Evaluation of Research Careers fully acknowledging Open Science Practices

Rewards, incentives and/or recognition for researchers practicing Open Science

Written by the Working Group on Rewards under Open Science
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Evaluation of Research Careers fully acknowledging Open Science Practices; Rewards, incentives and/or recognition for researchers practicing Open Science

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EUROPEAN COMMISSION

Evaluation of Research Careers fully acknowledging Open Science practices

Rewards, incentives and/or recognition for researchers practicing Open Science

edited by

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Directorate-General for Research and Innovation
2017 Open Science and ERA policy

Table of Contents

EXECUTIVE SUMMARY

Open Science represents an approach to research that is collaborative, transparent and accessible[1]. There are a wide range of activities that come under the umbrella of Open Science that include open access publishing, open data, open peer review and open research. It also includes citizen science, or more broadly, stakeholder engagement, where non specialists engage directly in research. Open Science goes hand in hand with research integrity and requires legal and ethical awareness on the part of researchers. A driver for Open Science is improving the transparency and validity of research as well as in regards to public ownership of science, particularly that which is publicly funded.

Researchers across Europe already practise Open Science to some extent through, for example, open access to their publications. Some already provide open data, engage in open peer review, and stakeholder engagement or citizen science. Researchers advance in their career through assessment and this is the key factor to ensure that Open Science becomes mainstream. The exclusive use of bibliometric parameters as proxies for excellence in assessment by most funding agencies and universities/research organisations does not facilitate Open Science. Researchers' engagement in Open Science will increase through encouragement and incentives from employers and funders through assessment.

Open Science offers researchers the means for greater transparency, reproducibility, dissemination and transfer of new knowledge[2]. OS provides greater access to data and publications which can improve the effectiveness and increased productivity of researchers (allowing more research from the same data). In an open environment there can be a more accurate verification of research results. These are examples of good reasons for researchers to practise OS.

In order to increase the practice of Open Science, it is critical that researchers, who are the key agents of change towards OS, are encouraged and incentivised. If OS practices (particularly open access, open data and stakeholder/citizen engagement) are to become mainstream then,

- Research Performing Organisations (RPOs) should be strongly encouraged to include OS practices in the evaluation of performance and of career development,
- Research Funding Organisations (RFOs), at regional, national, EU and international level, should be strongly encouraged to include OS practices in the evaluation criteria for funding proposals and as part of the assessment of the researchers.

The Open Science Working Group on Rewards/Recognition was created with the mandate (approved by the Open Science Policy Platform) to make recommendations in order that all researchers in Europe are recognised and rewarded for practising Open Science.

The following tasks were taken on:

- Promote a discussion with stakeholders on the current reputation system in the context of the standing ERAC groups and the Open Science Policy Platform (OSPP) which will work on the concretisation of a European Open Science Agenda;
- Within the OS environment, reflect about and propose alternative methods to recognise contributions to OS, including 'rewards and incentives' taking into account diversity in experience and career paths, while guaranteeing fair and equal career development of individual scientists;
- Propose new ways/standards of evaluating research proposals and research outcomes taking into consideration all OS activities of researchers, possibly recommending to pilot them under certain calls of Horizon 2020;
- Identify existing good practices on how OS issues are already taken up by researchers, research performing institutions and research funding institutions in Europe.

The results of the OS Rewards WG are practical recommendations that can be adopted by policy makers, funders, employers and researchers to promote the practice of Open Science. Funding agencies and research performing organisations must work in tandem to ensure that researchers are recognised and rewarded for practising Open Science. The report focuses on recommendations at policy and practical level to promote the engagement of researchers in Open Science. It provides a clear plan for incentivising and encouraging researchers to practise Open Science through recognition and rewards for recruitment, career progression and funding grants.

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[1] http://ec.europa.eu/research/openscience/index.cfm?pg=home&section=monitor

[2] https://www.fosteropenscience.eu/content/impact-open-science
https://www.innovationpolicyplatform.org/content/rationales-and-impact-open-science

The Career Evaluation Matrix

It is important to go beyond Open Science and frame this discussion in the broad context of the evaluation of researchers. European and indeed national policy across Europe promotes the mobility of researchers across borders, disciplines and sectors. Combined with Open Science, this can only be achieved if a far more comprehensive assessment of researchers by their employers and funders is introduced. For example, researchers who spend time in industry are clearly hindered in attempting to move back to academia, as they do not focus on academic publications as part of their industry work. To take into account this broad agenda requires a multidimensional approach that includes a range of evaluation criteria for researchers in all sectors, in all scientific domains and at all career stages. This also applies to the recognition of Open Science activities In terms of the focus of the ERA Priority 3, the recognition of Open Science in the recruitment process of researchers will be critical. The same must hold for career progression and research grant assessment.

There is often a focus on the emerging generation of doctoral candidates and postdoctoral researchers. However any changes to how researchers are evaluated must permeate through all stages of the researcher's career; in terms of the European Framework for Research Careers (EFRC) from First Stage Researcher (R1) through Recognised Researcher (R2) and Established Researcher (R3) to Leading Researcher (R4). This will be absolutely necessary if the practice of Open Science is to be embedded in the entire researcher community. In developing a system to evaluate and recognise engagement in Open Science, the full spectrum of OS activities must be taken into account. These include open access to publications, open data, open peer review, research integrity, citizen science and stakeholder engagement.

In general, evaluating a researcher cannot be reduced to a number because their merits and achievements are a complex set of different variables, difficult to be summarised by a single figure. A better approach is through multi-dimensional criteria evaluation, taking into consideration what is expected from a researcher and what is relevant for his/her career/recruitment.

The Open Science Career Assessment Matrix (OS-CAM) in Figure 1 represents a possible, practical move towards a more comprehensive approach to evaluating researchers through the lens of Open Science. This incorporates broader aspects of being an excellent researcher, such as service and leadership, research impact and contribution to teaching, many of which are starting to be included in research performing organisations' job descriptions and promotion criteria. The OS Career Assessment Matrix (OS-CAM) describes how these broader aspects can be taken into account in the context of recognising researcher's contributions to Open Science.

Figure 1. Open Science Career Assessment Matrix (OS-CAM) representing the range of evaluation criteria for assessing Open Science activities

Open Science Career Assessment Matrix (OS-CAM)	
Open Science activities	*Possible evaluation criteria*
RESEARCH OUTPUT	
Research activity	Pushing forward the boundaries of open science as a research topic
Publications	Publishing in open access journals Self-archiving in open access repositories
Datasets and research results	Using the FAIR data principles Adopting quality standards in open data management and open datasets Making use of open data from other researchers
Open source	Using open source software and other open tools Developing new software and tools that are open to other users
Funding	Securing funding for open science activities
RESEARCH PROCESS	
Stakeholder engagement / citizen science	Actively engaging society and research users in the research process Sharing provisional research results with stakeholders through open platforms (e.g. Arxiv, Figshare) Involving stakeholders in peer review processes
Collaboration and Interdisciplinarity	Widening participation in research through open collaborative projects Engaging in team science through diverse cross-disciplinary teams
Research integrity	Being aware of the ethical and legal issues relating to data sharing, confidentiality, attribution and environmental impact of open science activities Fully recognizing the contribution of others in research projects, including collaborators, co-authors, citizens, open data providers
Risk management	Taking account of the risks involved in open science
SERVICE AND LEADERSHIP	
Leadership	Developing a vision and strategy on how to integrate OS practices in the normal practice of doing research Driving policy and practice in open science

	Being a role model in practicing open science
Academic standing	Developing an international or national profile for open science activities Contributing as editor or advisor for open science journals or bodies
Peer review	Contributing to open peer review processes Examining or assessing open research
Networking	Participating in national and international networks relating to open science
RESEARCH IMPACT	
Communication and Dissemination	Participating in public engagement activities Sharing research results through non-academic dissemination channels Translating research into a language suitable for public understanding
IP (patents, licenses)	Being knowledgeable on the legal and ethical issues relating to IPR Transferring IP to the wider economy
Societal impact	Evidence of use of research by societal groups Recognition from societal groups or for societal activities
Knowledge exchange	Engaging in open innovation with partners beyond academia
TEACHING AND SUPERVISION	
Teaching	Training other researchers in open science principles and methods Developing curricula and programs in open science methods, including open science data management Raising awareness and understanding in open science in undergraduate and masters' programs
Mentoring	Mentoring and encouraging others in developing their open science capabilities
Supervision	Supporting early stage researchers to adopt an open science approach
PROFESSIONAL EXPERIENCE	
Continuing professional development	Investing in own professional development to build open science capabilities
Project management	Successfully delivering open science projects involving diverse research teams
Personal qualities	Demonstrating the personal qualities to engage society and research users with open science Showing the flexibility and perseverance to respond to the challenges of conducting open science

The matrix provides a framework that can be used to develop evaluation systems that can be applied in various contexts: at individual level for the purpose of recruitment and promotion, at individual or group level in the evaluation of grant and fellowship applications or adapted to develop institutional funding allocation models or incentives focused on building open science capacity.

The criteria are expressed as "doing" Open Science, but can be adapted to recognise a more introductory or advanced level. For example, they could range from "learning about OS" for First Stage Researchers, to "doing OS" for Recognised Researchers, "supporting others in OS" for Established Researchers and eventually to "shaping policy and practice in OS" for Leading Researchers.

An important aspect of this approach is that the weighting for each criterion should reflect the background of the researcher being evaluated. For example, if a researcher is seeking a position in academia from industry then it will be unlikely that he/she has been heavily engaged in publications or open data, but will bring strengths in other areas. The open science criteria in this matrix illustrate the broad range of activities of researchers involved in Open Science. It is not expected that every researcher will be doing all of these activities.

