EUROPEAN UNION

EUROPEAN RESEARCH AREA
AND INNOVATION COMMITTEE

– ERAC –
Secretariat

Brussels, 18 December 2018
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ERAC 1216/18

NOTE

From:	General Secretariat of the Council
To:	Delegations
Subject:	Recommendations by the ERAC Standing Working Group on Open Science and Innovation (SWG OSI) on open science and innovation

Delegations will find annexed to this Note the Recommendations by the ERAC Standing Working Group on Open Science and Innovation (SWG OSI) in open science and innovation, as approved by written procedure.

ANNEX

RECOMMENDATIONS ON OPEN SCIENCE AND INNOVATION

Opinion of ERAC Standing Working Group on Open Science and Innovation (SWG OSI)

SUMMARY OF THE RECOMMENDATIONS

In the spirit shared by all Member States on the need to pursue a national and European policy towards an open science system, according to the Council Conclusions on the transition towards an Open Science system adopted on 27 May 2016 (9526/16)[1], the Standing Working Group on Open Science and Innovation recommends ERAC to:

1. **Consider 'immediate FAIR and open' the default for all research output**. This first and fundamental recommendation presents the timeliness of increasing quality in research, increasing the impact of high quality research and increasing innovation for all researchers, businesses, citizens and society at large by unleashing the benefits of rapid access to research.

2. **Promote and protect open science within the European copyright legal framework**. This recommendation proposes a balancing of the copyright legal framework throughout Europe to accommodate open science and its benefits.

3. **Develop and advocate an understanding of innovation between Member States that is built on open science**. This recommendation suggests addressing the balance between openness and reserving some rights and highlights mutual benefits.

4. **Develop end user skills for better appropriation of knowledge deriving from research.** This recommendation aims at unleashing the appeal for re-using research outputs among end users who could be distant from research practices.

[1] http://data.consilium.europa.eu/doc/document/ST-9526-2016-INIT/en/pdf (retrieved October 17, 2018).

5. **Foster involvement of citizens in science.** This recommendation aims at deepening consultation and engagement of citizens in science.

6. **Adjust assessment, reward, and evaluation systems.** This recommendation stresses the need of stronger incentives that foster prestige in collaboration and quality, by visualizing and rewarding the use of researchers' outputs.

7. **Foster open peer review as the default legitimate approach for scientific validation**. This recommendation aspires to increase quality of reviewing, and to increase recognition and reward for researchers' reviewing work.

8. **Require that infrastructures, processes and workflows underpinning the European research system adhere to and adopt open standards**. This recommendation proposes that critical services and infrastructures underpinning the ERA remain in control of the academic community by requiring them to be provided through open and portable technologies.

9. **Facilitate full transparency for terms and conditions of subscription agreements and open access deals**. This recommendation highlights the need to organise and gain control over costs for publishing and reading scholarly content.

RECOMMENDATIONS ON OPEN SCIENCE AND INNOVATION

Opinion of ERAC Standing Working Group on Open Science and Innovation (SWG OSI)

INTRODUCTION

"At its meeting in May 2016, the Competitiveness Council adopted conclusions on 'The transition towards an Open Science system' where it acknowledges that "Open Science has the potential to increase the quality, impact and benefits of science and to accelerate advancement of knowledge by making it more reliable, more efficient and accurate, better understandable by society and responsive to societal challenges, and has the potential to enable growth and innovation through reuse of scientific results by all stakeholders at all levels of society, and ultimately contribute to growth and competitiveness of Europe. Open Science is a global movement to improve accessibility to and reusability of research practices and outputs. In its broadest definition, it encompasses Open Access to publications, Open Research Data and Methods, Open Source, Open Educational Resources, Open Evaluation, and Citizen Science."[2]

While there are some excellent examples on the practice and implementation of open science, the widespread adoption of open science for better engagement, research efficiency, new products and services is slow. Understanding and delivering open science is complex as it must address political, legal, financial, human resources skills and technical barriers, as well as negotiating new partnerships. The Amsterdam Call for Action on Open Science[3] (AC4A) presented a need of a speedy transition with a shared approach between European, or international, countries to an open science system, given that "the majority of scientific publications, research data and other research outputs are not freely accessible or reusable for potential users. Assessment, reward and evaluation systems in science are still measuring the old way." This was true in 2016, and it is true in 2018. At the same time, the apparent slowness and lack of homogeneity towards an open science system seems to be harming Europe's potential for innovation, especially open innovation, insofar as science and innovation are linked. Unleashing and accelerating the full potential of open science and innovation is a common responsibility of each member state, between Member States and between Member States and the Commission, the Council and the Parliament.

