusiness.net/news/are-research-infrastructures-answer-all-our-problems as accessed 01 June 2019.

[102] Zubaşcu, F. (2018): Are research infrastructures the answer to all our problems? Retrieved from Science|Business website: https://sciencebusiness.net/news/are-research-infrastructures-answer-all-our-problems as accessed 01 June 2019.

[103] Ibid.

[104] Ibid.

[105] OSPP (2018): Open Science Policy Platform Recommendations. Retrieved from the European Commission website: https://ec.europa.eu/research/openscience/pdf/integrated_advice_ospp_recommendations.pdf as accessed 01 June 2019.

[106] Schöpfel, J. (2015): Learning from the BRICS. Open Access to Scientific Information in Emerging Countries. Retrieved from: https://hal.archives-ouvertes.fr/hal-01586530 as accessed 01 June 2019.

Open research infrastructures range from those providing open access to publications, research data and research methods (repositories, workflow and notebook platforms, search and discovery interfaces etc.) to those providing access to large experimental services and facilities (e.g. high-performance computing, synchrotrons, observatories) or shared material resources and databases (e.g. protein or genome databases, biobanks). Furthermore, there is a call for research documentation and information systems to make their data available, too. Data sharing, and respective infrastructures are currently the focus of a global debate. Policy makers, research administrators and funders are pushing for more collaboration and sharing of resources, and one of the key issues for future RI funding is the potential shift away from funding projects to funding use of services provided – which brings about interesting options for industry and challenges for the preservation of knowledge commons. While industries and research actors alike understand the value of bases of shared common knowledge, they **call for internationally aligned clear scientific and legal standards for sharing and registering their data**.

The Beijing Declaration on Research data from 2019 lists the principles for making research data "as open as possible and only as closed as necessary [while making it] findable, accessible, interoperable and reusable (FAIR)". Furthermore, it is stated that "the stewardship of research data should avoid defaulting to the traditional, proprietary approach of scholarly publishing. Therefore, the adoption of new policies and principles, coordinated and implemented globally, is necessary for research data and the associated infrastructures, tools, services, and practices. The time to act on the basis of solid policies for research data is now."[107].

Decisions to place open research infrastructures for the global reuse of data and information high on the agenda are based on past experiences and historical success stories of highly beneficial translation of research outputs into innovation in its broadest sense in multiple fields due to large international collaborations. For example, in terms of the open sharing of data and methods see the Human Genome Project[108], for the successful synthesis of diverse maritime data see EMODnet[109] or the Elixir[110] model for a distributed research infrastructure engaging with industry. In these cases, the sharing of data and methods led and still leads to technoscientific breakthroughs and to socio-economic innovation.

The non-profit EGI Foundation coordinates a large computing infrastructure on behalf of national e-infrastructures and European Intergovernmental Research Organisations (EIROs) and supports Open Access and Open Data. Large research infrastructures themselves are also very actively promoting Open Science. Just to name a few examples: CERN launched its Open Data Portal in 2014, the SESAME synchrotron initiated an open knowledge transfer program and capacity building initiative, ESA run several open access and open data initiatives, and with Copernicus, there is open access to satellite images and data.

The Research Data Alliance (RDA)[111] represents the data-driven research community and was founded in 2013 by the European Commission, the American National Science Foundation and National Institute of Standards and Technology, and the Australian

[107] COdata (2019): Beijing Declaration on Research Data. Retrieved from: http://www.codata.org/uploads/Beijing%20Declaration-19-11-07-FINAL.pdf as accessed 12 November 2019.
[108] Human Genome Project. Retrieved from: https://www.genome.gov/human-genome-project as accessed 01 June 2019.
[109] EMODnet: The European Marine Observation and Data Network. Retrieved from: http://www.emodnet.eu/ as accessed 01 June 2019.
[110] Elixir: The European life-sciences Infrastructure for biological Information. Retrieved from: https://elixir-europe.org/ as accessed 01 June 2019.
[111] Research Data Alliance. Retrieved from: https://www.rd-alliance.org/ as accessed 01 June 2019.

Department of Innovation. Its Working groups and some national nodes are very active in disseminating knowledge and engaging public discussion about issues of data sharing and open research infrastructures. RDA is furthermore collaborating internationally with the Committee on Data for Science and Technology (CODATA) and World Data System (WDS). CODATA[112] was established in 1966 as an interdisciplinary committee of the International Council for Science. Its objectives are to compile, critical evaluate, store, and retrieve of data that is of importance to science and technology, and it has become an important actor in international data policy making. Similarly, the World Data System[113], which follows its predecessors the international Geophysical Year (IGY, 1957–58) and the World Data Centers (WDC), is still one of the largest international ventures for data sharing since its inception. It represents a paragon of open data diplomacy and science diplomacy. Even in the period of the Cold War it facilitated a global data collection network, exchange interfaces and scientific collaboration of hostile countries.

With increasing digitalisation and the availability of big data open, access to research infrastructures is advocated and supported in a wide range of countries. China promotes access to its research infrastructures beyond the host institutions with several awareness and bonus programmes, in South Korea there are several initiatives to open institutional knowledge on open access platforms complemented by targeted resources for specific user groups, and in New South Wales, Australia, a system of Tech-Vouchers is installed to encourage use of infrastructure from the broader innovation communities[114]. In the USA, data-sharing is increasingly promoted already from the advent of project design. The NIH, the US leading institution in data sharing advocacy, supports prospectively established data-sharing and is making large datasets available to the community, e.g. data from genome-wide association studies and autism spectrum disorder research[115]. These examples illustrate the push for more collaboration but are not necessarily aligned with the full spectrum of Open Science principles, or the principles listed in the Beijing Declaration.

Likewise, in Europe we find a multitude of programmes and initiatives dedicated to research infrastructures, which also promote Open Science in its broadest sense. The **European Strategy Forum for Research Infrastructures** was created by the European Council to "support a coherent and strategy-led approach to policy-making on Research Infrastructures in Europe"[116]. With 2019 it represents 28 Member States and 12 associated countries. Besides its role of hub for infrastructure funders, it also has the mandate to "explore mechanisms of better coordination of Member States' investment strategies in e-Infrastructures, covering also HPC, distributed computing, scientific data and networks". The **ESFRI Roadmaps** of 2018 and 2021 both emphasize the important role of infrastructures in the transition towards Open Science and in the development of "European Open Science Data Commons"[117]. The ESFRI roadmap includes an Open Access policy for

[112] CODATA. Retrieved from: http://www.codata.org/ as accessed 01 June 2019.

[113] World Data System. Retrieved from: https://www.icsu-wds.org/organization as accessed 01 June 2019.

[114] Dai, Q., E. Shin, C. Smith (2018): Open and inclusive collaboration in science: A framework. Retrieved from: https://doi.org/10.1787/2dbff737-en as accessed 01 June 2019.

[115] National Academies of Sciences, E., Affairs, P. and G., Information, B. on R. D. and, & Enterprise, C. on T. an O. S. (2018): Office of Science and Technology Policy 2013 Memorandum: Increasing Access to the Results of Federally Funded Scientific Research.; National Cancer Institute (2012): Advancing scientific progress through genomic data sharing and access. Retrieved from: http://epi.grants.cancer.gov/datasharing/ as accessed 01 June 2019.; NIH (2011): National Database for Autism Research. Data sharing. Retrieved from: http://ndar.nih.gov/ndarpublicweb/sharing.go as accessed 01 June 2019.

[116] ESFRI: European Strategy Forum for Research Infrastructures. Retrieved from: https://ec.europa.eu/info/research-and-innovation/strategy/european-research-infrastructures/esfri_en as accessed 01 June 2019.

[117] ESFRI Roadmap 2018. Retrieved from: http://roadmap2018.esfri.eu/ as accessed 01 June 2019.

infrastructures[118]. While the focus in the three O strategy of the EU Commission from 2016 was more on opening access to research infrastructures to researchers and innovation actors from outside Europe, with the launch of the European Open Science Cloud in October 2018 this focus shifted more to maintaining and creating open infrastructures. Yet, commitment to e-infrastructure for open data has a long tradition in the EU: several **European Research Infrastructure Consortiums (ERICs)** pioneered collaboration and open sharing of data and methods. For example, in the humanities, like DARIAH[119] or CLARIN[120]. **Horizon 2020** had implemented the Open Data pilot, and in the proposal for the coming framework programme **Horizon Europe** (2021-2027) Open Science will further be pushed[121]. The **European Open Science Cloud**[122] represents another approach to open infrastructures. The primary goal – besides increasing accessibility and visibility of European research data – is to make the sharing of research data easier for researchers. The federation of the vast but fragmented infrastructure landscape should also help to tackle the challenges due to limited resources and interoperability.

Open research infrastructures for data and methods are currently not only confronted with many pressing issues and global challenges but also bear a lot of opportunities for research and innovation, such as developing new models of governance, stewardship and for value creation with Open Science. Furthermore, research infrastructures will be the main negotiation area and playing field for the development of new standards for next generation evaluation frameworks, incentive and reward systems, and for skills development. Nevertheless, there is a lacuna in comparative knowledge of necessary properties in terms of what is recommended by experts and demanded by users, such as their attributes regarding metrics, incentives, human resources, but also their capacities for enhancing international collaboration and impacting innovation. Open infrastructures will bring about new ways of collaboration and will broadly impact the way we conduct research, assess quality and effect, and the ways knowledge transfer is happening. Moreover, considering the relationship of Open Science and intellectual property regimes in innovation will require international expertise. In terms of measuring quality and impact of open research infrastructures most attention is currently given to the availability and use of digital data sets[123]. We are already witnessing how recent policy shifts (funders and journals) are affecting the acknowledgment and citation behaviours in relation to research resources and infrastructures, and it is envisioned that these shifts will also put more emphasis on notions of "reproducibility" and "Open Science"[124]. There is evidence for a productivity benefit to data sharing, as it can double the publication output of research projects, as well

[118] ESFRI (2018): European Strategy Forum on Research Infrastructures Roadmap. Retrieved from: https://www.esfri.eu as accessed 01 June 2019.
[119] Digital Research Infrastructure for the Arts and Humanities (DARIAH). Retrieved from: https://www.dariah.eu/ as accessed 01 June 2019.
[120] Common Language Resources and Technology Infrastructure CLARIN. Retrieved from: https://www.clarin.eu/ as accessed 01 June 2019.
[121] SPARC Europe (2019): Open Science essential for new Horizon Europe funding programme. Retrieved from SPARC Europe website: https://sparceurope.org/open-science-essential-for-new-horizon-europe-funding-programme/ as accessed 01 June 2019.
[122] European Open Science Cloud. Retrieved from: https://ec.europa.eu/research/openscience/index.cfm?pg=open-science-cloud as accessed 01 June 2019.
[123] CODATA-ICSTI Task Group on Data Citation Standards and Practice (2013): Out of Cite, Out of Mind: The Current State of Practice, Policy, and Technology for the Citation of Data. In: Data Science Journal, 12(CIDCR1–CIDCR7); Costas, R., I. Meijer, Z. Zahedi, P. Wouters (2013): The value of research data–Metrics for datasets from a cultural and technical point of view. A Knowledge Exchange Report.; Costello, M. J. (2009): Motivating online publication of data. In: BioScience, 59(5), pp. 418–427.
[124] Stodden, V., F. Leisch, R.D. Peng (2014): Implementing reproducible research. CRC Press.; Willinsky, J. (2005): The unacknowledged convergence of open source, open access, and open science. 10(8), pp. 1396–0466.; Woelfle, M., P. Olliaro, M.H. Todd (2011): Open science is a research accelerator. In: Nature Chemistry, 3(10), p. 745.

as impact the citation rates of research papers[125]. Here the question is how to best link evaluations and policies of such infrastructures with incentives and reward structures, as well as which skills are necessary to master the sharing of data and methods for Open Science. Open Research Infrastructures therefore pose multimodal challenges, and openness has to be considered from technical architecture to international governance.

4.3 The largest experiment in Open Science Infrastructure governance – European Open Science Cloud

The European Open Science Cloud (EOSC) is a project of the European Commission to provide an open infrastructure for open research data and relevant meta-information. The project was launched in 2015 and should be completed by 2020. According to the High Level Expert Group on the European Open Science Cloud it is a support environment for Open Science with the objective to "accelerate the transition to more effective Open Science and Open Innovation in a Digital Single Market by removing the technical, legislative and human barriers to the re-use of research data and tools, and by supporting access to services, systems and the flow of data across disciplinary, social and geographical borders"[126]. The three-fold objective in other words is:

(1) to increase value of scientific data assets by making them easily available to a greater number of researchers, across disciplines (**interdisciplinarity**) and borders (**EU added value**) and (2) to reduce the costs of scientific data management, while (3) ensuring adequate **protection of information/personal data** according to applicable EU rules (e.g. REGULATION (EU)2016/679)[127].

In May 2018, the European Commission confirmed the plan for the development of a cloud solution. 600 million euros are available for this purpose by 2020. The official launch event for the European Open Science Cloud took place in November 2018 in Vienna. The Vienna Declaration on the European Open Science Cloud[128] was adopted by the ministers of the EU Member States present. The Declaration focuses mainly on the governance structure and summarizes the consultation process by highlighting steps and commitments, "agreed upon by the Member States in the format of various policy documents. It also emphasizes the need to actively support this joint effort to ensure smooth and successful implementation"[129].