While the **OS-CAM** can be populated with numbers and weighting this can only be part of the process. In any evaluation process, the wide diversity of researchers' experiences and capabilities are such that good decisions require qualitative judgement, preferably by a panel of independent researchers who, respecting the principles of openness, transparency and merit[3], assess the range of a researcher's achievements, whether this be for a new position, career advancement or for a funding grant.

Conclusions

For the practice of Open Science to become mainstream, it must be embedded in the evaluation of researchers at all stages of their career (R1-R4). This will require universities to change their

[3] https://cdn1.euraxess.org/sites/default/files/policy_library/otm-r-finaldoc_0.pdf

approach in career assessment for recruitment and promotion. It will require funding agencies to reform the methods they use for awarding grants to researchers. It will require senior researchers to reform how they assess researchers when employing on funded research projects. This is about changing the way research is done, who is involved in the process and how it is valued; evolving from a closed competitive system to one that is more open and collaborative. Overall, a cultural change is needed in organisations and in the research community for the promotion of and engagement in Open Science.

Evaluating a researcher cannot be reduced to a number because their merits, achievements, usefulness are a complex sets of different variables, impossible to be summarised by a single figure. It should be made clear that a multi-dimensional approach to the evaluation is by far more reliable than the 'single figure' one and it provides a more realistic proxy of the measurement of quality. It should be done through multi-dimensional evaluation criteria. The OS Career Assessment Matrix (OS-CAM) can be used for this purpose, taking into consideration what is expected from a researcher and what is relevant for the specific post, grant or career advancement.

This new approach will take time, needs to be well-planned and its implementation continuously monitored and improved. The outcome of this change must be to improve the quality of science in its own right in a manner that ensures research integrity and greater peer and public engagement in research. Most importantly, it must mainstream the practice of Open Science through incentivising researchers with recognition and rewards.

This will require feasibility studies and pilot exercises to ensure that the approach achieves the desired outcome. It must be recognised that there cannot be a one size fits all approach, given the difference between disciplines and institutional structures.

Recommendations

1. To change the culture and further engage the entire researcher community in the practice of Open Science a more comprehensive recognition and reward system incorporating Open Science must become part of the **recruitment criteria, career progression and grant assessment procedures** for researchers at all levels (R1-R4).
2. Where needed, there should be a review of **ERA policies, ERA roadmaps and National Action Plans through the lens of Open Science**. If necessary, policies must be updated in order to ensure compatibility with Open Science.
3. At European level all means to **encourage and incentivise researcher participation in Open Science** through support and funding mechanisms should be pursued. This should include,
   - The **Human Resources Excellence in Research Award (HRS4R)**[4] integrating Open Science assessment criteria for researcher recruitment, career progression and grant evaluation;
   - Open Science activity by researchers should become **a cross cutting theme in all of the Work Programmes of Horizon 2020 and, most importantly, in the future Framework Programme, FP9**.
   - At **national, regional and institutional** level, best efforts should be made to integrate the recognition and rewards for researchers engaging in Open Science into existing and future funding mechanisms.
4. The assessment of researchers during recruitment, career progression and grant evaluation should be structured to encompass the full range of their achievements including Open Science. This **multi-dimensional approach could be implemented using the instrument OS-Career Assessment Matrix (CAM)** that takes into consideration the full range of achievements to reflect diverse career paths. There should also be a validation process on the content and feasibility of the OS-Career Assessment Matrix (CAM) in researcher assessment at European, national, regional and organisational level as well as taking into account the wide spectrum of disciplines, research funding and research performing organisations.

[4] https://euraxess.ec.europa.eu/jobs/hrs4r

1. INTRODUCTION

"Policies to promote Open Science should include incentives and not just mandates"

Carlos Moedas 2017

Open Science represents an approach to research that is collaborative, transparent and accessible[5]. There are a wide range of activities that come under the umbrella of Open Science that include open access publishing, open data, open peer review and open research. It also includes citizen science, or more broadly, stakeholder engagement, where non specialists engage directly in research. Open Science goes hand in hand with research integrity and requires legal and ethical awareness on the part of researchers. A driver for Open Science is improving the transparency and validity of research as well as in regards to public ownership of science, particularly that which is publicly funded.

Researchers across Europe already practise Open Science to some extent through, for example, open access to their publications. Some already provide open data, engage in open peer review, and stakeholder engagement or citizen science. Researchers advance in their career through assessment and this is the key factor to ensure that Open Science becomes mainstream. The exclusive use of bibliometric parameters as proxies for excellence in assessment by most funding agencies and universities/research organisations does not facilitate Open Science. Researchers' engagement in Open Science will increase through encouragement and incentives from employers and funders through assessment.

The expected results of the OS Rewards WG[6] are practical recommendations that can be adopted by policy makers, funders, employers and researchers to promote the practice of Open Science by researchers. Funding agencies and research performing organisations must work in tandem to ensure that researchers are recognised and rewarded for practising Open Science. The report focuses on recommendations at policy and practical level to promote the engagement of researchers in Open Science. It provides a clear plan for incentivising and encouraging researchers to practise Open Science through recognition and rewards for recruitment, career progression and their evaluation in funding grants.

Researchers at all levels are the key to practising Open Science and it will be important that European and national policies that relate to their career development ensure that they are still compatible with Open Science. For example, the overarching European policy for researchers is the European Charter for Researchers and Code of Conduct for their Recruitment[7]. This policy document was published in 2005 and is a set of general principles and requirements which specifies the roles, responsibilities and entitlements of researchers as well as of employers and/or funders of researchers. While the term "Open Science" does not appear in the Charter and Code its principles are consistent with the pursuit of Open Science.

Open Science itself is not a new initiative but has been a trend in many disciplines for a number of years. The move to open access to publications (also under ERA Priority 5[8]) has been under development in many countries and there is for example the EU project OpenAIRE[9] .This has been accompanied by an explosion in the numbers of online open publications, the PLoS range[10], for example. Indeed some disciplines like physics started this trend many years ago, by using almost systematically ArXiv, a preprint (or prepublication) open platform freely accessible on the Web which turned out to be suitable as an open discussion forum. Even the traditional "prestige publishers" recognise the need to move to Open publications, including Nature Communications, ACS Omega, Royal Society Open Science and Scientific Reports.

The move to open data has been more recent. It proceeds from the same spirit of sharing, in order to facilitate reproducibility of results, a major concern in science, and to allow reuse of data as a springboard for further research. However, open data raises a number of challenges from the complexity of sharing large data in a meaningful way and generates issues pertaining to confidentiality, particularly in the medical field.

Researchers are also becoming more open in the way they conduct their research. The drive to demonstrate the impact of research has led to researchers engaging more closely with research users. There has been significant growth in engaging society in, for example, the formulation of

[5] http://ec.europa.eu/research/openscience/index.cfm?pg=home&section=monitor
[6] See Appendix I for details
[7] https://euraxess.ec.europa.eu/jobs/charter
[8] http://ec.europa.eu/research/era/era_communication_en.htm
[9] https://www.openaire.eu
[10] https://www.plos.org

research questions, in the composition of evaluation panels for research, or in stakeholder panels steering the research process.

Researchers become "open" when they conduct their research to ensure that:

- their publications are made available through open access;
- their data is made available through open data;
- their research is utilising open platforms, tools and services;
- their research is being conducted in an open collaborative manner; or
- engage in open peer review and citizen science

However in doing so, they must be acutely aware of the need to sustain quality, take into account commercial interests, privacy, security and research integrity. All of these require training that should begin at latest during the doctorate. This creates a greater demand on institutions to provide the necessary skills training which is dealt with in a parallel Open Science Working Group on Skills. Enhanced infrastructure is needed to store high volumes of data along with new staff technical expertise data stewardship and management.

Changing practice from the traditional approach in most disciplines will require a fundamental change in the way scientists carry out research. In order for this to be encouraged and incentivised, this changed approach must be recognised and rewarded by both employers (when recruiting and promoting researchers) and research funders (when performing peer review of researchers in grant applications). Moreover senior researchers must play a key role in this change as they are highly influential in the recruitment/promotion of researchers and conduct of peer review both for funding agencies and publishers.

The approach of the group to this issue of recognition and rewards is rooted firmly in the context of researcher career development and closely linked with ERA Priority 3, an open labour market for researchers[11].

Chapter 2 provides background information on Open Science in relation to ERA policy, researcher assessment and career framework. It also describes different aspects of Open Science including Open Data, Open Peer Review and Citizen Science. In Chapter 3, the limitations of current recognition and reward processes are presented, with suggestions on how to alleviate these and how new paradigms can be envisioned and implemented.

An illustration of taking a comprehensive approach to researcher assessment using the Open Science Career Assessment Matrix (OS-CAM) that recognises Open Science is presented Chapter 4. There is a brief analysis of the ERA Partnership policies and how Open Science can be included in the Human Resources Strategy for Researchers. Chapter 5 presents the results of a survey carried on Research Funding and Research Performing Organisations focusing on their approach to recognition and rewards for researchers engaged in Open Science. In addition, some good practice examples from across Europe are given.

[11] http://ec.europa.eu/research/era/era_communication_en.htm

2. BACKGROUND AND CONTEXT

"Open Science represents a new approach to the scientific process based on cooperative work and new ways of knowledge distribution using digital technologies and new collaborative tools." (OSPP[12])

2.1 Context of European Open Science policy and European Research Area policy

At one level, Open Science is often perceived as simply the sharing of research results through open access to publications and data. This is only a partial view of Open Science as the practice of Open Science brings about a fundamental change in how researchers carry out their work and disseminate the results. From a policy perspective we need to ensure that Open Science is firmly linked to ERA policy as the latter is anchored in the TFEU[13]. Linkages exist in particular through Priority 3 of ERA, "Open Labour Market for Researchers" and Priority 5, "Optimal Circulation and transfer of Scientific Knowledge". As the implementation of ERA is through the multi annual Framework Programmes, these can also be a vehicle for implementing Open Science policy. The current Framework Programme, Horizon 2020, provides an opportunity for pilot measures. The long term opportunity is embedding recognition and rewards for Open Science in FP9, the next Framework Programme.

