D3.3 Uptake of Open Science and Responsible Research and Innovation in Policy and Training

Observing and Negating Matthew Effects in Responsible Research and Innovation Transition

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Training and skills are acknowledged as key aspects in the uptake of Open Science and Responsible Research and Innovation practices. This deliverable presents work undertaken to understand current institutional structures for OS/RRI training. Through two studies – (1) an international survey of 167 active researchers, and (2) in-depth interviews with representatives responsible for training provision in 11 institutions across three continents – we show that currently OS/RRI training structures struggle to address practices beyond Open Access and Research Data Management, with a need for increased capacity, better institutional incentives, and more practical and flexible training (especially at the disciplinary-level).

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Authors	Antónia Correia, Anja Rainer, Ilaria Fava, Pedro Príncipe, Nancy Pontika, Thomas Klebel, Petr Knoth, David Pride, Tony Ross-Hellauer		
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Abbreviations

APC - Article Processing Charge
DORA - Declaration on Research Assessment
DMP - Data Management Plan
EC - European Commission
EOSC - European Open Science Cloud
FAIR (data) - Findable, Accessible, Interoperable, Reusable
FP7 - Seventh Framework Programme
GDPR - General Data Protection Regulation
H2020 - Horizon 2020
IPR - Intellectual Property Rights
MAG - Microsoft Academic Graph
MOOC - Massive Open Online Course
OA - Open Access
ON-MERRIT - Observing and Negating Matthew Effects in Responsible Research & Innovation Transition
OS - Open Science
RRI - Responsible Research and Innovation
RDM - Research Data Management

Executive summary

Training and skills are acknowledged as key aspects in the uptake of Open Science and Responsible Research and Innovation practices. This deliverable presents two studies undertaken to understand current institutional structures for OS/RRI training and their relation to current levels of adoption of OS/RRI practices:

1. An international survey of 167 active researchers to assess their practices and opinions regarding OS/RRI, as well as the institutional support for these practices
2. In-depth interviews with representatives responsible for training provision in 11 institutions across three continents to identify the support, drivers and barriers to OS/RRI from an institutional point of view.

The results from these studies show that currently OS/RRI training structures struggle to address practices beyond Open Access and Research Data Management, with a need for increased capacity, better institutional incentives, and more practical and flexible training (especially at the disciplinary-level). Our survey reveals that uptake of training is surprisingly low, despite showing that respondents themselves see concrete benefits for their research practices.

These results highlight the difficulties involved in providing OS/RRI training and support services at the institutional level but reiterate the fact that training in OS/RRI is essential for researchers to be able to perform science in a solid and transparent way and comply with most funder's requirements and mandates worldwide. There is a need for skilled professionals and the development, normalization and integration of OS and RRI into curricula. In addition, the role of communities in reinforcing practices and promoting a real cultural change must be fully embraced. More work to foster interoperable infrastructures, integrated training resources and peer-to-peer training, as well as increased resources for training staff and infrastructure are desirable.

1. Introduction

Open Science[1] (OS, the movement to make scientific research, data and dissemination accessible to all levels of inquiring society) and Responsible Research and Innovation[2] (RRI, a broader concept incorporating OS along with Science Education, Public Engagement, Governance, Gender, and Ethics to align scientific outcomes with the values of society) have been adopted as key ambitions of research funding and performing organisations (Directorate-General for Research and Innovation 2016; Owen, Macnaghten, and Stilgoe 2012).

Training and skills are recognised as a key driver of both Open Science and Responsible Research and Innovation (henceforth OS/RRI). A report from the EC's Expert Group on Education and Skills under Open Science (Berg et al. 2017) presenting the results of a survey on European researchers' perceptions of OS shows that researchers are largely unaware of international OS initiatives. That report concluded that researchers are unaware of what OS is and how to put it into practice and that they lack training courses, support from their institutions, institutional/funding guidelines and support for practicing OS. The report provides recommendations on how to develop OS policies, implement them, raise awareness, provide support and training and reward researchers who adopt those practices. Several initiatives and projects developed training activities to support the growing information needs about OS/RRI.

The objective of ON-MERRIT Task 3.3 "Uptake of RRI and Open Science principles in relation to policy and training" was then to understand whether the current OS/RRI training initiatives adequately address aspects of OS/RRI that researchers considered relevant for the success of their careers, and to identify the areas where more training is needed.

The survey, the results of which are presented in section 4, addresses the following research questions:

- To what extent are early career researchers familiar with OS/RRI concepts and practices?
- Does the participation of researchers in OS/RRI training have an impact in their daily workflows?
- Are research institutions providing enough/ adequate training? To what degree does the training offer match the needs of the subjects?
- How does the incorporation of OS/RRI practices within the daily research workflows relate to the institutional policies? Which OS/RRI principles are supported by institutional policies?

To complement the results of the survey, Task 3.3 also included interviews with experts in research support practices at their institutions, to deepen our understanding of tendencies, initiatives and existing support activities in Europe and beyond.

This deliverable is structured as follows: Section 2 reviews the literature to contextualise the study and Section 3 presents the methodology used to conduct the survey and the interviews. Sections 4 and 5 detail the results of the survey and the interviews respectively, while Section 6 presents discusses the deeper implications of these findings. Section 7 then provides overarching conclusions and suggestions for future work.

[1] FOSTER (2018). Open Science https://www.fosteropenscience.eu/taxonomy/term/7
[2] FOSTER (2019). Responsible Research and Innovation. https://www.fosteropenscience.eu/taxonomy/term/255

2. Literature review

To situate and contextualise our study we conduct a literature review summarising the current state of knowledge regarding the importance and development of skills and training for the uptake of OS/RRI. As will be shown, there is a clear need to better understand how uptake of OS/RRI principles and practices is related to policies and training programmes within research performing organisations, which is the key knowledge gap this deliverable seeks to address.

We structure this review of the literature as follows: First we examine the links between training and OS/RRI uptake; next, we examine broad frameworks for OS/RRI training, before then examining specific projects and initiatives which provide training. Finally, we examine the roles of research institutions and research communities in general.

2.1. The need for Open Science and RRI training

Over the last ten years, OS/RRI have become core elements of the European Commission's research agenda. Following an initial Open Access (OA) pilot in FP7, mandates for OA to publications and data were applied in all thematic areas of Horizon 2020 Research and Innovation Programme (Burgelman and Pascu 2019). These efforts have been paralleled by similar initiatives on the part of funders and institutions worldwide. Other cross-national initiatives have emerged: The G7 Open Science Working Group (2016)[3], OECD's OS Steering Group on Open Science[4] (2006), and UNESCO Open Science Advisory Committee[5] (2020).

Training as a means to make the transition from policy and engage researchers in OS/RRI practices has been acknowledged as a core element of these programmes since their inception (Directorate-General for Research and Innovation 2016; Ignat, Tiberius and Ayris 2020) and is one of the eight ambitions[6] of the European Commission's OS Policy. The Expert Group on Education and Skills under OS produced a report detailing the results of a survey on European researcher's perceptions of OS that evidenced that researchers are largely unaware of international OS initiatives. This report concluded that amongst researchers, awareness-levels of OS remained somewhat low, and especially that researchers lacked training courses, support from their institutions, institutional/funding guidelines and support for practicing OS. The report provided recommendations on how to develop OS policies, implement them, raise awareness, provide support and training and reward researchers who adopt those practices (Berg et al. 2017).

Emerging from the 40th session of UNESCO's General Conference in 2019 and having received inputs from various entities, the First draft of the UNESCO Recommendation on OS[7], to be approved at the General Conference of the United Nations Educational, Scientific and Cultural Organization meeting in Paris in

[3] http://www.g8.utoronto.ca/science/2017-G7-Annex4-Open-Science.pdf
[4] https://www.oecd.org/sti/inno/open-science.htm
[5] https://en.unesco.org/science-sustainable-future/open-science/advisory-committee
[6] Namely: FAIR and Open Data; European Open Science Cloud (EOSC); New generation metrics; Mutual learning exercise on open science - altmetrics and rewards; Future of scholarly communication; Rewards, Research integrity & reproducibility of scientific results; Citizen Science and Education and skills (https://ec.europa.eu/info/research-and-innovation/strategy/strategy-2020-2024/our-digital-future/open-science_en#8-ambitions-of-the-eus-open-science-policy)
[7] https://en.unesco.org/science-sustainable-future/open-science/recommendation

November 2021, sets as one of the key objectives investing in OS training as a way to build capacity and skills within the scientist's community (UNESCO 2020).

As far as training is concerned, it is advised to target from early career to fully established researchers, offering accredited and modularised OS skills training and professional development (Berg et al. 2017; Kuchma and consortium 2018).

Recent studies have shown that, in spite of understanding the advantages in adopting OS/RRI practices, many factors may influence its adoption by researchers. Kim and Stanton (2016) examine the results from a survey categorizing the influence of the following factors in data sharing: 1) institutional factors, which include funding agency's policy, journal requirements, and contract with industry sponsors; 2) information technology (IT) resource factors, including metadata and data repositories; 3) individual factors, including personal characteristics, perceived benefit, perceived effort (work and time), perceived risk (losing publication opportunities, misuse of data), and scholarly altruism (the degree to which a scientist is willing to work to increase others' welfare without expecting any benefits in return). This study found that sharing behaviours are positively influenced by journal requirements, disciplinary normative expectations, perceived benefits for careers and "scholarly altruism", whereas the perceived extra effort required to make research processes and products open had a significant negative influence.

Tenopir et al. (2018) examined the results from an online survey distributed to the members of the American Geophysical Union, with responses from 116 countries, and found that although the attitudes of researchers towards data sharing and reuse were generally positive, there were still concerns about potential data misuse and adequate citation/acknowledgement practices. It concludes that training in RDM and aid from research support staff (data librarians, research data managers) could help mitigate these concerns.

An online survey designed and conducted by the OS group of the Max Planck PhDnet, distributed among doctoral candidates, found there was a fairly good knowledge and predisposition to learn more about OS practices such as OA to publications, Open Data, Preregistrations, Registered reports, and Replication studies, contrasting with a low implementation level in the previous 12 months before the survey took place, concluding there is a crucial need for training (Toribio-Flórez et al. 2021).

We conclude that, although there are mainly positive attitudes towards, and a will to adopt, OS practices, training to foster awareness and build skills remains crucial for its full adoption by the researchers.

2.2. Training skills and frameworks

A number of frameworks for skills have emerged in the past few years, trying to address the need to train all interested parties in OS/RRI. The European Commission has played an important role in surveying researchers on OS, FAIR data and providing guidance and reports. In this section we also highlight relevant contributions and reports from European funded projects such as FOSTER and FOSTER Plus[8], EOSC-Pilot[9] and FAIRsFAIR[10], as well as the European Council of Doctoral Candidates and Young Researchers (Eurodoc)[11] in the developments of such frameworks.

[8] https://www.fosteropenscience.eu/
[9] https://eoscpilot.eu/
[10] https://www.fairsfair.eu/
[11] http://eurodoc.net/

The EC-funded FOSTER and FOSTER Plus projects[12] proposed a structured taxonomy for OS (Pontika et al. 2015) and created an infrastructure where interested parties can find and share training materials (Orth, Pontika, and Ball 2016; Schmidt et al. 2016). The first project (2014-2016) aimed to raise awareness on OS amongst a range of stakeholders (including early career researchers, senior researchers, librarians, library managers, research administrators, and funders). This was first achieved by collecting and formatting reusable training materials and developing a learning portal to make them available. FOSTER's OS taxonomy was developed to enable users to find related content between relevant topics, and training materials categorized by target audience, learning level, objectives and outcomes. The project also used a "train the trainer" approach to create a multiplier effect in the training of future OS trainers. This was further refined in the subsequent FOSTER Plus project (2017-2019), which targeted mainly early career researchers and multipliers that could provide further training within their institutions, countries or communities. As in the previous project, there was a focus on delivering both face-to-face events (allowing interaction between participants, networking and motivation), blended learning and fully online training (self-paced, allowing to reach a wider audience). Materials were developed to support trainers, such as the OS Training Handbook[13], the OS trainer's corner[14] (with standard presentations, videos, illustrations etc) and the Recommendations on OS Training (Kuchma & consortium, 2018) that gave practical advice on how to deliver training. Several OSTraining Bootcamps took place, creating a network of OS advocates and skilled trainers that fed the Trainer's directory[15]. The Roadmap for Implementing OS Training Practices in Research Institutions (Brinken et al. 2018) was also developed targeting policy makers and people responsible for implementing OS in institutions.

At the end of the FOSTER Plus project, more than 5,120 researchers, research support staff and project officers attended 157 face-to-face training events, 2,332 attended 56 webinars and online consultations, 10 toolkit courses were produced, 10 train-the-trainer bootcamps took place in European countries, Ghana and Brazil[16], and the OS training handbook was translated to Spanish and Portuguese and the Greek, Italian, French, German translations were in process[17]. As in similar European Commission funded projects, the sustainability of the project's outputs was an issue. This was addressed by the commitment of one partner (The Open University) to keep the FOSTER portal running, and by the commitments of several partners to continue answering inquiries about the project's outcomes, providing assistance with the issuing of badges, registrations in the learning portal, ongoing and future translations of the outputs (e.g. the OS Training Handbook, which recently had new translations to Turkish and Slovak starting), moderating the publication of materials, dissemination of OS related content in social media and on the long term collaboration with the Community of Practice for training coordinators (CoP), coordinated by OpenAIRE[18].

Beyond the FOSTER project, a range of other initiatives have investigated requirements for OS training. Weber et al. (2018) identifies the relevant skills for early career researchers to gather during their doctoral training program in order to increase their employability. From the skills presented in the matrix within

[12] ON-MERRIT partners Open University and the University of Minho were core partners in FOSTER
[13] https://book.fosteropenscience.eu/
[14] https://www.fosteropenscience.eu/trainers-materials
[15] https://www.fosteropenscience.eu/trainers-directory
[16] https://cordis.europa.eu/docs/results/h2020/741/741839_PS/foster-plus-infographic-2019.png
[17] https://github.com/orgs/Open-Science-Training-Handbook/repositories
[18] FOSTER Plus newsletter https://us16.campaign-archive.com/?u=c9575216d7047154957c576e2&id=ccdb83e02e

Research, 9 out of 15 are OS or RRI related: Citizen Science; Ethics/ Integrity in research, OA Publishing, Open Data Management, Open Education, Open Evaluation, Open Licensing, Open Methodology, Open Source.

Whyte and Ashley (2017) analyse training initiatives on data management and OS and defines "Training-as-a-service" for EOSC infrastructure layers: 1) registry: calendar or catalogue of training opportunities harvested from training portals or repositories; 2) delivery and presentation: online portals, environments and MOOCS; events; learning outcomes and certification; 3) trainers and facilities: facilities for face-to-face events; information on trainers available to deliver content; 4) training content; 5) environment to allow deployment of software, datasets, etc. to facilitate training. This is further developed in (Whyte et al. 2019).

The *Turning FAIR into reality* report (Directorate-General for Research and Innovation (European Commission) 2018) analyses several aspects concerning FAIR data and makes recommendations, of which two are considered a priority and impact the way training is delivered: Recommendation. 10: "Professionalise data science and data stewardship roles and train researchers" and Recommendation 11 "Implement curriculum frameworks and training". The first recognizes the need to have people specialized in these fields, with the ability to train others; and the second makes a move on the development of common curricula, transversal to institutions and countries.

For a paradigm shift in research to happen, there is a need for knowledgeable researchers and research support staff, which also implies a development and normalization of the curricula of OS, RRI and data management courses. The FAIRsFAIR project has been working on analysing skills and developing a competency framework for data stewards in Higher Education (Principe et al. 2020; Demchenko et al. 2021).

The report "Digital skills for FAIR and open science" published February 2021 (Directorate-General for Research and Innovation (European Commission) et al. 2021) provides a set of 10 roles within the of FAIR and OS environment: Researcher; Citizen; Policy maker; Data curator; Data steward/ data librarian; EOSC educator/ trainer; Data RI Support professional; Research software engineer; data scientist/ data analyst; EOSC enabler. It details each one of these profiles and provides a set of recommendations for the development of the next generation of professionals:

> "1) Utilise the Framework of Actors in the EOSC Ecosystem in the development and mainstreaming of FAIR and open science skills and training; 2) Coordinate and align relevant skills curricula and training frameworks; 3) Encourage and support the competence centres approach for FAIR and open science training; 4) Facilitate increased integration of FAIR and open science courses with university qualifications; 5) Build a learning and training catalogue to maximise interoperability; 6) Include learning and training resources in the EOSC Interoperability Framework (EIF); 7) Develop an EOSC Skills and Training Leadership Programme." (Directorate-General for Research and Innovation (European Commission) et al. 2021)

2.3. Training for Open Science and RRI

Beyond the frameworks mentioned above, many entities worldwide, including European Commission funded projects and infrastructures, have developed training events and resources for OS/RRI. Here we give an overview of major initiatives.

The Center for Open Science (COS)[19], a not for profit organization based in the United States of America, maintains an infrastructure and support materials for OS, Preprints, Preregistration and Reproducible Research (Dillon 2015). COS aims to promote the openness, integrity, and reproducibility of scientific research and is financially supported through donations and services provided (research and training). It provides a free, open source platform (the Open Science Framework[20]) where researchers can share their research data, publications and other materials, and collaborate with their peers. COS also created a system of open badges to acknowledge open practices that has been adapted by other platforms such as FOSTER, and relied on creating a community of ambassadors to deliver training on open and reproducible tools, methodologies, statistics, and workflows, and spread OS values and practices.[21]

Communities are also the centre of the Open Science MOOC[22]. It started as a grassroots movement from researcher's perceptions the need for training on OS topics and developed into a collection of resources and training modules on Open Principles, Open Collaboration, Reproducible Research and Data Analysis, Open Research Data, Open Research Software and Open Source, OA to research papers, Open Evaluation, Public Engagement with science, Open Educational Resources, and Open Advocacy.

The OpenAIRE project[23] has developed various types of OS support materials, including Factsheets, OS primers, and Guides (e.g. How to comply with H2020 mandates publications, Identifiers, Legal issues, RDM, Use cases). OpenAIRE regularly promotes events (e.g. Workshops, Webinars) on OS/RRI topics. These resources target especially researchers, but also research support staff and policy makers. OpenAIRE simultaneously provides support to all users (researchers, research support staff, research managers) through its network of 34 National Open Science Desks (NOADS); provides services to improve interoperability and monitoring of compliance with EC OS policies and regularly promotes training in OS/RRI topics. Its Community of Practice[24] unites research coordinators from various European funded ongoing and finished projects, as well as from recognized institutions and e-infrastructures.

As already covered above, the FOSTER and FOSTER Plus projects invested in promoting training events throughout Europe and developing online courses. The OS Toolkit[25] consists of independent e-learning courses on the following topics: What is Open Science?, Best practices, managing and Sharing Research Data, Open Source Software and Workflows, Data protection and Ethics, Open Licensing, OA Publishing, Sharing Preprints, Open Peer Review, OS and Innovation, Use Open Data in Teaching, and Assessing the FAIRness of data. The RRI Toolkit[26], developed by the FIT4RRI[27] project and hosted via the FOSTER platform, offers the Introduction to RRI, Engaging the public in RRI, RRI for companies, Openness in Science and RRI, Research and Data Ethics, and Open and FAIR Research Data courses. Trainees are supported in studying multiple courses through learning paths leading to the acquisition of an OS/RRI specialisation which is certified by badges.

[19] https://www.cos.io/services/training
[20] https://osf.io/
[21] Information taken from https://www.cos.io/
[22] https://opensciencemooc.eu/
[23] https://www.openaire.eu/support; note that ON-MERRIT partners University of Minho are core partners in OpenAIRE
[24] https://www.openaire.eu/cop-training
[25] https://www.fosteropenscience.eu/toolkit
[26] https://www.fosteropenscience.eu/rritoolkit
[27] https://fit4rri.eu/; ON-MERRIT partners Open University and University of Minho were core partners in FIT4RRI

Collaboratively developed by Research Data Netherlands, the Digital Curation Centre and the University of Edinburgh, the MOOC on delivering RDM services[28] offers training on RDM, Data Management Plans (DMPs), preservation and storage of data.

Project ORION[29] developed the ORION MOOC for OS in the Life Sciences, an OS Podcast and elaborated case studies, factsheets and guides.

Several members of the European Research Infrastructure Consortium (ERIC)[30] have developed their own platforms hosting training events, materials, tools and other resources relevant for their field, e.g. the Consortium of European Social Science data Archives (CESSDA)[31], the Common Language Resources and Technology Infrastructure (CLARIN), the Digital Research Infrastructure for the Arts and Humanities (DARIAH)[32] and ELIXIR[33] for the Life Sciences.

In addition, a number of institutes have developed their own courses and training materials, most of them available for free. Examples are the Digital Curation Centre[34], DANS Data Archiving and Networked Services (DANS)[35] , and Research Data Netherlands[36].

In brief, it is possible to find a wide range of training materials and courses, from face-to-face to distance learning, targeting different audiences, more general or focusing on specific topics of OS/RRI. Very often this is funded via project funding, however, and this creates issues of sustainability. In addition, the sheer number of overlapping initiatives means that often similar content is covered from multiple angles and, as we shall see later in this report, this can create issues of information-overload for researchers.

2.4. The role of higher education institutions and libraries

In most of the countries, higher education institutes have some degree of autonomy in drawing policies to support OS/RRI practices and can play an important role in providing training. The need for doctoral schools to create courses to provide the researchers skills on OS/RRI topics is identified in a policy document concerning the European Higher Research Area (Eurodoc 2020).

Institutional support is key to OS adoption (Ignat & Ayris, 2020). The League of European Research Universities (LERU) issued in December 2020 a note on how to better implement OS, affirming their commitment to its implementation, despite the challenges it may bring and considering the different paces and variation between disciplines. The document introduces a new Ad Hoc Group Open Science Ambassadors[37] to advocate, provide advice and act as a mediator for the academic community.

[28] https://www.futurelearn.com/courses/delivering-research-data-management-services
[29] https://www.orion-openscience.eu/activities/training
[30] https://ec.europa.eu/info/research-and-innovation/strategy/strategy-2020-2024/our-digital-future/european-research-infrastructures/eric/eric-landscape_en
[31] https://www.cessda.eu/Training
[32] https://campus.dariah.eu/
[33] https://tess.elixir-europe.org/
[34] https://www.dcc.ac.uk/training
[35] https://dans.knaw.nl/en/about/services/training-consultancy/training?set_language=en
[36] https://datasupport.researchdata.nl/en/
[37] https://www.leru.org/leru-groups/open-science-ambassadors

Also, the European Universities Association, through its Expert Group on Science 2.0/Open Science, has since 2014 been analysing the barriers to OS adoption, regularly launching surveys on OS and producing recommendations for their institutional members. The most recent survey (Morais et al. 2021) focuses on the practical implementation of OS and shows that the majority of the institutions rate OS's strategic importance as "High" or "Very high" and only 9% do not have an OS policy; the great majority monitors OA in their repository and in OA journals (including monitoring costs), with 90% maintaining a repository and providing OA infrastructure. Although this sounds promising, a lack of skills was mentioned as a factor by more than half of the institutions. One of the main recommendations is therefore for institutions to provide training for researchers and staff.

Libraries play an essential role in delivering OS training, the implementation of the physical infrastructure (repositories) and the preservation, curation, publication and dissemination of resources. Through training sessions and online resources such as dedicated web pages and courses, libraries have long been working to build capacity to publish in OA journals, discover trustable publishing venues, manage APCs, set up repositories for publications and data, advocate for OA and OS policies, and set up national library consortia.

Libraries coordinate and deliver OS training for researchers and academic staff, tailoring their programs to the perceived needs and existing OA and Research Data Management policies, adapting the formats to audience size, level of knowledge and discipline (Swiatek et al. 2020). In order to properly support researchers, librarians also need to be apt to deliver training on key subjects such as Scholarly Publishing, FAIR Data, Research Infrastructures and the EOSC, Metrics and Rewards, OS Skills, Research Integrity and Citizen Science (Ayris et al. 2018).

2.5. Research communities and "train the trainer" programmes

To foster a wider adoption of OS practices, there is a need for skilled trainers and to deliver training to a higher number of people. The need for skilled trainers is being addressed by the development of frameworks, but to reach a wider audience faster and produce a real cultural shift in the way research is done, the creation of communities seems to be vital.

Understanding the importance of peer-to-peer training, the Center for Open Science initiated an Ambassadors[38] program in 2014 with the goal of creating a network of OS supporters worldwide, to collaborate, share information, promote open practices and provide training. Using their OSF repository members can share or reuse resources (such as presentations and guides), focusing mainly on the subjects of OS, Preprints, Preregistration and Reproducible Research. These ambassadors come from countries worldwide and can deliver training in their respective countries.

The same approach was followed by Eurodoc and an OS Ambassadors[39] course and network was created in 2019, comprising modules on the key topics OS, OA, Open/FAIR Data, Open Peer Review, Data Management, and Plan S. The aim here is to disseminate knowledge on OS topics, to establish a network of peers, and to obtain the commitment of those trained to continue the transmission of the knowledge they acquired, by organising future training events or resources.

[38] https://www.cos.io/communities/ambassadors
[39] http://eurodoc.net/ambassadors

As already mentioned, this "train the trainer" approach was also incorporated by multiple initiatives including FOSTER, OpenAIRE and ORION. OS training bootcamps have been organized by projects FOSTER Plus, FIT4RRI, ORION and SSHOC, as an example, and resources have also been developed in order to give the trainers guidance in preparing materials and events. A trainer's directory and resources specifically designed for trainers were also developed, such as the OS Training Handbook (Bezjak et al. 2019) which was collaboratively written and covers key OS topics, learning theories, practical ideas for organizing training events and exercises to be re-used or adapted to different training purposes. Many OS, Citizen Science and Open Innovation activities – such as hackathons, datathons, service jams, knowledge cafés, fablabs, game labs and innovation sprints - involve some form of learning or knowledge transfer, which reinforces the need for a roadmap to organize them (Teo 2020). OpenAIRE has recognized the need for a trainer's network and started a Community of Practice for training coordinators in September 2018 for people who coordinate training programs of research and e-infrastructures.

Academic institutions also recognize the importance of creating a community to better implement and reinforce the uptake of the OS practices, and RDM presents an additional challenge, as it requires discipline-specific training. This led Cambridge University to launch the Data Champions Network[40] in 2016, targeting individual researchers with specific expertise and encouraging them to share best practices in RDM with their peers, receiving recognition for their contribution and networking. Delft University of Technology follows the same approach, facilitating a network of Data Champions and appointing Data Stewards at every faculty, in order to improve the connection to researchers and address the questions they might have on RDM. These Data Stewards can be seen by researchers as peers, as they also have a research background and a degree in the subject area of the faculty to which they are appointed (Plomp et al. 2019).

More recently, OS Communities started to appear, first in universities in The Netherlands, then spreading around other European countries. These communities are constituted by groups of researchers that promote regular meetings and discussions around OS topics events, and can play an important role in addressing the main challenges to the uptake, such as the disciplinary differences and the doubts around OS implementation (Armeni et al. 2021).

Similarly, ReproducibiliTEA[41] journal clubs first appeared in 2018 at the University of Oxford and rapidly disseminated to countries worldwide. This initiative helps researchers create journal clubs at their universities to discuss diverse issues related to reproducibility and transparency in research. This is one of the initiatives supported by the UK Reproducibility Network[42], a peer-led consortium which investigates how to conduct robust research, provide training, and disseminate best practice.

2.6. Summary

In this short summary of literature and initiatives to date, we have shown that the role of training and skills in OS/RRI uptake is well acknowledged, and that many initiatives have sprung up to address this. Very often these initiatives are top-down, funded either by research funders or cross-national bodies. However, the community-led aspects of training to foster real cultural change are acknowledged via "train the trainer" approaches, and more recently, through the fostering of specific peer-to-peer networks on, for instance,

[40] https://www.data.cam.ac.uk/intro-data-champions
[41] https://reproducibilitea.org/
[42] https://www.ukrn.org/

reproducibility. We found that although a wealth of training possibilities already exists, offered via many modalities including that offered by higher education institutions and libraries, by projects or other initiatives, in face to face events or online, uptake of this training remains an issue. The majority, although by now perhaps aware of OS/RRI and their benefits, are still in doubt on how to effectively incorporate OS/RRI practices into their everyday research workflows, especially given persistent concerns that doing so constitutes an extra burden on already scarce resources.

Therefore, however, work remains to be done to investigate whether and how current OS/RRI training adequately addresses aspects of OS/RRI, especially with regard to identifying areas where more training is needed, for which stakeholder groups. In addition, relating to ON-MERRIT's themes of equity in OS/RRI uptake, this investigation will offer an opportunity to gauge the extent to which levels of resourcing shape uptake of OS/RRI training and make recommendations to address potential issues.

To address this gap and understand the awareness and uptake of OS/RRI, we hence use an international survey of researchers and structured interviews with those responsible for OS/RRI policy and infrastructure within institutions to investigate levels of OS/RRI awareness, support services and their impact.

3. Methodology

3.1. Survey methods

In this section, we describe the methods, including design and implementation measures, for both the survey and interview.

The overall aim of the survey was to answer the following questions:

- To what extent are researchers familiar with OS/RRI concepts and practices?
- What kinds of impact does the participation of researchers in OS/RRI training have on their research practices?
- Are research institutions providing enough/adequate training? To what degree does the training offered match the needs of researchers?
- How does the incorporation of OS/RRI practices within researchers' daily workflows relate to the policies of their institutions? Which OS/RRI principles are supported by institutional policies?

3.1.1. Sample construction

Our target population were researchers from the following selected countries: Austria, Brazil, United Kingdom, Germany, India, Portugal, Denmark, Slovenia and Spain, as well as researchers that benefited from previous training initiatives carried out on the FOSTER Plus and FIT4RRI projects activities. These countries were selected in part to overlap with those selected for policy analysis in ON-MERRIT D6.1 Investigating Institutional Structures of Reward & Recognition in OS/RRI[43]. In addition, we aimed to include researchers from a mix of higher income, low-income and middle-income countries. This allows us to have a wide variety of different countries of the world in our sample, namely inside and outside the EU. ON-MERRIT's focus on Europe and our team's familiarity with the policy landscapes of the countries of our partner organisations meant that Austria, Germany, Portugal and the United Kingdom were included. For coverage of both South and Eastern Europe, Spain and Slovenia were also included. In addition, we included the USA as a representative of a leading research country. Brazil and India were included as larger research-producing lower-middle income countries, from South/Latin America and Asia/Pacific regions, respectively.

Email collation methodology

Using full-text research papers from CORE[44] (Knoth and Zdrahal 2012) we collated an initial dataset of approximately 25,000 research papers from repositories hosted in the selected countries of interest. The selected papers were drawn from multiple domains. Author names and email addresses were extracted from these papers using GrobID (Lopez 2009).

