University Commitments to Open Science

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Universidades Españolas

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Contents

I. Introduction

Open Science is a new collaborative, transparent and accessible approach to research, which implies a structural change in the way of designing research and disseminating its results. It is characterized by the making open not only of publications (traditionally known as Open Access), but also of research data, methodologies, processes, and by the involvement of citizens in a responsible research and innovation environment. In other words, it is about making the results of research financed with public funds accessible in a digital format to the scientific community that produces them, as well as to the society that finances them in general, enhancing the reproducibility of science and the reuse of results.

21st century research is characterized by its rapid, digital, costly and complex nature and it increasingly depends on data, computing capacity, communications and the technological infrastructure. For science to advance, results cannot be privatized, as this restricts access to knowledge through high charges. The general aim of Open Science must be "open by default": for all publications and research data to be available following FAIR principles (Findable, Accessible, Interoperable, and Reusable)[1] and that access to science should be Open as soon as possible and whenever possible. But this "open by default" rule and the actual implementation of Open Science also require a series of structural changes: the evaluation and incentive system, the training of researchers and managers, the interoperability of the various infrastructures for the management and reuse of data, the empowerment of research with and for society, the implementation of new scientific codes of integrity and others that are only hinted at or even that are difficult for us to imagine, but, above all, cultural changes.

Therefore, it is not surprising that Open Science has been on the agenda of the main European institutions, from the European Commission (EC), the Conferences of Rectors, Vice-chancellors and Presidents and the funding agencies to the most diverse authorities of the member states, which, through commissions, working groups, declarations and mandates, intend to make Open Science a reality as soon as possible.[2] Thus, Spanish universities and public research organizations must make it an ongoing challenge and a short-term aim. Spanish universities must adopt the eight pillars of the European Open Science Agenda and initiate a deep deliberation on the various recommendations that the Open Science Policy Platform has made for each of them, especially those that address universities and research centers[3]:

- Future of scientific communication;
- FAIR data;
- EOSC, European Open Science Cloud;
- Research indicators and next-generation metrics (NGM);
- Recognition and incentives;
- Integrity of the investigation;

1 https://www.nature.com/articles/sdata201618
2 Francia: https://libereurope.eu/wp-content/uploads/2018/07/SO_A4_2018_05-EN_print.pdf
Holanda: https://www.openscience.nl/en/open-science
Finlandia: https://openscience.fi
Portugal: http://www.ciencia-aberta.pt
Conferencia de rectores de Holanda: https://www.vsnu.nl/en_GB/openaccess-eng.html
3 OSPP-REC: Integrated advice of the Open Science Policy Platform Recommendations. European Commission, 2018 doi: 10.2777/958647
Conferencia de rectores de Italia: https://www.crui.it/open-access

- Skills and education in Open Science;
- Citizen science.

II. Principles of Open Science

1. Strategies for open science communication

In 2002, two strategies were proposed for achieving what is called "Open Access" (OA)[4], that is, making the results of scientific research accessible to the public with no barrier of any type. These strategies were known as Gold OA and Green OA. During the last decade, universities have clearly opted for the green route, developing institutional repositories and approving policies that oblige, encourage or recommend self-archival of publications. However, the amount of content has not been as great as expected, with exceptions.

In Spain there are 86 repositories in research centers and universities[5], and 32 institutional policies within these institutions[6]. In addition, Article 37 of the *Ley de la Ciencia, la Tecnología y la Innovación* (Law of Science, Technology and Innovation) makes the depositing of any publication resulting from a project financed mostly from the general State budget[7] compulsory. As for the *Plan Estatal de Investigación* (State Research Plan), the percentage of open access in Spain is 20% according to 2015 data from FECYT [8]. These figures vary between centers[9].

On the other hand, the gold route supports the development of a new generation of journals and the transition of existing ones towards this new model. However, the result has not been as expected either, because it has generated the APC (Article Processing Charges) business model, which introduces a new cost for institutions. Moreover, it has resulted in a hybrid model of journals that keep a cost of access and introduce new fees for publishing as open access. Currently universities are facing two costs that increase year on year: on the one hand, subscriptions for accessing resources and, on the other, fees for publishing in open access journals that offer this model by default or on an individual basis. The latter has been increasing as funders have supported it, together with the threat of publishers embargoing publications in repositories.

In Spain, in general, there is no data available on the cost of open access publications, although the REBIUN Libraries Network agreed that universities would include these payments in their accounting system. Moreover, there are no widespread institutional funds for paying for open access, as is the case in other countries.