Focusing on the open labour market for researchers, current policies stretch back to the original ERA concept (Lisbon Agenda 2000[14]) of striving for a Europe with the freedom of movement of people and knowledge. This has over the intervening years resulted in a number of initiatives at European level from hard to soft law. For example the Third Country Directive (2005)[15], a legally binding requirement, and the European Charter for Researchers and Code of Conduct for their Recruitment[16], that is voluntary. The latter has been strengthened in recent years with its inclusion as a requirement within the Model Grant Agreement for Horizon 2020. The Charter and Code require that researchers have access to professional development opportunities; these can include those skills necessary for Open Science.

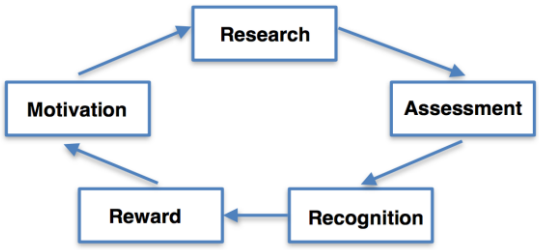
The concept of an open labour market is to ensure that researchers can move freely across borders, sectors and disciplinary boundaries. Open Science is a new way for researchers to work in an open collaborative manner, sharing data and publications. Collaboration stretches beyond the scientific community to engage citizens in the research process. The practice of working openly and collaboratively also promotes far greater integrity in the research process itself. If a researcher works in a scientifically open manner, research integrity will be preserved/monitored 'more easily' by their peers. This is a far more comprehensive view of Open Science rather than simply the practice of sharing data.

2.2 Open Science and Researcher Assessment

Researchers are motivated by curiosity and the desire to advance their subject area. However in order to progress their work must be recognised through assessment leading to the reward of a, for example, a funding grant, new job or promotion. The ERA Priority 3 promotes greater transparency and openness in recruitment of researchers and their career development. However the current mechanisms for recruitment, career progression and access to research funding grants is limited as it often focuses on a very narrow aspect of research activity, namely publications as a unique indicator of research quality in "prestigious" journals .

[12] European Commission Open Science Policy Platform: http://ec.europa.eu/research/openscience/index.cfm?pg=open-science-policy-platform
[13] Treaty on the Functioning of the European Union, http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A12012E%2FTXT
[14] http://www.europarl.europa.eu/summits/lis1_en.htm
[15] http://eur-lex.europa.eu/legal-content/en/TXT/?uri=celex%3A32005L0071
[16] https://euraxess.ec.europa.eu/jobs/charter

Figure 2. Research Reward Cycle



There should be a system in place that drives the virtuous cycle summarised in Figure 2 in the context of Open Science. There should be a clear focus on the researcher and on the quality of his/her scientific production more than on its quantitative measurement. Harmonisation of recognition and reward of researchers with the basic aims of Open Science is a necessary condition for promoting research excellence.

2.3 Open Science and the Researcher Career Framework

Researchers are not an amorphous community but fall into clearly defined categories as encapsulated in the European Framework for Research Careers (EFRC)[17], from First Stage Researcher (R1) through Recognised Researcher (R2) and Established Researcher (R3) to Leading Researcher (R4). Open Science needs to be embedded in the evaluation of researchers at all stages of their career (R1-R4). This will require universities and research institutes to change their approach in career assessment for recruitment and promotion. Funding agencies will have to reform the methods they use for awarding grants to researchers as well. However, the needs and responsibilities of each category will be different.

Collectively, senior researchers (R4) are in a position to change the current evaluation system. They assess researchers on behalf of their employer for recruitment and career progression. They also assess researchers and their work for funding agencies and publishers through peer review. Research Performing and Research Funding Organisations together with senior researchers should take the lead and change how quality is measured so as to incorporate Open Science (and other achievements of quality). This will incentivise researchers to practise Open Science.

2.4 Open Science

Open science encompasses a wide range of activities including open access to publications, open data, open peer review and stakeholder engagement or citizen science. Open data, for example, is quite different from open access to publications as it is relatively easy to place these on an open access repository. Sharing data is not in the habits of many of the scientific community[18] and often subject to legal and financial constraints, although widely recognised as essential to accelerate the progress of science and to prevent scientific fraud. A good example of the reluctance of researchers to engage in Open Science is the Open Data Research Pilot (ORD Pilot) in Horizon 2020[19]. This was designed to promote the opening up of data from H2020 projects. However many researchers did not see any incentive to invest time and funds to making their data open and opted out (see Appendix 3). Open sharing of research data is important[20] if crucial information is not to be lost[21] but does require concerted institutional management[22]. An important part of increasing the sharing of data is access of researchers to Open Science skills[23] and the development of the European Open Science Cloud (EOSC)[24] to provide the infrastructure store data.

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[17] https://euraxess.ec.europa.eu/europe/career-development/training-researchers/research-profiles-descriptors
[18] Note that there are disciplines, including astronomy and genomics, where the immediate sharing of research data is expected and provides significant benefits
[19] http://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/hi/oa_pilot/h2020-hi-oa-pilot-guide_en.pdf
[20] http://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/hi/oa_pilot/h2020-hi-oa-pilot-guide_en.pdf
[21] http://www.upi.com/Science_News/2013/12/19/80-percent-of-scientific-data-from-publicly-funded-research-is-lost-within-two-decades/8781387477327/#ixzz3PYcUxswu
[22] http://www.dcc.ac.uk/resources/briefing-papers
[23] This is the subject of another OSPP expert group that focuses on Open Science Skills.
[24] https://ec.europa.eu/research/openscience/index.cfm?pg=open-science-cloud

Open peer review should be seen as an umbrella term for a number of overlapping methods that adapt peer review models in line with the ethos of Open Science, including making reviewer and/or author identities open, publishing review reports or enabling greater participation in the peer review process[25]. According to some experts[26] open and transparent peer reviewing is increasing[27] and some have launched attempts in this direction[28].

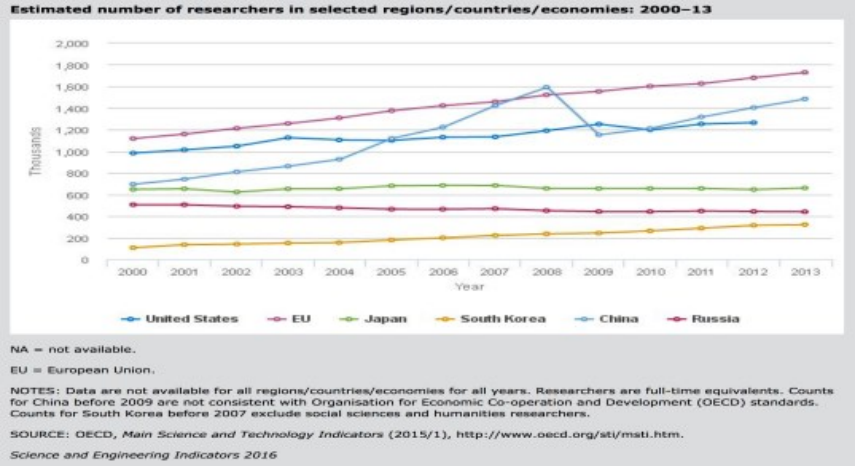
3. ASSESSMENT AND RESEARCHER CAREER PROGRESSION

Researchers will fully engage in Open Science if they are motivated though recognition and reward through recruitment, career progression and funding agency evaluation processes.

3.1 Researcher Assessment

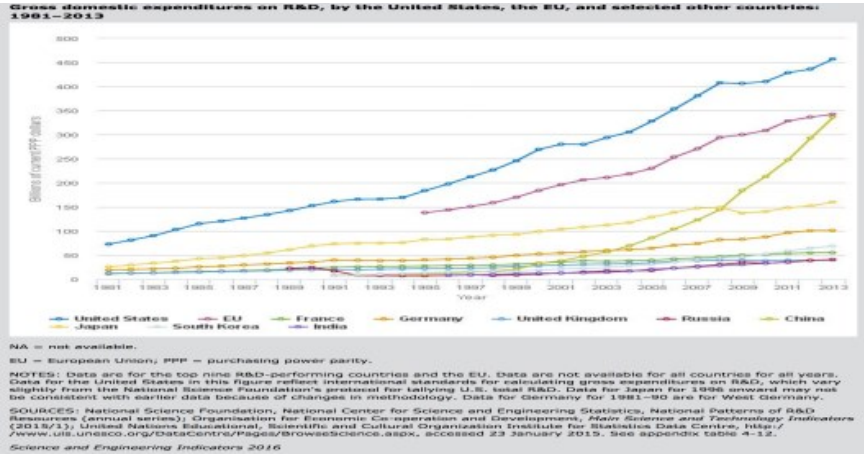
In the past scientific excellence was quickly recognised by peers but that was in the context of a small research community. Already in the period 2007 to 2015 the global population of researchers (Figure 3) increased by 20% to an estimated total of 7.5 million[29]. Europe has 22% of this total making it the largest labour market for researchers in the world. The change over time is due to an expansion on the size of the research system that has increased investment in research and as a consequence an increased investment in the number of researchers. Governments invest significant amounts of public funds in research and require accountability (Figure 4). Funding agencies have the mandate to distribute research funding in an efficient and effective manner.