Each record in the final dataset consisted of *author_name* and *author_email.* This list was then de-duplicated to ensure it was not possible for someone to receive the survey twice. This led to a final sample of 19,466 email contacts.

[43] https://doi.org/10.5281/zenodo.5552197
[44] https://core.ac.uk

This dataset of contact emails was then imported to the LimeSurvey platform, which both validates email addresses and flags non-functional ones. Invitations to take part in the survey were then sent via the LimeSurvey platform.

Field of Study Distribution

Using a technique known as hierarchical topic modelling, Microsoft Academic Graph (MAG) assigns one of 19 top-level fields of study to each paper within its collection. These fields of study were used to assign papers in CORE with a field of study from MAG. Titles were matched using cosine similarity, and any for which the result was less than 0.90 were discarded. In this way 74.54% of the CORE dataset was matched to a MAG field of study.

Figure 1 shows the breakdown by domain for this dataset, based on MAG top level field of study.

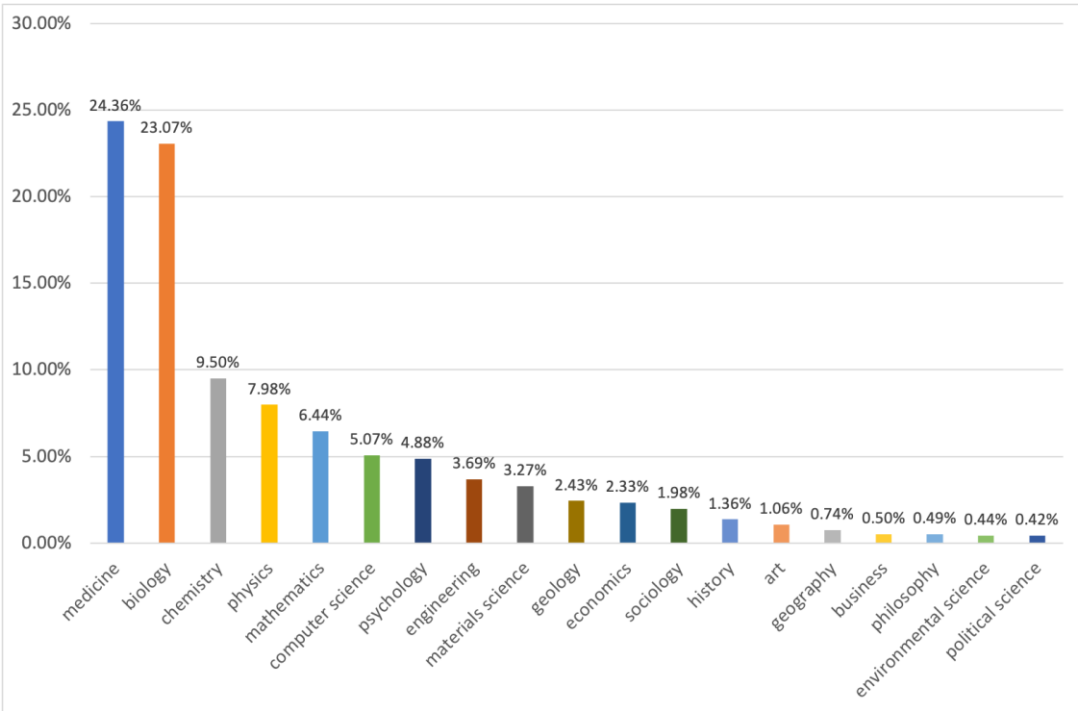

Figure 1. Breakdown of CORE dataset by MAG field of study

3.1.2. Survey instrument

The purpose of the survey was to understand to what extent are researchers familiar with OS/RRI concepts, whether and how these concepts are incorporated in their daily practices, as well as if and how their institutions support (in terms of, e.g., infrastructure, services, and training) them in doing so.

To investigate these issues we developed a survey instrument consisting of five sections:

1. **Researchers' practices:** The first section consisted of questions regarding the practical application of a mix of OS/RRI concepts: OS, OA Publishing, RDM, Reproducible Research, Open Peer Review, Open Source Software, Licensing, Research Integrity, Citizen Science, and Gender.

2. **Training:** The second section had the objective of finding the amount and type of training researchers might have had on OS topics, how it was delivered, at which stage of their academic life, and who provided it.
3. **Institutional support:** The section on institutional support aimed at understanding if the researcher's institutions support and/or incentivise the adoption of OS/RRI practices, and if these practices are in any way rewarded or have an impact on career and promotion.
4. **Drivers and barriers:** This section aimed to gauge researchers' attitudes towards what drives or holds them back from adopting OS/RRI.
5. **Demographics:** Finally, this section (which was asked last in the survey but will be presented first in the results) sought demographic information from respondents, including country, age, gender, education level, academic age, their type of institution, their position and general area of research.

This survey had 50 closed questions, a target completion time of approximately 25 minutes and was written in English.

3.1.3. Ethics and informed consent

Before starting the questionnaire, participants were informed about the purpose of our study and the ON-MERRIT project in general. There was also an explanation as to how the data would be gathered and the uses given to the data collected in the questionnaire, including that data provided would be treated confidentially and used only for research and report purposes, without any possibility of identification as to who provided it. The possibility to withdraw was also given and an email contact provided in order to clarify any questions that could arise.

3.1.4. Pre-testing of the survey

The questionnaire was pre-tested with a special focus on the comprehensibility of the questions, difficulties that respondents might have with their task, technical problems with the questionnaire, and the duration of the questionnaire completion.

There were two rounds of pre-testing, the first by the project partners and the second by 5 selected people from the OpenAIRE (National Open Access Desks): Andre Hoffmann, (Switzerland), Moja Kotar (Slovenia), Gerda McNeill (Austria), Gina Pavone (Italy), and Laura Valeria Bonora (Spain). The feedback was collected through a Google form and incorporated into the final version of the survey.

The main changes made as a result of this feedback were improvements on the clarity of the introduction and some of the questions; the positioning of the Demographics section to the end of the questionnaire; and in spite of an overall positive impression, on the length of the questionnaire.

3.1.5. Process and timeline

The survey was administered via the LimeSurvey tool hosted at Minho University. Initial invitations were sent on the 1st April 2021 with a deadline for completion of 30th April 2021. A low initial response rate led to extending the deadline until the 30th June and sending reminders on the 26th April, the 24th May and the 25th June.

Responses to the survey were anonymized. Each participant received a personalized token and could save and resume partially finished surveys.

In our sample we had emails retrieved from CORE dataset and CORE Discovery, from people we did not know if had received training; and a much smaller number of email contacts from people who had previously participated in FOSTER and FIT4RRI training.

3.1.6. Responses and limitations

The first time the survey was sent it received a high percentage of bounces (40%), some of them out of office messages, but most undeliverable. This can be partially explained because they were sent all at once and from a personal email. It is also likely that many of the recipients have moved to another institution and those email accounts no longer exist. To prevent the emails from being blocked by firewalls, the following reminders were sent from a dedicated ON-MERRIT UMinho email address and in smaller batches and the number of bounces reduced to 21%, which is still a high percentage. We also observed that many contacts were no longer active and we can speculate the researchers moved to other institutions or positions.

The survey received a total of 487 responses, 315 responses of which were left incomplete. We can speculate that many survey participants did not complete the survey due to its length. We therefore consider 172 responses for this study (corresponding to a response rate of 1.12%).

3.1.7. Survey Analysis

Responses were exported from LimeSurvey and anonymised. Subsequent analysis was conducted in the R statistical language (R Core Team 2020). Computational reproducibility was ensured by utilising the targets package (Landau 2021) for describing and executing the analysis pipeline. The analysis relied heavily on packages from the tidyverse (Wickham et al. 2019), complemented by the likert package (Bryer and Speerschneider 2016) for the bulk of the figures. All other figures relied on two core packages created by Bob Rudis (Rudis, Bolker, and Schulz 2017; Rudis 2020). The results from this analysis can be found at the GitHub repository.[45]

Many of the items included options for "Don't know/ Don't have enough information" or "This topic is not relevant to my research". These responses were excluded from the final analysis since they had low cell counts and did not add to the results in substantive terms. The sample size for individual items therefore varies, which we display in the figures. Figure 2 is an example of these visualisations. The number of cases (n) for each item is indicated on the right. In the analysis, the distribution of responses was determined by percentages. Percentages are aggregated for each side of the spectrum and the middle category. One can therefore state that 88% of respondents agreed or strongly agreed with the statement "OS values transparency in research", with 8% choosing indifferently ("Neither agree nor disagree"), and 4% disagreeing ("Disagree" or "Strongly disagree").

[45] https://github.com/on-merrit/os_training_survey

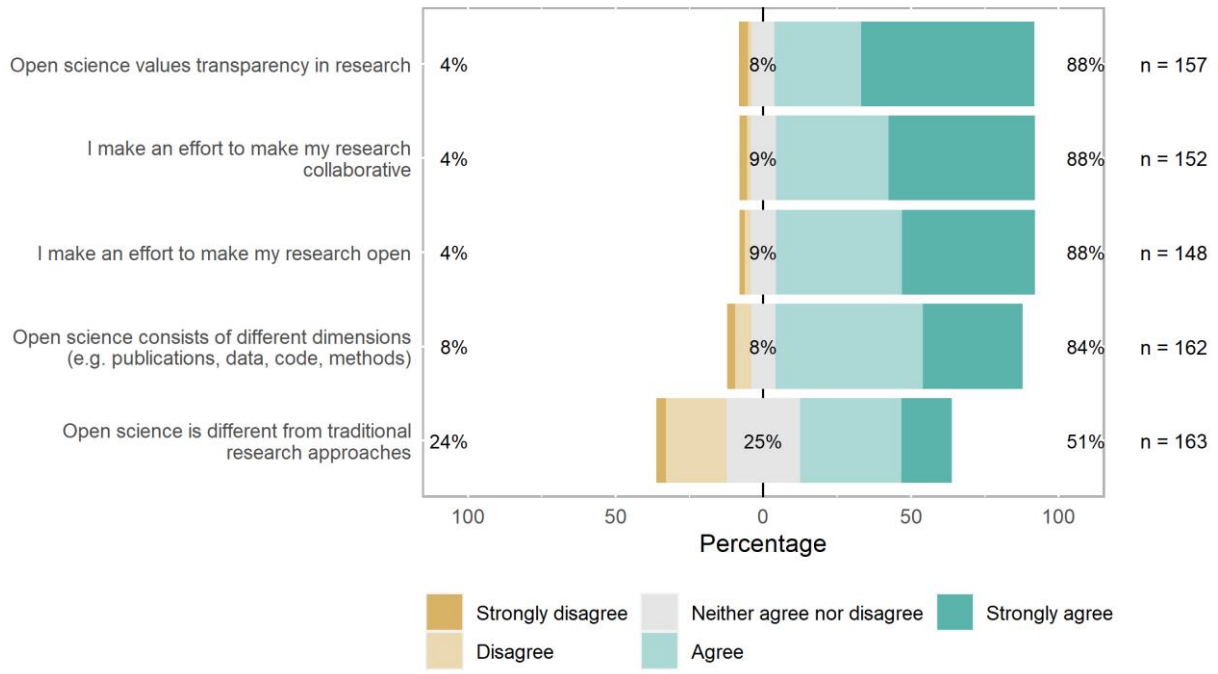

Figure 2. Example figure.

3.2. Interview methods

To complement the survey, in-depth interviews with people responsible for implementing OS and (to a lesser extent) RRI policy and support services in higher education institutions were conducted, in order to identify the institutional support and drivers and barriers to OS/RRI from a subjective point of view. The interviews complement the survey by allowing us to analyse experiences and actions from the different experts across several countries on a deeper level and furthermore let us understand drivers and barriers in terms of OS/RRI from diverse angles of, for example, different age groups, gender, positions, types of institutions and so on. Specific research questions assessed:

- *The interviewee's role in the institution and familiarity with OS and RRI.* Example questions include: "How familiar are you with OS and RRI concepts?" and "Can you describe your role in implementing OS and RRI at your institution?
- *Drivers and barriers to OS and RRI implementation.* Example questions: "How familiar with and receptive to concepts of OS and RRI are researchers at your institution?", "What are the main barriers the researchers in your institution face in uptake of OS/RRI?";
- *OS/RRI training in the institution.* Examples: "What services are available for OS/RRI training across your institution?", "Who delivers this training?", What improvements do you suggest in the way OS/RRI training can be implemented?".

3.2.1. Participant selection

Our sample targeted people responsible for implementing OS policies in their institutions, aiming for diversity in terms of gender, age, role and geographical coverage (within the limits of available resources).

We included people from the same countries targeted by the T3.3 survey: Austria, Germany, United Kingdom, Portugal and added countries from Eastern and Western Europe, such as Estonia, Slovenia and Spain; a country from South America, Brazil; and a country from Africa, Mozambique.

11 contactees agreed to be interviewed: 1 from Austria, 2 from Brazil, 1 from Estonia, 1 from Germany, 1 from Mozambique, 1 from Portugal, 1 from Slovenia, 1 from Spain and 2 from the United Kingdom.

Table 1 below gives an overview of our sample. The final group consisted of 5 male and 8 female participants, with an age range between 35 and 55 years old, with 3 directors of research support service (libraries and information management services), 4 repository (publications and research data) managers or coordinators, 5 heads of research support or RDM unit or office and 4 coordinators or managers of OS policy offices or teams.

Participant #	Gender	Job title	Country	Institution type
Participant 1	Male	Head of research support or Research Data Management unit or office;	Spain	University
Participant 2	Female	Directors of research support service (libraries and information management services); Repository (publications and research data) managers or coordinators	Slovenia	University
Participant 3	Female	Directors of research support service (libraries and information management services);	Estonia	University
Participant 4	Male	Head of research support or Research Data Management unit or office	Germany	University
Participant 5	Female	Coordinator or manager of Open Science policy offices or Open Research teams	United Kingdom	University
Participant 6	Female	Coordinator or manager of Open Science policy offices or Open Research teams	Austria	University
Participant 7	Female	Coordinator or manager of Open Science policy offices or Open Research teams	Austria	University
Participant 8	Male	Directors of research support service (libraries and information management services)	United Kingdom	University

Participant 9	Female	Repository (publications and research data) managers or coordinators	Brazil	Research Institute (Health)
Participant 10	Male	Repository (publications and research data) managers or coordinators	Brazil	Research Institute (Health)
Participant 11	Male	Directors of research support service (libraries and information management services)	Mozambique	University
Participant 12	Female	Repository (publications and research data) managers or coordinators	Brazil	University
Participant 13	Female	Directors of research support service (libraries and information management services); Repository (publications and research data) managers or coordinators	Portugal	Polytechnic Institute

Table 1. Sample composition overview

3.2.2. Interview design

The interviews were designed to be brief, with a maximum duration of 30 minutes, aiming to deepen our understanding of the institutional support to OS/RRI practices.

We used structured interview guidelines developed to mirror the structure and foci of the survey instrument. The interview guidelines are included as Annex B at the end of this document.

First, we asked the participants to briefly introduce themselves, their background, previous experiences and present duties in their institution, as well as their familiarity with OS/RRI concepts and their role in implementing OS/RRI - by developing policies, training, or support services - at their institutions. This allowed them to feel comfortable as we progressed into the institution's researchers' attitudes to OS/RRI - familiarity, perceived barriers and drivers to their uptake. The last part of each interview was focused on OS/RRI training at the institution.

3.2.3. Data collection

The eleven interviews took place in June and July 2021. Seven interviews were held in English and four interviews were held in Portuguese.

Due to COVID restrictions and scheduling convenience, the interviews were conducted online using the secure Zoom video conferencing tool.

Similar to the survey, participants were informed about the scope of the study, given the assurance that all data and information would be safely stored, that their answers and the information provided would only be used in an anonymous way for reporting purposes, and gave their permission to be recorded (sound and image). All sound recordings (in Portuguese and English) were professionally transcribed for the data coding and analysis phase, and the interviews held in Portuguese were translated to English.

3.2.4. Data analysis

Using a qualitative approach modelled on the framework approach set out in Gale et al. (2013), a thematic analysis was performed. At the pre-analysis stage, a first hearing of the audio recording of the interviews was carried out. Then, a first reading of all transcribed interviews was performed in order to have a general picture of the corpora to analyse.

From that reading a first set of codes was produced according to the main sections of the interviews and the most recurrent topics mentioned by the interviewees, e.g.:

- “familiarity with OA rather than OS”; familiar but reluctant in practicing OS”; “familiar with RRI/research integrity”; “mixed situation (it depends on the discipline / some researchers practice RRI/OS but other ignore that)”
- “lack of funding/resources”; lack of time”; “lack of awareness or knowledge”; “lack of appropriate communication”; “cultural change”; “lack of services (like formalised training) and infrastructures; “concerns of sharing/of the impact of openness and legal issues”; “lack of coordination”; “lack of policies”; “lack of incentives to practice OS”
- “indicators on OA and publications”; “indicators on Open Data and Research Management”; “other indicators relating to OS/RRI”; “Future plans”; “no measures in place”
- “training on the tools and services available”; “generic RDM training”; “RDM/Open data funders requirements or data management plans”; “research integrity & ethics workshops”; “Open Science modular online course; “GDPR training for researchers”; ”OS discipline for postgraduate programs; “Data carpentries”
- “Reach more people/reach the maximum number of people/have more participants”; The lack of staff/staff constraints”; “Need to be close to the researchers demands”; “Need to diversify the training through the different levels and customized according to the target audience”; “Researchers does not seen OS/RDM/RRI training as a priority yet”
- “Trainings tailored to individual scientific disciplines, provide discipline specific guidance”; “Deliver more practical training”; “Training new trainers,”; “Having the central policy and recommendations inside the university”; “Have peer-to-peer training”

A team of two people coded the interviews independently and deliberated on the main categories under which the interviews could be classified.

In a second, more in-depth reading, new codes were added to the first ones, e.g. “training provider”, “target audiences for training”, “tools used during the pandemic”, and the countries of the interviewees.

These occurrences of each of the themes were registered in an excel spreadsheet, as well as notes and interesting quotes from the interviewees. This registry of occurrences took into consideration, not only the explicit mentions of those terms, but also those which touched on related themes.

These codes were then analysed and grouped into a list of themes and the whole dataset was analysed again in order to test and improve them. This process allowed us to interpret the data from the interviews.

4. Survey Results

The aim of this survey was to understand the familiarity with selected OS/RRI concepts and their valuation and application, in relation with the training and institutional support. It consisted of five groups: Researcher's practices; Training; Institutional support; Drivers and barriers to practicing OS; and Demographics. Distributed to active researchers between 1st April and 30th June 2021, the survey received 172 complete responses. We next report the results of this survey.

4.1. Demographics

Our sample is drawn from various countries worldwide (Figure 3). The country with the most participants is the United Kingdom with 31.5%, followed by Spain (11.5%), Portugal (9.7%), Brazil (4.8%) and Italy (4.2%). Researchers from our targeted countries Germany (3.6%), United States (3%) and Austria (2.4%) come next, as well as from Norway (2.4%) and Australia (2.4%). A mix of "Other" countries - among which are researchers from targeted countries Denmark, India and Slovenia - gathers 24% (24.2%) of the survey respondents.

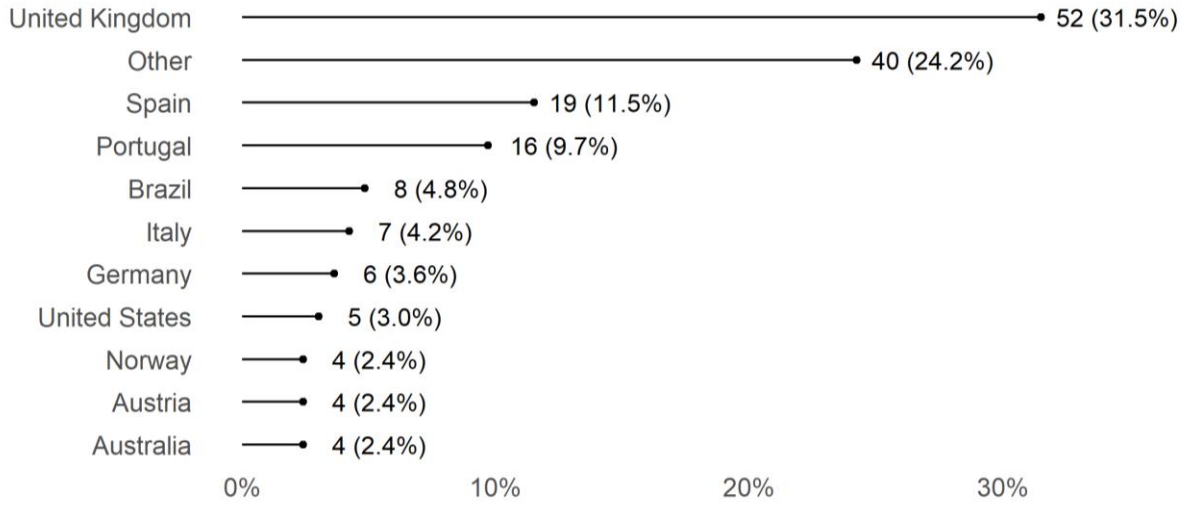

Figure 3. In which country do you work?

The majority of the respondents were male (58.1%) with females accounting for 35.3% (see Figure 35 in Annex D). In terms of age, our sample skews somewhat older (Figure 36 in Annex D), with less than a quarter (22.8%) below the age of 40, 28.7% 40-49, 29.9% 50-59, 12.6% 60-69 and 6.0% 70 or older. Most have a doctorate as their highest level of education (94.4%, Figure 37 in Annex D) and work within a university (79.0%, Figure 38 in Annex D). The majority are over thirty with a predominance of people over forty and fifty years old. This is reflected in the date of first publication (Figure 4), with most answers situated around the year 2000. This skewed composition towards more senior researchers is possibly an artefact of our sampling strategy, wherein email addresses of corresponding authors were harvested from OA papers in the CORE database (see section 3.2.1), since more senior authors likely have more papers within that set.

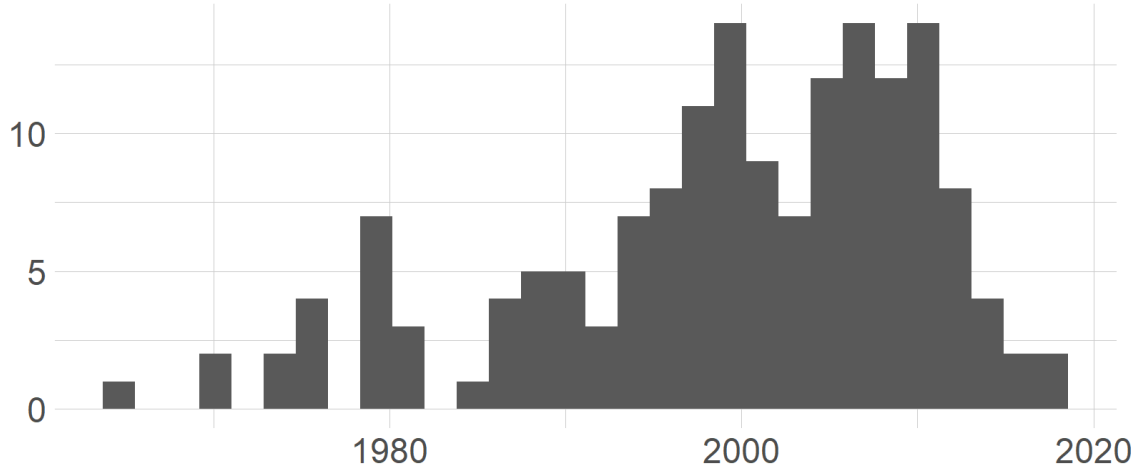

Figure 4. When did you publish your first academic publication (journal article, book, chapter, conference proceeding or similar)? Please tell us the year.

With regards to the participant's education level (Figure 5), the vast majority holds a Doctorate or equivalent (94.6%), works in a University (79%) and the most popular academic role is Full professor (26.9%), followed by Senior researcher (22.2%) and Associate professor (18,6%). The majority of the participants were from Social Sciences (42.5%), Engineering and technology (24.4%) and Natural sciences (13.8%), while they were also from Medical and health sciences (8.1%) and Agricultural and veterinary sciences (7.5%). Humanities and the arts were the area of knowledge with least participants (3.8%) (Figure 6).

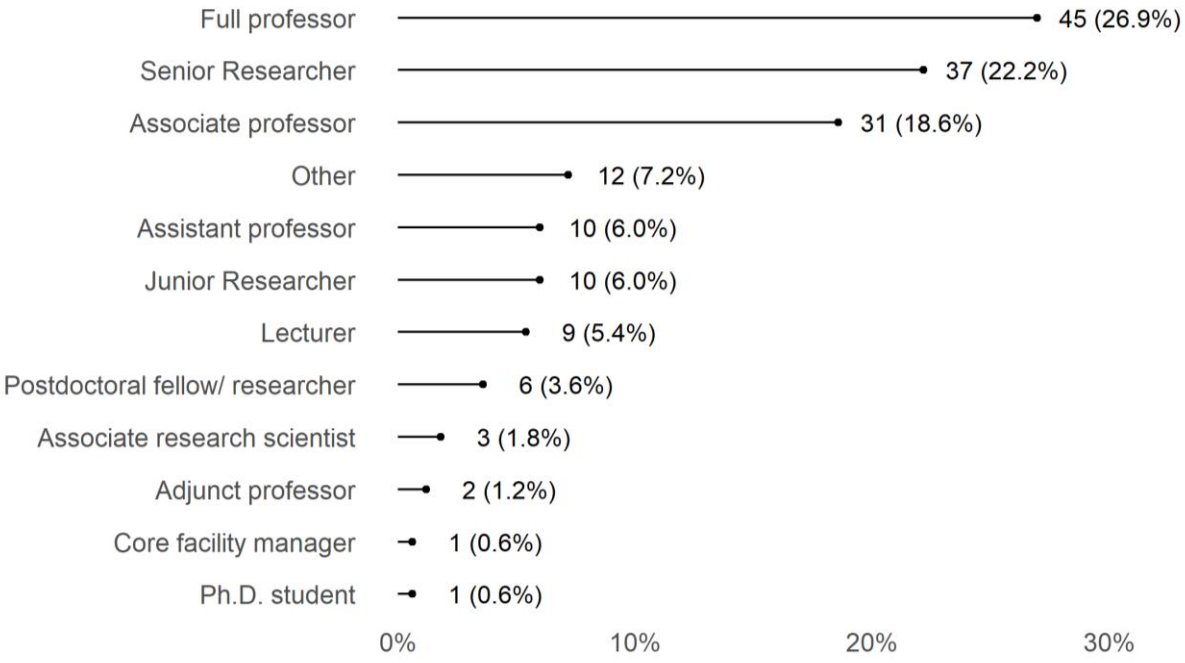

Figure 5. What is your position? Choose all that apply

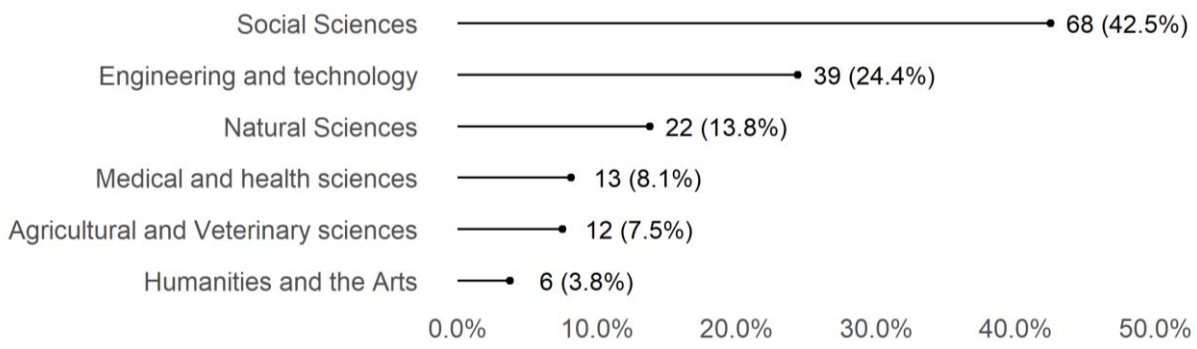

Figure 6. In which general area of knowledge do you work?

4.2. Practices

In the first substantive section of the survey, we sought to gauge respondents current knowledge and levels of uptake of OS/RRI practices.

This section aimed at understanding which practices are most known and widely applied, from ten selected OS/RRI topics: OS, OA, RDM, Reproducible Research, Open Peer Review, Open Source Software, Licensing, Research Integrity, Citizen Science, and Gender.

We asked the participants to rate a set of five statements on each topic. As these practices have different levels of uptake across different disciplines, these questions were not mandatory and so display different numbers of responses.

4.2.1. Open Science

In the first question on the practices regarding Open Science (Figure 7), the participants were asked to give their level of agreement with general statements, such as “OS values transparency in research”. Their answers would vary from “Strongly disagree” to “Strongly agree”. It is possible to see a high level of agreement - “Agree” or “Strongly agree” - in the first questions on transparency (87.9%), collaboration (87.7%), openness (87.7%) and knowledge of different dimensions of OS (83.8%), whereas the last sentence “OS is different from traditional research approaches” received a lower agreement, with nearly half of the participants not agreeing (23.7%) or neither agreeing nor disagreeing (25%). Nonetheless, more than half of respondents agreed with this sentiment, indicating that OS is seen by many as a radically different way of doing research.

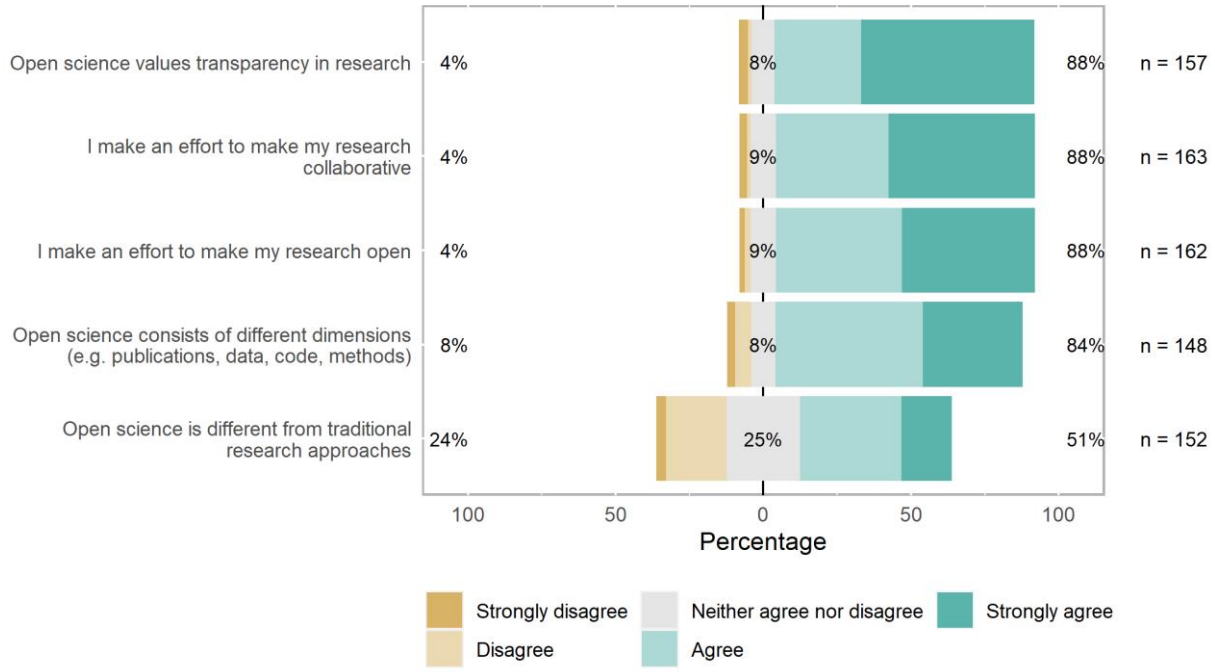

Figure 7. Please rate the following statements according to your practices regarding Open Science.