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[125] Baynes, G. (2017): Collaboration and concerted action are key to making open data a reality. Impact of Social Sciences Blog.; Hahnel, M., J. Treadway, B. Fane, R. Kiley, D. Peters, G. Baynes (2017): The State of Open Data Report 2017. Retrieved from: https://doi.org/10.6084/m9.figshare.5481187.v1 as accessed 01 June 2019.

[126] European Commission (2016): First report of High Level Expert Group on the EOSC. Retrieved from: https://ec.europa.eu/digital-single-market/en/news/first-report-high-level-expert-group-european-open-science-cloud as accessed 01 June 2019.

[127] European Commission (2018): Prompting an EOSC in Practice. Final report and Recommendations on the European Open Science Cloud of the Commission 2nd High Level Expert Group [2017-2018] [High Level Expert Group Report]. Retrieved from: https://www.eudat.eu/sites/default/files/prompting_an_eosc_in_practice_eosc_hleg_interim_report.pdf page 33, as accessed 01 June 2019.

[128] Vienna Declaration on the European Open Science Cloud. Retrieved from: https://eosc-launch.eu/declaration/ as accessed 01 June 2019.

[129] Vienna Declaration on the European Open Science Cloud. Retrieved from: https://eosc-launch.eu/declaration/ as accessed 01 June 2019. Some observers of the EOSC doubt the ambitious time schedule of the EOSC will be feasible: "[…] we're at the beginning of that process. I think it will take longer than currently envisaged for the European Open Science Cloud to really work as intended. It's probably the most important initiative ever taken to try and coordinate a federated system across Europe, no matter what discipline you're from – but the process to put that in place really demonstrates how difficult that is." (Sabina Leonelli in interview). Sayer, L.: Early-career researchers respond to Plan S: Interview with Sabina Leonelli of the Global Young Academy. Retrieved from International Science Council website:

With the European Open Science Cloud (EOSC), which is expected to become a central **virtual environment** for all researchers to store, manage, analyse and re-use data for research, innovation and educational purposes from 2021 onwards, Europe is taking a pioneering step towards a truly fundamental shift not only in the way science is done, but also in the way science is operating and having an effect within society. The EOSC is expected to generate a deep change in the scientific environment to be more accessible, transparent, collaborative and closer to citizens. To this end, Europe is adhering to the **FAIR data principle**: findability, accessibility, interoperability, re-usability. In that regard, besides the EOSC, there are also interesting developments on the national level: "National Open Science Cloud" in the Netherlands, the "Open Research Data Infrastructure" in the UK, the "Australian Research Data Cloud", or the German Research Data Infrastructure (NFDI).

Furthermore, EOSC should become the better **alternative to private platforms and services**, from publishing corporations, but also Amazon or Google. "The main idea is not to impose a new super structure, but to use what is already there. So, there is no magical trick there except that it was the right idea with the right approach in the right moment. Ten years ago, it would have been too early, and in five years' time it would have been too late, because then all our data are managed by foreign companies" said one interview partner. The strategy not to recreate the lock-in effects currently hindering the fast transition to Open Access in the field of scholarly publications ties in with the more general European efforts to cut too strong dependencies with foreign corporations and to protect European consumers' data and privacy.

The European Open Science Cloud can also be regarded as experiment in creating new governance models that serves the idea of Open Science and Open Research Infrastructures, by federating existing and future research data infrastructures, "connecting them with a soft overlay and build upon existing large-scale EU scientific networks including ICANN, IETF, AIOTI, GÉANT and ELIXIR"[130]. Jean Claude Burgelman, then head of the office at the DG Research and Innovation responsible for the cloud said: "We did not want to create a separate institution, or a separate entity somewhere where all the data will be merged and then controlled by a few bureaucrats overlooking how and who gets access to it. […] It is a decentralized approach. […] We had to align all these institutions, the research infrastructures, the repositories, all the ministries, 18 Member States. Inevitably, that was a complex thing, but we managed."[131] Coordination and alignment of interests across many different types of stakeholders and governance levels is one of the biggest challenges for the EOSC.

Actors in EOSC form three different types: strategic, executive and the users/producers as stakeholders. In all actor groups there are also non-European individuals or representatives of institutions involved.

https://council.science/current/blog/early-career-researchers-respond-to-plan-s-interview-with-sabina-leonelli-of-the-global-young-academy as accessed 01 June 2019.

[130] European Commission (2018): Prompting an EOSC in Practice. Interim report and recommendations of the Commission 2nd High Level Expert Group [2017-2018] on the European Open Science Cloud (EOSC) [High Level Expert Group Report]. Retrieved from: https://www.eudat.eu/sites/default/files/prompting_an_eosc_in_practice_eosc_hleg_interim_report.pdf page 14, as accessed 01 June 2019.

[131] Presentation by Jean Claude Burgelman on the Open Science MOOC (2019). Retrieved from: https://youtu.be/8N06jYFqoQQ as accessed 01 October 2019.

Figure 8: EOSC Governance Layers, reproduced from the EOSC Governance Framework github repository[132]

The current setup has the objective to create a governance and implementation model for 2020, when the piloting phase is over. An important aspect of the development of EOSC is the inclusion of stakeholders from the beginning. Those stakeholders are either participating in projects around the development of the cloud or are part of the stakeholder forum.

Primary Role	**Description**	**Typical Stakeholders**
Provider	Provides services, data or other resources (e.g. scientific instruments, training) into EOSC.	e-Infrastructures Information and computing service providers Academic Institutions and Research Libraries Research Infrastructures Virtual research environments and research projects Other Service Providers
Consumer	Will make use of services, data, or other resources from EOSC.	Learned Societies, Research Communities, Scientific and Professional Associations Research Infrastructures Research Producing Organisations e-Infrastructures, VRE, and Other H2020 Projects Academic Institutions and Research Libraries Enterprises General Public

[132] EOSC Governance Model. Retrieved from: https://europeanopensciencecloud.github.io/Governance/GovernanceModel.html as accessed 01 June 2019.

Decision-makers	Will be involved in the strategic direction, compliance and funding of EOSC.	National, Regional or Local Government Agencies Research Funding Bodies

Table 2: Types of European Open Science Cloud stakeholders. Table adapted from EOSC Governance Model github[133]

These stakeholders all follow different interests, still they share a common set of values based on the fundamental idea that the "underlying infrastructure and foundation of EOSC needs to be developed, owned and operated publicly. That platform will be extended and scaled. It will engage with private initiatives, but all will adhere to rules of participation and uphold the common values"[134], such as adhering to research needs, being community driven, inclusive and respectful of diversity. EOSC should be accessible to all "from large equipment, large computers & 'big data' to 'small data' & long-tail research", open by default, closed only where necessary. These values should support the creation of knowledge commons as well as the respectful exploitation of research output.

However, these values represent just a fraction of different rules, regulations, norms and standards, that all apply to the implementation and governance of the cloud. From the interviews we learn that from country to country the local governance differs. In some Member States the processes are mainly driven by funders or government agencies, in others by ministries, or by libraries and university associations. An interview partner recounts how EOSC stirred even unusual interest: "When the European Open Science Cloud was launched last year, the responsibility for it was transferred to the Ministry of Education. I was very surprised to find that the Ministry of Economy was very interested to participate in the working group on Open Science Cloud"[135].

[133] EOSC stakeholder types. Retrieved from: https://europeanopensciencecloud.github.io/Governance/GovernanceModel.html as accessed 01 June 2019

[134] EOSC Executive Board, European Commission (2019): European Open Science Cloud Strategic Implementation Plan (2019–2020): 5. Retrieved from: https://ec.europa.eu/info/publications/european-open-science-cloud-eosc-strategic-implementation-plan_en as accessed 01 October 2019.

[135] Interview 10, 28 May 2019.

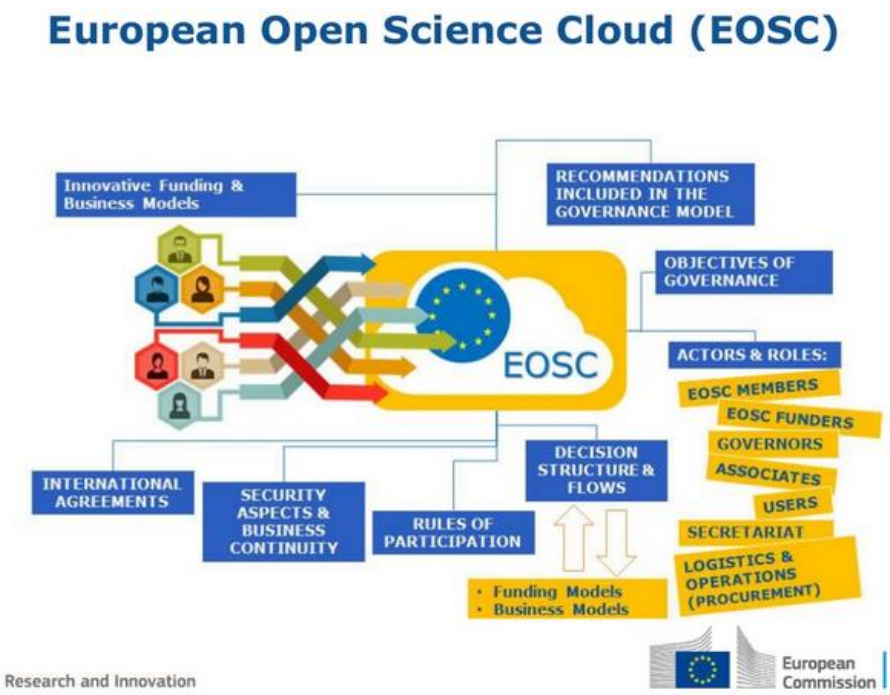

Figure 9: The multifaceted governance of the European Open Science Cloud. Slide copied from a presentation held by Carmela Asero (European Commission) @ SLA-Ready workshop in December 2016[136].

4.3.1 Open Science Diplomacy and the European Open Science Cloud

"The move towards open access is a worldwide endeavour. Member States have been part of this endeavour and should be supported in enhancing an open, collaborative research environment based on reciprocity at a global level. Open Science is a key feature of Member States' policies for responsible research and for open innovation. As new digital technologies become available, research and funding policies should adapt to this new environment."[137] The key aspect in this 2018 recommendation from the European Commission on access to and preservation of scientific information is "reciprocity at a global level".

Jean-Claude Burgelman reflects in a presentation[138] how difficult it was to get all 28 Member States on board for EOSC, and how it would not have been possible without the persistent support by the research communities, who created most impact in national lobbying for the cloud. Therefore, from his point of view, the focus now is mainly on the European needs and options, the realisation of the vision and not so much on the internationalisation of the cloud. On the other hand, there are many sceptical comments regarding the international dimension from other interview partners when it comes to discussing the modalities of access to the cloud regarding the **issue of reciprocity of**

[136] Presentation by Carmela Asero (2016). Retrieved from: https://www.sla-ready.eu%2Fsites%2Fdefault%2Ffiles%2Fcarmela_asero_european_open_science_cloud_eosc_sla-ready_workshop_brussels_15_dec_2016.pdf as accessed 01 June 2019.

[137] Recommendation from the European Commission (EU) 2018/790 of 25 April 2018. Retrieved from: https://www.eosc-portal.eu/sites/default/files/CELEX_32018H0790_EN_TXT.pdf point 12 as accessed 01 June 2019.

[138] Presentation by Jean Claude Burgelman on the Open Science MOOC (2019). Retrieved from: https://youtu.be/8N06jYFqoQQ as accessed 01 October 2019.

access. It was discussed publicly after the "Nica-Report" on the proposal for a regulation of the European Parliament and of the Council establishing Horizon Europe stated in an amendment that "Reciprocal open access should be encouraged in international S&T cooperation agreements and in relevant association agreements"[139] in November 2018. Since then, this issue is brought up mostly by representatives of economic affairs or innovation, be it ministerial, diplomatic or from innovation agencies. The main questions are: what does "reciprocity on a global level" mean – Access to my cloud for access to your cloud? - and what operationalisation in the form of access[140] and participation regulations[141] would be the best?[142] How to gain but also protect EU added value? Connected to these questions are the types of international policy partnerships required to realise reciprocity? Whereas on the one hand, there are examples and best practices from international research infrastructures[143], which can serve as role models, there is on the other hand the need to negotiate with international partners, if "wide access" - the "broadest possible gateway to scientific data and digital services provided by the e-Infrastructure to Users, wherever they are based"[144] – is not an option.

"We will ensure a discussion and probably a visit will be the next step to discuss with the right people in the ministry of science and technology, and the national science foundation. We need to explain what is behind, where we are going to ensure that our partner can converge towards the same kind of legislation. Because if we make all our data publicly available and nothing is coming from them, we create a situation where we offer a lot of information for free without reciprocity, reciprocal access to their data. We should be aware of that. If we do not have the same interests, then we should not make it available for people based in this country, when we do not have reciprocity. This has to be discussed in the joint committee and the high-level committees,"[145] says a European science diplomat in our interview. For this kind of negotiation for the European Open Science Cloud – and similarly for Plan S – it will be important to **build upon existing international collaborations**, either by scientific communities, international representative bodies, or successful international research infrastructures, as several interview partners highlight.