Figure 3. Estimated number of researchers in selected region



[25] What is open peer review? A systematic review, Ross-Hellauer (2017) https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5437951/
[26] http://www.nature.com/nature/peerreview/debate/nature04991.html
[27] http://blog.f1000research.com/2014/05/21/what-is-open-peer-review/
[28] *The Self Journal of Science* (http://www.sjscience.org); RIO (http://riojournal.com/about) and a few others: http://www.openscholar.org.uk/open-peer-review/; http://rsos.royalsocietypublishing.org/content/open-peer-review-royal-society-open-science ; http://p2pfoundation.net/Open_Peer_Review
[29] UNESCO Science Report Towards 2030 http://en.unesco.org/ unesco_science_report

Figure 4. Gross domestic expenditure on R&D by the US, Europe and a number of leading countries between 1981 and 2013



The conflation of these goals has led to a move to a system based on metrics facilitated by the growth of bibliometrics that provide seemingly simple numbers to estimate quality. Every procedure of evaluation – and, in particular, the use of metrics-based indicators – induces researchers in developing career strategies favouring quantity over quality. This strong trend can lead to over production of research publications, duplications, plagiarism and scientific fraud.

Today, both evaluation and selection are often resting on prestige[30], which has always been a major criterion of judgment in society. Prestige is partly built on real values and specific qualities (strength, intelligence and skills) but it can be strongly influenced by indirect factors (heredity, courtship or clubbing). Prestige-based assessment of research and researchers can be misleading[31], and it can reinforce the dominant power of publishing companies[32].

With the development of Open Science, new evaluation criteria are needed to further support researchers' careers and recruitment. Assessment must be fair and must offer all guarantees of treating every applicant equally.

In order to reduce costs and administrative overhead, some funding agencies are moving away from panel based reviews. The plethora of publication data available on various platforms and the use of remote evaluation through online systems make evaluations more efficient (from a process point of view). While metrics may provide an indication of researchers' experience and excellence, the collective view of a panel of peers can arrive at a more comprehensive and accurate evaluation.

3.2 Beyond the Impact Factor

In terms of metrics, evaluation is mainly based on researchers' prestige, which, very often, is inferred from the prestige of the journals in which researchers publish their works. The journals' prestige is in turn based mainly (if not only) on the Journal Impact Factor (JIF). Several works demonstrate clearly the disruptive value of the JIF: the vast majority of authors are taking advantage of the citations gathered by a small minority. Due to the shape of the frequency distribution of the number of citations (an over-dispersed distribution, where a few articles have a very high number of citations, and the vast majority articles have a few or, even, zero) calculating an 'average' figure and attributing it to all articles makes no sense[33].

For example, a study was carried out on all 1,944 articles published in Nature in 2012 and 2013 and looked at how many times each one has been cited in 2014. Only 75 of them (3.8%) provide 25% of the journal's citations, hence of the journal's impact factor (IF = 41.4) and 280 (14.4%) do account for half of the total citations & IF while 214 (11%) get 0 or 1 citation. The graphic representation in Figure 5 is even more striking.

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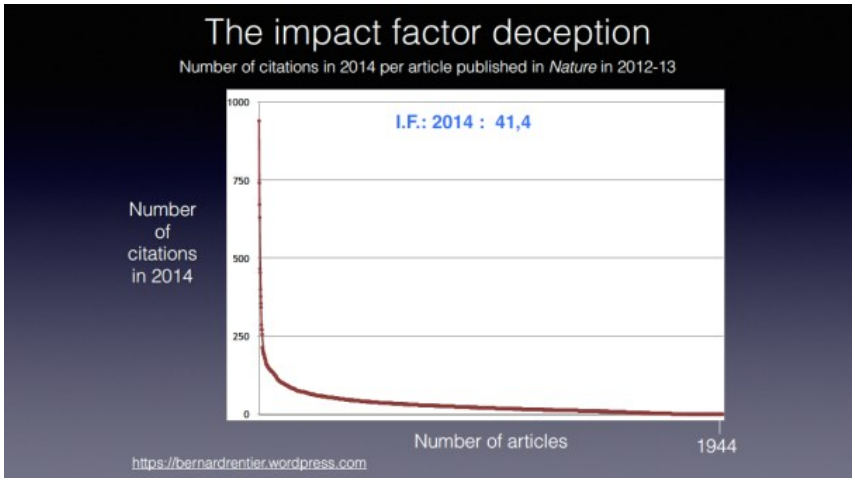
[30] http://legacy.earlham.edu/~peters/writing/jbiol.htm;https://books.google.be/books?id=SW_6Q_I5R-cC&printsec=frontcover&dq=inauthor:%22Serge+Lehky%22&hl=fr&sa=X&ved=0ahUKEwi4xpeI973LAhWBkQ8KHSqPD8UQ6AEICjAA#v=onepage&q&f=false

[31] http://occamstypewriter.org/scurry/2015/12/04/jolly-good-fellows-royal-society-publishes-journal-citation-distributions/; https://bernardrentier.wordpress.com/2015/12/31/denouncing-the-imposter-factor/

[32] https://www.timeshighereducation.com/news/high-rejection-rates-by-journals-pointless

[33] Measuring Up: Impact Factors Do Not Reflect Article Citation Rates V. Kremer et al http://blogs.plos.org/plos/2016/07/impact-factors-do-not-reflect-citation-rates/
Time to remodel the journal impact factor, Nature Editorial, Nature, VOL 535 | 28 JULY 2016 http://www.nature.com/news/time-to-remodel-the-journal-impact-factor-1.20332

Figure 5. Number of 2014 citations for each article published in Nature during 2012-2013



This goes to show that most Nature authors do benefit from an IF generated by the few (if one admits that citation is a valid assessment indicator, of course). This does not take away the fact that a high impact factor is a legitimate measurement of the prestige of a journal.

3.3 New Means of Measuring Quality

Several authors[34] have called for an alternative to the journal impact factor (JIF). In 2013, the American Society for Cell Biology and several scientific journals launched the San Francisco Declaration on Research Assessment, DORA [35], intended to end the practice of using the impact factor of journals to assess individual researchers or research groups or even institutions. To date, close to 13,000 institutions and individuals worldwide have signed the DORA, pledging to stop the JIF for inappropriate use such as individual researcher evaluation or assessment of research projects[36]. And yet only a handful of institutions who have signed it have actually implemented it. Review committees, assessment juries, funding organizations and academic authorities have continued using the journal impact factor as a determining element of judgement on the output of scientific research.

The DORA makes several suggestions, such as BioRxiv[37]. The British HEFCE has analysed[38] the question and Altmetric[39] has developed new methods. The Metric Tide[40] report provides a strong basis for developing the notion of responsible metrics. In tandem with the Leiden Manifesto[41] it includes the proposal that *"that quantitative evaluation should support – but not supplant – qualitative, expert assessment"*. Most importantly in the context of this report, both recommend a *"range of indicators to reflect and support a plurality of research and researcher career paths across the system"*.

Science must go back to cooperative rather than competitive processes and researchers must take advantage of the Internet revolution to do so[42]. The reading time will surely remain competitive – and even more so because of the growing scientific production[43].

These developments present an ideal opportunity for RFOS and RPOs to introduce a far more comprehensive assessment of researchers that will encourage and incentivise their participation in Open Science.

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[34] http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2126010/pdf/9056804.pdf
http://www.ncbi.nlm.nih.gov/pubmed/11953682
http://journals.plos.org/plosmedicine/article?id=10.1371/journal.pmed.0030291
[35] http://www.ascb.org/dora/
[36] http://dx.doi.org/10.3389/fnhum.2013.00291
[37] http://biorxiv.org
[38] www.hefce.ac.uk/pubs/rereports/Year/2015/metrictide/Title,104463
[39] https://www.altmetric.com
[40] http://www.hefce.ac.uk/pubs/rereports/year/2015/metrictide
[41] http://www.nature.com/news/bibliometrics-the-leiden-manifesto-for-research-metrics-1.17351
[42] https://www.digital-science.com/blog/guest/collective-collaborative-complementary-that-is-what-makes-the-oan-unique/ ; https://www.force11.org/about/manifesto
[43] http://www.cdnsciencepub.com/blog/21st-century-science-overload.aspx

4. OPEN SCIENCE AND RESEARCHER CAREER PROGRESSION

4.1 Towards a comprehensive research career assessment - the Open Science Career Evaluation Matrix (OS-CAM)

To encourage and recognise Open Science activities, it is important to go beyond Open Science and frame this discussion in the broad context of the evaluation of researchers. European and indeed national policy across Europe promotes the mobility of researchers across borders, disciplines and sectors. Combined with Open Science, this can only be achieved if a far more comprehensive assessment of researchers by their employers and funders is introduced. For example, researchers who spend time in industry are clearly hindered in attempting to move back to academia, as they do not focus on academic publications as part of their industry work. To take into account this broad agenda requires a multidimensional approach that takes into account a range of evaluation criteria for researchers in all sectors, in all scientific domains and at all career stages. This also applies to the recognition of Open Science activities In terms of the focus of the ERA Priority 3, the recognition of Open Science in the recruitment process of researchers will be critical. The same must hold for career progression and research grant assessment.

There is often a focus on the emerging generation of doctoral candidates and postdoctoral researchers. However any changes to how researchers are evaluated must permeate through all stages of the researchers' career; in terms of the European Framework for Research Careers (EFRC) from R1 to R4. This will be absolutely necessary if the practice of Open Science is to be embedded in the entire researcher community. In developing a system to evaluate and recognise engagement in the full spectrum of Open Science activities must be taken into account. These include open access to publications, open data, open peer review, research integrity, citizen science and stakeholder engagement.