4.2.2. Open Access

For the next question we asked participants how often they engage in various practices relating to Open Access (Figure 8). Frequencies of engagement varied widely across the elements. Most frequent was depositing publications in repositories (with the vast majority, 80.2%, stating they do so often or always). Much fewer publish in OA journals often or always (44.8%), while almost half publish often or always under an open license (49.6%). These results might be interpreted with a little caution, especially for the first element. Since our sample was retrieved from papers collected in OA repositories, this may represent a sampling bias. Nonetheless, these results seem encouraging regarding current uptake of OA practices. However, our results also suggest that some work remains to be done with regard to funding for OA publications and uptake of preprints, where respondents were roughly evenly split. For the former, 39.3% of respondents “Often” or “Always” know how to get funding for OA publication fees, versus 34.5% that “Never” or “Rarely” know. Regarding preprints, 38.3% “Often” or “Always” deposit preprints, against 40.2% that “Never” or “Rarely” do so.

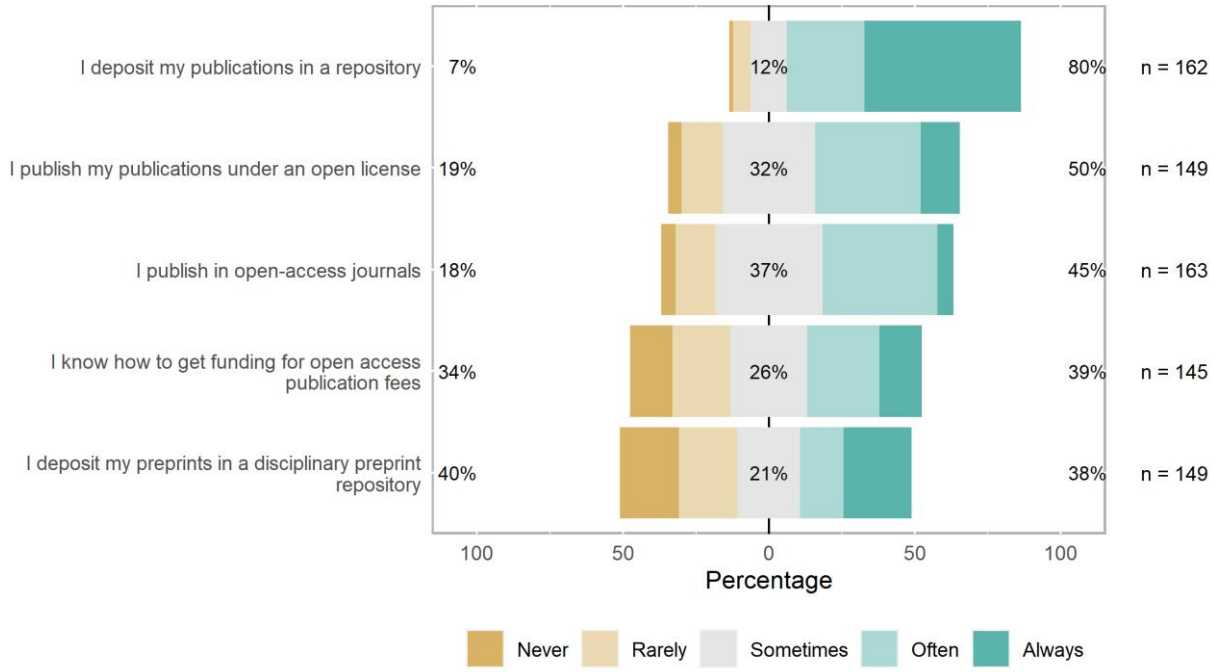

Figure 8. Please rate the following statements according to your own practices regarding OA publishing.

4.2.3. Research Data Management

In the following questions about practices regarding RDM (Figure 9), we can observe nearly half of the participants state they "Often" or "Always" publish their data description along with its identifier (45.3%). Practices considered key to good RDM, such as developing a data management plan (38.5%) and making sure reviewers can access data underlying publications in order to validate a publication's results (36.2%), are adopted by far fewer participants, and again, publishing data under a license seems to be problematic, being the least common practice, with a high percentage of "Never" or "Rarely" (68.7%), and an overall lower response rate (n=118). Although reasons exist for data not to be shared - e.g., confidentiality, commercial exploitation, etc - we can guess that the low levels of data sharing in a data repository (33.4%) also reflect an individual sense of ownership and lack of guidance on how to do it.

Figure 9. Please rate the following statements according to your own practices regarding RDM

4.2.4. Reproducible Research

Reproducibility of scientific results is key to increase transparency, efficiency and confidence in research. We next asked respondents about their practices relating to reproducibility (Figure 10). Almost three quarters of respondents agreed with the general statements "I foster results reproducibility" (74.2%) and "I extensively document and give access to the methodology used for each finding" (73.8%). However, far fewer reported engaging in specific practices linked to increased reproducibility, including sharing results via platforms like the OS Framework (62.8% rarely/never), sharing electronic laboratory notebooks (80.2% rarely/never, n=86) or pre-registering hypotheses (79.1% rarely/never). Hence, we might surmise that although reproducibility is valued in the abstract, concrete steps to foster it are not uniformly followed.

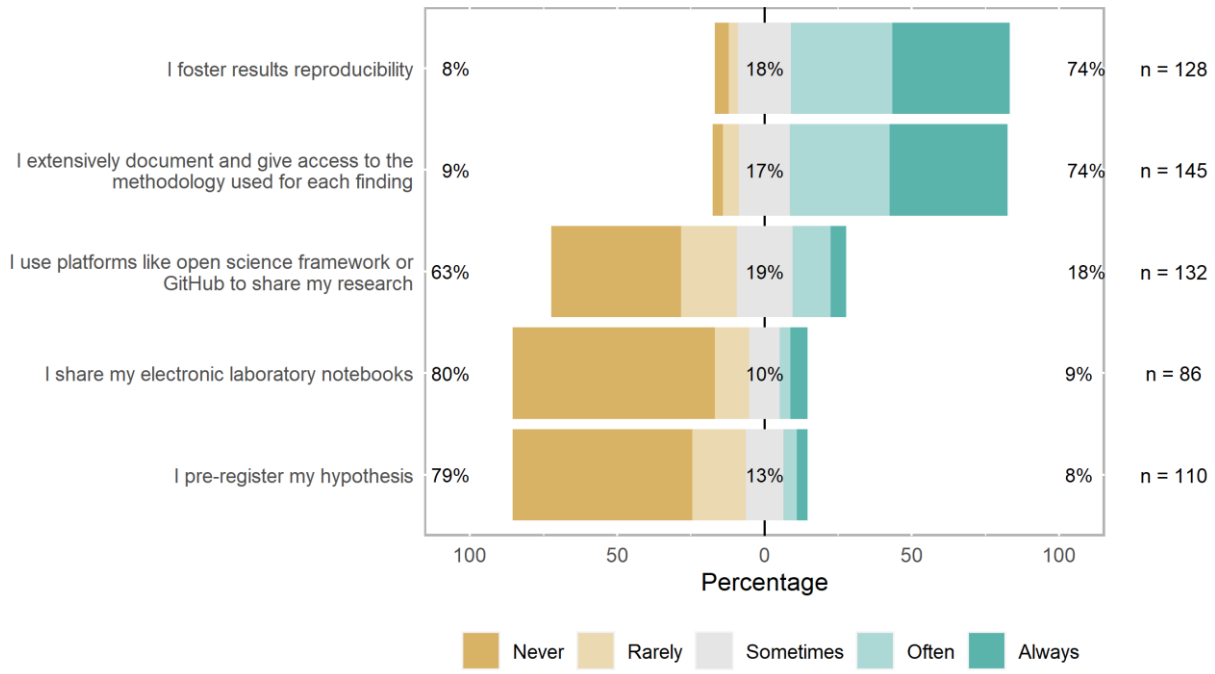

Figure 10. Please rate the following statements according to your practices regarding Reproducible Research

4.2.5. Open Peer Review

As for Open Peer Review (Figure 11), respondents generally agree that this practice improves transparency of the review process (59.9% agree/strongly agree), with open peer review platforms found generally easy to use (45.7% agree/strongly agree) and to foster attentive reviewer comments (48.2% agree/strongly agree). However, the majority (55.2%) of respondents do not usually sign their reviews. Neither does the majority deem an Open Peer Review process a priority in opting for a journal, with only 19% of respondents using this as a criterion for journal selection. Hence, although Open Peer Review seems favoured, it does not seem to be prioritised by our respondents.

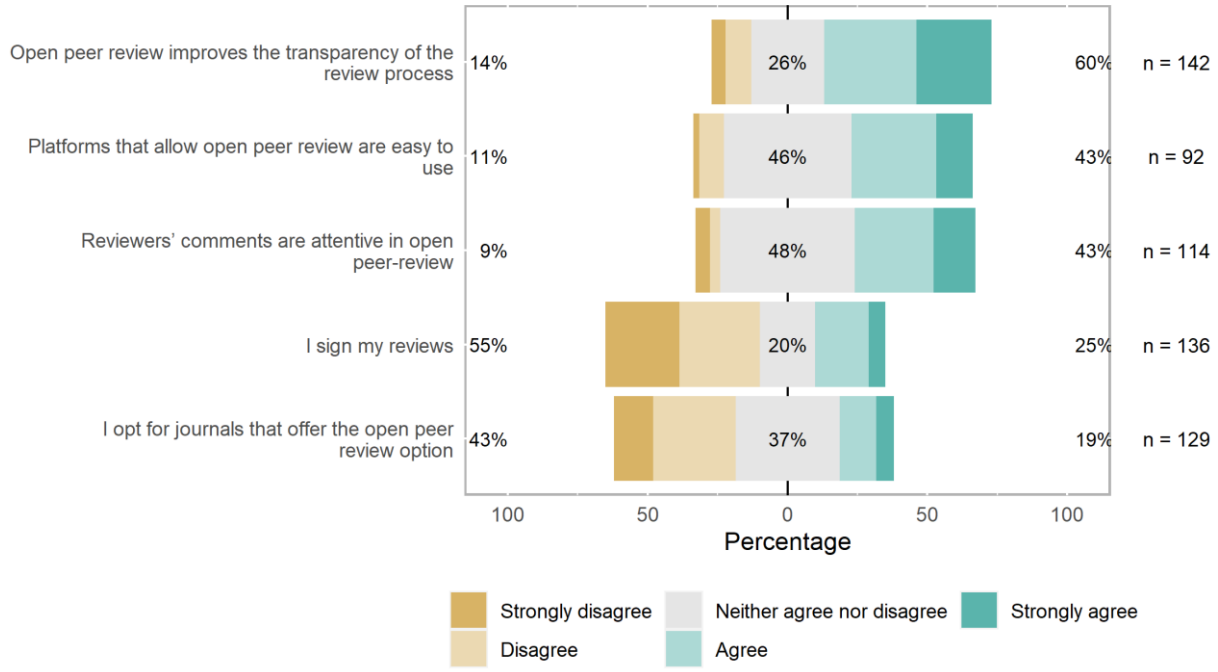

Figure 11. Please rate the following statements according to your practices regarding Open Peer Review

4.2.6. Open Source Software

Many of our respondents stated that the questions on Open Source software (Figure 12) were not relevant to their research, perhaps reflecting that many of our respondents were from fields (e.g., social sciences) where engagement with coding and software is less ubiquitous than in others. For those that did answer substantively, the percentages of accordance or disagreement are very similar across questions like "I develop software collaboratively" (41.4% "Always" or "Often" versus 37.1% "Never" or "Rarely"); "I share my software code" (40.7% "Always" or "Often" versus 43.2% "Never" or "Rarely"); and "I extensively document my software development methodology" (36.0% "Always" or "Often" versus 33.3% "Never" or "Rarely"). Almost a third of the respondents "Never" or "Rarely" reuses open-source software (31.4%) and more than half of the respondents "Never" or "Rarely" license their software to allow reusability (53.5%).

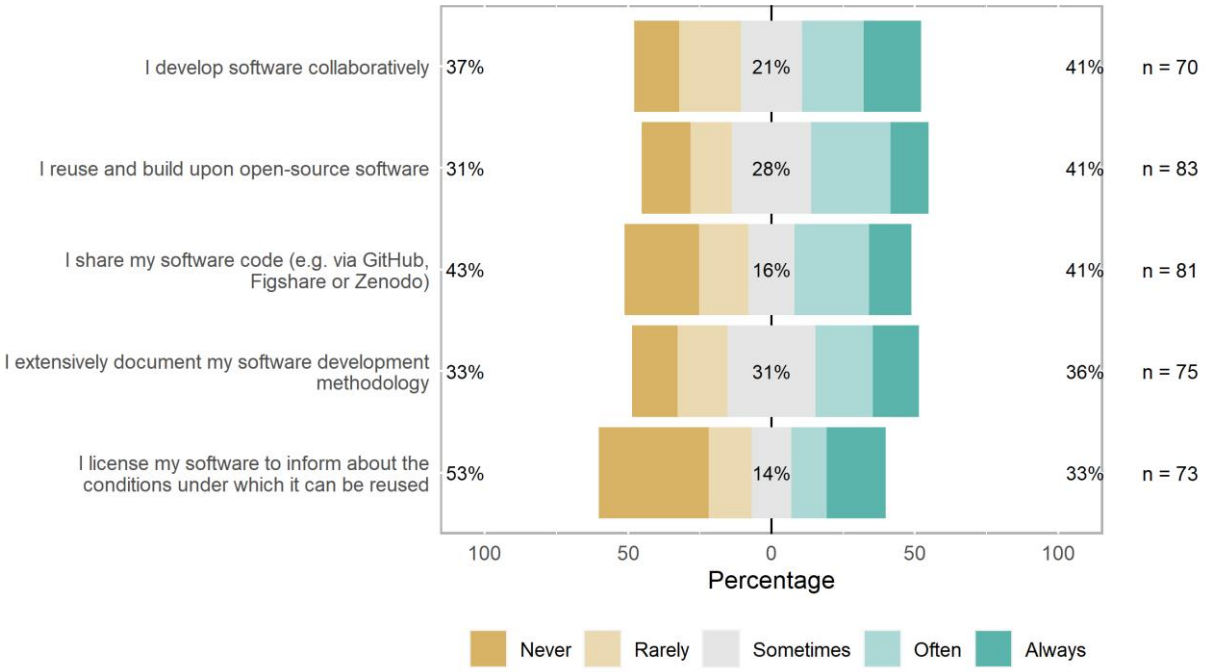

Figure 12. Please rate the following statements according to your practices regarding Open Source Software

4.2.7. Licensing

Regarding Licensing (Figure 13), the respondents' answers show support for open licenses, and Creative Commons licenses in particular. However, almost a third of respondents believe that using such licenses will not protect them from unauthorised uses of their work.

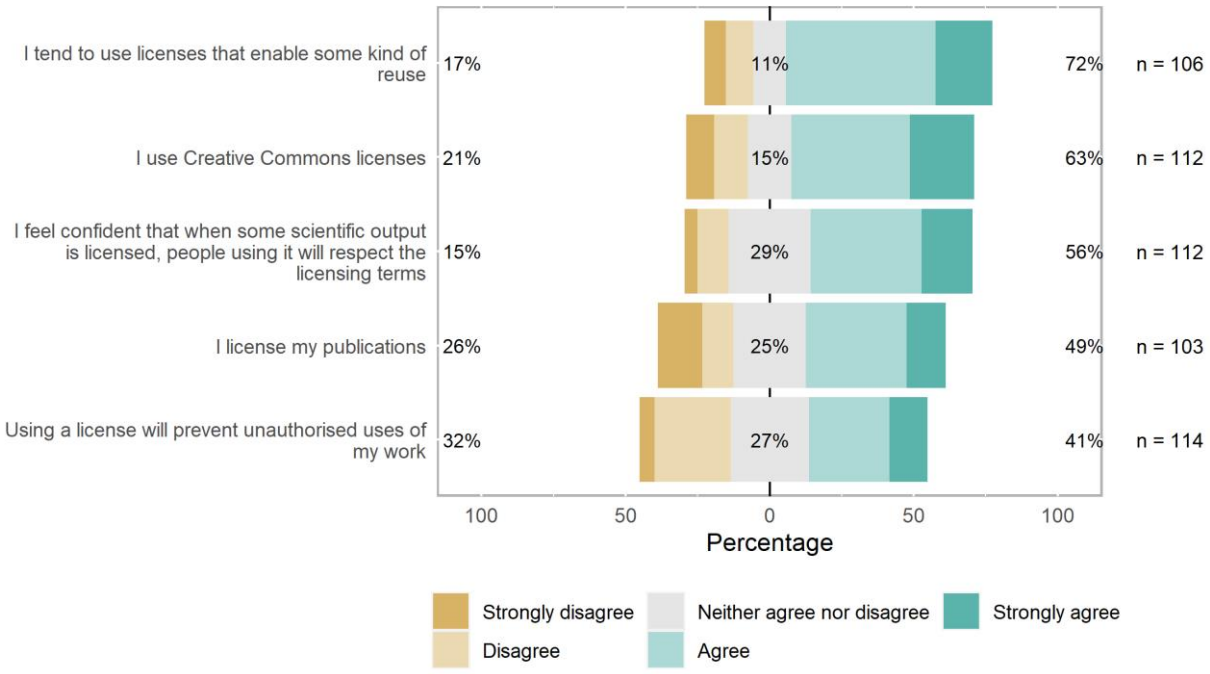

Figure 13. Please rate the following statements according to your practices regarding Licensing

4.2.8. Research Integrity

When asked about their practices with respect to Research Integrity (Figure 14), very nearly all of the respondents advised that they always or often follow correct protocols, including acknowledging all contributions and citing related work correctly (99.4%), thoroughly informing human subjects of all details concerning their participation in studies (96.9%), complying with discipline-related codes and regulations (96.7%), reviewing publications without biases (94.8%), and asking for human subjects' consent prior to dissemination of research (94.2%). Here we must of course note that respondents may not feel comfortable admitting otherwise (even in an anonymous survey). Despite this, the results are nonetheless encouraging for levels of Research Integrity amongst our respondents.

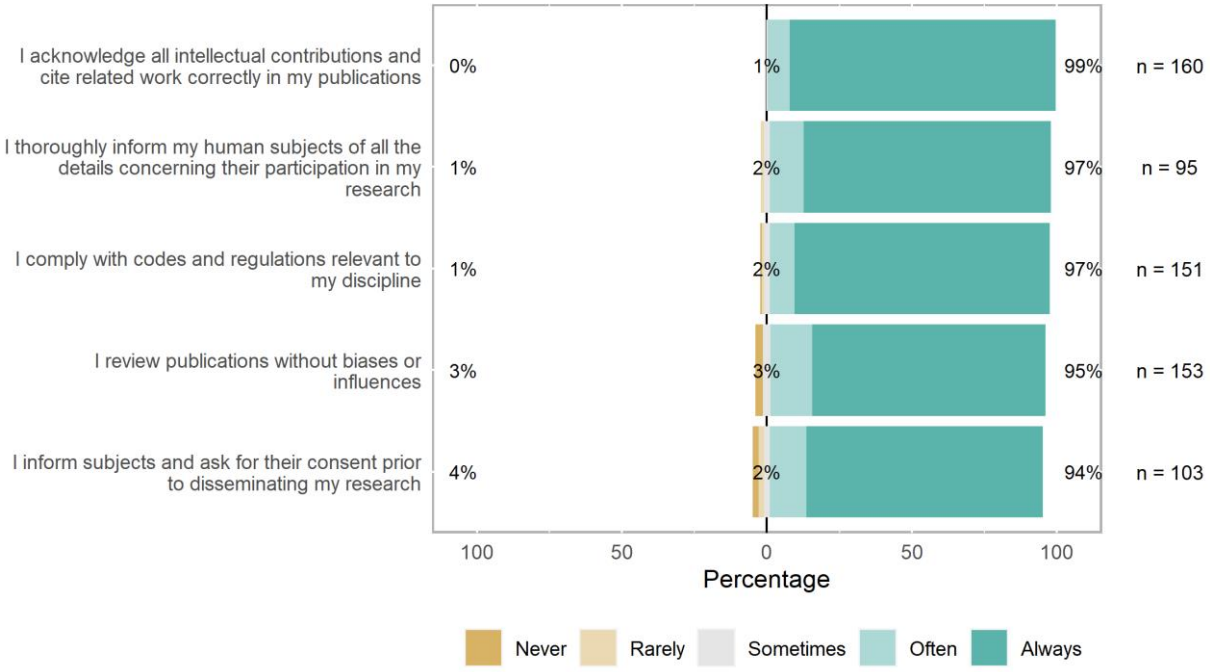

Figure 14. Please rate the following statements according to your practices regarding Research Integrity

4.2.9. Citizen Science

In the responses on the subject of Citizen Science (Figure 15), we see clear differences between levels of involvement of the public in research. Practices related to taking consideration of, or informing the public are clearly preferred to ones which invite public participation in research. 80.6% of respondents agree that they align their research with challenges relevant for society and 76.9% provide the public with information; but only 47.1% regularly publish news regarding their research, 42.9% involve citizens in data gathering, and 42.7% ask for citizen's feedback during the research process.

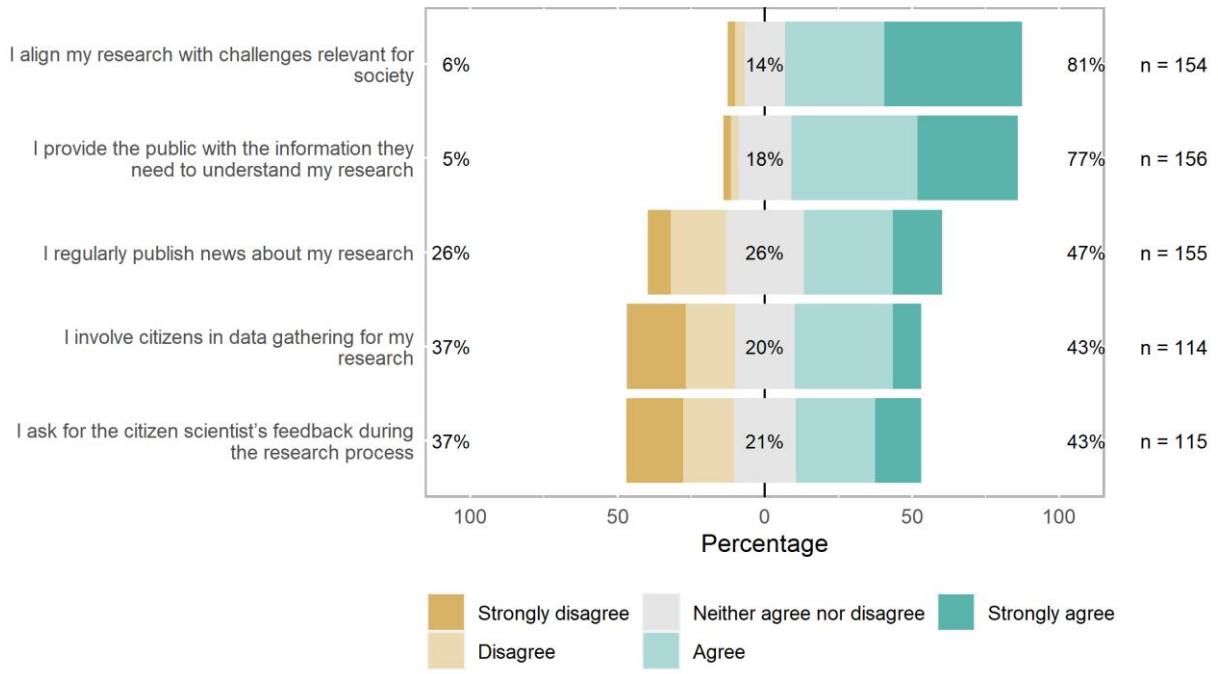

Figure 15. Please rate the following statements according to your practices regarding Citizen Science - consider all levels - information, consultation, public participation

4.2.10. Gender

Finally, regarding gender (Figure 16), we generally find high levels of support for practices to foster gender equity. Over four-fifths (80.3%) try to avoid imbalances in decision-making processes, while almost two-thirds (65.2%) take gender equality as a concern in constructing their research teams. The majority also agreed with the other factors: that they look for gender equality when looking for project partners (57.4%), they conduct gender-blind research" (55.4%) and seek gender-balance in groups involved in the project are gender-balanced" (50.4%).

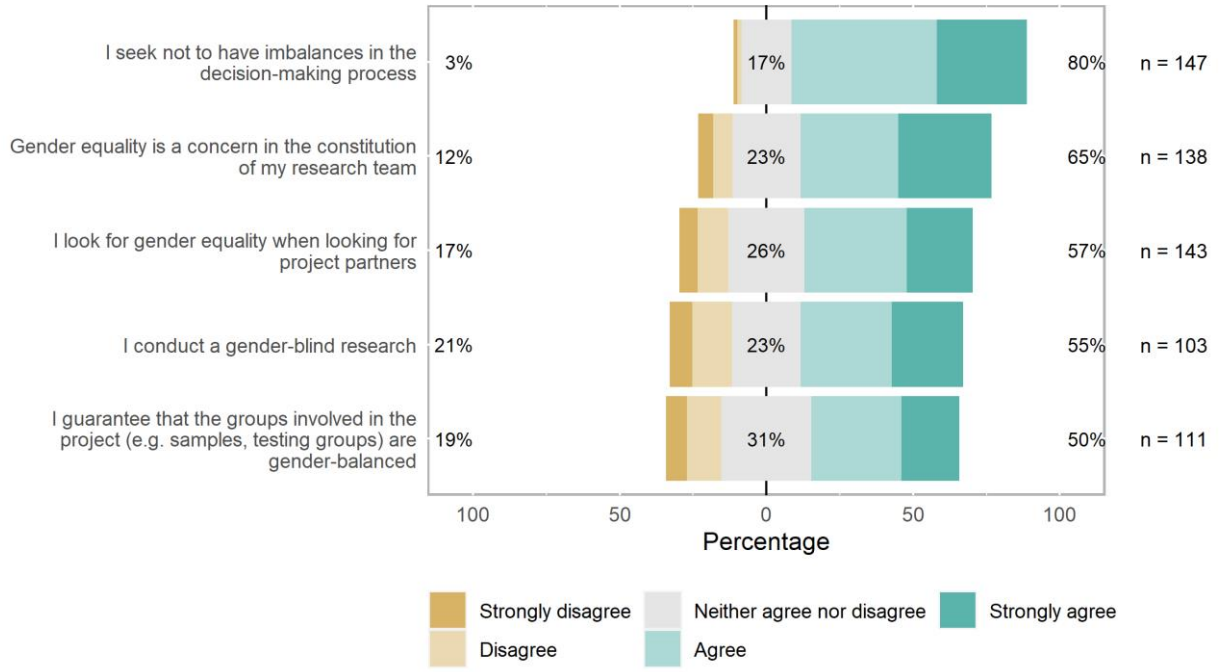

Figure 16. Please rate the following statements according to your practices regarding Gender issues.

4.3. Training

Having gauged participants' engagement with OS/RRI practices, we next sought to discover their experiences of and opinions on OS/RRI training.

4.3.1. Training events attended

We first asked on which topics respondents had previously attended training. In Figure 17 below, we can see that in fact the majority had never attended training on any topic. However, the most popular topics were OA (46.0% had attended at least one session), Research Integrity (44.3%), Gender (34.0%), Open Data (33.8%) and OS (24.9%). The least-attended topics, where less than 20% of respondents had attended at least one training session, were licensing, Open Source software, Open Peer Review and Citizen Science.

As said, overall we can see that the participants had very little training, with (depending on the topic) between 54% and 86% of respondents never having attended any training on these OS/RRI topics. This shows that funders and institutions have a lot of work to do to equip their researchers with the skills necessary for OS/RRI.