Both the technical and the service layer of the EOSC provide many opportunities for industry to participate. This participation will be guided by a set of criteria, which is currently developed within the EOSC governance scheme. Again, this area might also benefit from the expertise of international economic relations professionals, especially

[139] Nica, Dan (November 2018): Report by MEP Dan Nica on the proposal for a regulation of the European Parliament and of the Council establishing Horizon Europe – the Framework Programme for Research and Innovation, laying down its rules for participation and dissemination. Retrieved from: http://www.europarl.europa.eu/doceo/document/A-8-2018-0401_EN.html as accessed 01 June 2019.

[140] European Commission (2016): European Charter for Access to Research Infrastructures Principles and Guidelines for Access and Related Services. Retrieved from: https://ec.europa.eu/info/files/charter-access_en as accessed 01 June 2019.

[141] EOSC pilot: Roadmap for the development of rules of participation. Retrieved from: https://eoscpilot.eu/news/eosc-rules-participation-overview as accessed 01 June 2019.

[142] One potential option to operationalise a limitation in access would be geo-blocking – or "geo-walling" as one critic put it, which would in fact undermine the idea of global open access and open science. See: Hinchliffe, L. J. (2019, November 14): Can Geowalling Save Open Access? Retrieved from The Scholarly Kitchen website: https://scholarlykitchen.sspnet.org/2019/11/14/can-geowalling-save-open-access/ as accessed 15 November 2019.

[143] European Commission (2016): European Charter for Access to Research Infrastructures Principles and Guidelines for Access and Related Services. Retrieved from: https://ec.europa.eu/info/files/charter-access_en as accessed 01 June 2019.

[144] European Commission (2018): Prompting an EOSC in Practice. Final report and Recommendations on the European Open Science Cloud of the Commission 2nd High Level Expert Group [2017-2018] [High Level Expert Group Report]. Retrieved from: https://www.eudat.eu/sites/default/files/prompting_an_eosc_in_practice_eosc_hleg_interim_report.pdf pate 29, as accessed 01 June 2019.

[145] Interview 14, 22 November 2018.

when it comes to the necessity of **defining a clear and resilient intellectual property regime considering all re-use options** as well as **data protection policy** for the cloud, which work on global level. Part of these criteria will also be the access to metadata and subsequent transparency of e.g. service contracts etc., which are still discussed at the time of completion of this report[146].

We were also interested what kind of impact European activities around the development of EOSC create in other regions. Even though it might be too early to assess the success of the initiative, and only a few interview partners reacted, there are two dimensions we can highlight. First, EOSC pushes interest towards Open Science in general, especially in countries that are not forerunners, because they see that such a huge project is taking the open principles seriously and translates and enacts them into such a complex socio-technical platform. Second, because it triggers and resituates questions about private-public partnerships for the advancement of science in society, for example: why does a government not own research information data, even if it pays for the service to collect and maintain it.

An Open Access Programme Manager summarized in our interview the position towards EOSC from her experiences: "Sure, the launch of the European Open Science Cloud created a lot of momentum and discussions in other parts of the world, but open data availability was an issue that was discussed there long before. These topics were very high on the agenda of the Global South or non-European countries even before Horizon 2020, open data pilots. Looking at pan-African efforts, China and some Southeast Asian countries, we see a lot happening in infrastructure openness. […] I haven't seen EOSC mentioned in Chinese presentations about Open Science. In Africa, there is a willingness to see how collaborations could happen and whether in Africa an Open Science Cloud would be launched, or national Open Science clouds that would somehow collaborate with the European Open Science Cloud, so definitely in African policy discussions, it plays a role. And there is an African Open Science Policy Platform, which very strongly promotes this European Open Science Cloud agenda. And those European experts who collaborate with Africa always mention the European Open Science Cloud as an inspiration […], so we could say that in Africa it plays a role as pro argument for having Open Science in place, but I haven't really seen any actual steps of [harmonizing] with European Open Science Cloud or like really collaborating with European Open Science Cloud initiatives. But also, maybe it's a little bit too early to say because even in Europe we're still struggling to define its governance."[147]

The other important aspect that triggered reflection of national activities and provided inspiration for shifts in data policies is described in the interview by an Indian innovation policy expert: "We have lost an opportunity, we have lost all ownership over what we call our own output, right? […] you don't want to repeat this mistake as a global scientific community, the governments and the scientific community have to own the data that they produce. Not to give away the rights to somebody. This is exactly what is happening now. We may now [fight] all the publishers to get back the rights in the form of open access and Open Science, but what we are missing is we are doing the same mistake, or if not now in the future, we are going to the same mistake of leaving out all of our other data, like for example [technology-related] data."[148] The European Open Science Cloud will be internationally observed for its capacities to bring together high quality services with open and reusable metadata for monitoring the research system.

[146] EOSC Pilot Deliverable Final EOSC policy recommendations, July 2019. Retrieved from: https://eoscpilot.eu/sites/default/files/eoscpilot-d3.6-v2.7_0.pdf as accessed 01 October 2019.
[147] Interview 13, 27 June 2019.
[148] Interview 6, 21 May 2019.

At the International Conference for Research Infrastructures 2018 Wolfgang Burtscher, then deputy director general for research and innovation at the European Commission, said that policy makers are "not aware of the societal benefits of research infrastructures"[149]. If Europe would like to change this for Open Science and its infrastructures, then it will be of utmost importance to create awareness for the benefits and challenges in the international policy arena. The question hereby is, if the inception of the European Open Science Cloud – should it really become the global frontrunner in large scale, inclusive, Open Science infrastructure – is not the right time to start the international policy dialogue with the support of diplomacy, or whether it makes more sense to prepare the governance framework in detail and then reach out to test it in international partnerships.

[149] Zubaşcu, F. (2018): Are research infrastructures the answer to all our problems? [Blog]. Retrieved from Science|Business website: https://sciencebusiness.net/news/are-research-infrastructures-answer-all-our-problems as accessed 01 June 2019.

4.4 Excursus 3: Dutch de-facto governance practices (Ewert Aukes, Jan 2019)

4.4.1 Issues in the Dutch OS policy arena

With such a large number of actors, also many different issues are discussed on various interfaces between scientists and science politicians. First, talks with people involved in the policy arena suggest that OS is not (yet) a coherent issue. In some ways, it may even be a container term. The topics of Open Science, Open Access, Open Data, Citizen Science and rewards and incentives for scientists are emphasised to different degrees and lumped together in different ways. For some, OS is the overarching topic, others talk about specific elements of OS. The discussions about OS also differ in character depending on the policy level. Given the uncertain development of OS and its implications for individual scientists, the national debate circles around potentially negative repercussions for scientists' daily practices. On the EU level, discussions are much more general and strategic and revolve around visions and possibilities of OS. In general, though, OS is "about sharing, cooperating, open practices" (NWO representative).

4.4.2 Institutionalization of rules and procedures

Furthermore, OS is seen by many as a policy arena with currently few institutionalized rules and procedures. The Big Deals and OA rules for scientists are exceptions confirming that rule. In the field of OD, initial steps have been taken to institutionalize best practices with Green Route repositories including datasets at all universities. However, the fact that there are three actors dealing with research data management raises the question whether this is the optimal organization of this OS element. In addition, according to a KNAW representative, OD may present more challenges in the future due to the increased involvement of private parties in scientific research. In technical research, e.g. when patents or commercial stakes are involved, private parties are less interested in sharing data. The involvement of private parties in research leads to an entanglement of objectives, e.g. commercial and knowledge-generating, which in turn complicates the introduction of fully Open Science. Nonetheless, the nature of science infrastructure necessary for effective and efficient scientific collaboration is diversifying. Whereas localized science infrastructures such as particle accelerators had to be realized previously, nowadays these infrastructures are joined by concerns about digital infrastructures.

As a KNAW representative mentions, it is not (yet) possible to learn about Open Science from a handbook. The emerging state of the topic means that there is no systematized approach yet. It is a topic-in-negotiation. Learning about OS is currently only possible by talking to people who are involved with it, carefully hearing both positive and negative opinions. This also includes scientists from different disciplines and participants in the National Platform Open Science.

4.4.3 Interfaces in the Dutch OS policy arena

The OS policy arena is characterized by many interfaces at which OS issues are negotiated between different types of actors. These are the representative organizations of the NWO and KNAW on national level, and their European representative bodies Science Europe and ALLEA – as well as the Open Science Policy Platform OSPP. Finally, the issue of OS is promoted and discussed globally in the Global Research Council and International Science Council, where counterparts may take up the issue and with a kind of trickle-down effect stimulate debate in their home countries.

4.4.4 Conclusion of the situational analysis in the Netherlands

This country study has discussed the relatively recent phenomenon of Open Science as a policy arena and has fleshed out its institutions, actors and practices in the Netherlands. It is an exploratory study that presents starting points for more in-depth study. We see that Open Science's currently high position on the science policy agenda enables real-time observations about the further development of the issue. It is basically a policy field in the making. Relatively low activity in the domain of laws and regulations reflects this, with the cabinet ambition of making OS the standard as a first step in that direction. Other institutionalization processes include the uptake of OS requirements in funding rules. Given the international and networked character of science, it is not prudent for the Netherlands to move swiftly ahead of other countries in this field. Unilateral action holds harm potential for the Dutch scientific community, and this is a much-voiced concern. With its ambition to be an Open Science pioneer, the challenge for the Netherlands is to dose its innovation speed to remain ahead, but not too far.

While the repercussions in the international science policy arena are rather clear, interviewees often had a hard time linking Open Science with matters of foreign policy. The link between OS and a potential foreign policy effect was reflected on as "interesting" or "unanticipated", i.e. respondents had not been aware of a link before or had not thought about a potential link. It is certainly not seen as conditional in either direction, e.g. the one necessitates the other or vice versa. Conversely, both are perceived as largely separate fields (KNAW representative). One aspect which actors easily agree on is the fact that science and scientific collaboration as a principally apolitical effort has the ability of transcending political divides. Examples brought up in this respect relate to collaborations during World War II and Cold War periods. Some even go so far as to say scientific collaboration may prevent war (a.o. KNAW representative).

4.5 Interfaces

From the detailed analysis of the de-facto governance issues of Plan S, the European Open Science Cloud and the Dutch situational analysis based on conversations with relevant stakeholders we learn that interview partners do not see interfaces between local Open Science activities and foreign policy in general, and Dutch Science diplomacy efforts in particular. Although there might be many overlapping issues, especially when it comes to sharing information, guidance and explore technological challenges as well as industrial opportunities[150]. Furthermore, actors from the diplomacy field described international scientific collaboration as "apolitical in principle", which will not hold true as soon as one immerses in issues of multi-level policy making and distributed governance models of Open Science – as was already demonstrated and will be laid out in more detail later in this report. While issues of international scientific coordination might transcend partisan politics, they are still highly politicized in the interests of multiple stakeholders. So, even if Open Science activities are based on the principle of solidarity and cooperation for the creation of knowledge commons on which society and economy can then rely, they are highly competitive, as they operate not at interfaces of a platonic "pure science", but rather at interfaces of local and global knowledge economies. Certainly, the diplomatic concept of "the universal language of science" allows to "maintain open channels of communication in the absence of other viable foreign policy approaches, ensuring the EU maintains its

[150] See also Tomalová, E., E. Černovská, E. Aukes, J. Montana, E. Dall (2020): Water Diplomacy and its Future in the National, Regional, European and Global Environments. In: Young, M., T. Flink, E. Dall (eds.) (2020): Science Diplomacy in the Making: Case-based insights from the S4D4C project.

presence at the highest level of international scientific endeavour, and ensuring the EU has access to research performed outside Europe"[151].

Policy ambitions of making Open Science standard scientific practice have diverse competitive dimensions on their agenda: global rankings of higher education institutions, commercialization of scientific results via patents and technology, researcher mobility and brain drain, and many more. Therefore, if Science diplomacy is envisioned to act in behalf of national interests and regional cooperation, it can help to establish the right interfaces necessary to tackle the issues listed above. When Commissioner Carlos Moedas pointed to specific European research cooperation projects[152], such as the Synchrotron-Light for Experimental Science and Applications in the Middle East (SESAME)[153], CERN or ESA[154], or the Global Research Collaboration for Infectious Disease Preparedness (GloPID-R)[155], he did not stress the potential of Open Science within those initiatives, rather he repeatedly connected "Openness to the world" with international cooperation and the inclusion of foreign countries in the European funding schemes (e.g. Ukraine[156] and Tunesia[157]).

What are then the concrete interfaces of and for European Open Science Diplomacy?

As already indicated several times, the case study identified only very few formal interactions of EU research policy and representatives of EU foreign relations, such as the European External Action Service EEAS around Open Science. Interactions identified were happening at the level of the Directorates Generals for Research and Innovation and Communications Networks, Content and Technology (including their staff in European Delegations) and foreign policy bodies or research institutions. For example, the group of **R&I Counsellors in the Delegations of the European Union** were asked to help prepare Plan S negotiations. Beyond that, discourse in the European Commission on Open Science and Science diplomacy was not extended to formally include other DGs, such as the DGs Environment or Energy and certainly not DG Competition.