4 https://www.budapestopenaccessinitiative.org/
5 https://www.accesoabierto.net/repositorios/stats/GRUPO/_/grafico/sectores
6 https://www.accesoabierto.net/politicas/lista/PAIS/--RXNwYcOxYQ==
7 https://www.boe.es/buscar/act.php?id=BOE-A-2011-9617&tn=1&p=20171007#a37
8 http://www.ciencia.gob.es/stfls/MICINN/Prensa/FICHEROS/2018/PlanEstatalIDI.pdf Pàgina 93
9 https://apps.bibliotecnica.upc.edu/observatori/index.php?lang=es

Therefore, there is a need for institutions to push for a definite change towards total open access by 2020, as required by the main funding agencies, led by the European Commission. This requirement has been strengthened this year with the publication of the *S Plan*[10], which is committed to immediate open access for any publication financed by agencies supporting it. The implementation guide, published just a few days ago[11], foresees that this plan will be put into effect as of January of 2020 and its results will be formally verified as from 2023, thereby effectively contributing to the final implementation of open access.

2. Technological infrastructure for Open Science

a. Open Science and research data

Current research activity generates, consumes and uses data extensively. For the past five years, researchers who make regular use of data sets greater than 1GB in size make up more than half the scientific community[12]. Scientific development linked to this explosion of data and the vision that Open Science brings for its use, summarized in the FAIR principles, make data a key result of 21st century research, which can be shared and reused within the Open Science model.

The finding, accessibility, interoperability and reuse of data, during its exponential growth, can only be guaranteed through technological platforms of a size that meet the needs of this new Big Data environment. The use of large data sets will require high performance computing capabilities and the use of supercomputing platforms to carry out research. Likewise, the maintenance of data sources, as well as of the data generated during the research itself, will require extensive repositories of information. Finally, access to these computing and storage resources will only be possible through high-performance communications networks. Computing, storage and communications thus become three environments that require a high-capacity technological infrastructure.

b. EOSC: the data and services infrastructure for Open Science in Europe

Being aware of the importance of technological infrastructure in scientific progress, the European Commission has proposed the creation of a common infrastructure for research data, the European Open Science Cloud (EOSC)[13]. Launched in 2016 and endowed with a budget of € 6,700 million, the ultimate goal is that members of the scientific community should be able to store, manage and access data and digital scientific resources in a safe and accessible environment. On November 23, the EOSC portal was officially opened in Vienna.[14]

10 https://www.scienceeurope.org/coalition-s/
11 https://www.coalition-s.org/wp-content/uploads/271118_cOAlitionS_Guidance.pdf
12 European Commission. "Public Consultation. 'Science 2.0' Science in Transition", 2014.
13 http://ec.europa.eu/research/openscience/index.cfm?pg=open-science-cloud
14 https://www.eosc-portal.eu/

The EOSC technological concept goes beyond the traditional cloud environment. The European Commission assumes that there are various instances of technological infrastructure in the scientific field, not only European (as in the cases of GEANT, OpenAIRE, PRACE, or Zenodo to name but a few), but also national, at various levels of maturity, in various member states. To this end, EOSC is designed as an element to join up and communicate this infrastructure, setting up a common system of single access services. thus, the existing infrastructure in the member countries could provide services through EOSC and the new infrastructure and services would be designed based on EOSC-ready criteria, in order to be entirely or partially integrated into EOSC.

The need for high-performance computing has already been highlighted in the European Union (EU), with PRACE as its greatest exponent to date and with the support of the EuroHPC Declaration[15]. Various EU members are committed to putting forward a supercomputing infrastructure that is within the top-three in the world by 2022 or 2023. This statement is compatible with the model designed by EOSC, which will allow access to this type of infrastructure, among others.

Similarly, the availability of high-performance communications networks to the scientific sphere also has a long history and a benchmark: GÉANT[16]. This high-performance network facilitates communication between various national academic and scientific networks, such as RedIRIS in Spain. GÉANT thus becomes a key agent in the development of EOSC.

The pan-European technological infrastructure for the storage and management of data under FAIR principles is the least developed one, and the one on which the EOSC project has had an impact mainly through the design of a clear roadmap.
The EOSC Declaration[17] has been subscribed to by more than 80 institutions, which have shown their support and commitment to the initiative.

c. ICT Infrastructure for Open Science nationwide

The greatest exponents of technological infrastructure in the scientific field at the national level are the so-called Unique Scientific and Technical Infrastructure (ICTS). The ICTS are large facilities, resources, equipment and services, unique among their kind, which are dedicated to cutting-edge technological research and development of the highest quality[18]. This infrastructure covers a broad spectrum of the scientific field and includes transverse ICT infrastructure, such as the Spanish Supercomputing Network (RES) and the National Academic and Research Network (RedIRIS).