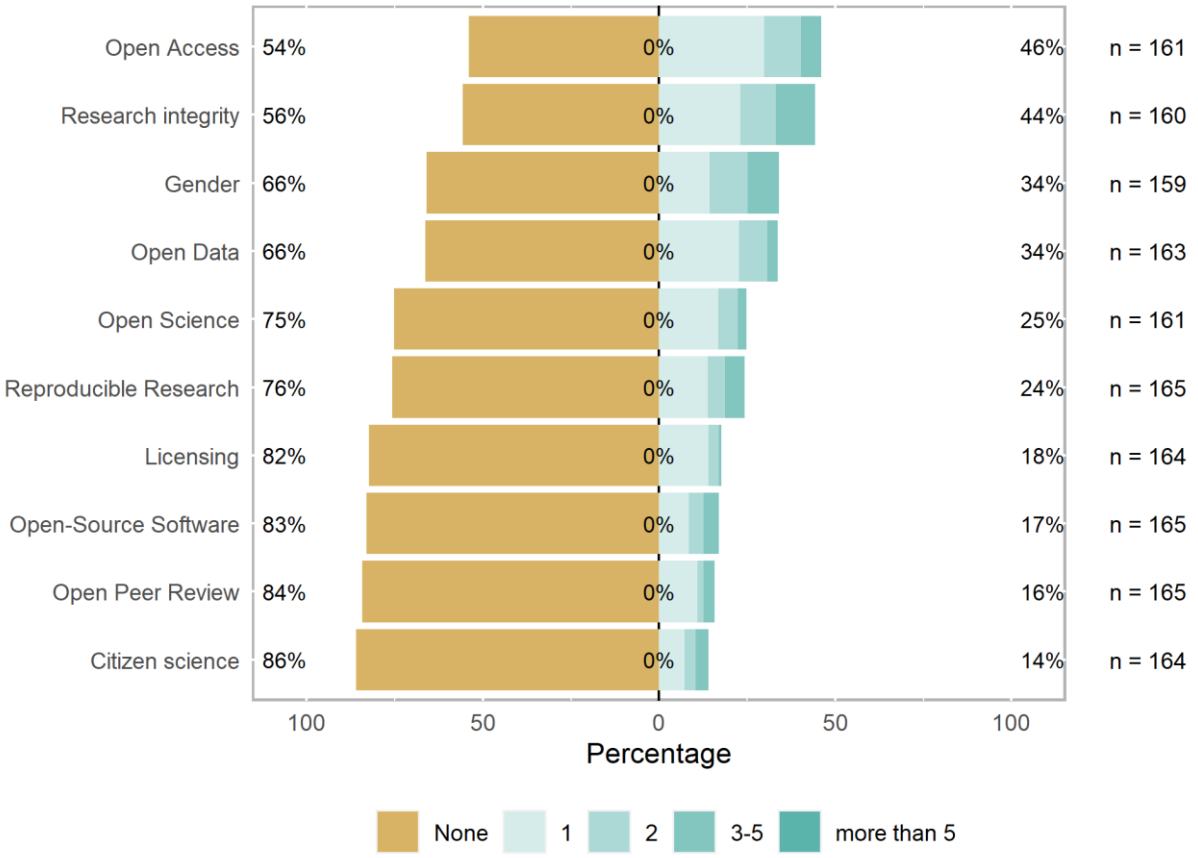

Figure 17. How many training events have you attended in these topics

4.3.2. Types of training sessions

When asking what types of training respondents had attended we found a mix of in-person and online events (Figure 18). The most popular types of training sessions attended at least once by a majority of respondents, were Webinars (56.3%) and followed by Seminars (52.1%). Also relevant, although more than half of the respondents never attended them, were half-day workshops (49.1%), online courses (40.2%) and full-day workshops (39.5%). However, there was a clear preference for short-form events over longer, more in-depth courses, as amongst the least attended types of training were workshops spanning several days, Massively Open Online Courses (MOOCs, usually consisting of several modules) and summer/winter Schools.

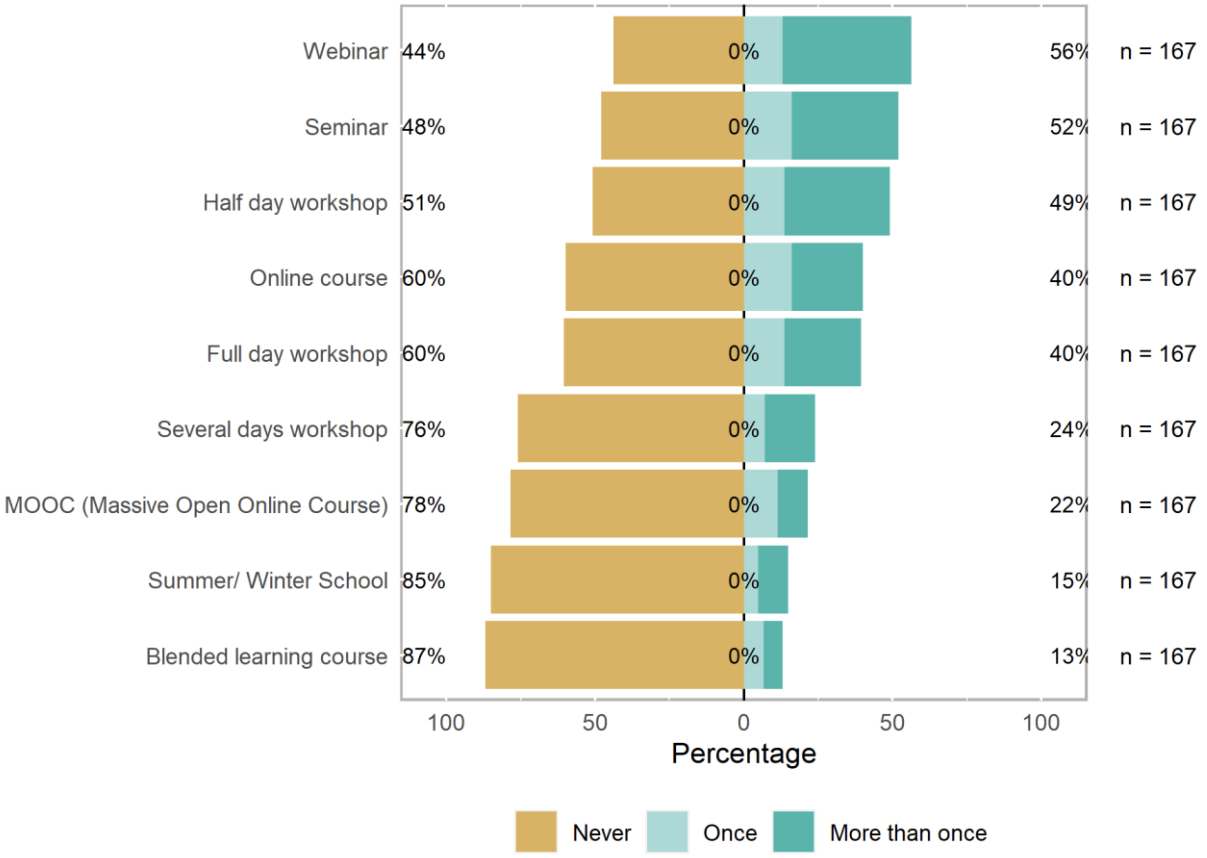

Figure 18. How often did you attend the following types of training sessions?

4.3.3. Total hours of training

Of those who had received training, more than half (64.1%) reported having had more than 5 hours, 19.7% had 3-5 hours, 13.7% had 2 hours and 2.6% of the participants had 1 hour of training (Figure 19).

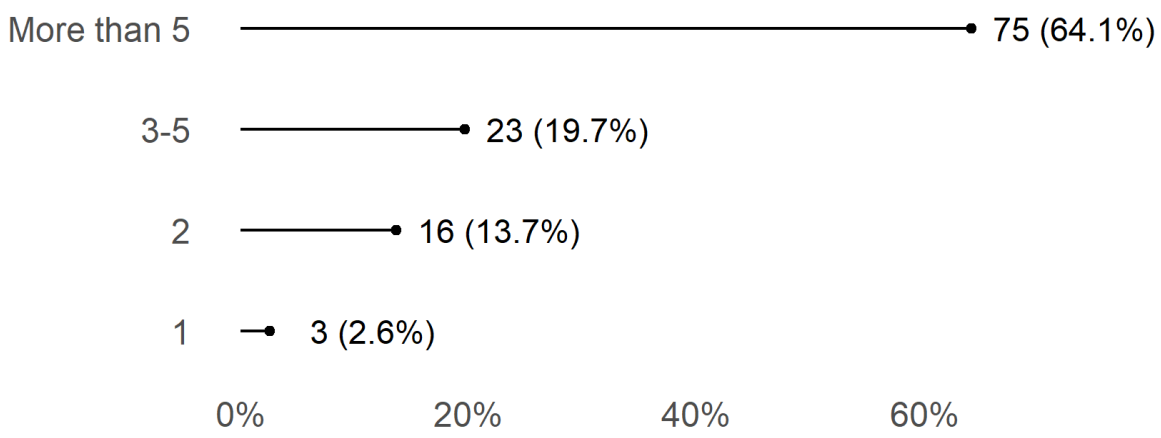

Figure 19. How many hours of training in total did you receive?

4.3.4. Training providers

We were next interested to learn which entity provided the training our respondents had attended (Figure 20). By far the most popular training provider was the institution overall, with 55.7% of respondents reporting having received some training. External organisations provided training to almost a fifth of respondents (19.2%), while a similar number (18.0%) had received training at a conference and slightly fewer (13.8%) from their professional association.

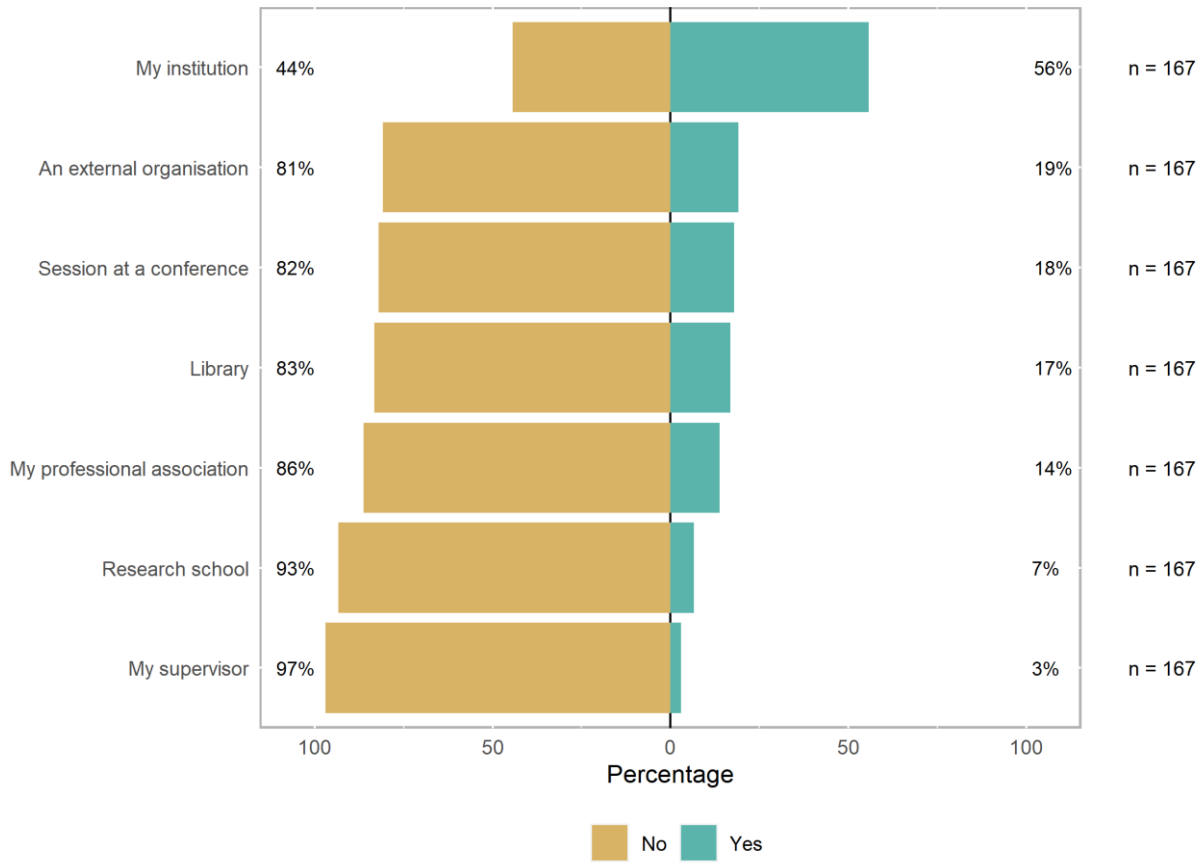

Figure 20. Who provided the training sessions you attended? (choose all that apply)

4.3.5. Preferred ways to learn Open Science topics

When asking the modes by which respondents most preferred to learn about OS/RRI topics (Figure 21), we can see a clear preference that such training should be optional rather than mandatory (with 50.3% favouring the former, but only 13.2% favouring the latter). In addition, almost half (47.9%) prefer peer-to-peer learning in informal settings through discussion with peers, and more than a third (37.1%) prefer self-directed learning via personal reading. In short, training should be compulsory only in those cases where it is necessary, and there is no one-size-fits-all format so training programmes should consider blended-learning approaches which also incorporate peer-to-peer learning.

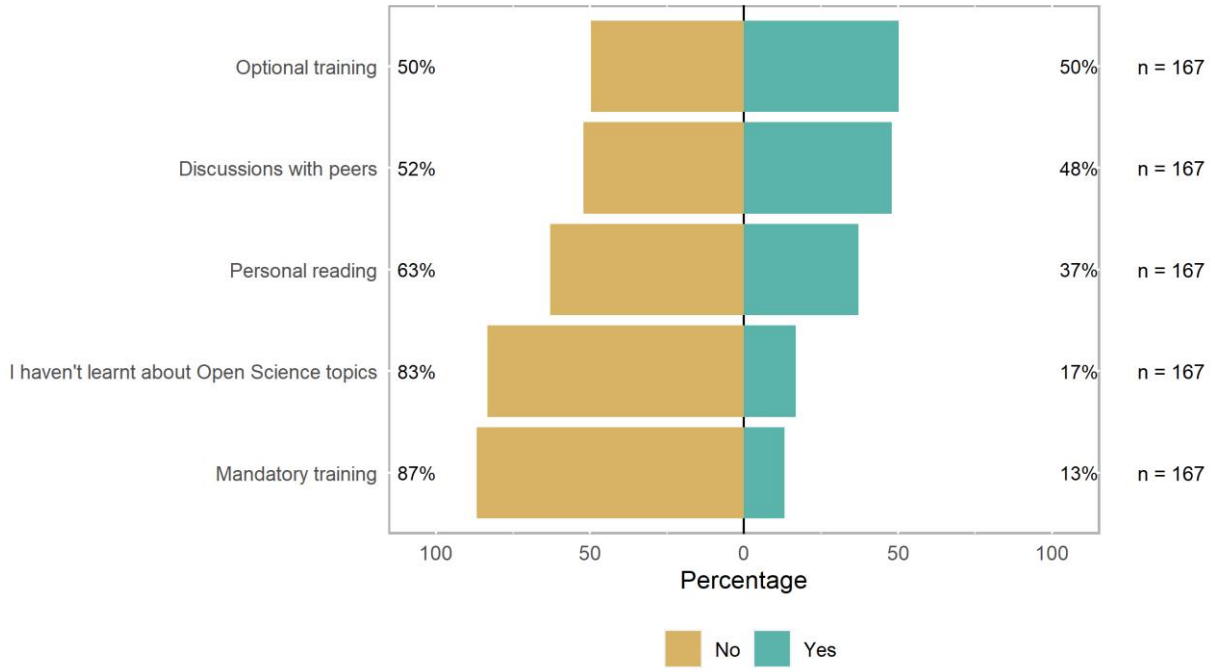

Figure 21. What is your preferred way to learn OS topics?

4.3.6. Increased awareness of Open Science practices after training

We next sought to gauge the impact on training, as understood by respondents' perceptions of changes to their practices (Figure 22). After having received training in OS/RRI topics, 65.5% of respondents understand why they should make an extra effort, 63.4% state that they have incorporated some practices in their daily research work and 63.4% are more aware of the opportunities offered by practicing OS. Still, 29.5% of the respondents are aware of the benefits, but do not practice what they have learned. Overall, OS training has had a largely positive impact on the awareness and practices of the respondents. The latter point, however, shows that a gap still exists between positive attitudes to OS/RRI topics and actually putting these into practice amongst a significant portion of researchers. More work may be required to better understand the dynamics involved here.

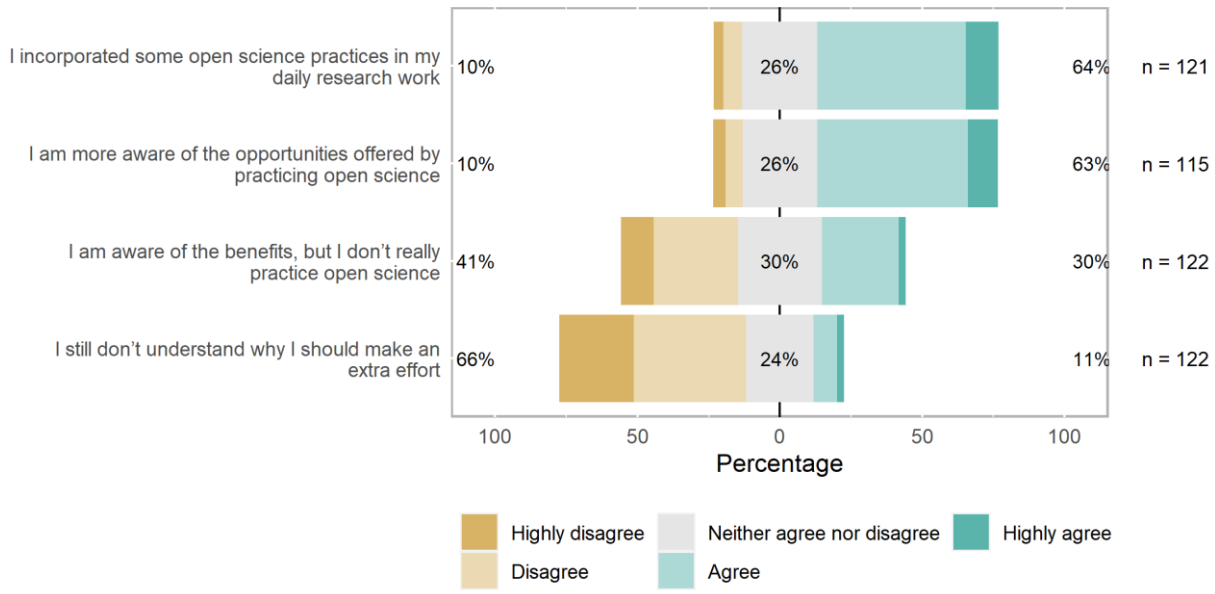

Figure 22. Has your awareness of OS practices increased after the training you attended?

4.3.7. Open Science and tools recommendation

We next asked respondents whether they would recommend OS/RRI practices to their colleagues and with the answer options sought to obtain contextual information as to why or why not (Figure 23). The majority of the participants would recommend some of the OS practices learned (71.3%). 47.3% of the participants claim that their research community already has established some OS practices, against 25.9% who state that the established tools and practices do not fit in OS. Only 17.1% of the participants think their colleagues would not make the effort to learn/use OS practices and tools.

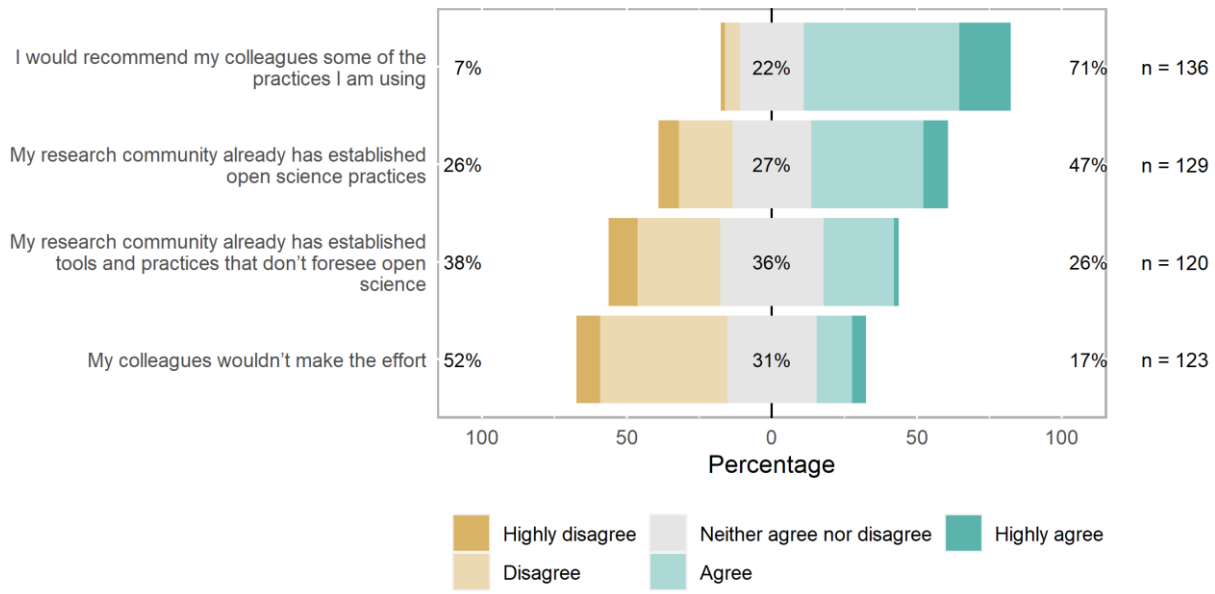

Figure 23. Would you share your experience with OS practices and tools with colleagues?

4.4. Institutional support structures

With the next bank of questions, we sought to learn what support structures were offered by respondents' institutions.

4.4.1. Policies and recommendations

Institutional support at the strategic level seems high. More than two-thirds (67.1%) of respondents advised that their institution has an OA policy (Figure 24), while 70.7% advised that their institution recommends OS or OA practices (Figure 25).

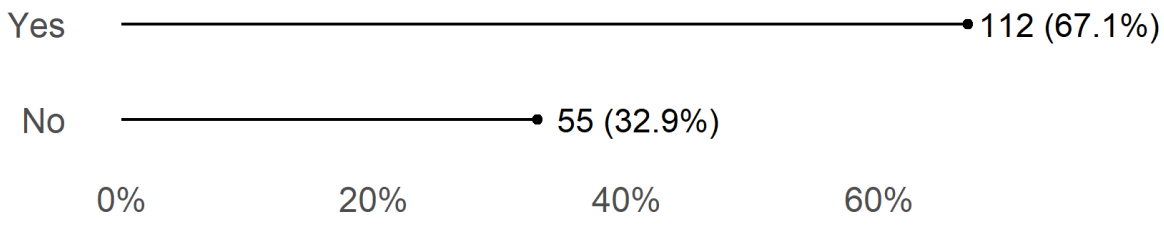

Figure 24. Does your institution have an OA policy?

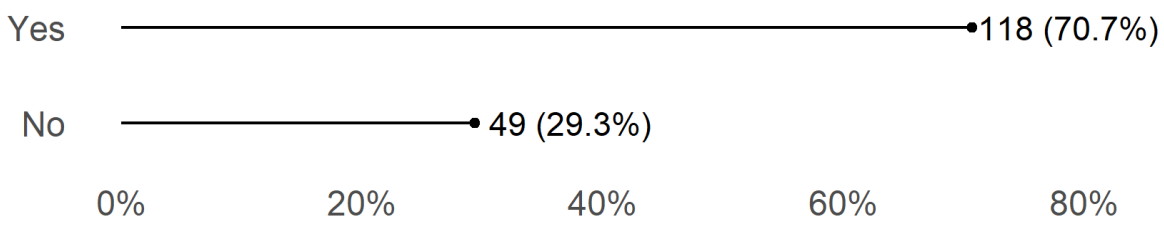

Figure 25. Does your institution recommend OS/OA practices?

4.4.2. Open Science/ Open Access helpdesks

42.6% of the respondents specified there is a dedicated OS or OA helpdesk or support group in their institution, while just above a quarter (25.3%) stated definitively there was not. However, a significant number (almost a third, 32.1%) stated that they did not know whether their institution had a helpdesk or not, which may be taken as a worrying finding for those interested to provide such services (Figure 26).

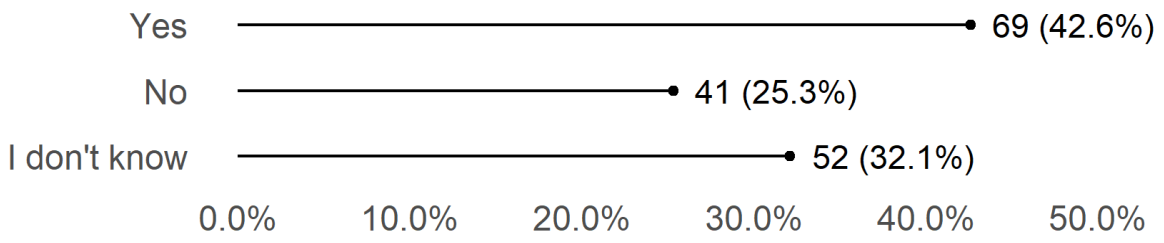

Figure 26. Is there a dedicated helpdesk/ group to support any issues related to the OS/OA policy?

4.4.3. Guidance on compliance with funder requirements on Open Access

When asked if they receive any guidance on how to comply with the policies issued by financing entities that require OA to publications, the answers were evenly split, with 40.9% indicating "yes", and a very similar number (41.5%) answering "no" (Figure 27).

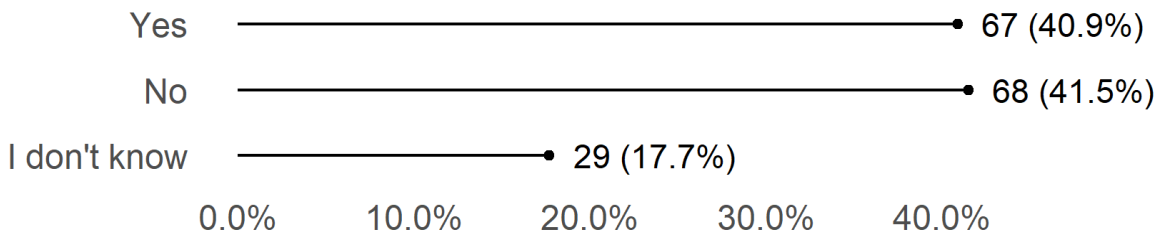

Figure 27. Do you receive any guidance on how to comply with the policies issued by the financing entities that require OA to publications, such as the European Commission or the European Research Council?

4.4.4. Financial support for APCs

Almost half of the respondents (46.6%) report they have institutional support to help them pay article processing charges (APCs), as 39.3% do not have financial support from their institution (Figure 28).

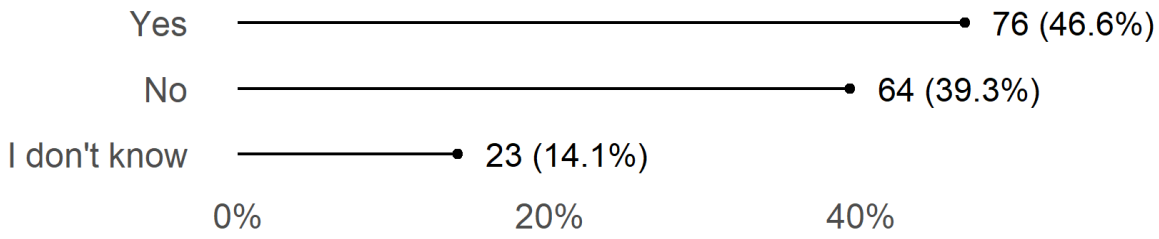

Figure 28. Does your institution support you financially in paying article processing charges (APCs)?

4.4.5. Institutional support to practice Open Science

Asked to rank various aspects of the institutional support and incentives to practice OS (Figure 29), the topics in which a majority respondents consider they receive at least some support or incentives are: Access to technical infrastructure (64.1%), Support by the Ethics committee (63.9%), Legal support on, e.g., licensing, IPR, data protection (54.1%) and Information on funders' policies and recommendations regarding OS (53.2%). Nonetheless, significant numbers (ranging from a third to almost half) advised that they do not receive institutional support or incentives on these factors.

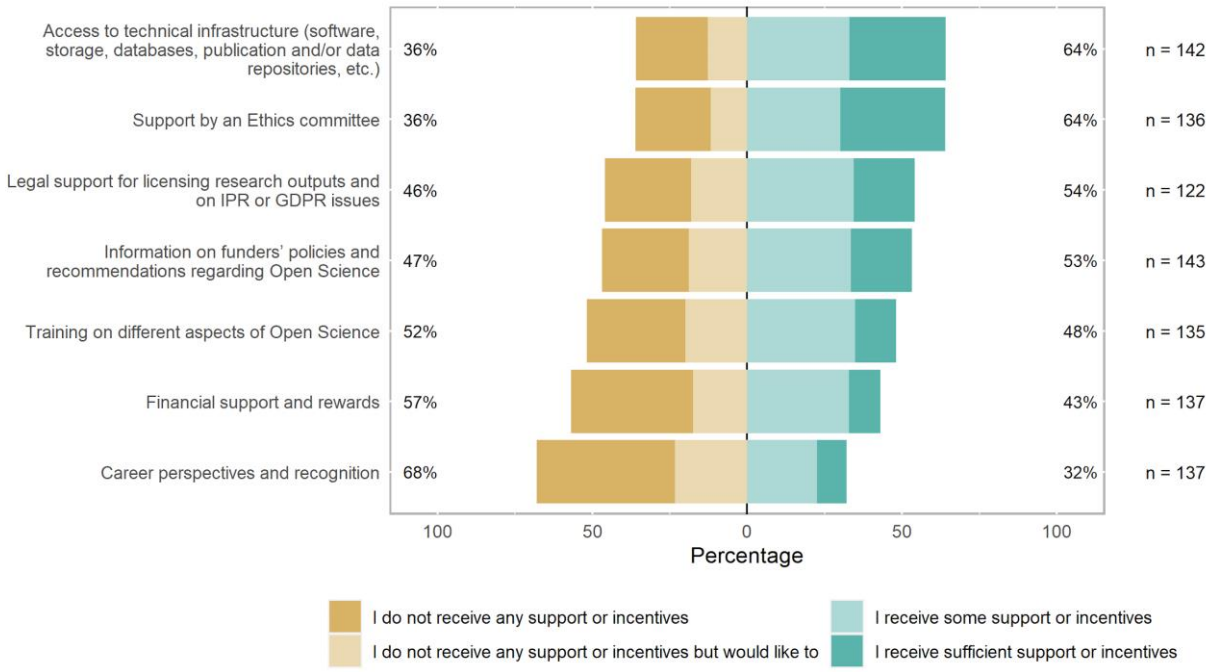

Figure 29. To what degree are you supported in practicing OS at your institution?

Finally, asked if there were other initiatives incentivising OS practices in their institutions, such as OS cafes or Data champions, the great majority of the participants (81.4%) said there are not (Figure 30).

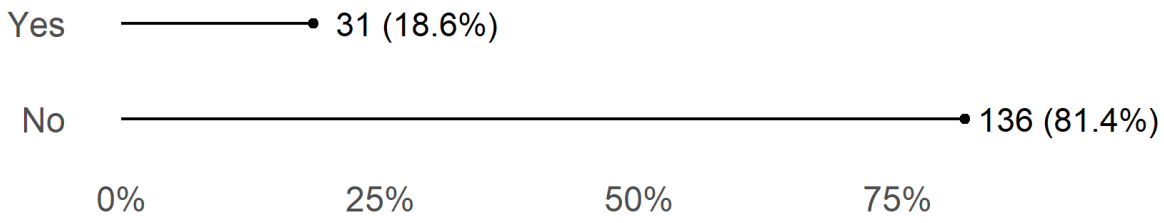

Figure 30. Are there other initiatives incentivising OS practices at your institution (eg. OS cafes, Data champions)?

4.5. Views on Open Science in general

In this final section of the questionnaire, we sought respondents' attitudes towards OS in general and their opinions on potential drivers and barriers to uptake.