An important instrument for the alignment of international research cooperation are the **Joint Steering Committees on Cooperation on Science and Technology** between the European Union and other countries. As already mentioned before, it was announced (and criticized by Open Access advocates) in June 2019[158] that the EU and Argentina agreed to a cooperation on Open Science. This event was co-prepared by the **Director for International Cooperation at the Directorate General for Research and Innovation**

[151] Moedas, C. (2016): Science Diplomacy in the European Union. Science & Diplomacy, 5(1). Retrieved from: http://www.sciencediplomacy.org/perspective/2016/science-diplomacy-in-european-union as accessed 01 June 2019.

[152] Ibid.

[153] See also Rungius, C. (2020): SESAME – a synchrotron light source in the Middle East: an international research infrastructure in the making. In: Young, M., T. Flink, E. Dall (eds.) (2020): Science Diplomacy in the Making: Case-based insights from the S4D4C project.

[154] ESA: A brief history of the European Space Agency. Retrieved from: http://www.esa.int/About_Us/Welcome_to_ESA/ESA_history/The_ESRO_Convention_and_juste_retour as accessed 01 June 2019.

[155] GLOPID-R: The Global Research Collaboration for Infectious Disease Preparedness. Retrieved from: https://www.glopid-r.org/ as accessed 01 June 2019.

[156] European Commission (20 March 2015) Ukraine Joins Horizon 2020 to Work with EU in Science and Research. Retrieved from: http://europa.eu/rapid/press-release_IP-15-4640_en.htm as accessed 01 June 2019.

[157] European Commission (1 December 2015): Tunisia Joins Horizon 2020, the EU's Research and Innovation Programme. Retrieved from: http://ec.europa.eu/research/index.cfm?pg=newsalert&year=2015&na=na-011215 as accessed 01 June 2019.

[158] Joint Communiqué – XI Joint Steering Committee Meeting of the Bilateral Agreement on Science and Technology between the European Union and Argentina. Retrieved from: https://ec.europa.eu/research/iscp/pdf/policy/ec_rtd_jc-11th-jscm-eu-ar_062019.pdf as accessed 01 October 2019.

of the European Commission, furthermore the **EU Head of Delegation in Argentina** and the Argentinian Ministry of Education and, Culture, Science and Technology. In June 2019 Argentina announced that it will join Coalition S, supporting **Plan S** and expressed interest in "promoting a regional initiative on this topic among the countries from Latin America and the Caribbean."[159] In reference to this event two aspects can be highlighted, which illustrate the scope of Open Science in cooperation. First, the joint planning focused on Open Access, but not on Open Science, therefore other important areas of cooperation, like bioeconomy, marine research and health research, as well as intellectual property development and innovation transfer were not discussed in the light of openness and sharing. There was one exception though, the successful conclusion of a cooperation arrangement on **data access and satellite data sharing** under the **Copernicus programme**.

Second, based on shared values and trust the **EU-CELAC Common Research Area**[160]**,** might also serve as an interface for Open Science activities in the future. However, transatlantic cooperation between Europe and Latin America on Open Science is already supported on other levels. A good example of such an interface is the **cooperation program for researchers** "Enlighten your research - LatinAmerica2Europe", which is organised in 2019 by RedCLARA[161] and GÉANT[162] with support from national research and education networks NRENs in Latin America and Europe, PRACE[163], RICAP[164] and OpenAIRE[165]. The goal of the program is to support the incorporation of "Open Science platforms, high performance computing, data storage data transfer tools, and/or trust and identity services into [the] research process" and to "increase the use and awareness of e-infrastructure resources in various fields of research. The goal of this new EYR-LatinAmerica2Europe is to provide access and support for network, compute, storage and trust and identity resources to meet the growing data and collaboration needs of research. It also aims to inspire new and understand existing collaborations between Latin America and Europe"[166].

A rather untouched interface seems to be the **Joint Programming Initiatives JPI,** which are a voluntary, structured cooperation program for Member States to formulate common research objectives and Strategic Research and Innovation Agendas (SRIA) to address major societal challenges. Led by the Member States, instruments include e.g. joint calls, so-called fast track activities, knowledge hubs, task forces etc. For example, the JPI on

[159] European Commission (7 June 2019): EU and Argentina to Cooperate on Open Science. Retrieved from: https://ec.europa.eu/research/iscp/index.cfm?pg=argentina as accessed 01 October 2019.

[160] The implementation of the Common Research Area (CRA) between the EU and the Latin American and Caribbean countries is based on three pillars: mobility of researchers, access to research infrastructures and jointly addressing common challenges. See the 2018 Roadmap for EU-CELAC S&T cooperation. Retrieved from: https://ec.europa.eu/research/iscp/pdf/policy/celac_roadmap_2018.pdf as accessed 01 June 2019.

[161] RedClara. Retrieved from: https://www.redclara.net/index.php/en/ as accessed 01 June 2019.; Interview partner Valeria Arza, of the Argentinian National Scientific and Technical Research Council CENIT, says that in Latin America organisations like RedClara are driving the progress towards Open Access. The governments are supporting, but the real impetus comes from these associations and infrastructures born in universities and libraries.

[162] GÉANT a pan-European data network for the research and education community connecting national research and education network. Retrieved from: https://www.geant.org/ as accessed 01 June 2019.

[163] Partnership for advanced computing in Europe PRACE. Retrieved from: http://www.prace-ri.eu/ as accessed 01 June 2019.

[164] RICAP: The Iberoamerican Network of Participatory Science. Retrieved from: http://cienciaparticipativa.net/the-ricap/?lang=en as accessed 01 June 2019.

[165] OpenAIRE: European Open Science Infrastructure, for open scholarly and scientific communication. Retrieved from: https://www.openaire.eu/ as accessed 01 June 2019.

[166] GÉANT: Call for proposals for "Enlighten your research - LatinAmerica2Europe" (2019). Retrieved from: https://www.geant.org/News_and_Events/Pages/Enlighten-Your-Research-Latin-America2Europe.aspx as accessed 01 November 2019.

Climate proposed a set of policy recommendations for the implementation of Open Science at both internal (i.e. JPI Climate network governance) and external (i.e. JPI Climate network activities) level already in 2015[167].

The need for alignment and cooperation of Member States is one of the recommendations of the Open Science Policy Platform and necessary to turn advocacy into political action. In our interview a member of the European Open Science Policy Platform, explains: "We plan to organize an OSPP meeting […] with the Member States in order to tell them about the need to align policies and coordinate initiatives. […] It will be important to have the economic players on board, too, to really commit money to change the system on an international level. That is really difficult because you need a lot of, a lot of coordination"[168]. The advice mechanism of the **Open Science Policy Platform** for the European Commission does not include a foreign policy dimension, even though the composition of experts shows that it was designed for a multiple-stakeholder discourse. The OSPP collects advice from several **High-Level Expert Groups**, as listed below

- HLEG on EU Open Science Cloud (I and II)
- HLEG on Altmetrics → Next generation metrics
- HLEG on Careers & Skills
- HLEG on Rewards
- HLEG on Future of Scholarly Communication
- HLEG on FAIR Open Data
- HLEG on Indicators

Furthermore, the OSPP is informed by many more sources: There are interactions between EU Member States and associated countries initiated by the EU commission (**Mutual Learning Exercise** Open Science), and in **ERAC workgroups** such as the ERAC for Open Science and Innovation, but not involving any representatives of foreign relations or diplomacy.

Nevertheless, even without the inclusion of professional diplomats there is a lot of Science diplomacy happening. The proposal for the next European framework programme for research and Innovation, **Horizon Europe,** has triggered a lot of responses and led to the forming of alliances to promote Open Science, some of which also included or even were mainly comprising of Open Access publishing corporations, such as an international consortium led by Frontiers[169]. The advocacy letter of this group was directed to the Industry, Research and Energy **ITRE Committee of the European Parliament,** i.a. to prevent the reciprocity principle that was proposed for new Open Access policies[170].

Since several years there is a steady increase in symposia, conference tracks and even dedicated **meetings and conferences**[171], which are organised mostly by international representative bodies like the International Science Council (e.g. CODATA 2019[172] is collocated with a high-level policy workshop "Implementing Open Research Data Policy and Practice"), research organisations or infrastructures. In particular, those organised by

[167] JPI Climate, Guidelines on Open Knowledge. Retrieved from: http://www.jpi-climate.eu/media/default.aspx/emma/org/10862502/JPI+Climate+Guidelines+on+Open+Knowledge.pdf as accessed 01 June 2019.

[168] Interview 9, 28 May 2019.

[169] Frontiers Science News (2018): Horizon Europe: Safeguarding the EU's role as champion for Open Science. Retrieved from: https://blog.frontiersin.org/2018/11/15/horizon-europe-european-parliament-open-science/

[170] See the Report by MEP Dan Nica November 2018. Retrieved from: http://www.europarl.europa.eu/doceo/document/A-8-2018-0401_EN.html as accessed 01 June 2019.

[171] Such as the International Open Science Conference Berlin https://www.open-science-conference.eu/ or the Nordic Open Science conference https://www.vr.se/english/just-now/events/all-events/calendar-events/2018-08-23-nordic-open-science-conference.html

[172] International Science Council: CODATA 19. Retrieved from: https://council.science/events/codata-2019

international science policy organisations nearly always include dedicated programs to bring together policy makers, research administration, researchers and infrastructure providers (academic, non-profit or commercial).

In general, **Model Open Access policies** and **implementation roadmaps**, such as proposed by Plan S are typical interfaces in that regard, aligning international stakeholders' interests, or divorcing them. The implementation of **Plan S** and its many supporters demonstrate the strong international networks at play, most of which were initiated by and built on personal relations and informal connections, as some interview partners recalled. Furthermore, Plan S now has "**ambassadors**", active scientists, who should "act as local points of contact for discussions and advice about Plan S and its implementation. Ambassadors will also listen to the concerns of the research community and relay these back to cOAlition S"[173]. The goal here is to better bridge research communities and policy, not so much the connection to other societal domains. However, the foreign research policy dimension and geopolitics are represented in the composition of the ambassadors' group: there are representatives from each continent. This fact is clearly pointing to future ambitions of cOAliton S to become a global initiative.

In general, **research infrastructures** typically gather together diverse stakeholders and require a broad range of multi-level negotiations, such as standards, protocols, governance and cost sharing, ownership, access, …. Recently several communities of practice have started targeted initiatives on open research infrastructures, such as The Global Sustainability Coalition for Open Science Services (SCOSS)[174] or Invest in Open Infrastructure (IOI)[175], both of which are designed to serve as international policy interfaces. Their aims are similar, sustainably securing open infrastructure services across the world, be it with funding, materials or expertise, and "creating a more interconnected network of services that works more closely together". A specific type of policy interface in this context is a **mapping instrument**, such as an online monitor based on selected indicators: IOI wants to "establish a framework for surveying the global landscape of Open scholarly infrastructure, making assessments based on functionality, usage, health and financial needs. Funding recommendation will be made based on this assessment. The second function will be to coordinate and direct funding, derived from institutions, agencies and foundations, to services — using the framework as a guide"[176].

Monitoring and indicator frameworks could also be turned into interfaces for science diplomacy. Even if Europe now develops and puts into place new indicator frameworks and toolboxes for Open Science, they have to be discussed negotiated beyond national and European interests[177]. This might be particularly important for questions of definition of checks and balances for "reciprocity" and the criteria for commitments of participants. Furthermore, European indicator frameworks will also be increasingly aligned with international reference frames like the Sustainable Development Goals, and – if they should be successful – feed into international research funding databases, and existing documentation infrastructures. However, an interview partner reminds us that indicator development and monitoring should not be left to policy actors alone: "We cannot leave

[173] Ambassadors of cOAlition S. Retrieved from: https://www.coalition-s.org/ambassadors/ as accessed 01 October 2019.
[174] SCOSS: The Global Sustainability Coalition for Open Science Services. Retrieved from: http://scoss.org/ as accessed 01 October 2019.
[175] Invest in Open Infrastructure. Retrieved from: https://investinopen.org/ as accessed 01 October 2019.
[176] Invest in Open Infrastructure (2019): Invest in Open Infrastructure: A Concept 0.2. Retrieved from Invest in Open Infrastructure website: https://investinopen.org/docs/statement0.2.html as accessed 01 October 2019.
[177] Wouters, P., I. Rafols, A. Oancea, L. Kamerlin, B. Holbrook, M. Jacob (2019): Indicator frameworks for fostering open knowledge practices in science and scholarship. (Independent Expert Report No. 10.2777/445286). Retrieved from: https://op.europa.eu:443/en/publication-detail/-/publication/b69944d4-01f3-11ea-8c1f-01aa75ed71a1/language-en/format-PDF as accessed 15 November 2019.

this to the nation states, especially with the SDGs. This might be a very cynical view: left of the nation states there will be cherry-picking of data, there will be at least procedures that mean that the data aren't necessarily as transparent as they might be. So, when we report on the SDGs or on Sendai or when we discuss large-scale and necessary scientific endeavours, we need to be, you know, a little bit less of Realpolitik and a little bit more international cooperation."[178]

As already described in detail before, a good example of science diplomacy interfaces can be found in the design process of the governance of the **European Open Science Cloud** that brought together not only representatives of participating countries, but also a diverse range of stakeholders. With EOSC being still more a concept under negotiation than a fully-fledged infrastructure, processes of organisational and technological closure can be observed "in the wild". Besides the quest to find the right legal vehicle to run EOSC, it could also be a (role) model for future endeavours in how to govern the collaboration between end users (science and innovation community), service providers (archives and repositories, developers, intermediaries, operators), funders and policy makers. Participation for those stakeholders in the process is facilitated via the experts in the **executive and advisory boards, working groups, co-creation calls, webinar and workshop series, and stakeholder forum** events such as symposia and conferences. All those measures are directed towards facilitating focused cooperation, and creating a truly federated, collaborative and open research infrastructure and a lively European community however they are focusing primarily on the European perspective.