15 https://ec.europa.eu/digital-single-market/en/news/european-declaration-high-performance-computing
16 https://www.geant.org/
17 http://ec.europa.eu/research/openscience/pdf/eosc_declaration.pdf#view=fit&pagemode=none
18 http://www.ciencia.gob.es/portal/site/MICINN/ICTS

RES is a distributed infrastructure consisting of the interconnection of 13 supercomputers with the aim of offering high-performance computing resources to the scientific community[19]. Coordinated from the Barcelona Supercomputing Center (BSC), where its reference facility is located, the Mare Nostrum supercomputer provides computing capacity from various nodes distributed around research centers and universities and integrated into the European supercomputing initiative PRACE[20].

RedIRIS provides advanced communication services to the national scientific and university community[21] and connects more than 500 institutions nationwide, including Spanish universities. It also facilitates access to commercial Internet and to international research institutions as part of the European GÉANT[22] network.

The aforementioned infrastructure provides a good starting point and support for the deployment of Open Science initiatives at the national level, giving initial coverage of two of the three technological environments identified above: computing and connectivity. Both the RES and the RedIRIS are a reflection of initiatives of European scope, such as PRACE and GÉANT. At the storage level, the third environment identified, there is no national benchmark technological infrastructure. This aspect is especially critical given the exponential storage requirement and, above all, proper management of the data produced by the current scientific sphere. At the European level, the EUDAT[23] project aims to facilitate the stewardship of data in and between European research communities through a collaborative data infrastructure (CDI), a common model and a service infrastructure to manage data that will be supplied to all European research data centers and community data repositories. Zenodo[24], storage infrastructure, data management and scientific software, located at CERN, is a good example to consider to meet the initial needs that exist in this area.

Spain has created a national node of the RDA (Research Data Alliance)[25] led by the BSC, within European project RDA Europe 4, to disseminate national standards, initiatives and implementation of research data infrastructures.

Science with and for society, citizen participation and scientific integrity

Open Science proposes a cultural change in the way of doing science: making science better and more relevant, making it open to ensure its integrity and reproducibility, and accelerating its evolution. This entails a multitude of challenges related to citizens' participation in the scientific process, as well as to the analysis of the ethical considerations related in the process of the creation and communication of science.

19 https://www.res.es/
20 http://www.prace-ri.eu/
21 https://www.rediris.es/
22 https://www.geant.org/
23 https://eudat.eu/
24 https://Zenodo.org/
25 https://www.rd-alliance.org/groups/rda-spai

Integrity in research can be promoted in research institutions through the design and implementation of codes of good practice. Integrity in research requires that all publications be prepared according to standards recognized by the scientific community, where available, and that researchers define the conditions under which their work could be reproduced or verified by others. In addition, researchers will have to be aware of the ethical, legal and social implications of their research practices.

Related to the social impact of science is another pillar of open science: science by and for citizens. According to Alan Irwin, there are two dimensions in the relationship between citizenship and science: 1) science can be sensitive to the interests and needs of society and 2) citizens can produce reliable scientific knowledge[26]. Open science, therefore, allows it to be more participatory, closer to society and more responsible.

3. Competencies, incentives and evaluation in open science

The implementation of such an important change in the way of doing, transferring and communicating science requires the transformation of the behavior of agents of the R & D system: researchers and research units -groups and organisms-. This transformation will not occur naturally, but requires an impetus from institutions that finance, evaluate or promote the careers of researchers at the individual level and at the level of research organizations.

Therefore, there is a need for leadership that guides researchers towards open science, the allocation of resources (financial and those linked to skills in open science) and the design of incentive and recognition systems, as well as forms of evaluation consistent with the aim of the undertaking.

The paradigm shift that open science entails must be accompanied by a mentality change in the actors of the R & D system. Sensitization actions are necessary, as well as training for the scientific community and other system agents[27].

At the Spanish and European levels there are numerous training offerings for various types of people using different methodologies.

The generation of skills in open science can only be achieved by providing basic training in open science to researchers, at all levels, and encouraging them to choose the preferred model for the creation and communication of science. Also, research managers and knowledge generation system agents (libraries, repository managers, data technology services, etc.) must receive suitable training.

26 Citizen Science: A study of People, Expertise and Sustainable Development. A. Irwin, Routledge, Oxon, U.K. (1995)
27 Providing researchers with the skills and competencies they need to practice Open Science. European Union, 2017. doi: 10.2777/121253

Research organizations must know that the design of the incentive and recognition system aimed at facilitating the desired transformation must be aligned with the way in which science is evaluated. Current evaluations, based primarily on the impact factor of journals and citations, discourage Open Science practices. The evaluation of projects and researchers must reconsider not just the metrics and indicators used, but also the improvement of processes, guaranteeing transparency for the measures used for the evaluation of researchers, the research and the projects[28].

The evaluation of science includes the evaluation of research itself (projects and results), of the individual researchers and of the research units (groups and organisms). The indicators used for its evaluation have a significant impact on the results achieved by individuals and groups, making them a very effective tool to guide their behavior. If project financing and research career promotion depend on such indicators, their adaptation to the aim of open science will be decisive in achieving it.