4.5.1. Open Science: opportunity or cost?

First, Respondents were asked their level of agreement or disagreement with a set of statements on OS (Figure 31), some positive, such as "[OS is] an exciting opportunity" and some negative such as "[OS is] an unimportant bureaucratic burden". Roughly a third (36.5%) of the respondents agreed that OS is "Mostly positive, it has benefits but also important drawbacks", with slighter lower numbers seeing it as "An exciting opportunity, mostly with benefits" (31.1%) and "An opportunity, with the benefits outweighing the

drawbacks" (27.5%). Only a small percentage of respondents agreed with the very negative statements about OS, that it is "not relevant" (9.0%), a "threat"(5.4%), a "bureaucratic burden" (4.8%). Hence, we can say that most certainly see benefits but nonetheless have some reservations about potential drawbacks.

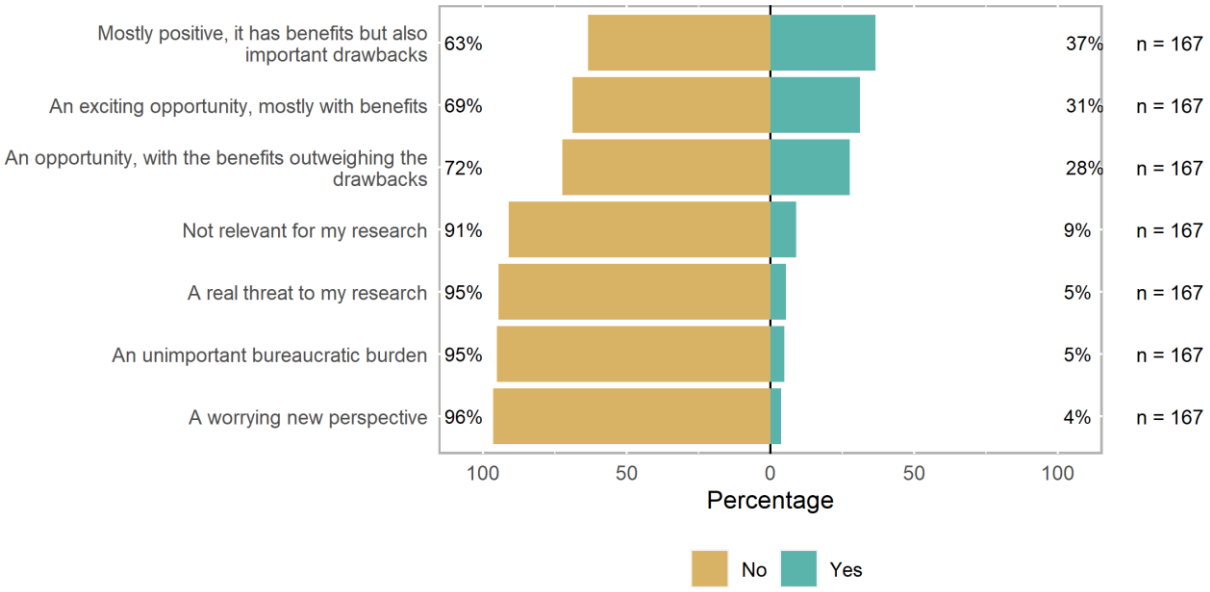

Figure 31. Overall, if you had to summarise your views, what would you say OS is?

4.5.2. Barriers to Open Science adoption

Our next question sought to dig down to gauge perceptions of these drawbacks by asking about the barriers to OS uptake (Figure 32). From respondents' answers, clear trends can be observed. The most significant barrier to OS adoption amongst the options presented to respondents was a lack of clarity in which sources or platforms to trust (61.8%), followed by the lack of clear steps to follow (55.5%), extra effort (54.1%) and time constraints (53.7%). In addition, a lack of proper infrastructure was pointed out by 52.9% of the respondents and a lack of clarity as to where to find relevant information by 51.4%. The majority saw all of these factors as significant or very significant barriers, whereas only 37.4% considered the lack of clarity on OS benefits as a significant or very significant barrier. Hence, while awareness-raising of the benefits of OS might still be required, it does seem that message is quite well-understood by most. However, issues of trust, time, resources and clarity on practical implementation steps persist and overcoming these may be considered a priority for future OS uptake.

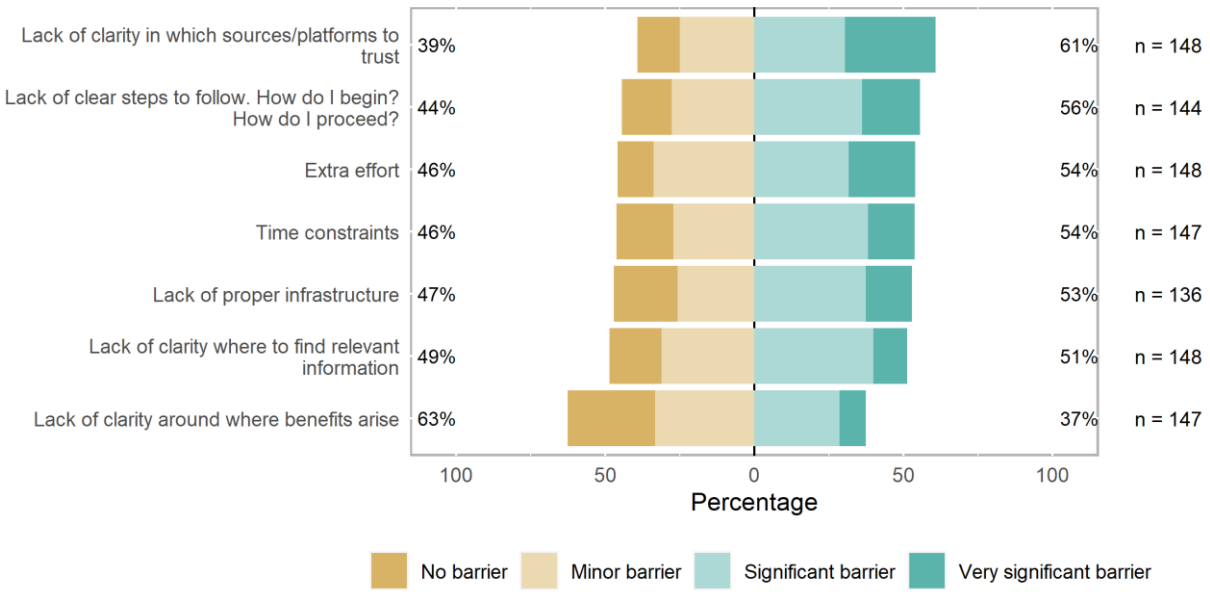

Figure 32. Which are the most significant barriers you will be facing while embracing an OS perspective?

4.5.3. Drivers to Open Science adoption

When identifying the main drivers to OS adoption (Figure 33), participants put societal ideals and policies mandating OA first: 82.5% say the value of sharing research outputs is a significant or very significant driver, followed by funder policies mandating OA to research outputs (77.2%) and institutional policies mandating OS practices (76.3%). Ethics principles came next, with 72.2% seeing this as a significant or very significant driver, followed by the adoption by their research community (70.8%) and publisher requirements (70.3%). The element considered least significant was career progression policies (58.6% significant/very significant), although an ambivalence in our phrasing leaves room for doubt here whether respondents thought it was current policies (which usually do not include criteria related to OS), or policies in general. ON-MERRIT's work in D6.1[46] suggests it may be the former. This theme is explored further in the interviews presented in our next section.

[46] Pontika, Nancy, Klebel, Thomas, Pride, David, Knoth, Petr, Reichmann, Stefan, Metzler, Hannah, Correia, Antonia, Brinken, Helene, & Ross-Hellauer, Tony. (2021). ON-MERRIT D6.1 Investigating Institutional Structures of Reward & Recognition in Open Science & RRI (1.0). Zenodo. https://doi.org/10.5281/zenodo.5552197

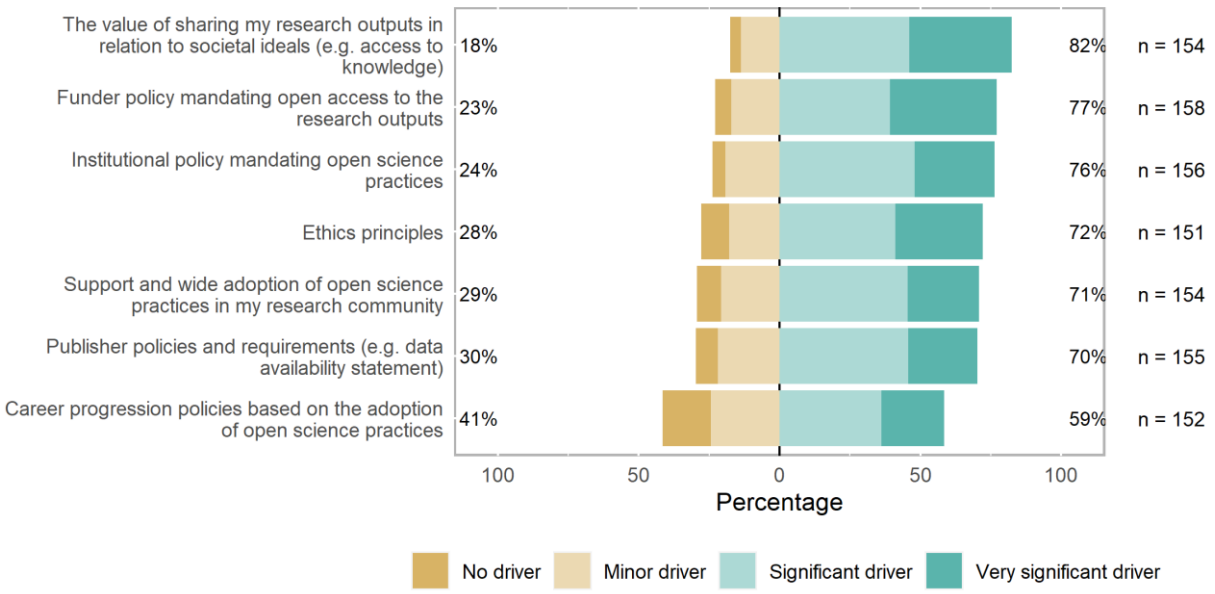

Figure 33. What could be the main drivers for you to practice OS?

4.5.4. Factors influencing Open Science adoption

Asked to rate different factors as drivers or barriers to OS adoption (Figure 34), the ones considered as main drivers were:

- Societal needs, values, interests and expectations - 76.4%
- Collaboration and communication among researchers - 66.4%
- Availability of high-quality OA publication choices in their research area - 58.4%

Researcher evaluation based on citation metrics is viewed mostly as a driver (39.3%), but almost the same percentage of people consider it neither a barrier nor a driver (37.2%). Also, plagiarism or theft of ideas is considered neither a barrier nor a driver (48.2%).

The main barriers to OS are, by decreasing order:

- Article processing charges - 85.5%
- Difficulties of applying licenses to publications or data - 55.6%
- Publishers' policies on the sharing of publications - 51.0%

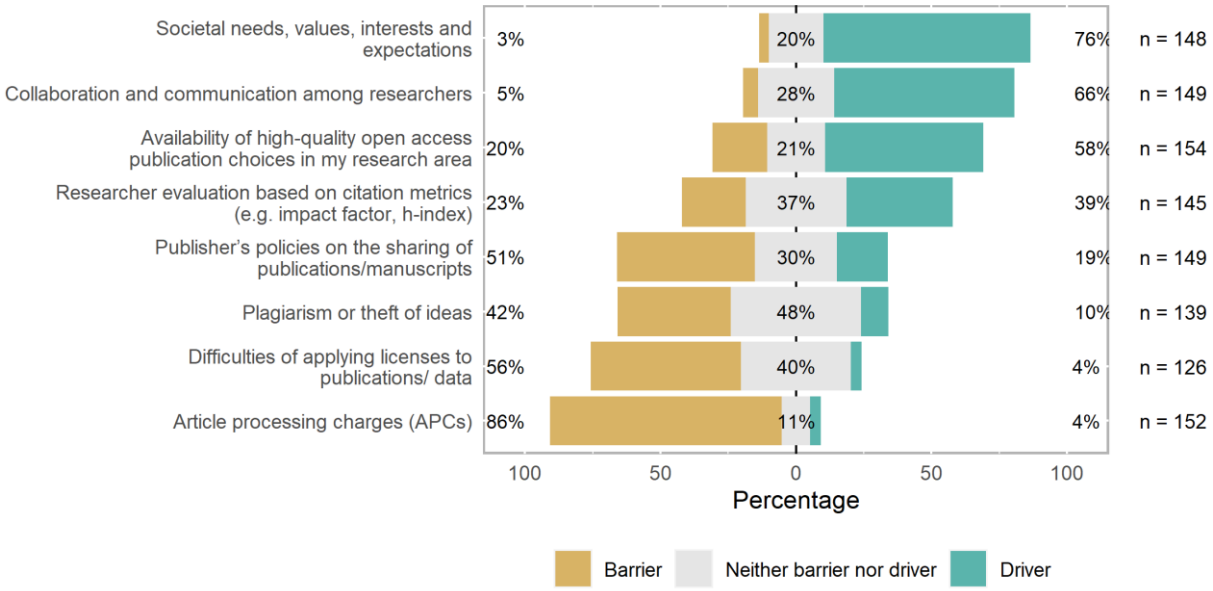

Figure 34. Would you say the following factors are drivers or barriers for you to practice OS?

4.6. Survey results summary

Summarizing our results, we can say that our sample is somewhat skewed towards more senior, male academics from Europe working in a University. Most are Professors (Full professors, Associate professors) and Senior researchers from Social Sciences, Engineering and technology and Natural sciences.

OS/RRI concepts are looked upon favourably, as a different way to do research, although some reluctance and doubts persist on how to put them into practice with almost all the topics inquired: OA, RDM, Reproducible Research, Open Peer Review, Open Source Software, Licensing and Citizen Science. Research Integrity and Gender are the topics that gather more consensus and are best implemented.

Interestingly, we found that the majority of our survey participants had not received training in any of the above OS/RRI topics (very often a large majority). The most popular topics for those who had training were OA, Research Integrity, Gender, Open Data and OS. We also found a preference for shorter training formats as well as for optional and peer to peer learning.

Although some institutions provide support through OA policies and recommendations, financial support for APCs, access to technical infrastructure, Ethics Committees and legal departments, there is much to be done concerning more generalized training, promotion of peer to peer networks and guidance on how to comply with the policies issued by the financing entities that require OA to publications.

5. Interviews

In order to complement the findings from the survey and to more closely investigate institutional support structures for, and drivers and barriers to, OS/RRI we interviewed representatives from eleven institutions responsible for implementing OS/RRI policy and support services in higher education institutions from nine countries in three continents: Austria, Brazil, Estonia, Germany, Mozambique, Portugal, Slovenia, Spain and the United Kingdom.

The interviews were structured around three main topics, 1) The interviewee's role in the institution and their familiarity with OS/RRI; 2) Drivers and barriers to OS and RRI implementation; and 3) OS/RRI training in the institution.

5.1. Interviewee standpoints

The first portions of the interviews were used to find out more about interviewees' backgrounds in OS/RRI and their roles within their institutions. Hence, we asked questions designed to elicit information on their areas of responsibility, their types of role (including levels of seniority), and their roles in implementing OS/RRI within their institutions.

5.1.1. Interviewees areas of responsibility

The people interviewed cover several roles, spanning from director of research support services such as libraries or information management services, to repository managers or coordinators for both publication and data repositories, from coordinator or manager of the OS policy offices, to head of research support in general or of the RDM unit in particular. In the UK, OS activities are often referred to as Open Research "because, open research tends to be more inclusive of the arts" (I5). I7 also advised that Open Research is used at their institution as a broader term than OS. For an overview of the interviewee sample description, please refer to Table 2 (section 3.2.1).

Many interviewees (1, 2, 3, 4, 5, 6) coordinate their institutions' support activities on OA to publications (including overseeing central OA funds for publication costs), RDM and OS more generally speaking. Others (4, 8, 9, 11) work on the organisation and support of OS training. Responsibility for maintaining institutions' repositories (for publications, data, or both) was common amongst respondents (1, 3, 5, 6, 9, 10).

5.1.2. Levels of seniority

Most of the respondents (9 out of 11) are senior in their roles. Many advised they had been actively involved in the implementation of OA (and later OS) in their institutions for many years. For example, I1 advised:

> "I've been quite active in implementing OS in my institution since the beginning when we started discussing Open Education and how to improve the open educational resources. That's how we started our institutional repository. Then a decade ago … we approved our first OA policy… Since then, I have been developing other policies and implementation of this policy by strengthening the mandate to put everything in the open repository and also implementing some funds for OA publications. We updated the policy … and also included OA as an indicator for the budget that we share with among our faculties. And we also implemented a new policy on research data." (I1)

Interviewees 10 and 11 report similar journeys:

> "I have this familiarity [with OS] since the beginning, since the early 2000s, I started working with the Theses and Dissertations Digital Library, and now in the last two years with data repository which will be launched soon which is the university's research data repository." (I10)

> "[M]y first contact was ... with the concept of OA, not OS, because at that time it was not called OS yet. It was in 2005… And this conference for me was revolutionary because if we think straight the libraries and librarians have always promoted the access to information and the development of the academic communities by supporting teaching, research and in this case our priority is to provide the information and scientific resources free of charges and without limiting the knowledge. The fact that I went to this first OA conference, as I said, was revolutionary and because of that in 2006 we applied for a project, to implement our first repository and in 2010 we approved the first OA policy to Science and to scientific publications that was renewed in 2016." (I11)

The remaining two participants only recently joined the offices covering the topics of OS/RRI in their institutions.

5.1.3. Interviewees' roles in implementing Open Science and RRI within their institutions

Regarding their roles in implementing OS/RRI, we can see that our sample reveals a much stronger involvement with some specific elements of OS (especially OA and Open Data) than with others, and that direct involvement in RRI activities was limited. Below we describe roles in detail.

Open Access support

The vast majority of the interviewees (10 of 11, interviewees 1, 2, 3, 4, 5, 7, 8, 9, 10, 11) mentioned some involvement in implementation of OA. The results, summarised below in Table X., show that this is most often in the areas of provision of the institutional repository for publications, formulating OA policies, and delivering OA training.

Statement	Interviewees count	Interviewees list
Run an institutional repository	5	2, 3, 5, 6, 10
Involved in the formulation of institutional OA policies	4	1, 4, 9, 11
Involved in OA training, including delivering courses	3	3, 8, 11
Assisting researchers with advice regarding their OA publications	2	1, 2
Assisting with APC enquiries	2	2, 6

Table 2. Interviewees' reported involvement in areas of OA implementation

Research Data Management

Another common area of involvement was RDM and related concepts such as Open Data. Six interviewees (1, 2, 3, 5, 6, 8) mentioned that, as part of their role, they implemented mainly RDM, while one (I4) mentioned Open Data. Three (1, 4, 6) were involved in drafting their institution's RDM institutional policy, and two each were involved in basic support for RDM landscape (2, 6), overseeing the data repository with support and training (8, 11), and assisting researchers in compliance with funder RDM and open data policies (I4, 6) .

Open Science

Seven interviewees (3, 4, 5, 6, 7, 8, 9) mentioned responsibility for OS in general, although respondents interpretation of the term was not always clear and often, even though they used the term OS, the activities that were describing related to specific aspects like OA or RDM. Amongst the activities reported here, most common (3, 6, 11) was the topic of providing OS training and awareness-raising courses or seminars. Two (1, 9) discussed their participation in OS expert and working groups. Single interviewees mentioned involvement in: supporting OS (I4), learning how to draft or drafting a policy and/or roadmap in OS (I5), and working on projects that promote OS (I1).

RRI

Mentions of involvement in activities to foster RRI were limited, perhaps reflecting a sampling bias within our pool of interviewees, but also perhaps reflecting this topic's less well-institutionalised development. Only one (I1) of the respondents mentioned undertaking activities related to RRI in their role:

> "I'm less engaged in the implementation because I don't see that we have a real strategy on RRI. However, we take into account, for instance, the gender. I'm now in the rector's team and we have a vice rector on different issues, and one of them is the gender. So, I participate in the debates we have as a team on this topic. We have released, for instance, a new guide on gender issues for anything we do at the university." (I1)

One interviewee (I3) somewhat erroneously mentioned Citizen Science as part of RRI, perhaps showing how poorly RRI is often understood as a concept:

> "RRI, as I said, we're trying to do the Citizen Science project now to get involved, how to get citizens more involved in, they put the concept of OS and actually talking about the OS to the public more than just the researchers…. [B]ut other than that,I have some knowledge I guess …" (I3).

Another interviewee (I2) implied that RRI is a non-existent topic in their institution:

> "Then regarding Responsible Research and Innovation … I don't really get questions with this expression, 'Could you help me with Responsible Research and Innovation for my topic?' This is not the question. They would probably ask something practical, 'How do I do something like this or how do I connect with industry or citizens?' or something like this. But that's really non-existent, basically." (I2)

5.2. Drivers and Barriers to Open Science and RRI amongst researchers

In the next section of the interviews, we sought to obtain interviewee's expert experience as to the drivers and barriers to uptake of OS/RRI amongst the various populations within their institutions. The answers to the various questions we posed, summarised here in order of how often they were mentioned, demonstrate that OS and to some extent RRI are increasingly well embedded within institutions but that there remains a long way to go until they become second nature for researchers and other groups.

5.2.1. Interviewees' perceptions of researchers' familiarity with and receptivity to Open Science and RRI

We asked interviewees for their general assessments of the level of familiarity with and receptivity to OS/RRI amongst researchers within their organisations. The answers to this show a mixed picture, with large variances amongst the different aspects of OS/RRI and across disciplinary and other contexts. Amongst the responses, we identify the following common trends.

Specific aspects only

Firstly, six interviewees (1, 2, 6, 7, 8, 10) reported that at their institutions there was very good familiarity with some specific aspects of OS (most prominently OA, but also RDM and FAIR data). I6 advised that although "OS as a term has arrived", they were "not sure if the researchers understand all the concepts or all the implications" (I6). In other words, although researchers and others may be increasingly aware of OS, this may still be a superficial understanding. It may even be that they understand OS mainly through the prism of OA. Indeed, the conflation of OS with OA was a common theme. In the words of Interviewee 1, "probably if we ask now, ten researchers in my institution, nine will say OS is OA and maybe some will add something about the data" (I1). Regarding general levels of awareness across topics, the responses from Interviewees 2 from Slovenia and 8 from Brazil can be taken as typical:

> "[O]verall I think that many researchers at the University or nearly all of them are aware of OS. The majority of them about OA to publications and research data, openness of research data, they are less aware probably of FAIR and how to do FAIR for their research data and less about Responsible Research and Innovation." (I2)

> "The concept of OA I think is a concept and an idea more widespread within the institution. I think that the idea of OS is still a process under construction and I still think that it's mostly misunderstood and that we have struggled a lot to clarify what the elements are, especially in relation to data sharing. Our institution has done several actions to try to expand the policy and advance in this awareness, but I think it's still a concept little absorbed by the scientific community as a whole. The concept of RRI is what I told you, although we are not familiar with the concept the way it is presented, but we have several policies and practices that go in that direction." (I8)

Familiar but reluctant to practice

A group of three interviewees from Slovenia (I2), the UK (I5) and Mozambique (I9) advised that although levels of familiarity may be high, this does not necessarily translate into practice. On the one hand, this was attributed by I2 to a lack of policies requiring action:

> "I think that they are, basically all of them, aware that there is OS. But many of them are still reluctant to practice OS unless this is really necessary because it is required by the grant agreement or any other reason which is like obligatory or mandatory." (I2)

However, I5 from the UK was more optimistic in seeing progress in this regard, especially once incentives tied to promotion are included:

> "I would say that people are very familiar. Maybe, if you asked a year and a half or two years ago that would be less, but I think it's really changed quite recently, and people are much more familiar with that. A number of reasons because obviously there's a lot of discussion going on out there, but also internally we've got our research strategy and we've also done a big push internally. We expect people to include, um, open research practices and their bid for promotion, for example, and it's discussed in people's annual reviews with their line managers. There's all sorts of extra steps that the university has taken to support that more recently. It's a very interesting topic because I think some people don't really see the point in it, or are a bit reluctant still to share. But I think most people are now, you know, encouraging and engaging with the open aspect of it. So that's good." (I5)

Finally here, I9 advised that perception of a lack of uptake may be related to a lack of effective monitoring of practices not specifically mandated by the institution

> "[I]t's probably the lack of knowledge of what they are practicing at that moment, because we may be doing things without knowing what we are doing, because... most of the researchers at the university have their partnerships with foreign universities and because of that, they end up following practices, which are practices of those universities, but those practices are not determined at the level of our university, so and for that." (I9)

Mixed situation across disciplines

Three respondents (interview 3, 4, 9) from Estonia (I3), Germany (I4) and Mozambique (I9) reported that the situation is very mixed at their institution across academic disciplines or levels of seniority, with some groups very engaged and others much less so. In the word of I4, discipline is key:

> "I think it totally depends of the researcher and the department in which they are working. There are some departments, like, for example, psychology, they are, you know, frontrunners in OS and there's OS ideas are widely spread. And on the other hand, maybe humanities. So, they are very far away from these ideas." (I4)

For I3 from Estonia, meanwhile, levels of seniority are key – with levels of awareness amongst students (including doctoral students) especially low, which they link especially to a lack of incentives:

> "We have actually researchers who are the champions of OS and who we invite to every event that we have and who are always behind it and saying that OS is a way and they actually practicing in their daily work that too, and you can see that. Then there are people who have never heard of it and I've seen more than one as a PhD student, I see my other students, who have not heard the concept of OS. I would say there are people who have never heard of it. The main part of it is pretty sceptical. First of all, they most likely lack of the knowledge, like the thorough knowledge, and that makes them sceptical. So, they've heard bits and pieces, and they're sceptical. Also, as a PhD student there are no

> incentives to support OS. So, they basically don't deal with it. They've heard of it but they're not, you know, very interested in it." (I3)

RRI

Only three interviewees (interviewees 2, 5, 11 from Slovenia, the UK and Portugal respectively) addressed RRI - potentially a sampling bias since OS people are much more identifiable in institutions, but also reflecting a lack of knowledge of this term (outside of those familiar with EC projects). Of those who touched on this subject, in the words of I5, it was considered "slightly peripheral". Especially pertinent here is that in contrast with OS, RRI is not a recognised concept even where its individual pillars (like ethics, science communication, and gender equity, for example) are well-known and accepted. As I2 said:

> "Some of them are, I could say, active in Responsible Research and Innovation but the majority of these, active in this topic, might not be aware that this is Responsible Research and Innovation, what they do. And some of them are aware of this name because somehow they have a project where in the call provisions there was the requirement to do this. So, overall I think that many researchers at the University or nearly all of them are aware of OS … and less about Responsible Research and Innovation." (I2)

5.2.2. Interviewees' perceptions of barriers to Open Science and RRI uptake within their institutions

We next asked interviewees to identify the barriers to further uptake of OS/RRI at their institutions. The answers show that common challenges - most prominently lack of incentives, awareness, resources and infrastructure - persist.

Lack of incentives

The most pressing issue (reported by interviewees 1, 2, 3, 7, 8, 10, 11) emerged as the need to incentivise OS practices. As we saw above, even amongst those who see the value in OS per se, the fact that there are no concrete benefits, especially those linked to career progression, is a major limiting factor.

As I2 from Slovenia pointed out, benefits can vary, "It can be either benefits for their career, their promotion or benefits for the advancement of researching their topic or whatever, like dissemination, better visibility, and so on" (I2). Yet for I2, the major factor is "that they're [researchers are] really very busy" and so the major need for reform is that "research evaluation, documents or requirements still do not reward or support OS practices" (I2). As we have seen, researchers are time-limited and acculturated to current priorities within research cultures. As I1 discussed, this leaves open practices as a "nice to have":

> "Another barrier is the evaluation. They are really focused on doing research the way they are going to be assessed or evaluated. Sometimes they choose a journal not by thinking by any other aspects than if there is the first quartile or that has a higher impact. It's the same with the data. Probably, the barrier with data is that they don't feel the need to manage data in a different way. So, even you train them or you explain them that it's better to have the data in this place or in the other place, at the end if they say, "If I'm not assessed or I don't get a reward for do that," they don't see yet the benefits of doing that." (I1)

I7 from the UK reported that this was a particular problem in uptake of OA, as researchers are acculturated to selecting journals based on their impact factor since this is what has traditionally been valued. I11 from Portugal, meanwhile, reported it as a barrier to data-sharing, as "the deposit of data is not considered in the evaluation of teachers and researchers and this would certainly stimulate researchers" (I11).