Another important dimension of the EOSC as interface was addressed in the interview by a rector of a Eastern European university: "Open Science and such infrastructures help us to counter the ongoing brain drain with better access to excellent research. It is also important for education, to establish our country as place for third level of education. When students and professors can already access high quality information. […] There is this trend of student mobility from the East or Far East, to study in Europe. Many of them cannot afford to go to the UK, NL or Germany. So, for countries like Moldova open access to data would also help to establish the country as attractive place for higher education."[179]

More generally, we should not forget the internationally highly mobile **students** trained in Open Science. This is a currently rather untapped and potentially very effective interface for the transition towards Open Science in terms of **human resources and skills**: Europe's higher education system, as well as its publicly funded research performing organisations, are training the next generation of researchers. In many fields, such as physics, psychology, molecular biology, Open Science principles are already or becoming standard scientific conduct, as well as integral aspect of training in research integrity. Foundations such as Wellcome Trust, and civil society organisations, like Wikimedia[180] organise special Open Science trainings with the student mobility and their function as multipliers in mind. When those professionals leave Europe for other world regions, they take with them a culture of Open Science.

At the same time, it is to decide if the EU is "open to cooperation on a global scale," as Deputy Director General Wolfgang Burtscher (DG Research) put it[181]. This would require different types of interfaces – even though some of the mentioned above are explicitly

[178] Interview 5, 15 May 2019.

[179] Interview 10, 28 May 2019.

[180] Open Science Fellows program of Wikimedia Germany. Retrieved from: https://en.wikiversity.org/wiki/Wikimedia_Deutschland/Open_Science_Fellows_Program as accessed 01 June 2019.

[181] Zubaşcu, F. (2018): Are research infrastructures the answer to all our problems? [Blog]. Retrieved from Science|Business: https://sciencebusiness.net/news/are-research-infrastructures-answer-all-our-problems as accessed 01 June 2019.

open to non-European participation. Creating a framework for open research and innovation infrastructures in Europe is not the same as expanding this to the global level. This global view – which is yet to be developed – would need to rely on Science diplomacy skills, especially as new types of organisations, models for cooperation and funding are needed. When Carlos Moedas says: "Research infrastructures are the assets for science diplomacy,"[182], adding that only Europe has understood so far that research infrastructures and their contexts are political endeavours, as they are commonly invisible to policy makers and public. Therefore, it seems that the first interfaces for a global political discourse on open research infrastructures will be negotiations of **standards and protocols**. At first sight such negotiations look quite technical, but in them a lot of socio-technical decisions are made, which will be leading the way to how the infrastructures can be used and how will benefit from them. Such negotiations do not only include technical standardization of data exchange formats, network architecture and alike. They also tackle issues of collaboration and governance, like which activities will be logged for further analysis, what kind of access will be provided to whom, how are the costs shared and monitored, what kind of procurement procedures will be necessary, what kind of legal entities are needed for maintenance, just to name a few. The vision of globally accessible research data commons – always resonating with the EOSC – needs an implementation framework that builds on robust interfaces between the research and the policy system that can deliver on the promises made.

Many of the interfaces described here are not visible or accessible to local or regional Open Science grassroots movements or advocates, as both the co-founder of AfricArXiv[183] and the founder of OpenScienceMooc[184] reflect in a discussion: "Working here on the ground we have to make sure that more people are aware of the large-scale changes happening around the world politically. […] Before however they need to learn how to empower themselves to become part of that change. […] And then if you want, why not take that to the next level? There are people there on the ground, you know, like you said [ ] and OECD and UN and UNESCO all working on these things, and I think as long as we sort of have a common picture in mind of where we want to be at both levels, then we're good." One of the issues here seems to be the intersectional communication: "I feel the communications are there, yes, but there's not much cross-sectioning, cross-communicating. There're few individuals going to these big scale United Nations events, and then also vice versa, there are not a lot of crosscutting interactions between the levels".[185] Therefore, if "diplomacy is the political level of advocacy" as one interview partner put it, there is still a lot to do to bring the levels together and coordinate actions for better effects.

[182] Ibid.

[183] AfricArXiv. Retrieved from: https://info.africarxiv.org/ as accessed 01 June 2019.

[184] OpenScienceMooc. Retrieved from: https://opensciencemooc.eu/ as accessed 01 June 2019.

[185] Interview 7 and 8, 21 May 2019.

5. Relevance and use of knowledge

The case study was guided by 2 horizontal perspectives: 1) a content/procedural perspective: how can/does Open Science help foreign policy-making, and 2) a thematic perspective: Open Science as topic of foreign policy (though those perspectives might be overlapping to some extent). Even though we found only marginal links between the European Open Science policy actors and official EU-level or national level foreign policy actors, as well as only peripheral links between international Open Science advocacy organisations and foreign policy actors, we need to emphasize the high demand for science diplomacy by our interview partners from the international research cooperation system. While analysing the empirical material, another horizontal perspective was added to the list:

- Knowledge about Open Science
- Open Science knowledge for diplomacy
- Diplomatic knowledge, skills and resources for Open Science

5.1 Knowledge about Open Science

From desk research and stakeholder interviews we conclude that a big challenge today is first and foremost go gather valid and balanced knowledge about the uptake of Open Science, its impact and its potential. While this seems to be true also for the international exchange and transparency of research information in general – most of which is stored in proprietary data bases – it is particularly true for Open Access and Open Data. Many current research information systems (CRIS) are still waiting to be updated with Open Science details, such as whether a publication is Open Access, whether there is an embargo, etc. Furthermore, only recently libraries as well as funders started assembling and sharing their data on costs and benefits of subscription and Open Access contracts with publishers. It requires national and international high efforts to bring this information together and make it comparable and interpretable. This kind of knowledge is closely tied to research infrastructures and CRIS, as many of those are also owned by publishing or content service industries, so that data for monitoring publicly funded scientific performance in general often must be bought back from such outlets. Therefore, many advocates claim that Open Science needs open infrastructures, otherwise we are iterating the same procedures eternally that we wanted to abolish. Others call for more evidence of the socio-economic impact and translation of scientific research that has been made open, e.g. in cooperation with industry or the public sector. But we certainly do not only need facts and figures, nor just metrics or altmetrics, we also need best practices, success stories, and stories of failure so that stakeholders can engage in mutual learning, which is the basis for international coordination of efforts.

5.2 Open Science knowledge for diplomacy

Open Science has already proven very useful in tackling global challenges at several occasions, e.g. health crisis like Ebola or Zika, in the aftermath of natural disasters like earthquakes or hurricanes, or for the fight against climate change. When fast action at the interface of science, technology and foreign policy is needed, Open Access to publications and data is vital.

Speed is everything in times of an outbreak, emergency respond teams have to be set up across borders, as well as research teams that must agree on standards and protocols to share crucial information when tested and available. Right now, in most cases the dissemination of data and results is "sporadic at best. In the case of influenza, an international consortium of researchers called GISAID established a framework for good

practice in 2006[186]. Largely thanks to this, during the 2009 H1N1 influenza outbreak, the US National Center for Biotechnology Information created a public repository that became a go-to place for the community to deposit and locate H1N1 sequence information4. By contrast, the publishing of sequence information in the early stages of the 2012 Middle East respiratory syndrome (MERS) outbreak in Saudi Arabia highlighted uncertainties about intellectual-property rights, and the resulting disputes hampered subsequent access to samples"[187]. Two Ebola outbreaks since 2014 have also triggered a range of international measures for data sharing and Open Science, with many international organisations like the WHO now restructuring their research strategies[188].

These examples show that "Open Science and Openness to the world"[189] do not only refer to expanding European knowledge markets, but also to tacking grand challenges sustainably and by international scientific cooperation. Furthermore, Open Science means that science diplomats themselves can get access to information needed – be it scientific results, contact points to experts, or better insights in research system monitoring. Open Science also requests to better communicate and translate findings into public knowledge, so science diplomats might also be able to collect policy briefings, educational resources etc. Finally, evidence on the productive entanglements of science commons and commodification based on scientific results, on the socio-economic benefits would help diplomats to bring Open Science on the agenda together with environment, culture and trade issues.

5.3 Diplomatic knowledge, skills and resources for Open Science

On the other side, Open Science coordination would greatly benefit from expertise in foreign policy while planning and implementing international coordination, building infrastructures, and negotiating new Open Access models. Since "Open Science is not happening in a vacuum" (Interview), instead it is part of a broader global Open Culture movement on the one hand, and on the other hand happening at the same time as security policies, new trade regulations, legal frameworks and ethical standards – e.g. ethical artificial intelligence – are negotiated. In all of those areas Europe is still trying to define its role and function on the global parquet. Whereas Europe is not the frontrunner in those mentioned areas, it is when it comes to Open Science and with it the potential of alternative routes to markets and public goods. Respondents to the S4D4C survey[190], ranked the following purposes of Science diplomacy as high/rather important:

- International collaboration for scientific purposes (83%)
- Developing partnerships for addressing global challenges (69%)
- Strengthening the international competitiveness of their country/the EU (68% of respondents: highly or rather important; more important in EU countries: 75%)

[186] GISAID. Retrieved from: https://www.gisaid.org/ as accessed 01 June 2019.

[187] Yozwiak, N. L., S.F. Schaffner, P.C. Sabeti (2015): Data sharing: Make outbreak research open access. In: Nature News, 518(7540), p. 477.

[188] Goldacre, B., S. Harrison, K.R. Mahtaniand, C. Heneghan (2015): WHO consultation on Data and Results Sharing During Public Health Emergencies. Retrieved from WHO website: https://www.who.int/medicines/ebola-treatment/background_briefing_on_data_results_sharing_during_phes.pdf as accessed 01 June 2019.

[189] Moedas, C., Directorate-General for Research and Innovation (European Commission) (2016): Open innovation, open science, open to the world. Retrieved from European Commission website: https://op.europa.eu/en/publication-detail/-/publication/3213b335-1cbc-11e6-ba9a-01aa75ed71a1 as accessed 01 June 2019.

[190] Degelsegger-Márquez, A., T. Flink, C. Rungius (2019): What it takes to do science diplomacy. Practices, identities, needs and challenges of science diplomacy practitioners. Baseline analysis and needs assessment. (No. Deliverable 2.3). Retrieved from S4D4C website: https://www.s4d4c.eu/wp-content/uploads/2019/03/S4D4C_WP2_D2.3_ZSI.pdf as accessed 01 June 2019.

Whereas all 3 purposes could be regarded under the light of changes brought by Open Science, the latter 2: partnerships for addressing global challenges as well as strengthening international competitiveness contain specific aspects of foreign relations and diplomatic expertise. In the interviews for this case study international Open Science actors wish for more support of diplomacy actors in

- Assembling and managing multi-level policy stakeholder discussions across borders, while identifying strengths, gaps and opportunities
- Providing the bigger policy picture and socio-economic context for negotiations
- Coordinating the sharing of costs and burdens of sustainable maintenance (e.g. of data infrastructures)
- Assembling expertise for planning and negotiating the socio-economic factors (e.g. how to best bring together openness and IPR, setting ethical standards, ...)
- Bridging localization with internationalization: Aligning open strategies with other national and international activities, understanding local and global impact
- Incentivizing policy actors to support information syndication, open knowledge bases and evidence-based policy making

6. Issues of multi-level policy-making

6.1 Changing stakeholder constellations

Open Science-related policy-making is multi-level by nature: As this report demonstrates – for example in the chapter on stakeholders – policy making involves a variety of actors, institutions, infrastructures. Matters of opening science on international scale with a foreign policy dimension – such as sharing of data – became particularly important during the period of cold war and a time of international secrecy, arms races and the quest for technological supremacy (Krige & Barth, 2006; Turekian, 2018). Some of the still very active international advocates of Open Science were founded in that period: the Committee on Data for Science and Technology (CODATA; established in 1966)[191], the International Network for the Availability of Scientific Publications (INASP)[192] based on earlier efforts and founded in 1992, and the World Data System (WDS)[193], which was established in 2008, based on the 1958 foundation of the World Data Centers and the Federation of Astronomical and Geophysical Data Analysis Services. All these initiatives co-driven by the International Council for Science (ICSU – now part of the International Science Council)[194] were certainly intervened with Science diplomacy long before the term was born, however the diplomatic dimension was often kept under the radar.