To demonstrate the challenges ahead for introducing recognition of engaging in Open Science, take the case of skills for researchers. The broader skills that researchers acquire as part of the research process and those learnt formally (during their university curricula) are strongly promoted. For example, this is a requirement in the H2020 Marie Sklodowska Curie Actions and for many national funders of research across Europe. Advocating skills such as leadership and project management, for example), that support researchers in academia for moving to other employment sectors. However the skills acquired are not always included in researcher evaluation for promotion or funding. This is despite the fact that many of these skills are acquired through formal training and have associated ECTS or a professional qualification.

In general, evaluating a researcher cannot be reduced to a number because their merits and achievements are a complex set of different variables, difficult to be summarised by a single figure. A better approach is through multi-dimensional criteria evaluation, taking into consideration what is expected from a researcher and what is relevant for his/her career/recruitment.

The ***Open Science Career Assessment Matrix (OS-CAM)*** in Figure 6 represents a possible, practical move towards a more comprehensive approach to evaluating researchers through the lens of Open Science. This incorporates broader aspects of being an excellent researcher, such as service and leadership, research impact and contribution to teaching, many of which are starting to be included in research performing organisations' job descriptions and promotion criteria. The matrix illustrates how these broader aspects could be taken into account in the context of recognising researcher's contributions to Open Science.

Figure 6. Open Science Career Assessment Matrix (OS-CAM) illustrating the range of evaluation criteria for assessing Open Science activities

Open Science Career Assessment Matrix (OS-CAM)	
Open Science activities	*Possible evaluation criteria*
RESEARCH OUTPUT	
Research activity	Pushing forward the boundaries of open science as a research topic
Publications	Publishing in open access journals Self-archiving in open access repositories
Datasets and research results	Using the FAIR data principles Adopting quality standards in open data management and open datasets Making use of open data from other researchers

Open source	Using open source software and other open tools Developing new software and tools that are open to other users
Funding	Securing funding for open science activities
RESEARCH PROCESS	
Stakeholder engagement / citizen science	Actively engaging society and research users in the research process Sharing provisional research results with stakeholders through open platforms (e.g. Arxiv, Figshare) Involving stakeholders in peer review processes
Collaboration and Interdisciplinarity	Widening participation in research through open collaborative projects Engaging in team science through diverse cross-disciplinary teams
Research integrity	Being aware of the ethical and legal issues relating to data sharing, confidentiality, attribution and environmental impact of open science activities Fully recognizing the contribution of others in research projects, including collaborators, co-authors, citizens, open data providers
Risk management	Taking account of the risks involved in open science
SERVICE AND LEADERSHIP	
Leadership	Developing a vision and strategy on how to integrate OS practices in the normal practice of doing research Driving policy and practice in open science Being a role model in practicing open science
Academic standing	Developing an international or national profile for open science activities Contributing as editor or advisor for open science journals or bodies
Peer review	Contributing to open peer review processes Examining or assessing open research
Networking	Participating in national and international networks relating to open science
RESEARCH IMPACT	
Communication and Dissemination	Participating in public engagement activities Sharing research results through non-academic dissemination channels Translating research into a language suitable for public understanding
IP (patents, licenses)	Being knowledgeable on the legal and ethical issues relating to IPR Transferring IP to the wider economy
Societal impact	Evidence of use of research by societal groups Recognition from societal groups or for societal activities
Knowledge exchange	Engaging in open innovation with partners beyond academia
TEACHING AND SUPERVISION	
Teaching	Training other researchers in open science principles and methods Developing curricula and programs in open science methods, including open science data management Raising awareness and understanding in open science in undergraduate and masters' programs
Mentoring	Mentoring and encouraging others in developing their open science capabilities
Supervision	Supporting early stage researchers to adopt an open science approach
PROFESSIONAL EXPERIENCE	
Continuing professional	Investing in own professional development to build open science capabilities

development	
Project management	Successfully delivering open science projects involving diverse research teams
Personal qualities	Demonstrating the personal qualities to engage society and research users with open science Showing the flexibility and perseverance to respond to the challenges of conducting open science

The matrix provides a framework that can be used to develop evaluation systems that can be applied in various contexts: at the individual level for the purpose of recruitment and promotion, at the individual or group level in the evaluation of grant and fellowship applications or adapted for institutional funding allocation models or incentives focused on building open science capacity.

The criteria are expressed as "doing" Open Science, but can be adapted to recognise a more introductory or advanced level. For example, they could range from "learning about OS" for First Stage Researchers, to "doing OS" for Recognised Researchers, "supporting others in OS" for Established Researchers and eventually to "shaping policy and practice in OS" for Leading Researchers.

An important aspect of this approach is that the weighting for each criterion should recognise the background of the researcher being evaluated. For example, if a researcher is seeking a position in academia from industry then it will be unlikely that he/she has been heavily engaged in publications or open data, but will bring strengths in other areas. The open science criteria in this matrix illustrate the broad range of activities of researchers involved in Open Science. It is not expected that every researcher will be doing all of these activities, nor that all of them will be required for an individual position.

While some of the evaluation criteria in the OS-CAM matrix could be translated into numbers, weighting this can only be part of the process. In any evaluation process, the wide diversity of researchers' experiences and capabilities are such that good decisions require qualitative judgement, preferably by a panel of independent researchers who respecting the principles of openness, transparency and merit[44], assess the range of a researcher's achievements, whether this be for a new position, career advancement or for a funding grant. It is important for evaluators to consider profile and balance of the collective criteria.

To test the usability and robustness of the matrix, we are recommending a pilot of the proposed evaluation criteria within existing funding programmes. Specifically they could be piloted (under certain calls of Horizon 2020) based on the experience acquired by a similar pilot already driven by the European Commission[45].

4.2 Recognising and Rewarding Researchers in the Context of Open Science

Research Performing and Research Funding Organisations must be challenged into developing alternative methods of evaluation, minimising those based on the prestige of the journals where the scholarly articles have been published. It should be stated here that this report does not go into the details of specific metrics as there is another OSPP Expert Group focusing on Altmetrics[46].

Nevertheless, the ideas behind the Metrics Tide report[47] and the Leiden Manifesto[48] provide a good basis for the development of Open Science evaluation criteria. These documents highlight the risk of misusing impact factors, but they do identify appropriate circumstances and usages acknowledging the value of a combination of bibliometric indicators in highlighting the multidimensional aspects of a scientific career.

It is useful to also state the obvious that "rewards" come in many different forms and shapes, and that Open Science practices can be included in the evaluation criteria of many different phases in a researcher's career. It should be noted that a "reward" in the narrow sense of the term is an ex-post criterion (giving acknowledgement to something already achieved) but in the broader sense ex-ante "incentives" should also be included (i.e. one does not reward past performance but steer

[44] https://cdn1.euraxess.org/sites/default/files/policy_library/otm-r-finaldoc_0.pdf

[45] DG CNECT (http://postgrantoapilot.openaire.eu)
[46] https://ec.europa.eu/research/openscience/index.cfm?pg=altmetrics_eg
[47] http://www.hefce.ac.uk/pubs/rereports/Year/2015/metrictide/
[48] http://media.leidenuniv.nl/legacy/leiden-protocol-for-research-assessments-2015-2021-update-impact-matrix.pdf

future behaviour). The actual criteria / measuring tools may differ according to these different settings but the Open Science policy principles will remain the same. Example of rewards for Open Science include,

- Science Communication ("giving attention" is the most basic and cost-free type of reward, e.g. on university's website, in promotional events, etc.)
- Project proposal assessment
- PhD thesis examination
- Recruitment
- Promotion
- Funding allocation systems (e.g. REF, criteria in allocation models,…)
- Research Evaluation Exercises (e.g. site visits for quality assurance)
- Research prizes

4.3 Researcher Career Policy and Open Science

The purpose of ERA policy is to achieve a European unified research area open to the world based on the internal market, in which researchers, scientific knowledge and technology circulate freely. The current ERA policy focuses on the five priorities,

1. More Effective National Research Systems - Boosting investment and promoting national competition.
2. Optimal Transnational Cooperation and Competition - On common research agendas on grand challenges and infrastructures.
3. An Open Labour Market for Researchers - Facilitating mobility, supporting training and ensuring attractive careers.
4. Gender Equality and Gender Mainstreaming in Research - Encouraging gender diversity to foster science excellence and relevance.
5. Optimal Circulation, Access to and Transfer of Scientific Knowledge - To guarantee access to and uptake of knowledge by all.

These policy priorities were agreed in 2012[49] and were a means to focus the broad set of ERA policy initiatives. It is important to stress that they were agreed before Open Science had come to the fore in EU policy. There should be a full review of all ERA policies and in particular, the ERA partnership through the lens of Open Science. If necessary, policies must be changed in order to ensure compatibility with Open Science.

In terms of the mandate for this report, the focus is on priority 3 that concerns policy on researchers. The main policy is the European Charter for Researchers and Code of Conduct for their Recruitment. The European Charter for Researchers is a set of 41 general principles and requirements which specifies the roles, responsibilities and entitlements of researchers as well as of employers and/or funders of researchers. The Code of Conduct for the recruitment of researchers consists of a set of general principles and requirements that should be followed by employers and/or funders when appointing or recruiting researchers. The Charter and Code was developed in 2005 and while it has no explicit references to Open Science, it certainly has nothing to hinder Open Science. In broader ERA policy development in the context of Open Science it may be necessary to revisit the Charter and Code with an overarching document or preamble that makes explicit its compatibility with Open Science. That being said there is already the means to implement any changes and in particular ensure that Open Science skills are integrated into institutional training as part of researcher career development.