Lack of awareness

The next most commonly-cited barrier (interviewees 1, 3, 4, 5, 8, 10) was a continuing lack of knowledge and awareness amongst researchers. We saw above that this lack of knowledge is often greater amongst certain cohorts (by discipline, or level of seniority) and our answers here further contextualise this. Firstly, there is just a lack of knowledge of the issues and their importance per se. As I1 says:

> "[T]he first barrier is to understand what OS means ... When you approach them and you talk about OS they just go to OA, and then they explain [to] you all the barriers they have, of APCs and if the journals have enough quality. Probably … the main barrier is to understand what is OS." (I1)

However, as OS in particular has become ubiquitous, it is less this first-level of understanding that is at issues, but rather a deeper appreciation of how to do OS in all its elements, especially data-sharing. For instance, I4 reported that "they don't have the knowledge about data creation or there's no data scientist in the group" (I4). Similarly, I5 also saw lack of knowledge as a barrier to good data management practices:

> "In particular with research data, people can be very afraid that it's going to be very difficult and time-consuming for them to create the data and organise the data. But in fact often once we speak people, they realise it's not as difficult as they think or perhaps wonderfully some of them have really organised their data very well, and there's not an awful lot to do to prepare it for sharing. So I think that that perception thing is really important. What happens sometimes as people will be quite resistant but once they experience it or perhaps even once they have a bad experience and they have to rectify it, then they convert and they tell their peers, "Oh, this was easy and it was good," and someone then came back invited me or contacted me. Not having case studies and not having peers who can tell you it's a good thing—and that that's where the champion could also come in. It can be a barrier, you know, people over there somewhere in the centre of the university, that's us. So sometimes you're just a little bit distant from being next to them working day-to-day with the people. If it's going to cause people work then they're going to be thinking, "This is a bit difficult for me." (I5)

Similarly, I8 from Brazil said:

> "I think that the main thing is about this lack of knowledge. It was a study that we did, a diagnosis of the researchers here, about OS and Data Sharing. They hear a lot about OS, there have been several events in our institution talking about OS, we have documents that are reference documents for the construction of the policy that were published with legal frameworks, talking about a study done in several countries... Therefore, the OS working group published all this here, but thinking about Brazil and thinking about the policy and several seminars and events were held talking about OS before the publication of the policy. Visits to the units, all the units in our institution to discuss OS within these units. However, even so what we have as a result is that this... There is no deepening, they don't know, they don't understand very well the goals of OS, they have a great concern and I see as an obstacle, both this, this lack of knowledge about the principles of OS." (I8)

Lack of time

Four interviewees (2, 4, 5, 6) mentioned lack of time as a basic barrier. The various pressures on academics mean that although in principle supported, OS/RRI practices remain unprioritized. As I5 said, "People are very busy … It's not that they're not interested. They just simply forget or they're not quite sure how to go about it". I4 similarly said:

> "I think the most of them are open for the ideas of OS. But, a lot of them don't have time for that. They think they have to do more work, they have to do to invest more time, and they don't see the benefits for their concrete work." (I4)

Here it is not simply about finding time, but that implementing OS/RRI requires such root-and-branch reform to working practices that sometimes researchers do not know where to start. Here, the importance of institutional mandates and incentives again emerge as key themes. As I2 said:

> "I think it's obvious that researchers are very busy people … and if they have to radically change the way they do research, they might be reluctant to invest some time in the beginning to do the change. So, they do change when this is mandatory, that's one reason, or where they see really benefits for doing this." (I2)

Here, the potential for support services to assume some of the perceived extra (especially administrative) load was highlighted by interviewees 5 and 6:

> "We don't ask them to fill in a form if they want to ask for money for their article processing charge. We take as much of the admin central as we can, and that's very popular. But of course, it's an economy of a scale because we have quite a large organisation. But that's one way to reduce the admin burden on people. Um, otherwise it can be difficult for people." (I5)

> "Also bureaucratic processes are a main barrier to make research results openly available, because it takes time. So, the problem is that the researchers have to do so many things and they don't want to spend too much time on bureaucracy for complicated procedures." (I6)

Concerns of sharing and legal issues

Linked to issues of lack of incentives, is the concerns over the possible negative impacts of sharing – especially of data. Four interviewees (4, 6, 10, 11) reported such issues as possible barriers, with two framing it explicitly as "fear", for example, I10 said "It is the fear of putting things open, that is one of the obstacles" (I10). I4 indicated this was linked to potentially enabling a competitive advantage amongst competitors. Relatedly, as I6 pointed out, sometimes such concerns are linked to legal issues, especially where collaboration with industry is concerned:

> "Another obstacle of course is sometimes legal issues. They would like to but cannot because copyrights are not clarified or in case you have a lot of cooperation projects with the industry and they are not allowed to go for openness. So, these are obvious barriers." (I6)

Lack of infrastructure and services

Three interviewees highlighted the need for supporting services to enable OS/RRI practices. As I6 said, it is a question of "missing infrastructures":

> "Our researchers, they're basically open-minded but they're also very practical people. They accept using or trying out new concepts but it must be facilitated. So, this is something we need to work on, to facilitate processes for them. We need to give them infrastructures and guidance." (I6)

I9 from Mozambique similarly said:

> "I believe that OS isn't practiced just like that, the environment is needed, I'm referring to those various platforms that are necessary to ensure OS. Because in the absence of this researchers are not able to do this practice and that's why I was saying that many of them end up doing it, more in their connection they have with their partners outside... the country. Not necessarily in the context of our University or country. There are many who are already doing it, but in an external context, and therefore in a foreign context. So, the big obstacle I think is the question of service, infrastructure, the question of training itself, for the practice of OS." (I9)

Cultural/behavioural change

Three participants (3, 4, 7 from Estonia, Germany and the UK respectively) also talked about just how deeply ingrained research cultures are such that large-scale changes to practices such as are required by OS/RRI are inhibited. The concerns of each were, however, very different - perhaps reflecting the range and complexity of the issues involved in this regard. The fundamental difficulties of cultural change, linked also to other factors like lack of awareness or incentives, hence emerged as an important theme. One reflected upon a "lack of culture of sharing" which meant that open practices do not currently come "naturally" (I3). I4, meanwhile, discussed for younger researchers, the influence of their supervisors: "they have often very strict guidelines from their professors because the professor has worked in that way since years". They expressed hope that they could "influence the younger generation and we hope that when they are professors, they could spread out these ideas" (I4). Finally, I7 reflected upon the extent to which uptake of practices is a "behavioural thing", with internalisation of regimes of metrics like the impact factor meaning that even those supportive of OS/RRI principles find them difficult to overcome. Reflecting upon proposed changes to remove the impact factors, I7 reported:

> "So, a good example there is in metrics. I'm involved in that working group I've mentioned and we're looking at metrics and we're trying to improve DORA at the institution. And all the people that are members of the group all the academics that are members of the group have an interest in this or claim to have an interest in improving the metrics that are used to assess researchers and research impact and they claim to dislike things like journal impact factor. But actually, when we discuss it you can very quickly see that actually they support them, because when it comes down to what we use instead they always want some kind of, uh, you know, figure some metric that they can use, "How will I identify a suitable journal to publish in if I can't use the journal impact factor?" Well, you probably need to use some other method, use qualitative methods, discuss with colleagues, and so on. "No, no, I don't have time for all of that. I just want a single metric I can look at." So, when you really start drilling down to some of these issues, you start to encounter some of these, some of these philosophical barriers." (I7)

Other factors

Other factors mentioned included lack of funding/resources (interviewees 3, 4), lack of central coordination within and between institutions (interviewees 3, 11), and the need for policies (interviewee 11).

5.2.3. Measures for monitoring OS/RRI uptake

In this section of the interviews, we asked interviewees about which measures (if any) were in place for monitoring the uptake of OS/RRI at their institutions. Seven interviewees (1, 3, 4, 5, 7, 8, 11) responded that at least some measures were in place for (some elements of) OS, while four (2, 6, 9, 10) advised there were no such measures for any elements of OS/RRI.

Indicators on Open Access and publications

When looking at the types of OS/RRI elements monitored, once again we find that OA is the most heavily represented element, sometimes seemingly taken to represent OS itself with indicators of OS conflated with indicators of OA. Various measures on monitoring OA uptake were reported by seven interviewees (1, 3, 4, 5, 7, 8, 11). I1 from Spain stated that their institution has a "fund for OA publication" and "are tracking those publications" and in addition "have indicators about the OA publications", as well as monitoring repository deposits (discussed below). In Estonia, we observe a quite inconsistent, but interesting answer from interviewee 3 in terms of OA:

> "So, as I said, there are no concrete measures to my knowledge, and there are some little parts that they… that you… We do take out how many publications are published OA, like, you know, at the end of the year the grant office looks at this thing. I am not sure what else they are doing with that knowledge, you know, because sometimes the minister asks us do you know, like, how much, you know, your publish… I mean, researchers are publishing OA and how much now they are publishing in closed journals. But other than that, I don't know if they do any statistics or if there is anything done with that information." (I3)

At first, interviewee 3 here advised that there are no measures for monitoring of OS/RRI, but then contradicts this by reporting that their grant office does take an interest in numbers of OA publications. This suggests that the reasons for such monitoring are diverse and can be spread across different areas of the institution. In addition, I3 reported that they also monitor OA for theses and dissertations:

> "One concrete measure that we do have, all our students need to publish their theses and dissertations, like PhD and Master's students, and all specialists students now, then they need to publish it in our repository and it needs to be OA." (I3)

Interviewee 4 was much more definite in reporting that their institution in Germany monitors OA publications:

> "[W]e measure our OA publications, so how many publications are of max is available … But not more measurements. Yeah, we're working on that. But, not at the moment." (I4)

Perhaps reflecting the great importance of the stringent OA requirements within the UK Research Excellence Framework (REF) evaluation exercise, I5 in the UK reported that monitoring of OA publications is intensive,

with summary reports regularly submitted to the "research planning and strategy committee" (I5). I7, also from the UK, reported:

> "[T]he main measures are in OA volume of content, OA compliance with all the various policies, and of course compliance varies across all the different funders." (I7)

I7 later went on to explain that their institution formed a dedicated OA working group which had the mandate to put monitoring in place: "it was the purpose of that group really to sort of monitor how OA and how we were complying with this particular policy" (I7).

Monitoring of OA via deposit of publications in institutional repositories also emerged as a measure in place at three institutions. I1 from an institution in Spain, reported:

> "We build what we call the thermometer to see how many papers are in the repository, from which faculties are coming those papers." (I1)

I8, from an institution in the area of health in Brazil, advised their institution also monitors repository deposits (amongst other OA monitoring elements) for reporting to their national ministry but that there are no other monitoring measures:

> "We have some annual indicators that the institution has to present to the federal government and to society and the number of deposits in the institutional repository is one of those elements that are evaluated annually. So there are always growth targets and in fact every year there is a graph in quite positive progression in relation to the deposit in the repository. Apart from that I don't think there is anything, there is no measurement in an organised way about all these practices." (I8)

In Portugal, I11 stated that the institution there, also focuses on repositories, but specifically targeting evaluation of teachers:

> "We have a teacher evaluation that goes through the scientific publications deposited in the repository, if they do not have scientific publications deposited in the repository it does not count for evaluation. The only thing that is included is community support, and this community support, for example, may be a teacher/researcher giving a lecture outside the institution (for example, give lectures to local communities, schools, for example to farmers)." (I11)

Indicators on Open Data and Research Data Management

Two interviewees (5, 7) talked about measures to monitor uptake of RDM issues including on Open Data and Data Availability. I7 from the UK reported that in addition to OA, they monitor Open Data:

> "[W]e would also produce reports on how we were performing on RDM and so on and open data because many of our researchers were subject to policies on, you know, research data as well. " (I7)

I5, also representing an institution in the UK, said that they have "a KPI [Key Performance Indicator] which looks at data statements, data availability statements and papers" (I5).

Other indicators relating to Open Science and RRI

Beyond OA and Open Data, only two interviewees (1, 5) mentioned any measures related to other elements of OS or RRI. Here, one institution in the UK requires quantification of OS practices in general as part of promotion applications (I5), while I1 reported that their institution in Spain uses indicators "for gender" (although they did not expand on what these entail). Here, we again urge caution in the interpretation of the fact that only two of our interviewees identified measurement measures related to RRI as being in place at their institutions. Our cohort were all far more familiar with aspects related to OS than RRI. As we have said, this partly reflects the fact that RRI as a unified concept is not well-known (beyond the ecosphere of EC projects), and hence there are usually not central contact points for RRI issues as there are for OS. However, it also reflects a sampling bias within our cohort of interviewees that is caused by our strategy of only seeking to speak to one or two participants per institution. Had we spoken, for example, to those who oversee the individual pillars of RRI (like gender equity or ethics) within their institutions, we may have seen clearer measures to monitor these distinct elements.

Future plans

Three interviewees (2, 6, 7) advised that plans were in place for future development of monitoring of OS practices. I7, whose UK institution already has measures on OA and Open Data, advised they are interested to monitor OS more broadly:

> "So, the main evaluation occurred on OA and open data at that particular time but as time has gone on more recently, as I've mentioned, you know, there's an interest in really evaluating how we're performing in other areas of OS." (I7)

Meanwhile, at one institution in Austria, we find that although there are no measures currently in place on OA and Open Data, there is a discussion over their implementation given a perceived need to effectively monitor adherence to policies: "we have to evaluate our policies, the OA policy as well as the RDM policy. But there are no concrete measures at the institutional level" (I6). These developments seem to be part of a nascent realisation that others, especially funders, are changing their practices in this regard:

> "So our rectors, they know that new metrics are coming, and I think they are discussing it. But I don't know, I have not heard real strategic concepts about if they want to change, you know, hiring processes, um, not so sure about it. I mean, we can see some movement from the funders. Funders are building a bit on alternative metrics already or, you know, that they look if a researcher has already published data sets, they take a closer look. But at the university, I would say it's a topic that has not yet been tackled in a strategic way." (I6)

Despite the fact that there are no measures on monitoring OS practices in one University in Slovenia, the interviewee reports some changes towards OS practices or paint an optimistic picture for changes in the future towards OS there as can be seen in the following statements:

> "Some time ago, when the new Statutes of [institution name] were adopted, I was really happy because there is this Article [number] on autonomy of [institution name]. The autonomy of universities is the constitutional right in Slovenia. So, there is this Article [number] on autonomy with some items. One of the items is that the university will design and implement higher education and research programmes according to the principles of OS. So, I thought, "Well, wow, this is really so good." But this is basically all that we have. This was not later developed into rules that would

> describe how let's say research publications have to be deposited in the repository, how research data need to be treated, and how activities in OS will be evaluated or recognised. So, we have nothing like this. We have only this article, Article [number] in the Statutes of [institution name] and no practical policy." (I2)

Here we can see the difficulty in translating abstract policy into concrete guidance and means of monitoring. I2 went on to advise that with a forthcoming change in university leadership, they are hopeful this will be developed in future.

Other factors

In addition to the reported measures from the interviewees, the Netherlands seem to be a role model for one institution in Spain in terms of making progress on OS topics, as the following was stated by I1:

> "We are now in this in the middle of this discussion. We are looking at what's going on in other countries, especially having a look at what the Dutch are doing with this room for talent." (I1)

5.2.4. Reform of research assessment criteria to foster Open Science and RRI

We were next interested in what initiatives were currently underway within interviewee's institutions to reform research assessment criteria to foster OS/RRI. As explored in ON-MERRIT Deliverable 6.1 "Investigating Institutional Structures of Reward & Recognition in OS/RRI",[47] reform to incentives related to career progression has been identified as a key issue for uptake of OS/RRI.

Overall, we can say our results here show a great degree of action in this area. A large number of the interviewees (2, 3, 4, 5, 6, 7, 9, 11) reported that discussions in terms of initiatives to reform assessment criteria are ongoing. Only one respondent (I10), from Brazil, reported complete stasis: "There is no institutional discussion, there is no institutional policy on OS, this is also one of the obstacles I see because the university is not moving towards an OS policy" (I10). The importance of external networks and communication amongst communities of practice for spurring change in this regard was highlighted by two interviewees (3, 6). I3 stated that it is "the pressure from outside, which is starting the dialogues" (I3). I6, meanwhile, advised:

> "I think this process comes more from the outside … [B]ecause it needs some international standards. So, I think if one institution, one university changes the system the institution cannot succeed, you need a broader community, a broader commitment." (I6)

In this regard, many respondents raised the crucial influence of the San Francisco Declaration on Research Assessment (DORA) and other community-led warnings about the dangers of uncritical use of metrics for research assessment such as the Leiden Manifesto.

Reforms on publication metrics

The influence of DORA, Leiden and similar declarations came through in the responses from more than a third of our interviewees (1, 2, 5, 7) to this question. One interviewee from the UK advised that discussions

[47] Pontika, Nancy, Klebel, Thomas, Pride, David, Knoth, Petr, Reichmann, Stefan, Metzler, Hannah, Correia, Antonia, Brinken, Helene, & Ross-Hellauer, Tony. (2021). ON-MERRIT D6.1 Investigating Institutional Structures of Reward & Recognition in Open Science & RRI (1.0). Zenodo. https://doi.org/10.5281/zenodo.5552197

at their institution are "driven by things like DORA and Leiden", but noted the difficulties of transferring such high-level declarations into concrete change at the institutional level by continuing, "but of course, they're just policies rather than actual actions" (I5). At our other UK institution, DORA had a similar influence but discussions were more advanced towards action:

> "[T]he working group about reproducibility and metrics is trying to formulate some kind of assessment plan for researchers that doesn't involve all of these traditional bibliometrics, looking at much more qualitative measures, peer review, and so on, to assess the quality of research and its significance. You know, we've just been kind of surveying what other institutions are doing. All of this is against the backdrop of DORA. We are a signatory of DORA and we're just trying to implement that." (I7)

DORA's influence came through in other countries too, although the discussions there seem more nascent. In Slovenia, for example, I2 advised that although there are no concrete initiatives to reform assessment criteria at their institution, high-level discussions amongst the Rector's Conference have begun, with a workshop on reform of research assessment due in Autumn 2021. I2 advised: "They're mentioning adhering to the DORA Declaration and Leiden manifesto in this public announcement which is really very good" (I2). Similarly, in Spain, I1 advised that a cross-university evaluation body had signed DORA as a first step to beginning conversations:

> "I asked them, "Well, are you going to change now the way you are assessing?" and they said… they confessed that was, like, "Well, we thought that was the moment to sign DORA, and at least we can start the discussion." They have using this signature to open the discussion, they have not radically changed the way they are assessing. But at least they… there is something there on the table where they cannot really avoid the discussion. So, they are thinking about how they can brought the idea, for instance, of research outputs, let's open this idea of well, why not a data set or a code could be as valuable as a paper." (I1)

Here we see that DORA, although quite targeted originally at reform of the metrics used to assess publications (i.e., eliminating use of the Journal Impact Factor for this purpose), is proving useful for starting a broader conversation about what should count in research assessment. I1 also went on to explain that even just on the level of signalling, the fact that external bodies have signed DORA can be leveraged to effect change within individual institutions:

> "So, I'm also using this for our internal discussion, so saying, "Well, you see, these agencies that are evaluating us externally, they have decided to open the discussion. They made the first step that it's just a signature." (I1)

Measures to incentivise other elements of Open Science and RRI

Although many respondents advised discussions had begun on reform of research assessment, as can be seen from the material already presented, we can say that these discussions are still quite high-level and abstract. Real change is thus far limited. This is also reflected in the concrete suggestions for changes to assessment regarding OS/RRI principles. Here, only a couple of interviewees had contributions. Firstly, I9 advised that they have a regulation and are in progress to set up a self-deposit in the repository, which "becomes the primary source of information for the purposes of verifying the scientific publication of

researchers, in all administrative processes, that is, if someone wants to make a career change" (I9). I11 advised that at their institution, reform of research assessment is underway and they personally were "going to push for this to happen so that the deposit of data is evaluated and considered valid" (I11). I8 also indicated that high-level commitments to change in this regard are yet to bear fruit:

> "So it's in the policy that we need to change the evaluation system and put indicators to evaluate the sharing of research data. But how this will happen, as we already have in OA, we still don't have." (I8)

More concretely, I5 in the UK advised that discussions are constantly ongoing at their institution, with some real changes already implemented. They advised that their current research strategy involves several strands including research integrity, collegiality ("encouraging people to support their peers"), as well as career development and research admission strands. This had already led to OS activities being a part of promotion applications:

> "These things are being recognised, and I mentioned that we're measuring those… So really, we're doing our best to make sure that we've included incentives for people in our, you know, appraisal system and in the promotion system." (I5)

The interviewee reports that this process has been very positive, with strong support from university management and support services, and positive feedback received from (especially young) researchers:

> "I feel it's gone really well and there's a lot of discussion about it and we can't go back, we can only go forward and make things better. So yeah, it's very much on the agenda. Our Vice Principal for Research's office has been leading on that and working with HR and working with the people who go out and train postgraduates and early career researchers as well to try and embed that. I would say that definitely early career researchers, we notice when they go to research events are they very strong on advocating for open research practices. It's very refreshing, it's lovely." (I5)

Future perspectives

Our results here show lots of discussions, with limited action thus far. Individual success stories, like that reported by I5, as well as the leveraging of public declarations of adherence to principles of reform (especially DORA), seem to paint a positive picture for change in the near future, however. Nonetheless, the ways in which abstract principles can or will be implemented remain very open to question and requiring of much work. As I1 told us, "I always say that it's very easy to sign but the important is how you implement that signature" (I1).

5.3. OS/RRI support and training in the institution

In the final section of the interviews, we moved on to ask interviewees questions specifically related to training support services for OS/RRI available at their institutions.

5.3.1. Training topics

First, our focus was on identifying the topics of training services made available within the institution (as well as by whom and for whom). We discerned training related to the following groups of issues.

Institutional services or tools

The most popular element related to training was on institutional services and tools (2, 4, 6, 7, 8, 9, 10, 11). Six interviewees mentioned training activities related to institutional repositories or CRIS systems (2, 7, 8, 9, 10, 11). For instance, interviewees 7 and 11 said:

> "[We offer] training on repositories and the CRIS, where we have a lot of training materials." (I7)

> "The library is the one who gives the training on OA to publications, depositing in the Institutional Repository." (I11)

Training related to RDM tools such as DPM tools or tools for data-sharing were also popular (mentioned by interviewees 2, 4, 6, 8, 10). Such training is sometimes offered flexibly, dependent on researcher needs:

> "But some of them approach us and they want help [on RDM] in a very different way. Some want to have a basic workshop, others prefer us to comment on the DMP". (I6)

In addition, two interviewees (4, 6) mentioned training on the software curation tool Gitlab, and I6 also indicated their institution offers bespoke training according to the Data Carpentries programme.

Generic RDM training

A group of five interviewees (3, 5, 6, 8, 9) referred to generic RDM training, including guidance on data management planning, GDPR and data sharing. The basic ideas of such introductory courses is explained by I6:

> The goal was more to make our researchers aware which kinds of services we have at the university and we always encourage them to approach us on an individual basis if they really were in the project…. So our plan is to go into certain RDM topics deeper in the future". (I6)

Open Access

Training relating specifically to OA was mentioned in five interviews (2, 8, 9, 10, 11). OA publishing and (overlapping the point about training on institutional services above) usage of the repository were the main topic of such training, as is revealed by quotes from interviewees 2 and 9:

> "There are a few events per year ... the majority of services are on OA to publications. Many questions about publishing in hybrid or OA journals, how to choose the journal." (I2)

> "[We provide] annual OS seminars, and workshops on the use of the repository." (I9)

Open Science funder requirements

Four interviewees (3, 5, 6, 8) indicated that their institutions provide training activities specifically related to funders' requirements on OS, especially sharing and managing research data. For example, interviewees 3 and 5 explained:

> "So there are trainings for ... all kinds of different grand requirements, how to meet the grand requirements that have to do something with, uh, OS." (I3)

> "We have courses that support help people create a data management plan as well. So, if they want to have their project and come along and actually create their data management plan with help on hand, then we will guide them through that." (I5)

Research Integrity and ethics

Workshops on research integrity and ethics were mentioned as training activities in four interviews (5, 6, 8, 10). Here, it is interesting to observe the different levels at which such advice is given. For I6, this training is given in conjunction with RDM training.

> "The Centre for Research Data Management has given trainings on data management, and the research ethics, and these trainings took place together with the library and the research ethics coordinator so far." (I6)

At I8's institution, meanwhile:

> "Research integrity is also dealt transversally in a common discipline that is offered to all postgraduate programmes. And the issue of ethics is addressed early on because students who develop projects involving human beings, are also required to submit their master's and doctoral projects to the Ethics Committees. And no project is officially developed without going through the Ethics Committee". (I8)

Open Science training by request

A group of four interviewees (4, 6, 7, 11) advised they offer OS training on request or as peer-to-peer consultation Two other institutions (2, 8) offer modular online OS courses. For I8 in Brazil, this online course is a shared national resource:

> "We have a modular OS course that was organized by the vice-presidency, which is an EAD course. So we have this course that's widely used nationally" (I8).

Data protection and handling of sensitive data

Two interviewees discussed training specifically oriented on data protection and handling of sensitive data. For I3, this was specific training on the European General Data Protection Regulation (GDPR), while for I8 in Brazil the scope was somewhat wider:

> "The issue of personal data protection, which is a complement to the actions that the ethics committees already had. It's a policy that in Brazil is still very recent and little disseminated and

absorbed by the institutions, although the Health area is a very important area in the matter, mainly of the sensitive data". (I8)

Postgraduate courses

Finally, in two cases (6, 8) there is an OS discipline for postgraduate programs:

> "We address the researchers but all the students because we hold courses within the transferable skills catalogue of [University]. So, we address Master's students and Doctoral students. We also hold classes in PhD programs. Our focus is on scholarly communication. So, OA publishing, um, and for the whole setting perhaps we also have a data management". (I6)

> "Besides a transversal discipline, a discipline for all postgraduate programs, for OS, so that our masters and doctoral students also leave here having studied this discipline". (I8)

5.3.2. Units responsible for delivering training

We next asked interviewees who was responsible for proving this training. As you can see from the summary in Table X below, by far the greatest provider of such training is the library (via dedicated teams for research information, scholarly publishing or RDM) which was mentioned by all interviewees. Next were specialist Ethics Committees (responsible for training on Research Integrity and Ethics), as well as dedicated training and research support units.

Training provider	Number of interviews with a mention to this provider	Interviewee numbers
Library (including information management, scholarly publications, or research data teams within library)	11	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11
Ethics (or bioethical) committee and the research ethics coordinator	3	1, 8, 6
Training office (centrally coordinated training system, institute of lifelong training)	2	1, 3
Research office or Institute of Scientific and Technological Communication and Information	2	7, 8
Professors, researchers or university teachers	2	8, 10

Table 3. Units responsible for training provision within the institution

5.3.3. Target audiences for training

We also asked for whom training was provided, and as can be seen below in Table X., the main target groups were researchers and students, but also with a high degree of training for librarian staff (train the trainers approach).

Target audience	Number of interviews with a mention to this audience	Interviewee numbers
Researchers	9	1, 2, 3, 4, 5, 6, 7, 10, 11
PhD students	6	3, 6, 7, 8, 9, 10
Students (Bachelor and masters level)	5	3, 4, 5, 8, 10
Staff, Librarians	4	1, 3, 7, 8
Teachers, Professors	3	1, 7, 11
Ethics committee	1	10
Project officers	1	1

Table 4. Target audiences for whom training is provided

5.3.4. Certification and accreditation

Only in two cases (4, 8) were training course accredited such that students could accrue credit for taking them. Firstly, I4 explained:

> "We have one OS online course which we created last year or two years ago, I don't know exactly. It consists of eight sessions and it has all the main aspects of OS, on science in general, OA, RDM, FAIR data, open educational resources. It's online available, it's for everyone and students can also get [ECTS] credit points for this". (I4)

In Brazil, a national initiative was undertaken to provide a course available to everyone there:

> "We have a modular OS course that was organized by the vice-presidency, which is an EAD course… Besides a transversal discipline, a discipline for all postgraduate programs, for OS, so that our masters and doctoral students also leave here having studied this discipline." (I8)

Given that gaining credit towards graduation may be an important motivational factor for students, that so few courses have such accreditation could be seen as a worrying factor. We shall see in our later section on suggestions to overcome the challenges of providing training that embedding such courses in masters' and doctoral courses emerges as a key recommendation.

5.3.5. Main challenges in training provision

During the final part of the interview we asked interviewees about what are the main challenges they faced in implementing OS/RRI training at the institution, as well as what improvements they might suggest to overcome these challenges.

Fostering participation

Over half of the interviewees (1, 2, 7, 8, 10, 11) identified a common challenge related to participation in training activities, advising they had difficulties in reaching people or ensuring participation in their training events. The emergence of this common theme can be seen in the following quotes from interviewees from diverse contexts:

> "The main challenge as always is to reach the maximum number of people and to let them see also that this is not a new burden, that it's something that will help them in their research." (I1)

> "So, the main challenge is that even if you organise, there's not a lot of attendance still and the second thing is why there is not a lot of attendance, it might be that it would be better to have peer-to-peer training as in your previous question ... We have some enthusiasts at the university and they do promote OS a lot, but they don't have time to themselves carry out such events. I'm sure that if they had enough time they would do it. But it's not." (I2)

> "Maybe the main challenge is to get a good audience because you want to have the professors, you want to have the stakeholders, you want to have the decision-makers. But you often only get the PhDs, the post-docs, some assistants. So yeah, to find the good audience … this is a real challenge, I guess." (I4)

> "Having the material and doing the training is not the challenge. The challenge is reaching all the people. So, again, it's communication." (I5)

A key element of this, mentioned by interviewees 7 and 8, was that researchers often do not see OS/RRI related training as a priority yet:

> "I guess for a lot of these researchers, it's not seen as a priority yet. And, uh, again, it's the behavioural thing. So, I guess that that is the main challenge because as I've mentioned, our team support researchers a lot and we try to reduce all the barriers. We try to assume as much responsibility for it on their behalf. We just need them to turn up sometimes or just give us a data set or, you know, we'll do a lot of the work for them." (I7)

> "There's a huge challenge, which is to reach researchers who aren't available and often have no interest and even a certain aversion, because there's still a portion of researchers who understand the data as a private good. As an asset that belongs to them or to their own research group. Here we need to diversify the training through the different levels." (I8)

Lack of staff

A group of five interviewees (3, 6, 8, 9, 10) referred to a lack of staff or constraints regarding support staff available to deliver training, which was also related to the need for further staff training. For example, interviewee 6 reported:

> "Another challenge is the given staff constraints we have. So, if you really want to roll out OS or RRI training you need more personnel." (I6)

Institutional support

Three interviewees focused on Institutional issues and support from decision makers, mentioning the need to obtain institutional support or have OS as an institutional priority. Additionally, the lack of funding or the lack of central coordination was also identified as a challenge (interviewees 3, 9, 10):

> "Then, the lack of resources. For instance, the recent data management training, then we are doing that one for entire country. And we have just basically one person doing that. So, I would say the lack of staff and lack of funding, and all the trainings we are doing, we're doing out of our own goodwill and our own budget. There is no central budgeting for that." (I3)

> "So the big challenge is that we're a very small team, which needs to assert itself in the university and then it is necessary for us to have some institutional support and so I think that the challenge is here, to get this institutional support so that this is an institutional initiative, and no longer an individual project, but a university project." (I9)

> "I would put the encouragement of the institution to assume definitively the OS issues, the encouragement both in training and in evaluations or else change the evaluation criteria as well. Another challenge is to motivate teams to work with those issues inside the university." (I10)

Proving the value of Open Science

A group of three interviewees (1, 2, 8) noted a perceived need to demonstrate within the institution that OS/RRI present opportunities and do not merely create additional burdens for researchers or that OS-related practices. The point was made that as researchers are always very busy, those in charge of training should prove that OS practices are not as time-consuming as researchers may think. In the words of interviewee 1:

> "I think that's the main challenge that we have to show the researchers that if when they are trained on doing OS and following the RRI, it's good for them. It's that we are here to help them and to help us, as a society, to have better science, a better research. And probably they have to, you know, to spend more time in doing something. But maybe they have to spend less time on doing other things that they do in the past or maybe as… I don't know… [F]or instance, they spend a lot of time to try to figure out where is the data they use in a project, uh, two years ago. And maybe if they were spending a bit of time by organising better the data, then they will spend less time on finding that data in the future." (I1)

Targeting diverse audiences

Another group of three interviewees (4, 8, 11) identified an additional challenge related to fostering participation in training events (detailed above). These respondents advised difficulties in engaging

researchers who may have little prior interest in OS or RRI related topics, as can be seen in the words of I8 from Brazil:

> "There's a huge challenge, which is to reach researchers who aren't available and often have no interest and even a certain aversion, because there's still a portion of researchers who understand the data as a private good. As an asset that belongs to them or to their own research group. Here we need to diversify the training through the different levels… It's necessary to increase the number of information professionals because, as the challenges of OS increase, you need more professionals to help develop the policy and to give support to this policy and also to help in this training, which is a daily training." (I8)

In addition, encouraging participation from groups beyond researchers (especially more senior staff and decision-makers) was highlighted by I4:

> "The main challenge is to get a good audience because you want to have the professors, you want to have the stakeholders, you want to have the decision-makers. But you often only get the PhDs, the post-docs, some assistants." (I4)

Tailoring training to audience needs

A final challenge was identified as the need to tailor modes of delivery and focus for different audiences. In this regard, the need for discipline-specific training was highlighted by interviewees 6, 8 and 10. For example, I6 advised:

> "The main challenge is what I perceive is you really need to be close to the researchers demands and close to the disciplines also. You know, this is a challenge… [T]he model of discipline specific data stewards … is one of the ways to tackle this challenge. I do it in a way that I take care when I compose my research data management team to have people with different disciplinary background, and at the technical university you need also people with IT background." (I6)

Two interviewees (8, 11) also made the closely-related point that it can be a challenge to offer diverse courses for those more or less advanced, customised to the needs of the target audience. In the words of I8:

> "For now, we want to create a specific training plan … There are intentions to create specific training plans in the area of OS and data. For example, online, face-to-face, hybrid. Training can be customized according to the target audience (e.g., teachers and researchers or master students)." (I11)

5.3.6. Suggestions for overcoming challenges

Following the discussion about the challenges, we wanted to understand what are the improvements that the interviewees suggest for the implementation plans of the OS/RRI training in their institution.