From the late 1980s on, the focus changed to tackling grand challenges by assembling the right data and analytical expertise, and with the foundation of the Intergovernmental Panel on Climate Change (IPCC, 1988)[195] the global policy dimension of the scientific study of climate change was at the heart of the organisational design. The Human Genome Project[196] – which could be regarded as another one of the pioneering international Open Science projects – attracted a lot of political interest and debate, produced internationally used protocols and procedures for open workflows and sharing data, used preprint servers

[191] COdata. Retrieved from: http://www.codata.org/ as accessed 01 June 2019.

[192] INASP. Retrieved from: https://www.inasp.info/ as accessed 01 June 2019.

[193] International Council for Science – World Data System. Retrieved from: https://www.icsu-wds.org/ as accessed 01 June 2019.

[194] International Science Council. Retrieved from: https://council.science/ as accessed 01 June 2019.

[195] International Panel on Climate Change. Retrieved from: https://www.ipcc.ch/ as accessed 01 June 2019.

[196] Human Genome Project. Retrieved from: https://www.genome.gov/human-genome-project as accessed 01 June 2019.

and provided Open Access to publications, and even demonstrated that international cooperation on scientific commons[197] can be successful without consolidated funding and involving commercial actors. These initiatives show how governance can be achieved jointly by scientists and policymakers from multiple countries. Besides scientific collaboration, governance tasks include the design, financing, management and maintenance of associated infrastructures and the sorting of legal frameworks and insecurities of exploitation and licensing. The mentioned organisations illustrate the growing importance of scientific collaboration in international relations, but they were not yet operating under the label of Open Science, nor Science diplomacy.

Even though data sharing, and activities related to Open Research Data predate Open Access advocacy, it was Open Access, which finally kicked off a global Open Science movement and draw more attention of policy makers to the necessities of transnational coordination[198]. Before the establishment of preprint servers in the 1990s[199] and the advent of coordinated Open Access declarations and manifestos in the early 2000s, policy actors were only marginally visible in both European and global debates, which were mainly ignited as well as fuelled by stakeholders from the science and research systems, such as librarians and researchers and their international representative bodies[200]. Stakeholder landscapes have changed over time, now involving many more national and international experts and Open Science advocacy groups and consortia in universities and academies. The field started to professionalize, i.e. with dedicated conferences and the installation of Open Access contact points in research performing organisations. Relatively new – since the mid 2000 – is the intensive involvement of the publishing industry as well as information service providers, because Open Access became a new model for expanding knowledge markets.

Ever since calls for Open Access to publicly funded research became more frequent and culminated with the Budapest Declaration (2002), the Bethesda Statement and the Berlin Declaration (2003), and it became apparent that there is demand for big changes in the system of scholarly communication, research policy makers started to approach experts (from research, funders, or libraries) to advise on how to best foster and expand access to scholarly research[201]. The European commission adopted an Open Access policy for its funding schemes already in its 7th Framework Programme for Research and Technological Development (2007-2013), covering ca. 20% of the research funded. From 2014 onwards with the new framework Horizon 2020, the Open Access policy covered 100% of funded research. This policy requests all projects to be required to make their peer-reviewed journal articles openly accessible, free of charge. Moreover, the EC introduced an Open Data pilot in Horizon 2020 which was later mainstreamed across all thematic programmes in 2017. This Open Data policy aims to make the research data generated by funded projects accessible with as few restrictions as possible, following the motto: "As open as

[197] In February 1996 the participants at the International Strategy Meeting on Human Genome Sequencing released the Bermuda Principles. The principles assert that "all human genomic sequence information, generated by centres funded for large-scale human sequencing, should be freely available and in the public domain". Suber, P. (2019): Declarations in support of OA - Open Access Directory. Retrieved from Open Access Timeline website: http://oad.simmons.edu/oadwiki/Declarations_in_support_of_OA as accessed 01 June 2019.

[198] To be historically correct: even earlier there was the Free and Open Source movement and in parallel to the growing public visibility of Open Access the call for Open Education and Open Educational Resources intensified globally.

[199] See for example the preprint Server arXiv. Retrieved from: https://arxiv.org/ as accessed 01 June 2019.

[200] In other world regions, this was different, e.g. in Latin America, where transnational OA initiatives were pushed early on also by science policy makers, see also page 157 of this report

[201] Suber, P. (2019): Declarations in support of OA - Open Access Directory. Retrieved from Open Access Timeline website: http://oad.simmons.edu/oadwiki/Declarations_in_support_of_OA as accessed 01 June 2019.

possible, as closed as necessary"[202]. These polices have since inspired many national and international funders[203] and will be continued in Horizon Europe, the 9th European framework programme. There, the pillar for basic research and infrastructure was even called "Open Science" in an earlier proposal for the text[204]. The programme also highlights further coherence across participating countries by the way of monitoring impact and development: "Accelerating the transition towards Open Science, by monitoring, analysing and supporting the development and uptake of Open Science policies and practices, including the FAIR principles, at the level of Member States, regions, institutions and researchers, in a way that maximises synergies and coherence at EU level."[205]

6.2 Governance challenges

However, with those new top-down governance aspects also come challenges and questions: which Open Access models are the best for the European research landscape, and can this be decided universally? How do we know about the impact of Open Access and Open Research Data, which monitoring infrastructures need to be developed? How to best govern transnational open infrastructures? What incentive and reward systems have to be established relying on which kind of assessments? These questions are among the currently most debated governance issues concerning Open Science policy implementation, and all of them clearly point to the international and collaborative character of their answers.

Not only since Open Access has been declared as the "future of academic publishing" in Europe (Finch et al., 2013), a rising dominance of the business model of the **gold route to Open Access** is observed, and Open Access journals have been flourishing, providing novel and huge revenues to commercial publishers and scientific societies or associations. Many of those are hosting "high impact" journals, which are obligatory passage points for researchers, who have to follow the "publish or perish" imperative. Studies demonstrated the unparalleled rise both of subscriptions and of Open Access costs at the same time when several big corporate publishers presented themselves as "Open Science Advocates". This resulted in uproar by several communities, e.g. proposing to boycott those publishers[206], but also led several institutions and national consortia to re-negotiate or even end their contracts with those publishers[207].

The preference for the gold model of Open Access in European policy making has been criticised a lot, and stakeholders from research communities, libraries as well as providers of alternative publishing models have repeatedly – lately in the consultation about the implementation plan of Plan S - pushed for the green model and the right to self-archiving[208]. Several nation states have already included the right to self-archiving of

[202] Horizon 2020 funding guide on Open Access. Retrieved from: http://ec.europa.eu/research/participants/docs/h2020-funding-guide/cross-cutting-issues/open-access-data-management/open-access_en.htm as accessed 01 June 2019.

[203] It remains unclear if European policy makers were inspired by at that time already existing and evaluated policies and strategies, as in Latin America.

[204] European Commission: Horizon Europe – the next research and innovation framework programme. Retrieved from: https://ec.europa.eu/info/designing-next-research-and-innovation-framework-programme/what-shapes-next-framework-programme_en as accessed 01 June 2019.

[205] European Parliament: P8_TA(2019)0396, Programme implementing Horizon Europe***I. Retrieved from: http://www.europarl.europa.eu/doceo/document/TA-8-2019-0396_EN.pdf as accessed 01 June 2019.

[206] The Cost of Knowledge. Retrieved from: http://thecostofknowledge.com/ as accessed 01 June 2019.

[207] See for example Project Deal in Germany https://www.projekt-deal.de/ or the Big Deal Cancellation tracker by SPARC: https://sparcopen.org/our-work/big-deal-cancellation-tracking/ as accessed 01 June 2019.

[208] See also the chapter on de-facto governance issues the section on Plan S. Besides the dominance of the gold model of OA, also other principles were criticized in the consultation phase of Plan S, i.e. some researchers

published scientific papers in their legal frameworks. For example, in 2018 Belgian copyright law was changed to allow authors of scientific articles funded with public money to "retain the right to make their article available in Open Access even if otherwise stipulated in their contract with the publisher"[209].

6.2.1 Socio-technical frameworks

Creating the right **legal frameworks** in Europe is still mostly a national effort but needs to be reflected in international exchange of best practices and analysis of failures and critique. For Open Access this exchange is currently happening but is – as our interview partners recount – based rather on individual initiatives or personal relationships than on systematic exchange between nation states. Whereas the design of Open Access (and Open Science) policies in universities and other research performing organisations is regularly reflected in meetings and conferences[210], and documented by reports of international representative bodies and umbrella organisations, as well as by internet platforms collecting information on policies[211], the documentation and comparison of national policies is not easily facilitated[212]. The same is true for the legal frameworks needed to build, sustainably run and monitor transnational open research infrastructures and defining coherent data sharing policies across borders and diverging domestic laws, e.g. when it comes to decide about data ownership, privacy regulations and secondary use. Another issue already lurking is the implementation of strict data localization regulations in some countries, such as China or Russia, and how this will affect scientific cooperation and data transfer. Some of these questions have been tackled by practitioners and are currently finding their ways into academic literature about Data Diplomacy[213], but we could not identify any formal involvement of foreign policy experts or diplomats in the Open Research Data debate. Data diplomacy seems to be executed either by researchers, infrastructure experts or representatives of international data societies or policy bodies, such as CODATA or the WHO[214]. Negotiations of data or infrastructure **standardisation and protocols** – as happening for example in the Research Data Alliance RDA[215] or the Internet Engineering

presumed a loss of scientific freedom by not being allowed to choose the publication outlet freely. Furthermore, some researchers were sceptical about the applicability of OA to scientific monographs, and the respective increase of costs to publish them. See: Harnad, S. (2012): Why the UK should not heed the Finch report. Impact of Social Sciences Blog.; Eve, M. P. (2018): On the practical implementation of Plan S [Blog]. Retrieved from Open Access website: https://eve.gd/2018/10/03/on-the-practical-implementation-of-plan-s/ as accessed 01 June 2019.

[209] Open Access Belgium: Belgian copyright law amended in favor of open access to scientific articles. Retrieved from: https://openaccess.be/2018/09/13/belgian-copyright-law-amended-in-favor-of-open-access-to-scientific-articles/ as accessed 01 June 2019. Such regulations are now enacted in many European countries, such as France, Austria, Germany…

[210] Such as Open Access Days, International Library Association conferences, etc.

[211] Register of Open Access repositories. Retrieved from: https://roarmap.eprints.org/ as accessed 01 June 2019.

[212] Even publishers Open Access policies are documented here in SHERPA. Retrieved from: http://sherpa.ac.uk/romeo/index.php as accessed 01 June 2019.

[213] Boyd, A., J. Gatewood, S. Thorson, T.D. Bowman (2019): Data Diplomacy. In: Science & Diplomacy, 8(1). Retrieved from: http://sciencediplomacy.org/article/2019/data-diplomacy as accessed 01 October 2019.

[214] Murillo, A. (2015): Data Diplomacy: Political and Social Dimensions of Data Collection and Data Sharing | CODATA Blog. Retrieved from Codata_blog website: https://codata.org/blog/2016/01/10/data-diplomacy-political-and-social-dimensions-of-data-collection-and-data-sharing/ as accessed 01 June 2019.
Rosen Jacobson, B., K.E. Höne, J. Kurbalija (2018): Data Diplomacy Report. Retrieved from DiploFoundation website: https://www.diplomacy.edu/sites/default/files/Data_Diplomacy_Report_2018.pdf as accessed 01 October 2019.

[215] Research Data Alliance. Retrieved from: https://www.rd-alliance.org/ as accessed 01 June 2019.

Task Force IETF[216] - could also be regarded in the light of science diplomacy practised without the involvement of diplomats.

"Whenever there's science, wherever there's science, there's a data component. There's this big driver for Science diplomacy, for cooperation and coordination of data through the Sendai framework on the one hand, or the SDGs on the other. And so, there's lots of activities there, but there are also real concerns because of the role of the nation's states"[217] says one interview partner.

European **copyright policies** – The European Copyright Directive was adopted in 2019[218] – do follow European Open Science strategies. Besides entertainment and content industries blocking Open Science efforts, representatives of research, cultural heritage and education systems have actively lobbied for an open-friendly copyright design. There are now copyright exceptions for text and data mining (art 3, 3a), facilitation of digital, cross-border teaching (art 4), digital preservation across borders (art 5), digitisation of out-of-commerce works and collective licensing (art 7-9a), and for achieving public interest by putting works in the public domain (art 10b). Open Access was protected in articles 11 and 13 by the exclusion of scientific publications from the copyright and making it possible to share them online; and by preventing that not-for-profit scientific and educational repositories and platforms have to run upload filters[219]. The lobbying for Open Science has been mainly organized by international science organisations, such as SPARC[220], LIBER[221] or EIFL[222] or similar NGOs, Science Europe[223] and the Member of European Parliament Julia Reda[224].

Another important component of the efficient coordination of the transition towards Open Science is a robust monitoring system of the developments in Europe. **Monitoring Open Science** should include policies, practices like the adoption of the FAIR principles and infrastructures across nation European states and even better around the word. Several of such monitoring platforms already exist, mostly hosted by NGOs or Open Science related initiatives, such as the Registry of Open Access Repository Mandates and Policies (ROARMAP), Sherpa-Romeo, Sherpa-Juliet, the Directory of Open Access Journals, OpenAIRE and many more.