4.4 The Human Resources Strategy for Researchers (HRS4R)

The 'HR Strategy for Researchers' supports research institutions and funding organisations in the implementation of the Charter & Code in their policies and practices. As the application of the Charter and Code is mandatory for all Horizon 2020 contracts (Art. 32 of Model Grant Agreement), the HRS4R is the recommended means for implementation. The 'HR Excellence in Research' award,

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[49] '*A Reinforced European Research Area Partnership for Excellence and Growth'* , SWD(2012) 211 final, http://ec.europa.eu/research/era/pdf/era-communication/era-communication_en.pdf

attained after a thorough analysis of an institution's HR policies for researchers, identifies the institutions and organisations as providers and supporters of a stimulating and favourable working environment for researchers. This can become a means for encouraging the embedding of Open Science in institutional researcher HR policies and practices. A key part of an institution engaging in the HRS4R process is analysing current practice on researchers and identifying gaps. This leads to an action plan for change. This provides an ideal means for institutions to identify a path to fully engaging in Open Science.

Within or outside the HRS4R strategy, any institution can make a checklist to assess the level of institutional support for Open Science. A possible framework for this is the following:

a) **Facilitate Open Science (focused on removing barriers)**

- Invest in technical infrastructure (Green OA & data management)
- Engage in discussions to remove misunderstandings & misconceptions concerning Open Science.

b) **Support (help those who are already converted)**

- All of the above, plus:
- Provide practical information on e.g. the FAIR principles in data management[50]. Certain conditions may apply, the data may not always be fully open but they should be "as open as possible, as closed as necessary"; transparent and available on request
- Provide practical information on quality processes for stakeholder involvement
- Invest in collaboration, cross-overs, interdisciplinarity, meeting spaces for researchers and stakeholders
- Engage in discussions on Open Innovation

c) **Encourage (convince those who are not yet converted)**

- All of the above, plus:
- Acknowledge Open Science practices alongside other evaluation criteria
- Guide business collaboration in a direction of open innovation
- Set up promotional campaigns within the institution

d) **Enforce (make it compulsory)**

- All of the above, plus:
- Make Open Science practices compulsory in all evaluation criteria for the recruitment and career progression of researchers.

[50] https://www.force11.org/group/fairgroup/fairprinciples

5. OPEN SCIENCE RECOGNITION/REWARDS – SURVEYS AND GOOD PRACTICE

A survey has been launched to obtain feedback from universities on the one hand and from funding agencies on the other hand concerning their involvement and support in favour of the current evolution of scientific research called Open Science (in some instances, universities considered themselves as both academic institutions and funders, when they allocate intramural funds for research). Our main interest was in knowing whether these institutions are currently supporting this evolution and which concrete measures they have set up, if any, in order to encourage researchers to enter the new research paradigm.

NOTE OF CAUTION: It should be clear that these surveys cannot be considered as representative of the European scientific community. Questionnaires have been widely dispatched and responses have been sent on a voluntary basis. People with many different statuses have responded and some questions were obviously more targeted to specific groups (researchers or administrative staff of universities, for instance). Hence these enquiries have no ambition of reflecting accurately the opinions of a representative range of stakeholders in research. They have been built and should be viewed as purely indicative. Although no scientific conclusion can be drawn from them, some indications of current trends and awareness have been useful for the group to design recommendations.

For these reasons, the results have not been analysed and exposed in detail in this report, but all the collected data are available in Appendix 4.

The two surveys were conceived similarly but they show differences linked to their specificities. For clarity, we will cover them separately.

5.1 Survey overview

Universities

The survey aims at collecting information on European universities' procedures for researcher recruitment, promotion/progression and support in a growing "Open Science" environment, and to get a sense of how much this new evolution has or has not yet been reflected in the evaluation procedures and in the mentalities of the various juries and committees in charge of evaluation of research projects and of individual researchers or research teams. The status of the respondents ranges from administrative staff to level R1-R2-R3-R4 researchers and others.

First, the survey questions the perceived level of autonomy of the Institutions. Besides the intrinsic attractiveness of OS on researchers, less autonomous institutions are, to some extent, lead to align their activities according to what is expected from them by decision makers. A large variety of incentives can be awarded to researchers to encourage them in adhering to the OS principles, but they are dependent on the level the institutional autonomy. If a university has no grasp on whom it hires, at whichever level and with which kind of salary, its range of possible incentives for researchers is rather narrow.

We tried to find out whether universities have developed written merit assessment procedures, a general Open Science policy, clear and transparent criteria for the assessment of researchers' quality, skills, accomplishments, and which weight is being granted to each indicator.

Funders

The survey is aimed at perceiving how much funding organisations are supportive of Open Science and which incentives they are setting up in this respect, with what stringency they are controlling the good compliance with OS rules as well as whether and how they recognise merits in these matters.

5.2 Results of the Survey

Universities

Responses

244 fully completed responses have been received, from 154 universities (the survey allowed for more than one person at the same institution to respond).

A total of 79 % of the responders wished to be kept informed of the results of the survey.

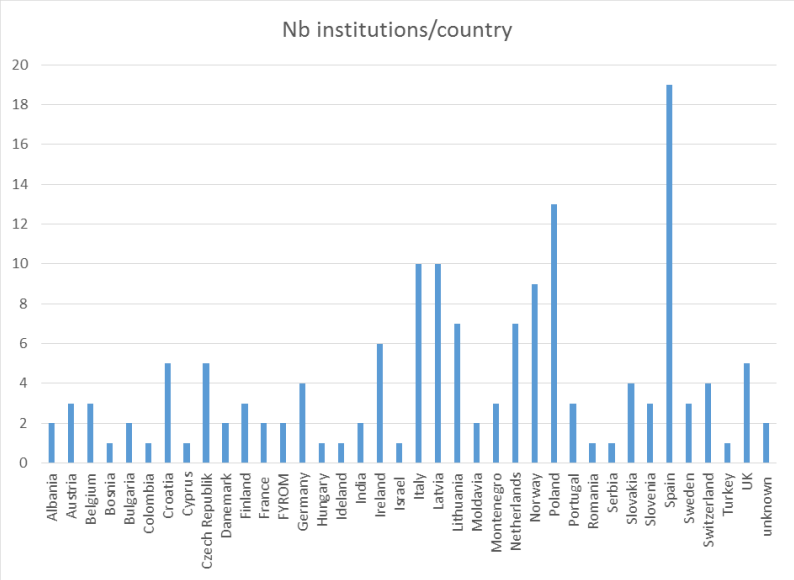
Status

The largest group was the researchers (54 %) of which two thirds were at the R3-R4 level. Administrative staff represented 44 %.

Distribution per country

Participation was widespread (37 different countries) although very unevenly distributed.

Figure 7. Distribution by country of survey respondants



Institutional autonomy

Approximately two thirds of the respondents consider that their institution is completely autonomous for the recruitment of researchers, for the promotion/progression of researchers and for providing financial support to researchers/research teams (grants, space, human resources, logistics, etc.), hence that they have a control on the those incentives, but only 25% declare the same about the setting of the salaries, mostly private universities or research centres. More than half consider that their institution is only partly autonomous in this respect, due to the legal constraints and official regulations, particularly concerning salaries. However, many respondents mentioned that their knowledge of the administrative procedures is too limited to answer questions on institutional autonomy.

Assessment standards and rules

Approximately one third of the respondents declared that their institution has developed written merit assessment procedures for the recruitment of researchers, for their promotion/progression, the setting of their salaries. 52 % know about written procedures to obtain financial support. However 14% to 20% are not aware of any written procedure for these matters.

Performance indicators

Research publications appeared to be the major element taken into account for evaluation of researchers' careers (68%), more than patents (35%), capacity to secure external funds (35%), teaching activities (34 %), interacting and collaborating with other researchers (32%) or industry (26%), participation in scientific conferences (31%), supervision of young researchers (25%), awards (23%), contribution to institutional visibility (17%), participation in science popularisation events (17%), community services and involvement (13%), in citizen science projects (12%) or in research commons (12%).

Considering scholarly publishing as an important indicator of quality for research activities, their number came up as the first or largely preferred criterion (80%), followed by the impact factor of the journals in which the work has been published (68%), the number of citations (61%) and the h factor or others (51%)

36% of institutions accounted largely or fully for variation by field in publication and citation practices while 52% do scrutinise indicators regularly and update them.

The assessment is seldom largely or fully based on qualitative evaluation of the research content after reading the publications (23%). It is more often based largely or fully on the journal's reputation such as the impact factor (64%) and not much on the number of citations (38%). Many universities (46%) do not take into account original research content presented outside of a traditional journal publishing framework (participatory websites, blogs, etc.).

Even though the San Francisco Declaration on Research Assessment (DORA) has been signed by over 13,000 universities worldwide, 62% of the responders don't know and 26% believe their institution did not. Among those (3%) who claim to know that their institution has signed the DORA, 77% estimate that the recommendations are being followed.

One respondent testified:

"Our institution has considered signing DORA and held intensive discussions on it. The overall conclusion was it would be unfair to sign a declaration and not be implementing it fully, for two reasons:

1) We have a responsibility to inform the younger generation of researchers about career opportunities. In a large number of disciplines, impact factors help to identify prestigious journals. We cannot be blind to this reality: publishing in these journals will enhance their career opportunities more than publishing elsewhere. We have a duty to inform our researchers about this AND at the same time raise awareness about the pitfalls of impact factors.
2) Our national funding system weighs publications according to journal rankings. We cannot ignore this context as it has a huge impact on our university's funding allocation. Our university's evaluation policy has made an explicit statement about the sensible use of impact factors, based on the Leiden Manifesto.