Integrate training in course curricula

First, four interviewees (3, 4, 9, 10) mentioned that one of the major improvement actions would be to integrate OS/RRI (especially the former) topics in the formal curriculum of master's or doctoral courses (3, 4, 9, 10). We saw above that very few institutions so far enable credit for their OS/RRI training, and in addition

to the added incentive this would provide, embedding training in established courses would also motivate uptake, as can be seen in the words of interviewees 3 and 9:

> "The OS related topic should be part of the curriculum, definitely in PhD level but why not also already in Masters level. And now, when we even talked to some of the professors who had to do the data management plan starting from … first year and PhD students, when they come, this is something they need to do how to deal with the data and where to put it and how to publish it then and all these things. So, I think being part of the curriculum would be a massive improvement." (I3)

> "It would be good if it was somehow introduced in the curricula, then for its adoption by young researchers. Because we think that young researchers are easier to accept, the new practices, the older ones, perhaps, are not so easy to convince, so if we introduce, this type of training, at those levels, even if it's not in that training, it's not... introduced in the formal curriculum, but making sure that everyone, those who attend our postgraduate courses, have somehow, the exposure, in those trainings, would be perhaps the best way to start, the process." (I9)

Develop discipline specific training

A second group of interviewees (2, 6, 10) identified the need for focussed development of training tailored to individual scientific disciplines or provision of discipline-specific OS/RRI guidance as an improvement needed in their institution:

> "But will there be an uptake by researchers who would use this information, they could definitely immediately use this information, and would there be a need or requirement to organise more in-depth training for certain topics or maybe the approach, the better approach would be to organise trainings specifically for disciplines, something similar to what you do in-person. When you advise a person, you advise for their topic, for his topic, for her topic. So, I guess trainings tailored to individual scientific disciplines would be better." (I2)

> "I think that these issues of OS should be implemented in all disciplines of scientific methodology, which all courses have. So, the methodology discipline should already include these issues and a discipline could be created, for example in the librarianship course, which would be offered to all courses." (I10)

Deliver more practical training

Three interviewees (1, 7, 11) also perceived the need to develop training that is less theoretical and more practically relevant, possibly including focus on specific use-cases or hands-on training. Relatedly, interviewees 2 and 11 suggested greater peer-to-peer training could improve engagement:

> "We need more practical training, completely practical. E.g., 'How to deposit in a data repository', 'Training on the Data Policy adopted by the Institute', 'How to make a Data Management Plan', 'Tools used to make Data Management Plans', 'Available platforms for data sharing'. One of the ideas we have is to train junior faculty researchers and give them that training at the beginning of their activity. For example, another idea we had was to train senior researchers so they could also train other researchers, and in this case the junior ones." (11)

Improve online training materials

Two interviewees (5, 7) suggest investing in improving online or self-learning training materials:

> "One improvement is working on the flexibility of the training … we were talking a lot about delivering training online, providing more video content, as a way of actually reaching some academics because it was so difficult to get some of them along to the training, and we were worried that they were just ignoring what was happening. But perhaps if they had a video or, some online training, then they might be more inclined to engage with the topics" (I7)

Here, the difficulty is not necessarily scarcity of materials, but on some topics rather a need to better filter a wealth of options:

> "In terms of wider materials, something that's a bit confusing is that if you imagine you were new to training and you wanted to find recommended materials, you might go to us, for example, and find some videos or somewhere else. But there's a myriad—there's so much stuff out there, how do you know what to choose without everybody doing that same piece of work and reviewing it all." (I5)

Boosting training capacity

Two interviewees (8, 11) also suggested improvements related to increasing training capacity, including train-the-trainers approaches and training staff (especially information professionals) to deliver training:

> "I think it's important that we think about training new trainers as well, because, for instance, in the course that will begin on August 1st, we had more than 100 enrolments for 40 vacancies and it was specifically for librarians." (I8)

> "For example, another idea we had was to train senior researchers so they could also train other researchers, and in this case the junior ones." (I11)

Policy as instrumental for training

Finally, two interviewees (3, 11) suggest that having central policy commitments and recommendations from the university should be a relevant improvement to address the challenges they have identified:

> "And then, from the library's perspective, the knowledge that we have so that we can actually legally share that knowledge without asking somebody else to help us out sharing this would be just the first improvement. And of course, having the central policy and recommendations inside the university would definitely help for that one too." (I3)

5.3.7. Providing training in a time of pandemic: Training provision during COVID-19

At the time of conducting these interviews (summer 2021), the COVID-19 pandemic had been disrupting university life for over a year. Hence, our interviews closed on this subject. We were especially interested to know how the pandemic had affected training provision, and whether interviewees were able to identify negative and positive effects that had resulted.

Positive aspects

The COVID-19 pandemic undoubtedly had a huge impact on training activities all over the world, but in spite of constraints and the cancellation of face-to-face events, many positive aspects were identified by the interviewees. The possibility to expand training sessions to a wider audience was most often mentioned, as well as increased flexibility for people who maybe could not otherwise attend in-person training sessions due to their geographical location, travel constraints or scheduling issues:

> *"*COVID helped a lot to open up things, and workshops that were initially planned face-to-face are now all virtual which allows us to open up things". (I6)

> "Unbelievably, this possibility of distance and virtual training has increased the supply of training in various sectors in various areas of knowledge". (I11)

> "It's easier to, for example, for our OS group to attend webinars from all over the world because you don't have to travel and … you can easily attend conferences online. For example, when you're going to a conference and just interested in one session, you don't want to go for two days to, for example, the United States. It's not possible, it's too expensive, maybe my boss says no. But now online, it's much easier to get information". (I4)

> "I see a positive side, because it supported the training of people who would not have been trained if it weren't for the pandemic, because our course, for example, the post-graduation course, had the selection done remotely, the selection for the program itself. So we got students from all regions of Brazil. The class is very rich. Because there's the contribution of people from every region of the north, the Amazon, etc... who graduated and are doing a Master's degree with us because of the pandemic. And the discussion is different, another level, isn't it? When we bring these different actors, who don't stay here in the Southeast, then we can elevate the discussion, including OS and Open Data, to a much richer level of discussion thinking about these geographical differences that we have here, different realities". (I8)

Moving training events online during the pandemic hence enabled greater opportunities for those whose time or travel options were limited to gain training. Interviewees also mentioned other positive aspects, such as an increase in the usage of information resources, the improvement of websites and materials, and the development of new online resources such as guides and videos.

Negative aspects

Whereas online training enabled access for those with constraints of time or travel, on the other hand it also seemed to increase existing inequalities, preventing people with less familiarity with technology and tools or technical issues (such as internet access issues) from participating in these training sessions. This point was made by I8 from Brazil:

> "But a bad side, which I also see as negative, is because it increases inequalities. It improved on the one hand, because of the remote issue, so those who wouldn't have access to training here in [City name] were able to have it, but on the other hand, some who don't have access to the Internet, who don't have a good computer, couldn't participate." (I8)

Some interviewees reported being unable to deliver training at all, or having to postpone scheduled training sessions. Those who were able to maintain their training activities reported negative effects such as difficulties in reaching trainees, technical difficulties, and online training fatigue.

> "We had some plans for this [running regular courses or workshops] then COVID arrived, and so, we're still not available at the campus for the main time. So, we cannot go into the departments. It's more difficult to reach people. But we have some plans for this, for example, for an OS roadshow where we want to tour through all departments at our university and make some marketing for OS." (I4)

> "I mean, not everyone, everybody is at the same level of adopting new technologies or new ways. I mean, it's easy to connect to a Zoom and listen to someone. But then, when you start to give some tools that they have to connect, they have to answer that not everyone is at the same level." (I1)

> "And I also think that people tend to sign up more on the online things and never show up rather than, you know, the physical thing." (I3)

Tools used during the pandemic

We then asked interviewees to name tools they had found particularly useful during the pandemic period. The tools mentioned were mainly video conference platforms (especially Zoom and Microsoft Teams), but some other tools were mentioned as particularly useful in ensuring engagement in online environments. Amongst these were:

- **Gathertown** (https://www.gather.town), an innovative web-conferencing software in which participants occupy virtual "rooms" visualised via retro 8-bit graphics, and can move around via their avatars to interact with others based on their physical location in the virtual space.
- **Miro** (https://miro.com), an online whiteboard and visual collaboration platform that uses digital "sticky notes" to allow distributed teams to work together to brainstorm ideas.
- **Mural** (https://www.mural.co), another visual collaboration tool which offers an online whiteboard, for collaborative problem-solving.

Long-term effects of the pandemic's impact on training

The rapid transformations required from OS/RRI training in response to the unexpected impacts of the COVID-19 pandemic were, as we have seen, substantial. Experiencing training delivered primarily online and at distance for such an extended period might be anticipated to have long-term consequences for trainees' and trainers' acceptance of such means of training delivery. The positive aspects of greater access to training for those with limitations on travel or time are, as we have seen, well appreciated by our cohort of interviewees. New tools like Gathertown and Mural have been used in innovative ways. Nonetheless, the limitations of online training are also acknowledged, including difficulties in engaging participants, technical difficulties and online fatigue. Yet the importance of face-to-face training in shared physical spaces must not be forgotten. As I6 advised:

> "We switched to virtual trainings in a very short time but I think now ...(…) everyone wants to meet in a physical space. So, I think the personal training will get more relevance in the future. It is perhaps more appreciated also ..." (I6)

Hence, we might expect greater use of online training, but in flexible ways which make sense according to the aims of the training and the target audiences to use the most suitable means for maximizing impact. As I1 from Spain told us:

> "It depends of the training you want to do. If you want to do a general training more like an informative training to raise awareness among researchers, they were really fantastic and probably we will repeat the situation. We had a really interesting webinar on ... the novelties of Horizon Europe, and ... we had almost 500 people attending that meeting. So, that was impressive for us because when we do that in person, probably because we are this huge institution with different campuses ... we don't reach, I don't know, maybe 100 people…. But on the other hand, if you want to be more practical and you want to do a more hands-on workshop with, I don't know, 20 people or 25 people, it's difficult ... we tried to be as creative as possible trying to figure out new tools. We were learning not just Zoom or Teams or that, but other tools that could improve the training sessions. It has been hard, not just for the trainers but also for the trainees." (I1)

5.4. Interview results summary

We interviewed representatives from eleven higher education institutions responsible for implementing OS and RRI policies, from nine countries and in senior positions - directors of research support service (libraries and information management services), repository (publications and research data) managers or coordinators, heads of research support or RDM unit or office and coordinators or managers of OS policy offices or teams. Their main activities were related to OS and OA implementation – running the institutional repository, being involved in the formulation of institutional OA policies and OA training, assisting researchers with advice regarding their OA publications or assisting with APC enquiries – showing a very limited involvement with RRI implementation.

Although in general researchers at these institutions are aware of and show some familiarity with OS, OA, RRI and FAIR data concepts, misunderstandings remain. Awareness differs across disciplines and levels of seniority and does not necessarily translate into practice. The main barriers to OS/RRI uptake are the lack of incentives, awareness, and time; concerns of sharing and legal issues; lack of infrastructure and services; cultural/behavioural issues; lack of funding/resources; lack of central coordination within and between institutions; and the need for OS/ RRI policies. Interviewees advised conversations regarding reform on research assessment criteria and publications metrics were underway.

Training support services for OS/RRI available at the institutions is focused on institutional services or tools, RDM (data management planning, GDPR and data sharing), Data protection and handling of sensitive data, OA, Open Science funder requirements, Research Integrity and Ethics. The main providers of this training are the libraries, with contributions from ethics (or bioethical) committees, centrally coordinated training offices, research offices and professors, researchers or university teachers. The training programs targets researchers, PhD students, Bachelor and masters level students, but also University staff, such as librarians, Professors, the ethics committee and project officers. Certification and accreditation for this training is not common. The main challenges faced in providing training are ensuring participation from diverse audiences; lack of staff; lack of institutional support (funding or central coordination); and tailoring training to audience

needs. These issues may be mitigated through the integration of training in course curricula, the development of specific and more practical training, and the improvement of online materials.

6. Discussion

As we saw in our literature review, the role of training and skills in OS/RRI uptake is well acknowledged, with many initiatives having sprung up to address this. Very often, these initiatives are top-down, funded either by research funders or cross-national bodies. However, the community-led aspects of training to foster real cultural change are acknowledged via "train the trainer" approaches, and more recently, through the fostering of specific peer-to-peer networks on, for instance, reproducibility. We found that although a wealth of training possibilities already exists, offered via many modalities including that offered by higher education institutions and libraries, by projects or other initiatives, in face to face events or online, uptake of this training remains an issue. The majority, although by now perhaps aware of OS/RRI and their benefits, are still in doubt on how to effectively incorporate OS/RRI practices into their everyday research workflows, especially given persistent concerns that doing so constitutes an extra burden on already scarce resources.

Therefore, our study has aimed to investigate whether and how current OS/RRI training adequately addresses aspects of OS/RRI, especially with regard to identifying areas where more training is needed, for which stakeholder groups. In addition, relating to ON-MERRIT's themes of equity in OS/RRI uptake, our investigation has offered an opportunity to gauge the extent to which levels of resourcing shape uptake of OS/RRI training and make recommendations to address potential issues.

To address these gaps and understand the awareness and uptake of OS/RRI, we hence undertook an international survey of researchers and structured interviews with those responsible for OS/RRI policy and infrastructure within institutions internationally to investigate levels of OS/RRI awareness, support services and their impact.

In this discussion section we will aim to synthesise these findings. We do so by first systematically distilling the findings from the survey and interviews respectively, and then go on to draw out common discussion points and key findings to inform future development of OS/RRI training.

6.1. Survey results summary

6.1.1. Practices

Our survey results show that in general, awareness of OS/RRI and their potential benefits are quite high, but that this awareness is often in the abstract, relates to specific elements of OS/RRI (especially OA) and that researchers often lack the skills necessary to take concrete steps towards implementation. Put briefly, there is a gap between theoretical appreciation of OS and its concrete adoption into practice. This is especially so for OA Publishing, RDM, Reproducible Research, Open Peer Review, Licensing, Citizen Science, and Gender.

Regarding OA, a majority of the participants deposit their publications in a repository, as is increasingly required by institutions and funders globally (including the European Commission). A high percentage of the respondents advised that their institution has a policy or recommends OS and OA practices. Fewer publish in OA journals and know how to get funding for APCs. Publication fees for APCs are indeed a major barrier to the implementation of OA, with less than half of respondents having access to institutional support for covering these costs.

With RDM, less than half of the survey participants develop a DMP or make sure the reviewers can access data underlying publications; these two are mandatory conditions for most funding entities and many journal publishers. Sharing data in a repository and publishing data along with its identifier are also good practices that are followed by the minority.

In the practices regarding research transparency, such as reproducible research, we see a great difference between the general statements and practices such as sharing electronic laboratory notebooks or pre-registering hypotheses. The same thing is true of Open Peer Review, where there is a consensus with this practice improving transparency of the research process, but very little uptake when it comes to the selection of a journal that allows open peer review or signing the reviews. In the former case, disciplinary differences may play a role in the exact steps required for reproducibility, but it may also be the case that although reproducibility is valued in the abstract, researchers are less clear on the concrete practices that may foster it. In the case of Open Peer Review, it seems that although it is valued, it is not a priority in making publication decisions.

Similarly, with Open Research software, few participants engage in collaborative software development, share their software code, or reuse open source software or license their software to allow reusability. Similarly, regarding licensing of research outputs, we see a high level of agreement with general statements about benefits, but much lower uptake of open licensing. We see a tendency in not licensing shared research results (publications, data, and software), which has a huge impact on reusability of outputs and is not in accordance with stricter definitions of OA and the FAIR Data principles which state that (meta)data should be released with a clear and accessible data usage license.

From all of the practices, those related to Research Integrity found most consensus. This may reflect an issue with self-reporting, whereby researchers may not wish to disclose engagement in questionable practices (even anonymously), but could also be explained by institutional support and the existence of Ethics committees in the institutions, and also available training reported later in the survey.

With Citizen Science, we clearly see a difference between the levels of involvement of the public in research: the practices situated at the “information” level are more used than those that demand a greater participation of the public, such as involving citizens in data gathering or asking for citizen’s feedback during the research process. We observe the same detachment of theory from practice across gender related questions, i.e. questions relating to gender balance within research groups or projects.

6.1.2. Training

Regarding training, we aimed at understanding if there was training available, if participants engaged in it and its relation with the reported practices. We found that the majority of survey participants usually had not yet had any training in the above-mentioned OS/RRI topics.

The topics where the participants had attended most training were OA, Research Integrity, Gender issues and Open Data.

As for the training attended, the most popular training types were webinars and seminars. Types of training requiring more time from the participants, such as several days workshops, MOOCs, summer or winter schools and blended learning courses, were least attended by participants. For a majority of participants, the first formal OS/RRI training was provided by their institution.

Respondents showed a very strong preference for training to be optional, as opposed to mandatory. They also valued discussions with peers as a mode of training, highlighting the importance (flagged in our Literature Review) of communities as facilitators of OS/RRI uptake.

The importance of training is reinforced by the fact that the trained participants do understand the importance of OS/RRI and why they should make an extra effort, stating that they are more aware of the opportunities offered by practicing OS and have incorporated some OS/RRI practices in their daily research work.

6.1.3. Institutional support structures

Regarding institutional support, the survey confirms our expectation that most of the institutions have an OS/OA policy or recommendation. Most of the participants advise they have access to at least some technical infrastructure, support by the Ethics committee, legal support (licensing research outputs and dealing with IPR and GDPR issues) and information on funders' policies and recommendations regarding OS.

The aspects in which the participants would like to receive greater support are career perspectives and recognition, financial support/rewards and training on different aspects of OS. This is in line with the reports stating the importance of rewards in incentivising OS/RRI adoption cited in the Literature Review (see also ON-MERRIT Deliverable 6.1[48]).

Institutions can play a more active role in promoting community initiatives incentivising OS practices, such as OS cafes or Data champions, as the great majority of the participants stated such initiatives do not yet exist at their institutions.

As for the drivers and barriers, the most significant barrier to OS adoption is the lack of clarity in which sources or platforms to trust, followed by the lack of clear steps to follow, extra effort and time constraints. A need for advanced infrastructures and lack of clarity as to where to find relevant information were highlighted as barriers by a majority of respondents. Lack of clarity on the benefits of OS was seen as a significant or very significant barrier by a third of respondents, highlighting that awareness of OS and its benefits is increasing, but there remains work to do to convince a significant proportion of researchers.

When identifying the main drivers to OS adoption, participants valued good practices and policy mandates first: the inherent ethical value of sharing research outputs was followed by funder and institutional OS policies as the main drivers. Societal needs, values, interests and expectations, collaboration and communication among researchers and the availability of high-quality OA publication choices in their research area are also valued, however.

[48] https://zenodo.org/record/5552197

The main reported barriers to OS are Article Processing Charges (APCs), difficulties of applying licenses to publications or data, and publisher's policies on the sharing of publications.

6.2. Interview results summary

We next summarise the findings from our interviews with representatives of institutions responsible for OS/RRI implementation, policy and infrastructure.

6.2.1. Open Science and RRI uptake within institutions

Our sample was integrally involved in OS (especially OA and RDM) implementation at their respective institutions, but less so in RRI. Within their work related to OS, the vast majority of our interviewees were in some way involved with OA implementation, and many had a role in implementing RDM - activities were related to maintenance of institutional repositories, drafting policy, advising regarding funder requirements and providing support and training. Overall, interviewees painted a picture of awareness of OS having reached a critical mass - as one said, "OS has arrived". Yet they also acknowledge that there is still a great deal of work to do to translate good intentions into good practices. OS remains often poorly understood beyond OA, and researchers still lack knowledge to make concrete changes to their research practices. Awareness of Open Science topics being centred first on Open Access, and then Open Data and Research Data Management, to some extent perhaps merely reflects the history of their implementation. Open Access has been a talking point for the last twenty years, while RDM has become increasingly central over the last ten years. Other elements of Open Science are at a much earlier stage of development. We also found that the picture varied across disciplines, where especially the Humanities and Social Sciences . In English-speaking countries (where the term "Open Research" is preferred), this may have to do with the lingering impression that Open Science is exclusionary of qualitative methodologies.

As said, our interviewees had less experience with RRI. This reflects a limitation of our study, but also reflects the fact that responsibility for RRI-related issues is not centrally coordinated within institutions as is usually the case with OS. Indeed, beyond those familiar with EC-funded projects, the term RRI was little recognised by our participants. They advised that there are people within their institutions working on distinct elements (like gender equity or ethics), but that these responsibilities are largely separate. Fostering a more coherent approach to RRI within institutions may improve recognition of this agenda.

Our interviewees highlighted several barriers which inhibit uptake of OS/RRI. The main factors (in decreasing order of number of mentions) were:

- **Lack of incentives:** A lack of concrete benefits for researchers, especially those linked to career progression, is a major limiting factor. Without them, OS/RRI remain "nice-to-have" but not essential practices for many researchers within the current "publish or "perish" paradigm.
- **Lack of awareness:** Despite clear progress on this front, a continuing lack of knowledge and awareness amongst researchers remains a barrier. This is often greater amongst certain cohorts (by discipline, or level of seniority) and for certain elements of OS/RRI (basically everything beyond OA and RDM/Open Data).
- **Lack of time:** The various pressures on academics mean that although in principle supported, OS/RRI practices remain unprioritized. Here it is not simply about finding time, but that implementing OS/RRI

requires such root-and-branch reform to working practices that sometimes researchers do not know where to start. Prioritising OS/RRI was hence strongly linked to the need for reform to researcher incentives and streamline processes to make OS/RRI as easy as possible to take up.

- **Concerns regarding sharing, including legal issues:** Linked to issues of lack of incentives, are the concerns over the possible negative impacts of sharing – especially of data. Fear of the unknown seems a major barrier here, especially as to how such sharing may affect collaboration with industry.
- **Lack of infrastructure and services:** Although progress has been made in providing repositories for data and publications, there is a need for enhanced supporting services to enable OS/RRI practices. Although researchers may wish to take up OS/RRI they are held back by what one interviewee called "missing infrastructures" as well as a lack of guidance to use those infrastructures that are available.
- **Cultural/behavioural change:** Finally, we must remember that research cultures are so diverse and deeply ingrained that effecting large-scale changes to practices is a highly complex and difficult task. Interviewees reflected on diverse issues here, including differences in cultures of sharing, the influence of more senior researchers on the practices of junior researchers, and the deep internalisation of current, more-closed modes of doing research.

These varied inhibitors of OS/RRI uptake weave a complex web within the various contexts within which our interviewees work. Untangling them in order to effect change is no easy task. Yet as might be seen, there seems to be consensus that a major priority must be the reform of structures of reward and recognition to encourage, rather than discourage, open practices.

When we specifically enquired as to whether reforms to incentives related to career progression are underway within their institutions, the answers were very encouraging: only one interviewee reported complete stasis. However, although most of our interviewees reported that conversations had begun, concrete progress beyond this was not in evidence except at one of our institutions. How these conversations develop into action should be closely monitored and supported. From the interviews we can see the crucial importance of external initiatives and declarations such as DORA for setting an expectation for action within institutions.

Linked to this, we see a lack of consensus on ways of monitoring OS/RRI uptake, beyond OA at any rate. Occasionally, other indicators (e.g., on RDM or gender) were mentioned, but these seemed to lack systematisation. Future plans for further development of monitoring of OS/RRI practices were mentioned to a large extent by some interviewees, but the translation of abstract policy into concrete guidance and means of monitoring remains low in most institutions.

6.2.2. Training and support services for Open Science and RRI

Moving on to the specific provisions for training and support in place within our target institutions, we see a varied picture with different support structures and levels of implementation.

With regard to topics of training provision, the bulk of training remains very much focused on Open Access and RDM, with limited focus on broader Open Science or RRI topics (with the exception of ethics). The following (in descending order) were the most-often mentioned as being offered:

- **Institutional services or tools:** The most popular training element was on institutional services and tools including using institutional repositories, CRIS systems, tools for Data Management Plans and software curation (e.g., GitHub).
- **Generic RDM training:** General Research Data Management training was also very popular, including guidance on data management planning, GDPR and data sharing.
- **Open Science funder requirements:** Institutions provide training specifically related to funders' requirements on OS, especially sharing and managing research data.
- **Research Integrity and ethics:** Workshops on research integrity and ethics were mentioned, sometimes in conjunction with RDM training.
- **Open Access:** Such training typically includes tuition on OA publishing and usage of the repository
- **Open Science training by request:** Many institutions also offer flexible OS training on request or as peer-to-peer consultation.

Units responsible for delivering this training varied widely, often dispersed across the institution according to the topic. The library was the main provider, but ethics committees, training and research offices were also involved. Target audiences were usually researchers, PhD students, and students (bachelor or master level), but could also include staff, librarians, ethics committees and project offices. Accreditation for training was reported by only two interviewees, even though this is a potentially large motivational aspect for engaging students at bachelor, masters and doctoral levels (we discuss this further below).

Interviewees identified a wide range of core challenges in training provision relating in various ways to incentives, resources and political support. The main challenges (in decreasing order of times mentioned) were:

- **Fostering participation:** Difficulties in reaching people or ensuring participation in training events was a major theme. Motivating researchers and others to attend training was especially linked to a perception that this is often not a priority for most. This can be linked to our point above about the need to sufficiently incentivise OS/RRI practices to make them a priority.
- **Lack of staff:** Constraints regarding the availability of trained support staff able to deliver training was also a key challenge. One element here is the need for staff training ("train the trainers"), but this also links to the lack of resources for training.
- **Institutional support:** Support from senior management with the institution was also a major factor, along with linked issues of lack of funding or central coordination for OS/RRI training.
- **Proving the value of Open Science:** A more abstract issue was a perceived need to demonstrate within the institution that OS/RRI present opportunities and do not merely create additional burdens for researchers or that OS-related practices (this again relates to our previously-mentioned issues of prioritisation and reward/recognition structures).
- **Targeting and tailoring training for diverse audiences:** Providing training on diverse OS/RRI issues for diverse stakeholders was also an issue, especially in engaging groups from disciplines for which there is little tradition in these practices. The need to tailor modes of delivery and focus for different audiences.

Interviewees made interesting suggestions for overcoming these challenges, including:

- **Integrating training in course curricula:** The most often mentioned suggestion was to integrate OS/RRI (especially the former) topics in the formal curriculum of master's or doctoral courses to

enable credit towards graduation. Although this seems an easy and straightforward way to motivate uptake of OS/RRI training by young researchers, we see only few institutions doing this so far.

- **Developing discipline specific training:** The need for greater discipline-specific training was also identified. Beyond generic advice regarding OA or RDM, very often OS/RRI issues become very discipline-specific such that training is best provided at this level.
- **Delivering more practical training:** Relatedly, our interviewees also expressed a need for training to become less theoretical and more practically relevant, possibly including focus on specific use-cases or hands-on training.
- **Improving online training materials:** Online or self-learning training materials should also be improved or better curated to make OS/RRI learning as flexible and easy as possible.
- **Boosting training capacity:** Related to the challenge of lack of staff, another suggestion was to target increased training capacity via a "train-the-trainers" approach.
- **Boosting policy commitments:** Finally, greater central policy commitments and recommendations from the institution are needed to motivate researchers and others.

6.2.3. Effects of COVID-19

We closed our interviews by asking respondents to reflect on the impact that the COVID-19 pandemic had had on training and support for OS/RRI within their institutions. We found that interviewees saw both positive and negative aspects in this experience. On the positive side, the need to move events online meant that training sessions were expanded to wider audiences, including those who may have previously faced difficulties in attending face-to-face sessions. On the other hand, however, negative aspects included the upheaval from needing to cancel or postpone planned training sessions as well as the potential exclusion of those not familiar with the required technology and tools for online training.

The rapid transformations required from OS/RRI training in response to the unexpected impacts of the COVID-19 pandemic were substantial. Experiencing training delivered primarily online and at distance for such an extended period might be anticipated to have long-term consequences for trainees' and trainers' acceptance of such means of training delivery. The positive aspects of greater access to training for those with limitations on travel or time are, as we have seen, well appreciated by our cohort of interviewees. New tools like Gathertown and Mural have been used in innovative ways. Nonetheless, the limitations of online training are also acknowledged, including difficulties in engaging participants, technical difficulties and online fatigue. Yet the importance of face-to-face training in shared physical spaces must not be forgotten.

6.3. Implications

Distilling these findings, we can highlight the following overarching implications:

- **Awareness of Open Science:** Open Science seems to have "arrived", at least at a superficial level of understanding. The vast majority of our survey respondents agreed with the statement that they try to make their research open, and our interviewees painted a positive picture of general acceptance amongst many researchers. Yet beyond such high-level agreement with abstract principles, both our survey and interview results suggest that researchers often lack in-depth knowledge, especially of topics beyond Open Access and RDM.