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2 "Mutual Learning Exercise on Open Science - Altmetrics and Rewards - Final Report", available here: https://rio.jrc.ec.europa.eu/en/library/mle-open-science-altmetrics-and-rewards-final-report (retrieved October 15, 2018).

3 "Amsterdam Call for Action on Open Science", https://wiki.surfnet.nl/display/OSCFA/Amsterdam+Call+for+Action+on+Open+Science (retrieved November 9, 2018).

ERAC is a strategic policy advisory committee that advises the Council, the Commission and Member States on the full spectrum of research and innovation issues in the framework of the governance of the European Research Area (ERA). The ERAC Standing Working Group on Open Science and Innovation (SWG OSI) has been operational since mid-2016. Its overall objective is to provide strategic policy advice to ERAC, in the context of open science and open innovation, on the development and implementation of policies and initiatives to enhance access to scientific information, and the circulation and use of knowledge for research and innovation for the benefit of scientists, research institutions, education, businesses, citizens, and society.

MANDATE

- Provide forward looking policy advice to ERAC on knowledge circulation and the areas in which the SWG OSI is responsible in line with its mandate, including the framework conditions and regulatory issues affecting knowledge circulation and related dimensions in Europe, and address emerging issues linked to knowledge circulation, especially when identified by ERAC.

- Provide advice, for which it is responsible in line with its mandate, to ERAC on any other topic related to digital and open science and innovation that ERAC may consider of interest.

- Develop initial recommendations by mid-2017 and subsequently update them according to ERAC's needs. This task will be completed in 2018 on the basis of the results of the assessment of the Amsterdam Call for Action.

APPROACH

The open science and innovation policy agenda advances by promoting practices and facilitating arrangements, including legal provisions, among relevant stakeholders and contexts. With this in mind, an effort was made to produce a document with a focus on possible practices that have not been highlighted in former recommendations or assessments or to address issues not properly dealt with before. The deliberately chosen approach for this document was to try to be creative and bold, pushing the envelope on previously elaborated recommendations and policy documents. Moreover, it was acknowledged by the SWG OSI that open science and open innovation are sometimes presented separately rather than feeding off each other. Therefore, the recommendations also present a starting point for bridging open science and innovation.[4]

Of course, the recommendations are to some extent overlapping the work of other groups and existing initiatives/recommendations and the group agrees that most of those recommendations are currently still valid. Moreover, it is understood that some parts of the Recommendations hereof may need to be developed in more detail by other task forces within the SWG OSI[5] or external stakeholder groups.

4 Given the workload represented by the activities under the previous work programme of the ERAC SWG OSI, the topic open innovation was not properly addressed until 2018 in the group. For this reason the recommendations in this document focus mostly on open science. Additionally, the ERAC SWG OSI decided to install a temporary "Task Force on Open Innovation" in May 2018 that should work on the topic open innovation with the mandate to develop an Opinion on Open Innovation for the ERAC SWG OSI. Therefore, recommendations focusing especially on open innovation will be delivered by the Opinion paper of the Task force on Open Innovation at a later stage.

5 See footnote above.

For this approach, preceding steering documents have been considered, such as the ERAC SWG OSI's Assessment of the Amsterdam Call for Action[6], Opinion on the EOSC Governance Models and Strategic Implementation Plan[7], Opinion of the ERAC SWG on OSI on the Interim Evaluation of Horizon 2020 and preparations for the future Framework Programme, the Open Science Policy Platform Combined Recommendations for the Embedding of Open Science[8], the reports from the European Commission (EC) Policy Support Facility Mutual Learning Exercise on Open Science: Altmetrics and Rewards[9], the Council Conclusions on "Accelerating knowledge circulation in the EU" (9507/18)[10] and the Council Conclusions "From the Interim Evaluation of Horizon 2020 towards the ninth Framework Programme" (15320/17)[11], among others.

WORKING PROCESS

The drafting of this document has been facilitated by a task force comprised of volunteers from the delegations to the SWG OSI.[12] The working method has been to promote brainstorming sessions within the task force in an open and collaborative way and extending the discussions to the other members of the SWG OSI. The following chart presents the process of this shared and inclusive method.

6 http://data.consilium.europa.eu/doc/document/ST-1202-2018-INIT/en/pdf (retrieved November 8, 2018).

7 http://data.consilium.europa.eu/doc/document/ST-1212-2018-INIT/en/pdf (retrieved November 8, 2018).