For previous questions and the next one, we ticked the box "YES" but we are in progress to implement the institutional repository (IR), the guidelines for researchers and the strategy / policy for the institution. The objective is to be operational in January 2018.".

Several responders specified that a limited number of publications chosen by the author are qualitatively assessed, claiming that in their institution, it is the overall collective impression of the research quality that counts mostly.

One respondent claimed that they assess researchers on their

"Consistent record of published research in peer-reviewed journals and conference publications", and *"High quality writing for academic and practitioner audiences, with evidence of ability to publish at national and international level"*

Another respondent wrote:

"Through the Research Excellence Framework researchers are assessed on things like number of publications, citations, journal impact and other citation-based indicators. While the REF only takes place every 7 years (last in 2014, next in 2021), these same indicators are considered when reviewing a researcher for advancement and promotion, and at annual Performance and Development Reviews."

Original research content presented outside of a traditional journal publishing framework is generally not taken into account during the researcher's assessment, unless it is also published in a recognised journal. However 27 % consider it should be evaluated positively as it reflects open communication. Among those who admit that it is viewed negatively, a large majority feels it is inappropriate and that such an attitude should be modified in the future. Some consider it is bypassing the necessary guarantee of the peer review.

For humanities, it is generally stated that monographs are the number one criterion.

Most institutions are basing their assessments on the opinion of in-house committee members (65%, only 9% never do), slightly less on that of external experts (59%, while 14% never do).

Open Access

Open Access is well known by the respondents: 73% know how researchers can open the access to their publications. Among the 27% who do not, it is interesting to note that more than half of them (58%) would like to know more about it.

Only 42% of responders claimed that their institution has an official policy on open access to scientific publications (20% don't know). That leaves 38% of institutions whose members consider there is no official in-house policy on this topic.

Concerning institutional repositories, 60% of the responders' universities have one, 17% don't and a surprisingly high number (23%) don't know if there is one. The deposit is mandatory for 31% of the responders' institutions and 68% believe that ignoring to this mandate can have a negative effect in an assessment procedure.

Training sessions on OA are being organised in 46% and official guidelines are provided in a similar number.

Only 36% are aware of an institutional monitoring of which and how many, what proportion, of the publications by their researchers are openly accessible, full text.

Some respondents assume that demand for this issue is low among researchers. When it is high, support and training are sometimes performed outside the university. However, when no specific service is provided and the issue is not on the agenda, researchers work in a fragmented approach, each one for themselves.

Open Data (OD)

Around 20% of the responders are aware of an institutional policy on Open Data in their institution, supported by a committee or a management structure and management plan, with training sessions, guidelines and an official recommendation. However, 32% report having an in-house research data repository available. 40% consider that compliance has an impact on assessment.

Open Software, Open Source

The results for Open Source/Software are similar to those for Open Data (23 % of the responders are aware of an institutional promotion of open software).

Open Peer Review (OPR)

The OPR procedure is known to 40% of the respondents who have participated in one at least once, 11% having done it "often"). However, in this case, the question should be addressed only to the researchers, not the administrative staff or others.

Transparency

Clarity and simplicity are reported as fulfilled by 11% and in part or largely by another 37%.

Half of the respondents think performance is measured against the research mission of their institutions, and one third confirms that the official OA policy is visible and accessible on the institutional website.

Institutional values

Half of the respondents consider that, in their institution research performance is actually being measured taking into account the university's proclaimed missions and values. One out of five does not.

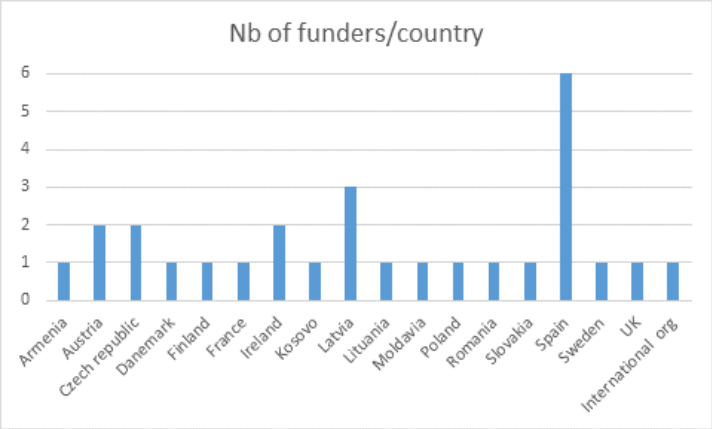
5.2.2 Funders

A total of 28 fully completed responses have been received, from 18 countries.

All those who filled the questionnaires and gave their names considered themselves as "top managers", except 2 "researchers".

82 % of the respondents wished to be kept informed of the results of the survey.

Figure 8. Number of respondents per country



Assessment standards and rules

A little over half of the respondents declare that their organisation has developed written merit assessment procedures for the recruitment of researchers, for their promotion/progression, the setting of their salaries and mention that procedures and templates are publicly accessible.

Scholarly publications

Developing scientific collaborations with other academics appears to be the major element taken into account for evaluation of researchers' careers, slightly above the research publications.

Considering scholarly publishing as the second most important indicator of quality for research activities, their number comes up as the first or largely preferred criterion (64%), followed by the number of citations (47%), the impact factor of the journals that have published the work (43%), and the h factor or others (32%).

43 % of organisations account largely or fully for variation by field in publication and citation practices while 57 % scrutinize indicators regularly and update them.

*A**ssessment procedures***

The assessment is seldom largely or fully based on the number of citations (25 %). It is more often based largely or fully on the journal's reputation such as the impact factor (40 %) and a little less on qualitative evaluation of the research content after reading the publications (36 %). Most funding organisations (43 %) do not take into account original research content presented outside of a traditional journal publishing framework (participatory websites, blogs, etc.).

Most organisations base their assessment on the opinion of external experts (57 %), while 7 % never do.

Open Access

Open Access is rather well known by the respondents: 61 % know how researchers can open the access to their publications. Among the 39 % who do not, only 3 % would like to know more about it.

61 % of responders claim that their organisation has an official policy on open access to scientific publications (4 % don't know). That leaves 36 % of institutions whose members consider there is no official in-house policy on this topic.

Only 14 % of the funding organisations have signed the San Francisco Declaration on Research Assessment (DORA) and 7 % state that they have no intention of signing it. Obviously a large proportion does not seem to be well aware of the DORA directives.

Open Repositories

53 % of funders are recommending the use of open repositories, mostly not institutional ones. 36% do not suggest any specific repository.

Only 68% believe that non-compliance with this recommendation can have a negative effect in an assessment procedure.

43% provide official guidelines about Open Access.

Exactly half of the responding organisations measure / monitor the number / percentage of publications with open access in assessment procedures.

Open Data (OD)

39% of the respondents claim that there is an institutional policy on Open Data in their organisation, 25% have a management plan, 32% provide guidelines (webpages, leaflets, videos) on how to open the data adequately. 39% give an official recommendation. 36% consider that compliance has an impact on assessment.

Open Software, Open Source (OS)

29% of the respondents know that their organisation is promoting the use of Open Source / Open Software

Open Peer Review (OPR)

Half of the organisations are encouraging Open Peer Review, the other half are not.

Transparency

Clarity and simplicity are acknowledged as fulfilled by 11% and in part or largely by another 61%. 43% confirm that the official OA policy is visible and accessible on their website.

Institutional values

83% of the respondents consider that, in their institution research performance is actually being measured taking into account the university's proclaimed mission and values.14% do not.

5.3 Summary of the Survey Results

The surveys have generated responses from a wide range of origins (154 universities from 37 countries, 28 funders from 18 countries). However, due to limitations earlier stated the working group does not consider that any statistical conclusion could be drawn from them at the European level. Some large countries are clearly under-represented and also the scope is limited. However the surveys provide useful insight into the level of awareness about Open Science, as well as into the willingness of the responders to see and help things evolve.

There is a definite need for widespread, clear and complete written procedures for evaluation. Two thirds of the respondents from universities and about half of those from funding organisations admitted that it was not current practice in their institution to make such information readily available yet or were not aware of it.

Evaluation criteria are still most often based on scholarly publications and their number is the most widespread indicator of performance. Other criteria such as measuring the impact of the scientific production on the academic community (citations, h index, etc.) are much less assessed and the least used are the purely qualitative evaluations that require critical reading of the publications and assessment of other achievements than scientific production such as openness, sharing, support to the community, team spirit, participation in citizen science and information of the lay public.

Open Access (OA) is the best known aspect of Open Science. Although there are still a few misconceptions about the OA features, the attractiveness of OA is clearly perceptible. However, close to 40 % of the university respondents mentioned that their institution has no official OA policy yet. Surprisingly, almost half of the universities organize training sessions on OA already.

Open Research Data (ORD) is much less well understood, reluctance is still high, official policies, infrastructures and ORD management plans and/or committees are still quite rare. The same conclusions can be drawn for Open Source/Software and Open Peer Review.

Transparency of the procedures is growing but still absent from half of the universities and it is more present in funding organization.

Overall, it can be concluded from these surveys that awareness concerning Open Science and its various components is growing and reaching a quarter to half of the institutions who responded.

5.4 Examples of good practice and potential for mutual learning

It is important to state that while still much needs to be done to embed Open Science in the research system, there are already many universities, research organisations and research funders across Europe that engage in Open Science.