With ROARMAP for example, it is possible to visualize alignment to Horizon 2020 policies of individual countries.

[216] Internet Engineering Task Force. Retrieved from: https://www.ietf.org/ as accessed 01 June 2019.

[217] Interview 5, 15 May 2019.

[218] European Parliament, & European Council: DIRECTIVE (EU) 2019/790 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 17 April 2019 on copyright and related rights in the Digital Single Market and amending Directives 96/9/EC and 2001/29/EC (2019). Retrieved from: http://www.europarl.europa.eu/doceo/document/TA-8-2019-0231_EN.html as accessed 01 June 2019.

[219] SPARC Europe: A new Copyright Legislation for Europe. How will this impact Open Access? Retrieved from: https://sparceurope.org/a-new-copyright-legislation-for-europe-how-will-this-impact-open-access/ as accessed 01 June 2019.

[220] SPARC Europe. Retrieved from: https://sparceurope.org/ as accessed 01 June 2019.

[221] LIBER Europe. Retrieved from: https://libereurope.eu/ as accessed 01 June 2019.

[222] EIFL. Retrieved from: https://www.eifl.net/ as accessed 01 June 2019.

[223] Science Europe. Retrieved from: https://www.scienceeurope.org/ as accessed 01 June 2019.

[224] Blogpost of former MEP Julia Reda. Retrieved from: https://juliareda.eu/eu-copyright-reform/text-and-data-mining/ as accessed 01 June 2019.

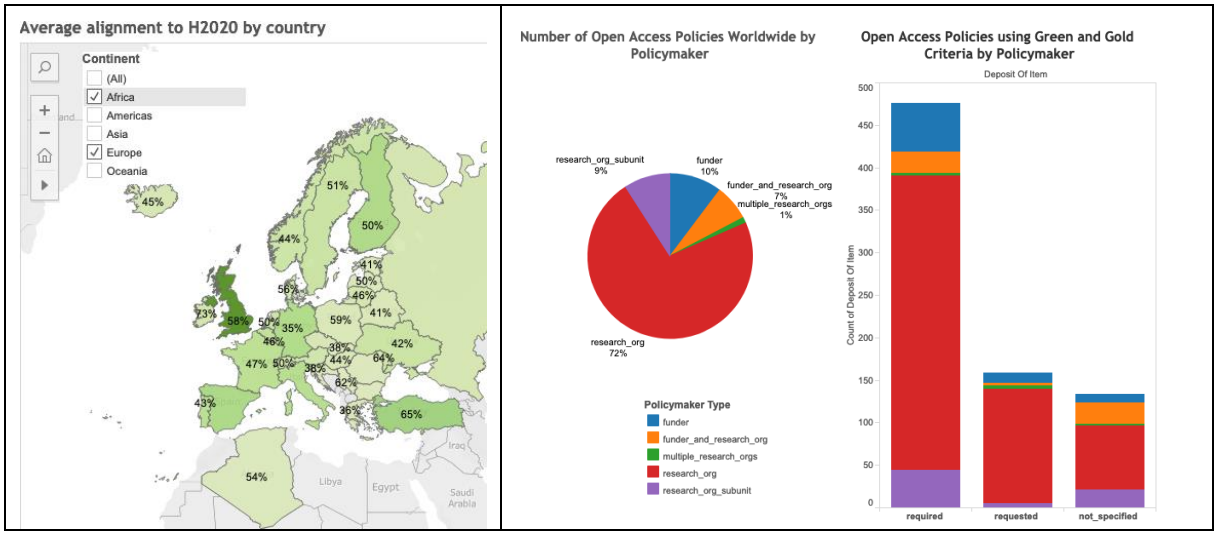

Figure 10: Screenshots from ROARMAP, left: Alignment of countries with H2020 Open Access policy, rights: OA policy by type of policy maker, status of OA mandate by policy maker. (http://roarmap.eprints.org/ 28 June 2019)

In spring 2018, the European Union published the Open Science Monitor (OSM), which should become a central tool for measuring the progress of Open Science in Europe. As much as the creation of a European "Open Science Monitor" is urgently needed, the disappointment in the Open Science community was that the data and methods underlying the instrument were not completely openly accessible. This is because some of the data and methods originate from the Elsevier/SCOPUS data set, or similar proprietary systems, which can only be further processed and evaluated by the owners themselves and some selected research groups[225]. The organisations responsible for the Monitor explained that they do not yet have enough open data sources to measure Open Science, and the European Commission assured that with the establishment of the European Open Science Cloud, monitoring will become easier. Until then, "we are dependent on actors giving access to data sources, which are useful for the tracking and monitoring of Open Science practices"[226].

The issue here is that **monitoring infrastructures** are powerful actors in policy negotiations and grassroots Open Science activists feel, that too much power still lies with individual corporations that monopolise both the data for indexing scientific knowledge and the evaluation of scientific performance. How difficult and politically questionable it is to conduct balanced and critical research on science - let alone cost and benefit calculations - based on these closed data sources has already been noted several times. All too often, distortions lying within the data (e.g. dominance of Anglo-American publication organs, discrimination against certain subjects and publication formats, ...) up to the distribution of research funds have been reproduced and reinforced a highly biased view on the global science system. It should therefore be in the interest of nation states with a developed STI system to build alliances for open research information systems based on open research infrastructures, and to be involved in the development of internationally valid and balanced metrics. So far, we could not identify any formal diplomatic or foreign policy dimension in

[225] The Lisbon Council, ESADE Business School, CWTS Leiden University, & Elsevier (2018): Open Science Monitor Methodological Note. Retrieved from European Commission website: https://ec.europa.eu/info/sites/info/files/research_and_innovation/open_science_monitor_methodological_note_april_2019.pdf as accessed 01 June 2019.

[226] Open Science Monitor website. Retrieved from: https://ec.europa.eu/info/research-and-innovation/strategy/goals-research-and-innovation-policy/open-science/open-science-monitor/about-open-science-monitor_en as accessed 01 June 2019.

ongoing initiatives for Open Science monitoring – there are clearly other priorities, such as bringing together data on Climate Change, collecting information on SDG compliance and so forth, but it would be important to learn from open data advocacy in those domains for the transnational collaboration of research information systems.

6.2.2 Different velocities and exclusive concerns

When Moedas called for more openness and diplomacy to improve the European science and innovation system as well as finding solutions for pressing societal problems in 2015, some policy makers in Member States or associated countries were feeling blindsided. Some have just tediously transformed their national research system to a performance-based funding model, that builds on international competition and patents rather than on cooperation and openness. Whereas others might have thought that the EC is moving rather slowly: in 2017 Aarhus University in Denmark initiated a novel Open Science platform together with leading industry to collaboration on "industrially relevant basic research. Researchers and companies from all over Denmark publish all their results and data on the innovative Open Science platform, where the information is available free of charge to everyone interested".[227] There is a danger that a system with a universal vision is trying too hard to integrate multiple velocities into processes and thus creates asymmetries. On the other hand, there is an armada of industries, from Google[228] and Amazon[229] downwards now increasingly involved in co-shaping and harvesting the knowledge economy, so policy makers are obliged to counter the privatization of publicly funded research or at least turn this kind of commodification from shareholder benefits to public benefits.

The European Research Area ERA already serves as a good instrument in balancing those differences, as it is binding to Member States (Lisbon Treaty) even if the implementation of the roadmaps is going slower than originally intended. The OECD report "Making Open Science A Reality"[230] already stated "Open Science policies should be principle-based but adapted to local realities". Therefore, the science diplomacy skills needed revolve around bringing together the right stakeholders to carefully design roadmaps, knowledge transfer and feedback loops. Multi-level Open Science policy making should be based on best practices and examples how the strict duality of open versus closed, cooperative versus competitive can be relaxed towards a better understanding of the dynamics and co-constructive effects of knowledge / science commons and related resources. This should also include a broad understanding of contextual matters, such as digitalisation, cybersecurity, (higher) education systems and local (socio-political) cultures. The novel concept of Data Diplomacy is already integrating some of those matters, however it is not yet mature enough to tackle Open and FAIR data realms.

[227] Patent Free Campus. Retrieved from: http://scitech.au.dk/en/about-science-and-technology/current-affairs/news/show/artikel/aarhus-universitet-og-industrien-aabner-patentfri-legeplads/ as accessed on 01 June 2019.

[228] Google Scholar. Retrieved from: https://scholar.google.com/ ; Google Dataset Search. Retrieved from: https://toolbox.google.com/datasetsearch as accessed 01 June 2019 etc.

[229] For example Amazon Web Services. Retrieved from: https://aws.amazon.com/de/ ; and Amazon Mechanical Turk. Retrieved from: https://www.mturk.com/ as accessed 01 June 2019, etc.

[230] OECD (2015): Making Open Science a Reality. OECD Science, Technology and Industry Policy Papers No. 25.

6.3 Issues of multi-level policy making: conclusions

The stakeholder landscape in the Open Science theatre has changed dramatically in the last 30 years. From dedicated institutions advocating data sharing and access to scientific information in the second half of the 20th century, via grassroots initiatives and first open infrastructures of open access in the 1990s, the establishment of global collaborations with the goal to create science commons such as the Human Genome Project at the turn of the Millennium, towards a broad, already hardly comprehensible variety of advocacy actors on international and national level, policy implementing organisations such as funders and research organisations, to the increased involvement of publishing and content service industries in the 2000s and 2010s. And the journey continues, some interview partners would even say it is just the beginning. Even though grassroots bottom up principles sometimes clashed with policy top down strategies and regulations, the entanglement of all levels currently leads to complex but increasingly robust policies and infrastructures for the transition towards Open Science. Whereas there is less and less resistance and opposition to Open Access to Scholarly Publications and it has become more a matter of negotiating the models, there is still a lot of scepticism towards the realisation of Open Research Data and respective infrastructures. A big challenge seems to be the bridging and coordination of international national and research field interests, all of which are represented in different velocities, with different stakeholders, in different arrangements. Even though most of the described processes happen on the level of international scientific cooperation, science diplomacy aspects are mostly perceived by actors not from the domain of foreign relations, but from the research domain, even though some of the topics, e.g. Plan S, received quite a lot of attention by international news media and science media.

With Open Science being part of a bigger, global movement of Open Culture, which also includes the development of Free and Open Source Software, access to cultural heritage, and the promotion of participatory and inclusive policies and commons, it also represents a positive political agenda. This is not immediately comprehensible: where some see it as a risk to invite free riders to parasitize our knowledge markets, others regard it as fundamentally neoliberal exploitation of public knowledge, and again others see it as necessary fundament for scientific integrity and sustainable knowledge production. Best practices show that there might be aspects of all three perspectives assembled in success stories, it is just a matter of setting the right priorities. In the next years to come, with all the challenges of making Open Research Data a reality, it will therefore be vital to find sound ways of international coordination, that is aware of asymmetries and different local realities and capable of dealing with it in a productive way.

7. How is the case changing our understanding of Science diplomacy?

From the discussion of the de-facto governance issues and the various stakeholders and interfaces this report concludes that

- European Open Science priorities are seen internationally rather positively, commitments and partnerships are increasing, but the implementation is still cautious.
- Open Science is rarely on the diplomatic agenda, and science diplomacy is only marginally used for international orchestration and coordination, even though advocates would welcome the involvement of foreign policy actors.
- Pressing issues, like the harmonization of standards and legal frameworks for the exchange of data ('data diplomacy'), as well as new opportunities for innovation have not yet been discussed in the light of diplomatic action for Open Science.
- The rare instances of involvement of diplomatic institutions has mostly been triggered by local advocates and is often not sustainable.

Open Science strategies, in particular Open Access policies and Open Data infrastructures are not yet regarded as central topics, action points or instruments of- and for science diplomacy in foreign policy realms. Their potential link was reflected in most case interviews as "inexistent", "unanticipated", but "interesting" and "improvable". So, the push for putting the bundle of Open Science (and Open Innovation) topics on the diplomatic agenda is rather unidirectional, and still remaining rhetoric, tracing back to the original quotes of Carlos Moedas[231], and occasional mentions in literature on innovation diplomacy[232]. Actors at Open Science and Science diplomacy interfaces have a rather asymmetrical awareness of scientific and diplomatic issues. Whereas on the one hand stakeholders from the research systems as well as stakeholders from research policy organisations call for more diplomatic support for the international development and coordination of Open Science in our case interviews, persons acquainted with diplomacy realms, as well as persons working in foreign relations were on the other hand rather hesitant to either give examples of international Open Science collaboration or imagine the necessities of international cooperation for a transition to Open Science.

In view of the fact that Europe and other world regions are currently very actively implementing far-reaching changes in the research system based on Open Science principles, it will be important to not only accompany and support them from a foreign policy position, but also to understand the potential and the challenges of Open Science for regional and international interests – especially those going beyond science and research towards culture and innovation systems. Furthermore, issues of international orchestration of Open Science deserve more attention. Just as large international scientific infrastructures or organisations, such as CERN or SESAME, need the political backing, the implementation of e.g. open access infrastructures as well as policies - so that they can enfold their benefits and challenges can be tackled - need international policy alignment

[231] Moedas, C., Directorate-General for Research and Innovation (European Commission) (2016): Open innovation, open science, open to the world. Retrieved from European Commission website: https://op.europa.eu/en/publication-detail/-/publication/3213b335-1cbc-11e6-ba9a-01aa75ed71a1 as accessed 01 June 2019.