8 https://ec.europa.eu/research/openscience/pdf/ospp_combined_recommendations.pdf#view=fit&pagemode=none (retrieved November 8, 2018).

9 Six reports focusing on the topics of altmetrics, incentives and rewards for researchers to engage in open science activities, available here: https://rio.jrc.ec.europa.eu/en/policy-support-facility/mle-open-science-altmetrics-and-rewards (retrieved November 8, 2018).

10 http://data.consilium.europa.eu/doc/document/ST-9507-2018-INIT/en/pdf (retrieved November 7, 2018).

11 http://data.consilium.europa.eu/doc/document/ST-15320-2017-INIT/en/pdf (retrieved November 7, 2018).

12 Volunteers came from the delegations of France, Portugal and Sweden.

Phase	Who	What	When
1	Task force	prepares first draft	<16 May 2018
2	SWG OSI delegates	comment the draft at the meeting on 16 May and via email	16 May to 29 May 2018
3	Task force	incorporates comments from delegates to a second draft	29 May 2018
4	Stakeholder experts[13]	comments on the second draft	29 May to 31 May 2018
5	Task force	incorporates comments from experts to a third draft	31 May to 8 June 2018
6	Task force	open online collaborative document to all delegates of the SWG OSI	8 June 2018
7	SWG OSI delegates	directly comment and edit third draft; comments produced also by email	13 to 20 June 2018
8	Task force	prepares a fourth draft for circulation	21 June to 14 of September 2018
9	SWG OSI	discussion on recommendations	25 September 2018
10	SWG OSI	online and offline recommendation comments and editing	27 September to 12 October 2018
11	Task force	incorporate and consolidate comments and prepare cleaned up document for formal approval	12 October to 8 November 2018
12	Member States	are invited to nationally discuss the recommendations.	12 November to 26 November 2018
13	Secretariat	Approval of the final recommendations by written procedure	18 December 2018

[13] Katja Mayer, Sabina Leonelli, Kim Holmberg, Swedish Innovation Agency (Vinnova), National Library of Sweden, Swedish Research Council, French Ministry for Research and Innovation - Innovation Policies Department, French Ministry of Economy and companies - Innovation Policies Department.

PREAMBLE: ADDRESS THE WHOLE ECOSYSTEM OF OPEN SCIENCE AND (OPEN) INNOVATION.

The following recommendations are especially directed at open practices that are part of and stimulate both science and innovation. It is asserted that science that is performed in an open and collaborative way is a driver for innovation, while at the same time innovative processes, for example real time, free, community peer review performed on digital online platforms, can improve the production, quality and openness of research. Open science accelerates and is an asset to innovation, and innovation speeds up and improves the quality of research, strengthening both.

The concept of open science and innovation is closely tied to the principle of research integrity which is one of the key features of the agenda of European Research & Innovation policies. Open science and research integrity are strongly interconnected, in particular by making research results more reproducible, and through promoting evaluation systems that transparently assess the quality of the research contents, rather than the quantity of the research outputs.

Therefore, for any policy initiative to be effective, it must address the research and innovation system in its entirety through a comprehensive, holistic approach which also takes the needs of the various stakeholders into account. For instance, the evaluation of researchers and research is related to the publication process as a whole. Enhancing the understanding and the relationship between open science and innovation is needed. Open innovation in this document is considered in a broad sense, as a collaborative, externally focused innovation[14], where it generates new knowledge and develops new research, products, services or processes.[15] Hence, (open) innovation can also be non-technological/non-industrial, and encompass social and cultural dimensions. Societal impact of research through open innovation and open science practices should be fostered.

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14 "Open Innovation 2.0 – A New Paradigm" White Paper by the EU Open Innovation Strategy and Policy Group (OISPG), available here: https://ec.europa.eu/digital-single-market/en/news/open-innovation-20-%E2%80%93-new-paradigm-and-foundation-sustainable-europe (retrieved October 15, 2018).

15 "Open Innovation Strategy for Austria", http://openinnovation.gv.at/wp-content/uploads/2015/08/OI_Barrierefrei_Englisch.pdf (retrieved June 21, 2018).

The principle of innovation is related to the "precautionary principle", which tends to protect the integrity of the people and their environment.[16] However, these two principles should not work in "opposition", but in cooperation. Open access to knowledge and to data participates in this principle. There is growing evidence that open access places research at the heart of the economic and innovation system, giving advantage to those businesses that are aware of and use it. Removing currently existing unwarranted barriers and delays from the way of knowledge transfer and appropriation assists in materialising this competitive edge.