Ghent University

Ghent University has adopted eight broad principles that must guide every evaluation of research:

- *The choice of an appropriate evaluation method for research is in line with the objective of the evaluation.*
- *The evaluation takes into account the intended impact of the research; strictly academic, economic, societal, or a combination of these.*
- *The evaluation takes into account the diversity between disciplines.*
- *For each chosen evaluation method, the simplicity of the procedure is weighed up against the complexity of the research.*
- *The evaluation criteria are drawn up and communicated to all stakeholders in advance.*
- *There are sufficient experts on the evaluation committee who are in a position to adequately assess the quality of the research.*
- *The above principles are implemented by means of a smart choice of evaluation indicators and by adopting a holistic approach to peer review.*
- *Any committee or policy measure evaluating research makes a best effort commitment to translate the above principles into practice.*

The full text is available here: http://www.ugent.be/en/research/research-evaluation.htm

Finnish Open Science and Research Award

The Finnish Open Science and Research Roadmap (OSR Roadmap) was published in 2014 to support us in making progress towards openness. In the OSR Roadmap, certain objectives and actions were defined, as well as the responsibilities of different stakeholders in policy implementation. To support the monitoring of the implementation of the Roadmap the initiative has conducted evaluations of openness culture twice. The target of this evaluation has been to assess the openness of operational cultures in research organisations and research funding organisations. The key objectives, against which the assessments are made, are defined in the Roadmap. The purpose of the evaluation is to highlight best practices and areas of development while initiating discussions on open science and research at international level. The indicators for research performing organisations in the evaluation were:

- *Strategic Steering*
- *Policies and Principles*
- *Indicators and Scoring Principles*
- *Competence Development*

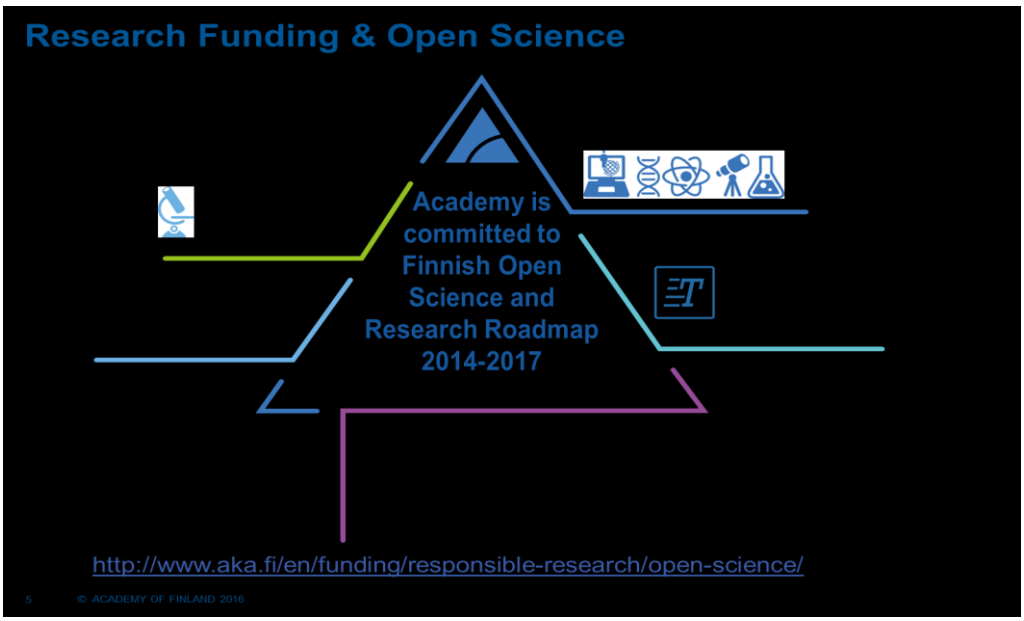
In 2015 the two rewarded organisations were the University of Jyväskylä and the University of Helsinki. The University of Jyväskylä received the award for the most comprehensive measures for promoting openness and visibility. The University of Helsinki was awarded for being the highest ranking organisation in the national assessment of operational cultures of higher education institutions.

In 2016 two research performing organisations were rewarded for best progress in openness (improvement by 30 score points in the national evaluation). The two rewarded organisations were Lappeenranta University of Technology and the University of Oulu. In addition to the organizational awards two rewards were given to individuals in two categories. Firstly, for the efforts in promoting the availability of open data sets researchers from the Seinäjoki University of Applied Science were rewarded. Secondly, for efforts in innovative usage of open data a research group from the University of Helsinki were rewarded

More information can be found here: https://avointiede.fi/web/openscience/openculture

The Finnish Academy

This funding agency promotes open science based on the following scheme:



LERU advice paper on Citizen Science (2016)

Citizen science, the active involvement of non-professional scientists in research, is experiencing an upsurge of interest. Activities range from small projects by groups with a common interest to large international projects, which involve professional scientists and research institutions. Citizen science can involve a vast range of activities, from gathering data in remote regions of the planet to crowdsourcing over the internet. LERU recognises the potential of citizen science for research and its role in the open science movement. LERU is aware that modern IT technologies enable citizens to engage in monitoring pollution, collecting data on biodiversity, language studies as well as many other research activities.

LERU distinguishes three important trends:

a) *Increasing coordination and collaboration between citizen science practitioners from different fields, which leads to sharing procedures and best practices, and to the creation of networks and associations.*
b) *Emergence of platforms that support a variety of citizen science projects, creating broader public awareness and encouraging a greater retention of volunteers.*
c) *Expanding the role played by citizens in the projects beyond simple tasks to include greater participation in all phases of the research process from conceptualisation to publication.*

In its report LERU lists guidelines for researchers and recommendations for research organisations when engaging in citizen science.

More information can be found here:
http://www.leru.org/files/publications/LERU_AP20_citizen_science.pdf
http://www.leru.org/index.php/public/news/not-everything-that-can-be-counted-counts/

University College London (UCL)

Open Science represents a new paradigm in the way research is undertaken and disseminated. The invention of moveable-type printing in the West in the fifteenth century transformed the ways ideas were shared in Europe. So in the twenty-first century, open approaches to the performance and dissemination of research – with outputs such as publications, research data, software – enable researchers to share their findings and to contribute wise solutions to the challenges which face Society.

Many researchers adopt open approaches to research to ensure that the benefits which openness brings – reproducibility, transparency leading to greater research integrity – are available to their subject domain and to Society as a whole. However, it is only fair that such approaches should also deliver a personal reward for individual researchers.

In the era of Open Science, research funders and research performing organisations should re-model their HR frameworks to include openness as an explicit criterion for reward and promotion. Such a move would encourage greater take-up of open approaches to the performance and dissemination of research as a result. UCL (University College London) is considering such an approach as part of a wider review of HR frameworks, to ensure that the gains of Open Science can be reflected in its HR policies and frameworks.

Other LERU Universities:

Many LERU universities have OS policies and resources on their websites – to name just a few:

- *Universitat de Barcelona (http://diposit.ub.edu/dspace/handle/2445/27711);*
- *University of Cambridge (http://www.cam.ac.uk/research/research-at-cambridge/open-access);*
- *Università degli Studi di Milano (http://www.unimi.it/ricerca/air/76762.html).*

Also LERU universities have training courses for students and staff. Some examples:

- *The University of Edinburgh, through Edina & Data Library, has developed MANTRA, an open online research data management training course complete with 8 units which map onto the data lifecycle: http://datalib.edina.ac.uk/mantra/*
- *Edina & Data Library also developed the DIY RDM Toolkit for Librarians: http://datalib.edina.ac.uk/mantra/libtraining.html*

Information Services offer a range of RDM training workshops and courses: http://www.ed.ac.uk/schools-departments/information-services/research-support/data-management/rdm-training

- *The University of Helsinki has a Data Management Planning training course – see http://www.helsinki.fi/kirjasto/en/home /*
- *KU Leuven has a RDM Support Desk:*
- *https://www.kuleuven.be/english/research/scholcomm/rdm/index*
- *The University of Oxford has an Open Access Oxford Project Group, which among other tasks, advises on information and training for researchers:*

https://www1.admin.ox.ac.uk/researchsupport/researchcommittees/scworkgroups/oao-pg/

It also has a Research Data Working Group, which among other tasks, supports researchers in taking advantage of the opportunities to stimulate discovery and collaboration and maximise impact through appropriate data sharing and 'intelligent openness' (Royal Society, Science as an Open Enterprise, 2012)

https://www1.admin.ox.ac.uk/researchsupport/researchcommittees/scworkgroups/rdmopendata/

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OPEN DATA FROM THE EU
The EU Open Data Portal (http://data.europa.eu/euodp/en/data) provides access to datasets from the EU. Data can be downloaded and reused for free, both for commercial and non-commercial purposes.

Changing practice from the traditional approach in most disciplines will require a fundamental change in the way scientists carry out research in an Open Science environment. In order for this to be encouraged and incentivised, this changed approach must be recognised and rewarded by both employers (when recruiting and promoting researchers) and research funders (when performing peer review of researchers in grant applications). Moreover senior researchers must play a key role in this change as they are highly influential in the recruitment/promotion of researchers and conduct of peer review both for funding agencies and publishers.

The approach of the group is rooted firmly in the context of researcher career development and closely linked with ERA Priority 3, an open labour market for researchers.

The report provides background information on Open Science in relation to ERA policy, researcher assessment and career framework. It also describes different aspects of Open Science including Open Data, Open Peer Review and Citizen Science. The limitations of current recognition and reward processes are presented, with suggestions on how to alleviate these and how new paradigms can be envisioned and implemented.

An illustration of taking a comprehensive approach to researcher assessment using the Open Science Career Assessment Matrix (OS-CAM) that recognises Open Science is developed. There is a brief analysis of the ERA Partnership policies and how Open Science can be included in the Human Resources Strategy for Researchers. Finally, the results of a survey carried out on Research Funding and Research Performing Organisations focusses on their approach to recognition and rewards for researchers engaged in Open Science. In addition, some good practice examples from across Europe are given

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