[232] Carayannis, E. G., D.F.J. Campbell (2011): Open Innovation Diplomacy and a 21st Century Fractal Research, Education and Innovation (FREIE) Ecosystem: Building on the Quadruple and Quintuple Helix Innovation Concepts and the "Mode 3" Knowledge Production System. Journal of the Knowledge Economy, 2(3), pp. 327–372.

(national Open Science roadmaps, data exchange policies …) sometimes even synchronisation (responsible performance metrics, big deal negotiations, ….).

Future science diplomacy efforts with and for Open Science should therefore include planning of the following actions:

1. Understanding and mediating the benefits (and challenges) of Openness
2. Bringing together and managing multi-level, multi-national, multi-format stakeholder negotiations

Moreover, since Open Science is such a cross-cutting issue, other science diplomacy efforts should always consider this dimension in their fields of action (e.g. how could data be best shared openly and immediately when epidemics spread or crisis hit regions ….).

1. Understanding and mediating the diverse benefits and challenges of Open Science

To many policy makers it may seem rather risky and naïve to promise better science and innovation with Open Science in a time of increased resource scarcity and global competition. To others it may seem inherently paradox to promote openness at the same time as enforcing intellectual property regimes, counting patents to measure STI performance, as well as enforcing strict regulations of governance of access to personal information on content and media corporations. How can science be described as main driver for competitive advantage in our knowledge economies, and simultaneously be shared openly with the world?

The main reason why European Union policymakers (and other advocates) adapted and reformulated Open Science concepts into political strategies is twofold: 1) they are foreseeing better commercial exploitation of research results to speed up and scale up investments in innovation and the creation of new markets[233] and 2) they are understanding that global challenges such as climate change, hunger and peace can only be tackled in collaboration and based on high quality evidence, which partly comes from science. It seems diplomats are well suited to cope with such issues of competition and cooperation. In that regard Science diplomacy is defined as facilitator for the "openness to the world" while attending to Europe's interests[234].

When asked about potential roles and functions of science diplomats in the global Open Science arena, our interview partners put forward the following suggestions. In order to make sense and grasp an opportunity of this presumably paradox strategy, science diplomats could **take the position of mediating the cross-border exchange of experiences of - and the development of**

- National open access and open infrastructure strategies and policies in line with European and national STI policies (and other wider agendas, such as the Sustainable Development Goals). This also means learning from political processes in other world regions, especially from Latin America and its successful, long standing Open Access policy and infrastructure coordination.
- Legal frameworks and necessary conditions for sustainable knowledge economies, science commons and their commercial exploitation (licensing, clearing, public-

[233] This neo-liberal adaptation of Open Science has also been criticized, for its shift of the power game and the "Open-Washing" of inequalities. See: Mirowski, P. (2018): The future(s) of open science. In: Social Studies of Science, 48(2), pp. 171–203; Tkacz, N. (2014): Wikipedia and the Politics of Openness. University of Chicago Press.

[234] Moedas, C., Directorate-General for Research and Innovation (European Commission) (2016): Open innovation, open science, open to the world. Retrieved from European Commission website: https://op.europa.eu/en/publication-detail/-/publication/3213b335-1cbc-11e6-ba9a-01aa75ed71a1 as accessed 01 June 2019.

private partnerships, …) For example, how to best balance European and national copyright legislative to accommodate scientific data sharing and secondary (re-)usage rights of scientific publications? How to advocate innovation building on Open Science, learning from best practices?[235]

- Support open monitoring infrastructure and grounds for international or regional consortia to negotiate new deals with publishers as well as develop new open access publishing models strongly rooted in regional STI specialization domains.
- Options to tackle issues of brain drain and widening participation in European STI regimes, including initiatives to develop skills and trainings for knowledge sharing and re-use, and thus knowledge transfer.
- New incentive and reward systems in science. Closely linked to initiatives for open monitoring infrastructures, diplomatic entities could enable or support grants or residency programmes for Open Science scholars and practioneers tackling grand societal challenges in cooperation with regional research and education organizations.

2. Bringing together and managing multi-level, multi-national, multi-format stakeholder negotiations

Since one of the biggest concerns by advocates was that Open Science is still a too fragmented political debate and its implementation is not discussed and coordinated enough across nation states, consequently its uptake is too slow, and its socio-economic potential is thus narrowing. With new political pressure in the system, e.g. the commitment of G7[236] or all European Member States in 2016[237] to make Open Access a reality by 2020, as well as the implementation of Plan S the political debate has gained momentum. However, as stated by several stakeholders from the science system, even though the political will to international cooperation has been stated several times in various instances, the implementation of this new dimension to science diplomacy is still in the beginning. In Europe the problem is that most political activities and dialogue are organized top-down from Brussels, and there is not much systematic political pursuit between the Member States and associated countries. On a global scale – even though all continents are eagerly

[235] Entrepreneurship building on Open Science and science/digital commons is mostly still in its infancy or unrecognized by politics, similarly to the field of Open Data. Missing is the connection of ideas with markets, especially in the creation of services around open tools and instruments, or data sharing. Regions and neighbouring countries could develop strategies to link activities within their complementary areas of specialization, announce prizes for best open science business ideas for public or hybrid goods, and thus foster regional cooperation. A famous example for a best practice is the Human Genome Project. The public and private money invested, has already been multiplied many times over in revenues of genome-based research and biotechnology, and triggered uncountable improvements in health. See: Drake, N. (2011): What is the human genome worth? In: Nature, news.2011.281.; Gitlin, J. M. (2013): Calculating the economic impact of the Human Genome Project. Retrieved from Genome.gov website: https://www.genome.gov/27544383/calculating-the-economic-impact-of-the-human-genome-project as accessed 01 June 2019.

[236] The G7 established an Open Science Working Group (OSWG) in 2016 to share expertise, best practices and to develop Open Science principles together. See: G7 Science and Technology Ministers (2016): Tsukuba Communiqué: G7 Science and Technology Ministers' Meeting in Tsukuba, Ibaraki 15-17 May 2016. TRENDS IN THE SCIENCES, 21(8), 8_72-8_75; G7 Science Ministers (2017): G7 SCIENCE MINISTERS' COMMUNIQUÉ. Retrieved from: http://www.g7italy.it/sites/default/files/documents/ANNEX%204_WG%20Open%20Science/index.pdf as accessed 01 June 2019; G7 Science Ministers (2017): Annex 4: Expert Group on Open Science. Retrieved from: http://www.g8.utoronto.ca/science/2017-annex4-open-science.html as accessed 01 June 2019.

[237] Ministerie van Onderwijs, C. en W. (2016, April 4): Amsterdam Call for Action on Open Science—Report—Government.nl [Rapport]. Retrieved from: https://www.government.nl/documents/reports/2016/04/04/amsterdam-call-for-action-on-open-science as accessed 01 June 2019.

observing European Open Science activities – there is even less exchange between nation states, with exception of Latin America[238].

The present case study on (the infancy of) Open Science Diplomacy teaches us how science diplomacy and international science cooperation could and should overlap, as they could share the same objectives and would reasonably complement each other. With Open Science the main political priority is to get as many on board as possible, to share benefits as well as responsibilities by balancing or bridging many global rifts, such as developed / emerging knowledge economies in Global North and South, centralized / federated science systems, hence also international organisations / domestic science policy within more or less democratic governance, market orientation and intellectual property regulations / science and knowledge commons, English / multilingual systems and local languages, cheap and high bandwidth internet access / expensive and low bandwidth internet, slow / rapid uptake of Open Science, and many more[239].

Here, Open Science advocates need to "harness diplomatic actions and skills"[240] or cooperate with diplomats to broker and push for a sustainable transition across borders and socio- as well as geo-political interests. In the Open Science arena, the link from scientific conduct and research performance to transnational impact and innovation potential in international cooperation still must be highlighted. Policy makers and research administrators not only want evidence for the benefits and limits of Open Science, they also need opportunities to meet with stakeholders from research, civil society and industries to negotiate priorities and strategies for an Open Science transition – and all of this in the light of a highly dynamic global development.

The roles and skills of science diplomacy are to create such (formal or informal) settings, bringing together and managing multi-level, multi-national, multi-format stakeholder negotiations, sometimes even under pressure e.g. because of a health crisis[241]. The diplomatic capacity to bridge international and national interests, the diplomatic tools to work with and reduce imbalances, the diplomatic channels to assemble, inform and advise policy makers, all these options are only marginally exploited for the global transition to Open Science until today. Open Science Diplomacy is much more than international research cooperation or "soft power"[242] information brokerage, as it has the potential to maximize political added value.

As Open Science is not a delicate political topic, one that has to be masked or hidden behind other actions, respective diplomacy can be very straight forward, not having to carefully avoid even its own unmasking. On the contrary, Open Science will only unfold its potential, when it is harnessed and negotiated as international research policy agenda that must cope with many asymmetries and insecurities. Moreover, a point all interview partners agree on: since Open Science impact stretches beyond academic realms and intervenes in culture and innovation systems, the "foreign perspective" needs to integrate this awareness. Being part of a much larger, global Open Culture movement Open Science

[238] In Open Access initiatives Latin America is also cooperating with other areas, such as with South Africa, see: Schöpfel, J. (2015): Learning from the BRICS. Open Access to Scientific Information in Emerging Countries. Retrieved from: https://hal.archives-ouvertes.fr/hal-01586530 as accessed 01 June 2019.

[239] This is very similar to science diplomacy for other cross-cutting issues such as the implementation of the Sustainable Development Goals, see: Saner, R. (2015): Science Diplomacy to support global implementation of the Sustainable Development Goals (SDGs) (Policy Brief No. 1; p. 4). UN-DESA.

[240] Boyd, A., J. Gatewood, S. Thorson, T.D. Bowman (2019): Data Diplomacy. In: Science & Diplomacy, 8(1). Retrieved from: http://sciencediplomacy.org/article/2019/data-diplomacy as accessed 01 June 2019.

[241] Park, D. J., G. Dudas, S. Wohl, A. Goba, S.L.M. Whitmer, K.G. Andersen, … P.C. Sabeti (2015): Ebola Virus Epidemiology, Transmission, and Evolution during Seven Months in Sierra Leone. In: Cell, 161(7), pp. 1516–1526.

[242] Nye, J. S. (1990): Soft power. In: Foreign Policy, (80), pp. 153–171.

is more than just a science issue and has as normative framing the potential to change or even disrupt traditional cultural and socio-economic relations.

Measures for Future Open Science Diplomacy

If Open Science Diplomacy is defined as international political cooperation for the advancement of the transition towards Open Science, then actors in that domain will need the following measures in place:

- Points of contact and designated communication channels. Every state and organisation have their own ways of building outward relations, it might be through a science advice mechanism, via expert committees, spokespersons, etc., however, for future activities it will be important to designate a point of contact for (inter-)national or organizational Open Science coordination.
- Elaborated evidence and accessible information (including facts and figures from national and international Open Science activities) e.g. in the form of policy briefs and expert / country reports building on the understanding as there is neither one unique model of Open Science nor a unique set of metrics, but there are many shades that require robust local and international cooperation
- Open and transparent documentation systems and robust scientific analysis are the basis for any elaborated evidence.
- Training sets and materials for (science) diplomats and Open Science advocates with information about options of mutual support (including critical reviews of limitations and challenges)

Only with these and similar measures in place, the motto “open to the world” can manifest itself beyond the integration of more non-European actors in European Science funding.

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List of Interview Partners

Interview Nr	Governance Level of the interviewee	Country	Type of actor	Date of Interview	Format	Inter-viewer
1	EU	EU	Public administration	January 2019	Tel	KM
2	National	ES	Public administration	April 2019	Tel	KM
3	National	AT	Public administration	May 2019	F2F	KM
4	EU	EU	Public administration	May 2019	Tel	KM
5	International	FR	Non-governmental	May 2019	Tel	KM
6	National	India	Political	May 2019	Tel	KM
7	International	UK	Scientist	May 2019	Tel	KM
8	International	DE	Scientist	May 2019	Tel	KM
9	EU	ES	Scientist	May 2019	Tel	KM
10	National	MD	Public administration	May 2019	Tel	KM
11	National	AR	Scientist	June 2019	Tel	KM
12	EU	EU	Public administration	June 2019	Tel	KM
13	International	UA	Non-governmental	June 2019	Tel	KM
14	National	NL	Diplomatic service	October 2018	F2F	EA
15	National	NL	Public administration	October 2018	F2F	EA
16	International	DE	Non-governmental	June 2019	F2F	KM
17	National	NL	Science support / admin	November 2018	F2F	EA
18	International	AT	Non-governmental	June 2019	F2F	KM
19	National	NL	Science support / admin	January 2019	F2F	EA
20	National	NL	Science support / admin	January 2019	F2F	EA
21	International	BE	Private Sector	June 2019	Tel	KM

22	EU	EU	Diplomatic service	November 2018	F2F	AD
23	National	AT	Diplomatic service	November 2018	F2F	AD