This principle meets the need for science and innovation to be socially responsible, ethical and, ideally, aligned with the United Nations' Sustainable Development Goals17. The new EU General Data Protection Regulation (GDPR) is a good case of a policy initiative in this domain, helping to promote sustainable ways to make data FAIR[18] while also encouraging responsible innovation.[19]

For the benefit and purpose of making open science and open innovation successful and sustainable for the European Union, policies, programs and actions have to be collective, transparent and aimed at bridging the gap between the Member States, including providing support such as capacity building measures and human and financial investment. The recommendations and corresponding actions that follow should be interpreted in the light of these fundamental principles.

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16 For example, the inclusion of cybersecurity requirements could be viewed as slowing down innovation in countries that adopt them in their regulations and as favouring faster innovation in countries that waive them. An analogy can be made with environmental regulations, where the challenge is to protect people and their environment without stopping innovation, and with a certain level of risk considered as acceptable for society.

17 For example, many countries are in acute need of research results and science based analysis, especially on grand challenges like climate change and water management.

18 Findable, Accessible, Interoperable and Re-usable, according to the "FAIR Data Principles", detailed here: https://www.force11.org/group/fairgroup/fairprinciples (retrieved November 8, 2018).

19 For more information on the GDPR, please check the following links : https://gdpr-info.eu/ ; https://ec.europa.eu/info/law/law-topic/data-protection_en ; https://ec.europa.eu/commission/priorities/justice-and-fundamental-rights/data-protection/2018-reform-eu-data-protection-rules_en (all of them retrieved October 26, 2018).

The order of the recommendations has been chosen intentionally. Priority has been given to recommendations with foreseen impact in a greater number of stakeholders and wider sections of the society, as well as those that seemed more effective to lay the foundations for bridging science and innovation. The recommendations that address more specific areas of the science and innovation ecosystem, or that affect a smaller number of stakeholders, come towards the end.

RECOMMENDATION 1: CONSIDER 'IMMEDIATE FAIR AND OPEN' THE DEFAULT FOR ALL RESEARCH OUTPUT

The FAIR principles were originally developed to be applied on data: making data open access, and encouraging data reuse. Recent lessons show that the FAIR principles need to be understood in much wider sense. Following the example from Australia, an appropriate evolution that ought to be introduced is to support that all publicly funded research output should be FAIR and open immediately when finalized. Opt-outs should be allowed for in a legal framework, such as for privacy or security reasons[20].

There is a collective need to develop strategic thinking on whether and how to protect and whether and how to open. Although FAIR isn't necessarily equal to open[21], or immediately available, the current societal demand for knowledge and the corresponding level of public investments[22] in research, place a moral requirement on public authorities to give back to the public the results of their investments, openly and immediately, whenever there is no sound reason to do otherwise.[23]

20 In line with the recast proposition of the Directive on Public Sector Information.

21 See "Cloudy, increasingly FAIR; revisiting the FAIR Data guiding principles for the European Open Science Cloud", https://content.iospress.com/articles/information-services-and-use/isu824 (retrieved August 15, 2018).

22 As well as the related efficient management of public funds.

23 Especially in the case of research publications – since a publication represents a formal communication of the author to the public – it is very hard to explain to both researchers and potential users why a research paper stemming from a publicly funded research, which has been validated and improved by other researchers working for free, shouldn't be allowed to be made openly and immediately available by its authors, research performing institution or funder upon publication. Above all, when there is more than enough current technological capability to make it immediately available for free or at a very low marginal cost at the time of publication, given the advent and widespread adoption of the Internet, the existence of a network of public research infrastructures and the fact that research publishers get hold of the content they publish for free.

All research outputs, including publications, data, code, methods, tools, models, open educational resources, research projects themselves and other administrative data, such as call applications, bear considerable potential usefulness and should be subject to the FAIR principles. This would ensure they are increasingly findable and that the conditions that regulate their access and reuse are also known and acted upon accordingly, both by humans and machines. Likewise and additionally, all these research outputs should also be "as open as possible, as closed as necessary", i.e., be made immediately available as a default. This does not conflict at all with the acknowledgement that there are good causes to keep some research outputs embargoed or with restricted or even closed access.[24] The case of certain categories of research data that should be kept with partially restricted to completely closed access – especially identifiable personal data both for privacy and personal safety reasons – is a good illustration of research outputs that could be FAIR without being openly or immediately available. But only as long as they are findable and the conditions governing their access and reuse are known in accordance with certain rules.

[24] Except research publications, which, as argued above, are communicating with the public.