- **Awareness of RRI:** Amongst our interviewees, awareness of RRI as a concept was relatively low, even where awareness of its individual pillars (like ethics, science communication, and gender equity, for example) is high. While this may reflect a sampling bias within our pool of interviewees, it also points to this topic's less well-institutionalised development. In the words of one interviewee, RRI was considered "slightly peripheral". Responsibility for RRI-related issues is not centrally coordinated within institutions as is usually the case with OS. Indeed, beyond those familiar with EC-funded projects, the term RRI was little recognised by our participants. They advised that there are people within their institutions working on distinct elements (like gender equity or ethics), but that these responsibilities are largely separate. Fostering a more coherent approach to RRI within institutions may improve recognition of this agenda. However, our survey results do show positive outcomes for some individual elements of RRI - uptake of training on issues like ethics and gender was amongst the highest for any of the topics we enquired about, and (self-reported) adherence to issues of Research Integrity approached 100 percent.
- **Low uptake of training:** From our survey (Figure 17), we can see that overall the participants had surprisingly little training, with (depending on the topic) between 54% and 86% of respondents never having attended any training on these OS/RRI topics. This shows that funders and institutions have a lot of work to do to equip researchers with the skills necessary for OS/RRI.
- **Benefits of training:** This is especially important since our survey showed the impact of OS/RRI training, as understood by respondents' perceptions of changes to their own practices (Figure 22). After having received training in OS/RRI topics, 65.5% of respondents understand why they should make an extra effort, 63.4% stated that they have incorporated some practices in their daily research work and 63.4% are more aware of the opportunities offered by practicing OS.
- **Attitude-behaviour gap:** Throughout our results, we found that researchers are increasingly aware of OS/RRI yet often fail to translate this awareness into concrete changes in their practices. In the answers to the same question from our survey, 29.5% of the respondents advised that after training they were aware of the benefits, but do not practice what they have learned. This shows that a gap still exists between positive attitudes to OS/RRI topics and actually putting these into practice amongst a significant portion of researchers. More work may be required to better understand the dynamics involved here. A significant factor, visible in both the survey and interview results, is no doubt the fact that OS/RRI, although often valued in the abstract, are sometimes not placed highly amongst competing priorities.
- **Importance of incentives:** As explored in ON-MERRIT Deliverable 6.1 "Investigating Institutional Structures of Reward & Recognition in Open Science & RRI,"[49] there is increasing recognition that a lack of reward and recognition for Open Science and RRI practices is a barrier to uptake. This also applies to uptake of OS/RRI training. Our interviewees recommended a change to incentive structures to motivate participation in training, and were elements of OS/RRI to be better embedded in assessment processes related to career-progression, this would also help researchers better prioritise these practices.
- **Types of training:** Our survey results show a clear preference for optional as opposed to mandatory training amongst researchers. They are also much more likely to attend short-form training (both online and face-to-face) as opposed to longer-form training like summer/winter schools or MOOCs. Institutions would do well to focus on flexibility in their training, to offer modular options so researchers can choose the types of topics they require. In addition, the types of training offered

[49] https://zenodo.org/record/5552197

seem to revolve heavily around Open Access and RDM - topics which are already amongst the most well understood elements of OS/RRI. Broadening training to include a wider range of topics is to be recommended.

- **Need for more practical, hands-on and disciplinary-specific training:** We also saw a clear need for more in-depth practical training, especially at the disciplinary-level. Given that most training seems to be organised at the cross-institution level (whether by library, research office or other), there is perhaps a coordination issue here. Disciplinary-specific training is potentially better suited to be led by individual faculties or departments within the institutions. This could still be coordinated in tandem with a central body (such as the library) however.
- **Lack of accreditation:** Amongst students - whether at Bachelor, Masters or Doctoral level - gaining credit towards graduation seems a natural motivator. Yet we saw that only two of the eleven institutions represented by our interviewees offered course credit for (some) OS/RRI training. That this should be a priority area for change is evidenced by the fact that when asked to suggest actions for improvements in uptake of OS/RRI training, the most often mentioned factor was to integrate OS/RRI (especially the former) topics in the formal curriculum of master's or doctoral courses to enable credit towards graduation.
- **Resources:** Amongst the main challenges to OS/RRI training provision identified by our interviews. A lack of staff resources was a key factor. Increasing the number of staff able to give training by training university staff with a “train the trainers” approach is therefore advisable, in addition to an overall increase in budget available for hiring trained staff for this purpose. Furthermore, one key missing element revealed by our survey was a lack of institutional support for funding for OA Article Processing Charges (Figure 28), where fewer than half stated definitively that their institution does.
- **Post-pandemic opportunities:** The COVID-19 pandemic (as in so many elements of life) created extraordinary demands on OS/RRI training, which had to be unexpectedly moved to a largely online environment in a short period of time. Sustained periods of providing training online seem to have made trainers appreciate the flexibility and inclusivity of such modalities, including new platforms like Gathertown. However, adjusting to a “new normal” in a post-pandemic world will not mean online by default - the engagement and immediacy possible via face-to-face learning is still appreciated. Institutions should hence look to optimise training according to their target audiences.
- **Online resources:** The flexibility offered by self-directed online learning resources is appreciated by researchers, yet it seems that for many Open Science topics, it is not a lack but a surfeit of online resources that is the issue. Better curation and synthesis of existing resources is required.

7. Conclusions

Training and skills are acknowledged as key aspects in the uptake of Open Science and Responsible Research and Innovation practices. This deliverable has presented two studies undertaken to understand current institutional structures for OS/RRI training and their relation to current levels of adoption of OS/RRI practices: (1) An international survey of 167 active researchers to assess their practices and opinions regarding OS/RRI, as well as the institutional support for these practices; (2) In-depth interviews with representatives responsible for training provision in 11 institutions across three continents to identify the support, drivers and barriers to OS/RRI from an institutional point of view.

We have shown that currently OS/RRI training structures struggle to address practices beyond Open Access and Research Data Management, with a need for increased capacity, better institutional incentives, and more practical and flexible training (especially at the disciplinary-level). Our survey revealed that uptake of training was surprisingly low, despite showing that respondents themselves saw concrete benefits for their research practices.

These results highlight the difficulties involved in providing OS/RRI training and support services at the institutional level. Regarding future work, we can say that our findings reiterate the fact that training in OS/RRI is essential for researchers to be able to perform science in a solid and transparent way and comply with most funder's requirements and mandates worldwide; there is a need for skilled professionals and the development, normalization and integration of OS and RRI into curricula; and the role of communities in reinforcing practices and promoting a real cultural change. More work to foster interoperable infrastructures, integrated training resources and peer-to-peer training, as well as increased resources for training staff and infrastructure are desirable. This study is not free of limitations, and identifying them also directs our attention towards potential future work:

- Our survey received relatively few responses from early-career researchers, a key category of interest when it comes to OS/RRI training. An expanded study targeting this key demographic may reveal particular challenges particular to this group.
- For reasons of resourcing, we interviewed representatives of relatively few institutions, and took a highly structured approach to the interviews. An expanded study with more interviewees, which took a semi-structured approach enabling a more in-depth discussion would no doubt reveal the underlying issues in greater depth.

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9. Annexes

Annex A: Survey instrument

Introduction

As part of the ON-MERRIT project, we are conducting a survey to develop deeper insights into the participation of researchers in Responsible Research and Innovation (RRI) and Open Science training, across both geographical areas and RRI and Open Science subtopics, providing an understanding as to the extent that researchers are familiar with the application of RRI and Open Science in their own research areas.

In addition, we aim to identify which RRI and Open Science principles are supported by institutional policies and which principles are more frequently adopted by academics.

We invite researchers to participate in this survey. We would be grateful for your help in circulating this survey within your networks.

To learn more about ON-MERRIT, visit our website: https://on-merrit.eu/ .

This project is funded by European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement number 824612.

Consent Form
Please read the following information before deciding whether to participate in our study. Please ask the researcher any questions you may have about the process or project before completing the consent form (see contact details below). You are invited to participate in this study on a voluntary basis and you are free to withdraw from the study at any time without providing any reason for doing so, even after completing the survey. If you agree to participate, you give us permission to:
Collect information from you;
Share information with project team members (no personal information will be shared); Conduct the study; Use this information for data analysis, in publications and presentations. This survey does not ask you to provide any personally identifying information. Still, all the data you provide will be anonymised and treated confidentially and will be used for research purposes. It will not be used in a manner which would allow identification of your individual responses. This applies to all outputs that might stem from the project, including academic papers and other reports, conference presentations and published datasets. The raw data will be stored in the internal servers of Know-Center GmbH and will be protected by passwords that are only known to researchers conducting this study. All the raw data will be deleted five years after the completion of the project. For further information or to withdraw from the study, contact antonia.correia@usdb.uminho.pt

Consent Form
[YES/NO]

- I confirm that I have read the participant information.

- I understand that my participation in this study is voluntary and that I am free to withdraw at any time. I understand that it will not be possible to remove my data from the project once it has been anonymised and forms part of the data set. I agree to take part on this basis.
- I agree that any data collected may be published in anonymous form in books, reports or journals and shared in presentations.

Part A - Researcher's Practices

In this section we would like to learn more about your practices while conducting research.

A1. Please rate the following statements according to your practices regarding Open Science

Scale: Strongly disagree/ disagree/ Neither agree nor disagree/ Agree/ Strongly agree/ This topic is not relevant to my research/ Don't know or don't have enough information

1. I make an effort to make my research open.
2. I make an effort to make my research collaborative.
3. Open science is different from traditional research approaches
4. Open science consists of different dimensions (e.g. publications, data, code, methods).
5. Open science values transparency in research.

A2. Please rate the following statements according to your own practices regarding Open Access publishing.

Scale: never/ rarely/ sometimes/ often/ Always/ This topic is not relevant to my research/ Don't know or don't have enough information

1. I deposit my publications in a repository
2. I publish in open-access journals
3. I know how to get funding for open access publication fees.
4. I publish my publications under an open license
5. I deposit my preprints in a disciplinary preprint repository

A3. Please rate the following statements according to your own practices regarding Research Data Management

Scale: never/ rarely/ sometimes/ often/ always/ This topic is not relevant to my research/ Don't know or don't have enough information

1. I share my data in a data repository
2. I publish my data Regarding preprints, 38.3 description along with its identifier (DOI, handle ,...)
3. When submitting an article, I make sure my data can be accessed by the reviewers
4. I publish my data under a license
5. I develop a data management plan

A4. Please rate the following statements according to your practices regarding Reproducible Research

Scale: never/ rarely/ sometimes/ often/ always/ This topic is not relevant to my research/ Don't know or don't have enough information

1. I pre-register my hypothesis
2. I extensively document and give access to the methodology used for each finding

3. I use platforms like open science framework or GitHub to share my research
4. I share my electronic laboratory notebooks
5. I foster results reproducibility

A5. Please rate the following statements according to your practices regarding Open Peer Review
Scale: Strongly disagree/ disagree/ Neither agree nor disagree/ Agree/ Strongly agree/ This topic is not relevant to my research/ Don't know or don't have enough information

1. Open peer review improves the transparency of the review process
2. Reviewers' comments are attentive in open peer-review
3. Platforms that allow open peer review are easy to use
4. I opt for journals that offer the open peer review option
5. I sign my reviews

A6. Please rate the following statements according to your practices regarding Open Source Software
Scale: never/ rarely/ sometimes/ often/ Always/ This topic is not relevant to my research/ Don't know or don't have enough information

1. I share my software code (e.g. via GitHub, Figshare or Zenodo)
2. I license my software to inform about the conditions under which it can be reused
3. I extensively document my software development methodology
4. I develop software collaboratively
5. I reuse and build upon open-source software

A7. Please rate the following statements according to your practices regarding Licensing
Scale: Strongly disagree/ disagree/ Neither agree nor disagree/ Agree/ Strongly agree/ This topic is not relevant to my research/ Don't know or don't have enough information

1. I license my publications
2. I use Creative Commons licenses
3. I tend to use licenses that enable some kind of reuse
4. I feel confident that when some scientific output is licensed, people using it will respect the licensing terms
5. Using a license will prevent unauthorised uses of my work

A8. Please rate the following statements according to your practices regarding Research Integrity
Scale: never/ rarely/ sometimes/ often/ Always/ This topic is not relevant to my research/ Don't know or don't have enough information

1. I thoroughly inform my human subjects of all the details concerning their participation in my research
2. I inform subjects and ask for their consent prior to disseminating my research
3. I acknowledge all intellectual contributions and cite related work correctly in my publications
4. I comply with codes and regulations relevant to my discipline
5. I review publications without biases or influences

A9. Please rate the following statements according to your practices regarding Citizen Science - consider all levels -information, consultation, public participation
Scale: Strongly disagree/ disagree/ Neither agree nor disagree/ Agree/ Strongly agree/ This topic is not relevant to my research/ Don't know or don't have enough information

1. I align my research with challenges relevant for society
2. I provide the public with the information they need to understand my research
3. I regularly publish news about my research
4. I involve citizens in data gathering for my research
5. I ask for the citizen scientist's feedback during the research process

A10. Please rate the following statements according to your practices regarding Gender issues
Scale: Strongly disagree/ disagree/ Neither agree nor disagree/ Agree/ Strongly agree/ This topic is not relevant to my research/ Don't know or don't have enough information

1. Gender equality is a concern in the constitution of my research team
2. I look for gender equality when looking for project partners
3. I seek not to have imbalances in the decision-making process
4. I guarantee that the groups involved in the project (e.g. samples, testing groups) are gender-balanced
5. I conduct a gender-blind research

Part B - Training
In this section we would like to explore the training you might have had on open science topics.

*B1 - How many training events have you attended in these topics?
Scale: None/ 1 / 2 / 3-5/ more than 5

1. Open Science
2. Open Access
3. Open Data
4. Reproducible Research
5. Open Peer Review
6. Open-Source Software
7. Licensing
8. Ethics in research/ Research integrity
9. Citizen science
10. Gender
11. Other _____

*B2 - Please specify in which other open science related (topics) have you received training

*B3 How often did you attend the following types of training sessions?
Scale: never, once, more than once

1. Half day workshop
2. Full day workshop
3. Several days workshop
4. Seminar
5. Summer/ Winter School
6. Webinar
7. MOOC (massive open online open course)
8. Online course
9. Blended learning course
10. Other_____

B4 - Please specify which other types of training events have you attended

*B5 - How many hours of training in total did you get?

1. None
2. 1
3. 2
4. 3-5
5. more than 5
6. Other_____

*B6 - Did the training you receive fulfill your needs?
Scale: I didn't receive training/ I need more training/ I received adequate training/ This topic is not relevant for my research

1. Open Science
2. Open Access
3. Research data management
4. Reproducible Research
5. Open Peer Review
6. Open-Source Software
7. Licensing
8. Ethics in research/ Research integrity
9. Citizen science
10. Gender
11. Other _____

B7 -Please specify if the training events you have attended in other open science related topics fulfilled your needs

*B8 - When did you attend your first formal training in any Open Science topic?

1. During doctoral studies
2. As a researcher
3. During a conference
4. Other - which?

B9 - Who provided the training sessions you attended? (choose all that apply)

1. My institution
2. My professional association
3. Library
4. Research school
5. An external organisation
6. My supervisor
7. Session at a conference

B10 - What is your preferred way to learn open science topics? (choose all that apply)

1. Mandatory training

2. Optional training
3. Personal reading
4. Discussions with peers
5. I haven't learnt about Open Science topics
6. Other - which?

*B11 - Has your awareness of open science practices increased after the training you attended?
Scale: Highly disagree/Disagree/Neutral/Agree/Highly agree/ Don't know

1. I am more aware of the opportunities offered by practicing open science
2. I incorporated some open science practices in my daily research work
3. I am aware of the benefits, but I don't really practice open science
4. I still don't understand why I should make an extra effort

*B12 - Would you share your experience with open science practices and tools with colleagues?
Scale: Highly disagree/Disagree/Neutral/Agree/Highly agree/ Don't know

1. I would recommend my colleagues some of the practices I am using
2. My research community already has established open science practices
3. My research community already has established tools and practices that don't foresee open science
4. My colleagues wouldn't make the effort

B13 - Are you aware of available free training materials that can help you learn more about open science? Y/N
B14(Nested question) Which?_____

Part C - Institutional support
In this section we would like to know more about the support your institution provides to you.

*C1. Does your institution have an open access policy?
(Y/N/ I don't know)
C2. IF Yes, Could you please briefly describe your institution's Open Science policy main features? (nested question, text)

*C3. Does your institution recommend open science/ open access practices (Y/N)
C4. IF Yes,Could you please briefly describe your institution's recommendations on Open Science/ Open Access? (nested question, text)

C5. Is there a dedicated helpdesk/ group to support any issues related to the open science / open access policy? (Y/N/ I don't know)

C6. Do you receive any guidance on how to comply with the policies issued by the financing entities that require open access to publications, such as the European Commission or the European Research Council? (Y/N/ I don't know)

C7. Does your institution support you financially in paying article processing charges (APCs)? (Y/N/ I don't know))

*C8 - To what degree are you supported in practicing Open Science at your institution?
Scale: I receive sufficient support or incentives; I would like to receive more support or incentives; I do not receive any support or incentives but would like to; I do not receive any support or incentives; I don't know/I don't have enough information

1. Information on funders' policies and recommendations regarding Open Science
2. Access to technical infrastructure (software, storage, databases, publication and/or data repositories, etc.)
3. Support by an Ethics committee
4. Legal support for licensing research outputs and on IPR or GDPR issues
5. Training on different aspects of Open Science
6. Financial support and rewards
7. Career perspectives and recognition

C9 - Please elaborate on the impact Open Science practices have in your career/ promotion chances (open question)

*C10 Are there other initiatives incentivising Open Science practices at your institution (eg. Open Science cafes, Data champions)? (Y/N)
C11. IF Yes, Which?_____

Part D - Drivers and barriers to practicing Open Science
In this section we would like to learn more about your attitudes towards Open Science.

D1 - Overall, if you had to summarise your views, what would you say Open Science is?

1. An exciting opportunity, mostly with benefits
2. An opportunity, with the benefits outweighing the drawbacks
3. Mostly positive, it has benefits but also important drawbacks
4. An unimportant bureaucratic burden
5. A worrying new perspective
6. A real threat to my research
7. Not relevant for my research.

D3 - Which are the most significant barriers you will be facing while embracing an Open Science perspective?
Scale: Very significant barrier/ Significant barrier/ Minor barrier/ No barrier/ I don't know / I don't have enough information

1. Lack of proper infrastructure
2. Lack of clear steps to follow. How do I begin? How do I proceed?
3. Lack of clarity where to find relevant information
4. Lack of clarity around where benefits arise
5. Lack of clarity in which sources/platforms to trust
6. Time constraints

7. Extra effort
8. Other

D4 - which other barrier do you identify?

D5 - What could be the main drivers for you to practice open science?
Scale: Very significant driver/ Significant driver/ Minor driver/ No driver/ I don't know / I don't have enough information

1. Support and wide adoption of open science practices in my research community
2. The value of sharing my research outputs in relation to societal ideals (e.g. access to knowledge)
3. Funder policy mandating open access to the research outputs
4. Institutional policy mandating open science practices
5. Publisher policies and requirements (e.g. data availability statement)
6. Career progression policies based on the adoption of open science practices
7. Ethics principles
8. Other

D6 - which other driver do you identify?

D7 - Would you say the following factors are drivers or barriers for you to practice Open Science?
Scale: driver/ barrier/ neither barrier nor driver/ I don't know / I don't have enough information

1. Article processing charges (APCs)
2. Publisher's policies on the sharing of publications/manuscripts
3. Difficulties of applying licenses to publications/ data
4. Plagiarism or theft of ideas
5. Collaboration and communication among researchers
6. Societal needs, values, interests and expectations
7. Researcher evaluation based on citation metrics (e.g. impact factor, h-index)
8. Availability of high-quality open access publication choices in my research area

Part E - Demographics

E1. - In which country do you work? [drop-down/ open text]

E2 - Please select the gender category that best describes you

1. Man
2. Woman
3. Prefer not to say
4. Other _____

E3 - What is your age?

1. <20;
2. 20-29;
3. 30-39;
4. 40-49;

5. 50-59;
6. 60-69;
7. 70+

E3b - When did you publish your first academic publication (journal article, book, chapter, conference proceeding, or similar)? Please tell us the year.

E4 - What is the highest education level you completed? [drop down]

1. Post-secondary non-tertiary education (e.g. VET Schools, schools of healthcare and nursing)
2. Short-cycle tertiary education (e.g. master schools, colleges, vocational training schools)
3. Bachelor or equivalent
4. Master or equivalent
5. Doctorate or equivalent
6. Other_____

E5. In what type of institution do you work? [drop down]

1. University
2. Public research institute
3. Private research institute
4. Company
5. Nonprofit
6. Other_____

E6 What is your position? Choose all that apply

1. Junior Researcher
2. Senior researcher
3. Ph.D. student
4. Postdoctoral fellow/researcher
5. Assistant professor
6. Associate professor
7. Full professor
8. Associate research scientist
9. Instructor
10. Lecturer
11. Adjunct professor
12. Technician or lab manager
13. Core facility manager
14. Other____

E7. In which general area of knowledge do you work?

1. Natural Sciences
2. Engineering and technology
3. Medical and health sciences
4. Agricultural and Veterinary sciences
5. Social Sciences

6. Humanities and the Arts

E8 - If you would like to stay informed about this survey and ON-MERRIT project please provide us your email_____

Thank you very much for participating in the ON-MERRIT study.
If you want to get more information about ON-MERRIT, please visit https://on-merrit.eu/.

Annex B: Pre-interview questionnaire

Thanks for agreeing to take part in our interview.
As agreed, prior to that, we would like to understand a bit more the framework around Open Science and RRI in your institution. Answers shouldn't be too long (bullet-point answers are ok); pointers to online resources are welcome.
Please answer as many of the questions as possible. In case you can't answer the following questions personally, we'd appreciate it if you could gather the information from colleagues.

1. Does your institution have specific guidelines/policies/frameworks in place to support Open Science? (there is a mandate to Green OA, it applies to OA data only, ...)
2. Does your institution support researchers financially in paying article processing charges (APCs), i.e. is there a central fund available?
    a. Which service within the institution is managing the APCs? (Library, research support office…)
3. Does your institution provide specific support services and/or technical infrastructure to enable researchers to adopt the existing OA policy and OS practices? Examples: dedicated helpdesk, software, storage, databases, publication and/or data repositories, ...
4. Does your institution have an Ethics Committee?
5. Does your institution provide Legal support for licensing research outputs and on IPR or GDPR issues?

Annex C: Interview Guidelines

Interview Guidelines

Focus: institutional support and RRI and OS practices

Duration: 20-30 minutes

1. **Introduction**

ON-MERRIT (https://on-merrit.eu) is an EU project that investigates the impact, influence and uptake of Open Science in academia, industry, and policy in the domains of climate, health and agriculture.

With this interview study, we would like to identify what are the institutional support and drivers and barriers to RRI and Open Science by interviewing relevant people we know are best placed for answering those questions (because of their knowledge or their roles in their institutions).

Publication: The results of this interview will be on the one hand made available to partners of the ON-MERRIT project and we also plan a publication. However, before we process the gained insights, we ensure that all data and information that you share with us, will be anonymized, so that no one will ever be able to draw conclusions to refer back to you or your institution.

Consent for recording: All information you will give me during the interview will safely be stored (encrypted) and the results/answer given will only be used in an anonymous way (for a publication) and will not be given to any third person.
So, is it ok if I record this interview for later analysis w.r.t. research conducted?

2. Familiarity with OS/RRI

At the beginning of the interview, I am interested to learn more about you and your background: what is your role in your institution,

1. How familiar are you with OS and RRI concepts?
2. Can you describe your role in implementing OS and RRI at your institution? (Follow-up: Are you involved in creating policy, implementing training, providing infrastructure or other services)
3. Overall, if you had to summarise your views, how would you characterise Open Science? (Follow-up: If not responsive "For example, different people can see it as an opportunity, a burden, too bureaucratic, a threat, and so on …")

3. Drivers and Barriers to Open Science and RRI

1. How familiar with and receptive to concepts of OS and RRI are researchers at your institution?
2. What are the main barriers the researchers in your institution face in uptake of Open Science and RRI?
3. What measures does your institution have in place to evaluate uptake of OS/RRI principles amongst your researchers?

4. OS and RRI training in the institution

1. What services are available for OS/RRI training across your institution?
    a. Who delivers this training (follow up: for instance, library, special services, faculty)
    b. Are there initiatives and networks to support peer-to-peer training? (eg. Open Science cafes, Data champions, reproducibility networks)
2. What are the main challenges in implementing OS/RRI training at your institution?
3. What improvements do you suggest in the way OS/RRI training can be implemented?

End of the interview

- Is there anything you would like to add to the interview?
- Do you have any final comments for us?

Thank you for participating!

Annex D: Figures for survey demographics

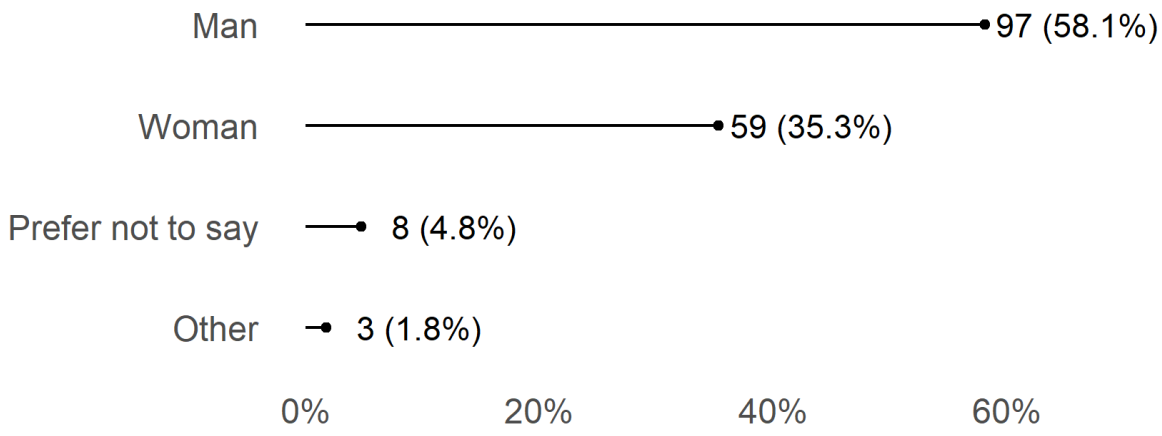

Figure 35. Please select the gender category that best describes you.

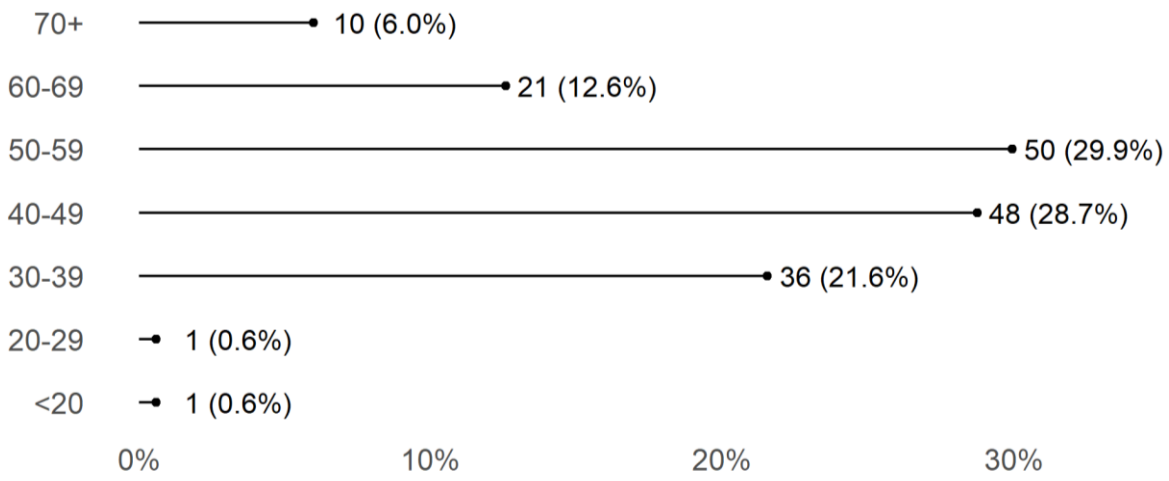

Figure 36. What is your age?

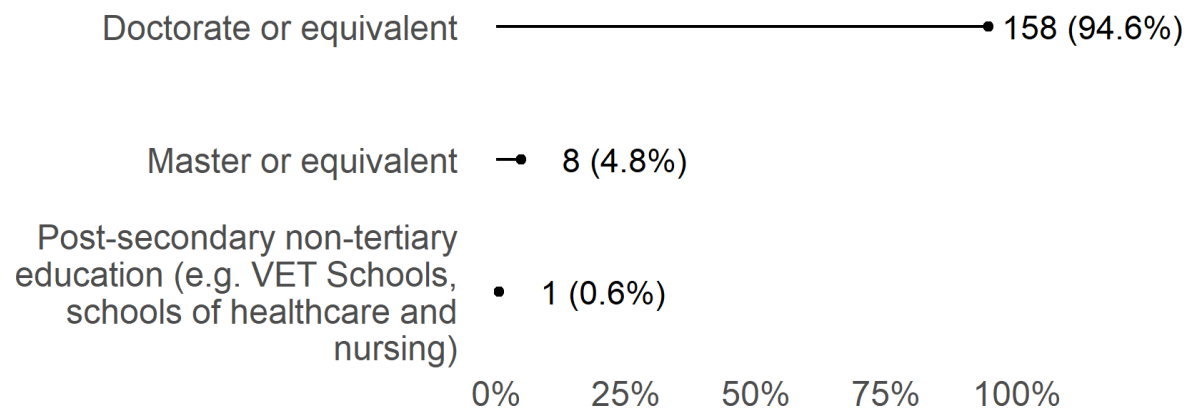

Figure 37. What is the highest education level you completed?

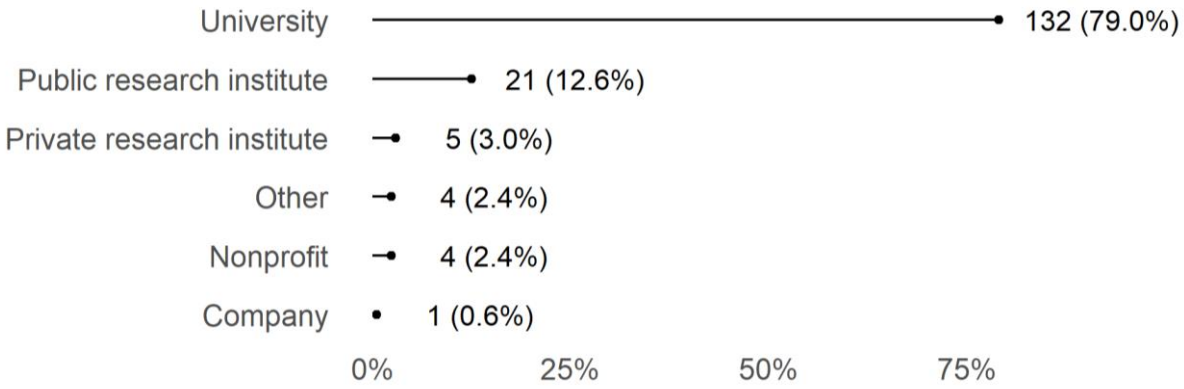

Figure 38. In what type of institution do you work?