Currently, the evaluation of science in Spain is mainly focused on a quantitative evaluation of results, especially scientific publications, without considering any aspect related to open science. This quantitative evaluation tends to be confused with the evaluation of the research quality, given that our system gives significant weight to the impact factor of the journal in which an article has been published. This indicator has been widely criticized by the international scientific community; proof of this is the 580 scientific organizations and over 12,700 people who have signed the San Francisco Declaration on Research Assessment (DORA) since 2012[29].

In this sense, the Leiden Manifesto for Research Metrics[30] was published in 2015, and proposed the following 10 principles that should be considered for any scientific evaluation:

1. Quantitative evaluation should support qualitative, expert assessment.

2. Measure performance against the research missions of the institution, group or researcher. 3. Protect excellence in locally relevant research.

4. Keep data collection and analytical processes open, transparent and simple.

5. Allow those evaluated to verify data and analysis.

6. Account for the variation in publication and citation practices in different scientific fields.

28 OSPP-REC: Integrated advice of the Open Science Policy Platform Recommendations. European Commission, 2018 doi: 10.2777/958647.
29 https://sfdora.org/read/es/
30 http://www.leidenmanifesto.org/

7. Base evaluation of individual researchers on a qualitative judgement of their research portfolio.

8. Avoid misplaced concreteness and false precision.

9. Recognize the systemic effects of evaluations and indicators.

10. Review indicators regularly and update them.

Therefore, any evaluation process affects the object being evaluated. When these processes are implemented, they should always be accompanied by the corresponding recognition within each institution's incentive systems of those researchers, groups or organizations that are able to achieve the objective. Accordingly, several reports published by the European Commission intend to advance these aspects of the evaluation of open science, focusing on the analysis of incentives and recognition[31]. However, to date, no consensus has been reached. Therefore, the debate between academia, funders and evaluation agencies should be as far-reaching and open as possible.

III. Declaration

Since the beginning of this century, a new way of envisaging research, in all its facets, has been taking root. This shift is primarily based on the creation and exchange of the results of the research activity, and on their impact on society. The goal is to promote higher quality research, while increasing collaboration and accessibility for the whole of society.

Several European agents involved in research, including several countries' Conferences of Rectors, Vice-chancellors and Presidents, have adhered to this new way of understanding science and have encouraged its implementation through mandates, declarations, or recommendations. Following this approach, the universities associated to the Spanish Universities' Crue held a General Assembly on February 19, 2019 in Madrid, where they decided to join the initiatives proposed by similar European institutions and associations, committing, where possible, to the implementation of Open Science through the following actions:

1. Analyzing the status of Open Access in Spain and monitoring its evolution so the available information is always up-to-date.

2. Collecting and making public the expenditure of universities on accessing electronic information resources, as well as publishing results. Moreover, analyzing any changes in expenditure that universities would incur when moving from the current system of access through payment to a system of immediate Open Access.

31 Evaluation of Research Careers fully acknowledging Open Science Practices; Rewards, incentives and/or recognition for researchers practicing Open Science. European Union, 2017. doi: 10.2777/75255
Mutual Learning Exercise: Open Science — Altmetrics and Rewards. European Union, 2018. doi: 10.2777/468970

3. Including immediate Open Access in any negotiation with editors of scientific publications, while promoting the payment of an equitable price that in no circumstances should imply an expenditure greater than the current one, making the system of scientific communication sustainable.

4. Promoting a cultural change in the R & D system agents through awareness and training in Open Science, as well as promoting ethical behavior in research.

5. Exploring ways of encouraging the implementation of Open Science through evaluation and recognition models different from the current ones for researchers, units and projects. For this purpose, creating a specialized group, formed by representatives of Spanish Universities' Crue and of agents that are part of the state evaluation system, with the task of developing and promoting the implementation of more comprehensive indicators, both quantitative, based on publication impact indices, and qualitative, allowing for the incorporation of multiple criteria beyond the purely bibliometric and an analysis of the potential impacts of their use.

6. Implementing systems of incentives and recognition within universities that are in line with the aims of Open Science and that entail the modification of the current criteria used in the evaluation of researchers, units and projects.

7. Promoting collaboration with the relevant national entities to establish a national infrastructure, shared by universities and research centers, and integrated into EOSC, for the storage, management and publication of scientific data from thematic areas not covered by European infrastructures already integrated into EOSC.

8. Follow the principles of the "EOSC Declaration" of October 2017 to show Crue's support for the initiative and for the principles of Open Science that underlie it, and to encourage active participation in its stakeholder forum.

9. To consolidate a cross-sectoral working group on Open Science within Crue that, in coordination with any state administration or initiative, analyzes and monitors its implementation in Spanish universities.

10. Making Crue's presence effective in national and international forums where different alternatives are being evaluated for implementing Open Science.