The concept of "Immediate FAIR and open" can thus be an integral part of the European Union research and innovation framework and applied to all research output. Drawing again from Australia's example, Member States' different routes[25] to immediate FAIR and open research outputs must be anticipated and respected. In doing so, each country's own timing for achieving an immediate FAIR and open environment for the sharing of research outputs should be respected, recognising the structural diversity (e.g.: funding, evaluation systems, research priorities) of research systems across Europe and the way each country is affected by these transformations. Even by their own timing, the countries have to show continuous and clear progress towards an immediate FAIR and open ecosystem. The goal for immediate FAIR and open as the default for all research output should be pursued swiftly and through a coordinated approach as much as possible. In depth collaboration and mutual support among European countries will be important enablers for an inclusive and quick implementation of these principles. Immediate in this context means that there should be no delay for research to reach the public from the moment researchers decide to present their work.[26] That will ensure that all types of research outputs are findable, accessible, interoperable, reusable, and open, with the overall aim to meet highest scientific quality so that anyone can confidently innovate from them.

This broad interpretation of the concept of FAIRness does not exclude quality assessment, and, in particular, the concept of (open) peer reviewing. A peer review validation procedure, preferably open peer review, should be applied to every type of research output, not only to publications, and the difference between peer reviewed and non-peer reviewed outputs must be clear at all times.

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25 In the case of research publications, this means that, in the future, they could be made immediately available either by publishing in an open access journal or through the deeds of any interested party (researcher, institution or funder) by opening up a copy of the publication via their scientific repositories at the time of formal publication, effectively eliminating current barriers to knowledge dissemination that have no legitimate reasons to continue.

26 It may be any outcome of the research: the researcher may decide to present a tool he/she developed, a dataset and also, of course, a publication.

The problem

- The main obstacle is**:** who will collect the benefits of the open data? Who will use the open data? There is a concern of "free riders" benefiting more from open science practices than the ones who share.

- Authors are still asked to give up their copyright in the case of agreements with publishers and thus don't retain copyright by default. Their work, even when it is publicly funded, then becomes largely inaccessible due to the exercise of copyrights

- Publications are still produced primarily with copyright protection that limits knowledge circulation, rather than copyright that both protects the author and accelerates knowledge circulation and re-use. For example, most publications do not have a CC-BY license by default.

- Some research outputs, including data or software, are not made available with future-proof interoperable formats[27] by default, and are not accessible and reusable.

- The imposition of excessively long embargoes in the use of green open access[28] repositories, unfair APC[29]-based gold open access[30], and the practice of hybrid open access[31], directly or indirectly contribute to support the business models of commercial publishers more than it is cost effective for research performing organisations. This is due to the overall, and conceivably increasing, costs of subscriptions, APCs, and other costs. It also creates barriers to the added value of open science.

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27 These issues can be addressed with an interoperability framework such as the European Interoperability Framework, detailed here: https://ec.europa.eu/isa2/eif_en (retrieved October 17, 2018).

28 Often forcing research publications to unjustified excessively long embargoes before they are openly available and hindering a democratic and wide knowledge dissemination and appropriation.

29 Article Processing Charges.

30 Besides the ethical reservations around the fact that the authors must pay to be published, it often places financial burdens upon them unrelated to the actual costs or quality of publishing. It also bears the risk that APC price evolution mimic the patterns observed in the prices of subscriptions due to the documented pitfalls of the scholarly publishing market and the fact that research publishers' profits depend more on the quantity of publications than on their quality.

31 Challenged with questions such as double-dipping.

- Some national research infrastructures in several states implement open data in their field, but there is still the need for national and international coordination towards open research data and to put in practice the European recommendations, e.g. as proposed by the FAIR data action plan and as the already stated ambition in the Commission's proposal for the next Framework Programme, Horizon Europe[32].

- There are disparities between the various Member States in this domain, with some countries and respective research communities better placed to promote a quick implementation of "immediate FAIR and open research outputs" and other countries lacking essential conditions, such as adequate infrastructure.

- There is still a long way before most research outputs, especially data but also lab notebooks, methodologies and workflows, are FAIR by default, perpetuating current known inefficiencies of the research endeavour.

- Human users[33], particularly people with disabilities, do not always have access to research outputs published online because they often do not meet the Web Content Accessibility Guidelines.[34]

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32 Detailed here: https://ec.europa.eu/info/designing-next-research-and-innovation-framework-programme/what-shapes-next-framework-programme_en (retrieved November 8, 2018).

33 In addition to the fact that citizens in general may not be aware of where to find research outputs on a number of occasions.

34 https://www.w3.org/WAI/standards-guidelines/wcag/ (retrieved August 17, 2018).

Concrete actions

- Implement monitoring practices throughout the research process, in order to manage and analyse the data; program; disseminate data; provide training**.** Personal IDs and standardized data models should be used, such as the DataCite Metadata Schema for an accurate and consistent identification, citation and access of data sets.

- Support further research on FAIR data metrics.

- Develop a general framework presenting how the FAIR principles can be applied to all research outputs with a condition of immediate open access, inspired by a principle of responsible research. This should include big datasets but also smaller sets of data (sometimes called "smart data" or "micropublications"), negative results, research publications, methods, software, code, tools, models, metadata, open educational resources, and any other type of outputs arising from publicly funded research, since these have reuse value which would be wasted otherwise.[35]

- Apply the Web Content Accessibility Guidelines (WCAG) to all research outputs made available online by default.[36] Aim at meeting all levels of the WCAG 2 requirements.[37]

- In particular, apply FAIR principles to peer reviewing so that good peer reviewers get the visibility they deserve, and peer reviewing becomes a more transparent and open dialogue between peers.

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35 Data sharing has to be sufficiently valued and rewarded on its own so that researchers confidently engage in data sharing as a valued outcome of their work and don't have to rely solely on publishing to get rewarded. This would make researchers more comfortable to share their data even before publication.

36 That is, unless there is a good reason not to do it.

37 "How to Meet WCAG 2 (Quick Reference)", https://www.w3.org/WAI/WCAG21/quickref/?versions=2.0 (retrieved August 17, 2018).

- Explore how the Immediate FAIR concept can be part of the innovative Open Research Europe[38] platform for open access.

- Investigate the concept and design of an "immediate FAIR" indicator for research outputs.

- It should be made clear which research outputs and publications have been (openly) peer reviewed or not. Making a diversity of research outputs visible and accessible does not imply any lack of scientific quality.

- Integrate international initiatives, such as the GO-FAIR[39] initiative, into national policy making.

- Encourage digital training that equips researchers with the skills to practice open science.[40] Furthermore, provide support (resources, such as venues and materials, trainers) to institutions or communities which are acting nationally/locally to provide such training.

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38 The Open Research Europe Platform will provide an open access publishing venue without cost to the beneficiaries of Horizon 2020. The platform will manage the entire publication process, from submission to publication, post-publication curation and preservation, of original articles stemming from Horizon 2020 funding and will implement an open peer-review system.

Further information about Open Research Europe can be found here: https://etendering.ted.europa.eu/cft/cft-display.html?cftId=3418 (retrieved May 29, 2018).

39 https://www.go-fair.org/ (retrieved December 12, 2018).

40 There are many examples of successful open science training projects and centres that can inspire national action. For instance, check Project FOSTER in the inspiration and references section.

Inspiration and references

- Measures have been taken in Australia to simplify the perception of digital research content, while in Europe the latest recommendations still honour the division between open access publications and FAIR data.[41]

- The FOSTER European project provides training resources and courses aiming for the widespread uptake of open science practices by researchers.[42] Also, the Digital Curation Centre has similar initiatives in the UK.[43]

- On the 4th of September 2018 a "Plan S" was presented together with a coalition of funders who aim to implement the plan. The Plan S advance towards the open access of scholarly publishing by 2020, saying that all scholarly publications resulting from public research funding must be published in open access journals or on open access platforms. In addition publications must have a CC-BY license and cannot be published in hybrid journals. The Plan S was jointly developed by Science Europe, a group of heads of national research funding organisations, and Robert-Jan Smits, Senior Advisor on Open Access within the European Political Strategy Centre at the European Commission.[44]

- The Open Science Policy Platform has recommended that the European Commission must move toward a broader definition of open access that incorporates the full range of emerging formats and applications of scientific research output[45].

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41 "Policy Statement on F.A.I.R. Access to Australia's Research Outputs", (retrieved November 9, 2018).

42 https://www.fosteropenscience.eu/ (retrieved October 26, 2018).

43 http://www.dcc.ac.uk/ (retrieved October 26, 2018).

44 "Plan S", https://www.scienceeurope.org/wp-content/uploads/2018/09/Plan_S.pdf and "cOAlition S", https://www.scienceeurope.org/coalition-s/ (both retrieved September 13, 2018).

45 "Recommendations on Open Science Publishing", https://ec.europa.eu/research/openscience/pdf/ospp_open_access_publishing_report.pdf (retrieved November 08, 2018).

- The National Library of Sweden (NLS) is undertaking a government commission on how to measure scientific publications immediate open access with the FAIR principles. This work is tightly knit to the development of FAIR principles for research data in Sweden, performed by the Swedish Research Council.

- Aarhus University and industry open patent-free playground.[46]

- France's concept of Bibliodiversity as presented in the Jussieu call.[47]

- France announced a National Plan for Open Science on July 4, 2018. With this national plan, France is adopting an ambitious Open Science policy linked to the international commitments it has made for the Open Government Partnership (OGP) and also addresses the Amsterdam Call for Action.[48] One of its fundaments is to make scientific research results open to all researchers, companies, citizens, without hindrance and without delay.

- Some French academic institutions and research centres have developed repositories for the depositing of electronic scientific information which apply trusted quality standards reflecting the FAIR principles. They have also defined policies or strategies to support scientific data infrastructures for dissemination.[49]

- Finland's portal for FAIR Data services.[50]

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46 Further details available here: http://scitech.au.dk/en/about-science-and-technology/current-affairs/news/show/artikel/aarhus-universitet-og-industrien-aabner-patentfri-legeplads/ (retrieved November 8, 2018).

47 "Jussieu Call for Open science and bibliodiversity", https://jussieucall.org/jussieu-call/#call (retrieved June 8, 2018).

48 More details can be found here: https://libereurope.eu/blog/2018/07/05/frenchopenscienceplan/ (retrieved September 13, 2018).

49 For example, INRA, that is developing an approach to make digital scientific information accessible and usable, whether it's publications or data from research projects. Also, CIRAD and IRSTEA propose research data management to ensure sustainability, accessibility and reuse of the data. See http://2025.inra.fr/openscience_en/CONTEXT-AND-VISION; http://www.cirad.fr/nos-recherches/ressources-et-infrastructures-de-recherche-ouvertes and http://www.irstea.fr/la-recherche/information-scientifique-et-technique (retrieved June 8, 2018).

50 https://www.fairdata.fi/en/ (retrieved June 29, 2018).

- Horizon 2020 Programme has Guidelines on FAIR Data Management in Horizon 2020.[51]

- The European Commission has published the Recommendation of 25 April 2018 on access to and preservation of scientific information, updating its previous recommendation on open access.[52]

- DataCite Metadata Schema for accurate and consistent identification, citation and access of data sets.[53]

- ALLEA's (All European Academies) code of conduct declares that withholding research results, delaying or inappropriately hampering the work of other researchers is an unacceptable conduct.[54]

- The Expert Group "National Strategy" of the Open Access Network Austria (OANA); Universities Austria (uniko) published 16 recommendations and efforts should be made to achieve the following goal: By 2025, a large part of all scholarly publication activity in Austria should be Open Access."[55]

- Report of the EC's Working Group on Education and Skills under Open Science "Providing researchers with the skills and competencies they need to practise Open Science"[56]

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51 "H2020 Programme Guidelines on FAIR Data Management in Horizon 2020", http://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/hi/oa_pilot/h2020-hi-oa-data-mgt_en.pdf (retrieved June 29, 2018).

52 "Commission Recommendation of 25 April 2018 on access to and preservation of scientific information, C/2018/2375", https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32018H0790 (retrieved November 8, 2018).

53 The DataCite Metadata Schema is a list of core metadata properties chosen for an accurate and consistent identification of a resource for citation and retrieval purposes, along with recommended use instructions. More details can be found here: https://schema.datacite.org (retrieved June 29, 2018).

54 "The European Code of Conduct for Research Integrity", https://www.allea.org/wp-content/uploads/2017/05/ALLEA-European-Code-of-Conduct-for-Research-Integrity-2017.pdf (retrieved November 9, 2018).

55 "Recommendations for the Transition to Open Access in Austria", https://zenodo.org/record/51799#.W-VeM9X7Tcs (retrieved November 9, 2018). Also see a collection of Austrian national activities in: https://oana.at/en/national-activities/ (retrieved October 17, 2018).

56 https://ec.europa.eu/research/openscience/pdf/os_skills_wgreport_final.pdf (retrieved June 29, 2018).

Expected added value and innovation potential

- Efficient and high-quality digital preservation and dissemination of scientific information.
- Higher visibility through increased findability of the scientific information.
- More data-driven research.
- More variation in (and appreciation for) other forms of research output (e.g. software).
- Greater number and diversity of research outputs to be found and reused through research infrastructures, namely the EOSC.
- Greater number and diversity of research outputs accessible by people with disabilities.
- Strengthening the academic freedom to access and utilise all kinds of research outputs as soon as possible and thereby building upon the free choice of subject and method.
- More efficient research processes (re-use).
- Transparency, which in turn promotes quality.
- Higher accountability and research integrity.
- Higher societal impact.
- Stronger support for lifelong learning.
- The avoidance of some forms of conflict of interest between authors and publisher.
- More industry funding into research.
- Uptake and stronger engagement of SMEs in innovation and research processes with associated benefits.

Expected challenges/risks

- The assessment, reward and evaluation systems of today typically reward research outputs which are not open or do not adhere to the FAIR principles only because they appear in journals with a high impact factor. Researchers often feel that open and FAIR research outputs are disregarded or not sufficiently valued in comparison.

- Embargo periods might also apply to research data in the future - in order for researchers to benefit from their own data before it is re-usable by other researchers.

- There are still researchers or communities which are not fully aware of, or are not yet significantly affected by, open science, and therefore don't see the benefits. The changes it brings may then be difficult to understand or to accept.[57]

RECOMMENDATION 2: PROMOTE AND PROTECT OPEN SCIENCE WITHIN THE EUROPEAN COPYRIGHT LEGAL FRAMEWORK

For Europe, access to knowledge and encouraging innovation are priorities, including through its dispositions and recommendations in education and research. Addressing these challenges involves a system of strong copyright law which takes into account the needs of the research and innovation in terms of open science. Copyright legal framework throughout Europe and a proper implementation of the future "Directive on copyright in the Digital Single Market" should therefore be able to balance the interests of science with society and public interests (including those of public sector entities which are right holders) and those of the rights holders with purely commercial or economic interests. The ERAC is suggested to be an actor of this reconciliation and promote the principle of open science all through the European-wide legislative framework. Publicly funded research outputs should benefit from a different copyright status considering the public investments at their root and their purposes. An harmonisation of copyright rules with this proposition as a backdrop, including a concerted, common transposition and implementation of European legal instruments, is needed in order to protect publicly funded research authors and their embracement of open science activities within Europe. It ultimately enables building common and competitive European open science and innovation policy.

[57] Even the simple fact that any change is needed can be a handicap to practice open science.

The problem

- The current European legislative framework regarding copyright across the different Member States is fragmented and can lead to different interpretations of the exceptions for research purposes. The situation leads to confusion and uncertainty among researchers and the growing transnational characteristic of research worsens this situation. Additionally, even with referred exceptions for research purposes, the legislative framework is essentially directed at the protection of those authors and content producers who expect to have some sort of material return from their works. Usually, they get compensated (or expect to somehow) by the publishers when they give up their copyright to them, who are then entitled to collect revenues from the copyrights. This is not the case in the majority of the works which are research outputs. The authors / researchers indeed give their copyrights for free only in the hope that their work gets disseminated and then the publishers are entitled to collect all revenues originated from these works, with no costs to bear at all from the obtainment of copyright.

- The problem is even worse when one considers the publicly funded nature of a great deal of the research being done in Europe. The copyright is conceded by the publicly funded author/researcher at no cost to the publisher who then charges for access to the very same work. The public, including all potential beneficiaries of the research and which originally paid for the research in the first place through its taxes, is refused access to its investment without extra disproportionate payments.

- The current European legislative framework, with a few notable exceptions (e.g. France, Germany, Netherlands), somehow loses sight of the interests of science and especially those of an open science, so it is important to find an appropriate balance with the interests of the rights holders / publishers.

- The view that open science is an all or nothing game does not reflect the reality: there are many levels of articulation between open and commercial exploitation, including synergies, as in the case of the human genome project. It would be worth to explore those in more detail.

Concrete actions

- Clearly state that all research outputs arising from public funding must be considered as a public good and thus should follow the FAIR and the ”as open as possible, as closed as necessary” principles.

- State that copyright stays with the author who also chooses the appropriate open license for re-use of the content. Preferably, this license should be the CC-BY license since it allows a wider range of reuses and it is an internationally acknowledged license. This would also be the case for the funder or research performing organisation of the author in countries / research systems where it is those entities which are originally entitled to the copyright of the publicly funded research output.

- Consider defining research outputs originating from publicly funded research as a different category of works / contents, subject to a specific type of copyright protection with a default open license.

- Promote collaboration between public science, industry and society so that all together will participate to a European or international open science strategy.

- Promote a secondary right of free publication rights for publicly funded research authors. In accordance with the recommendation of the European Commission on Open Access to Scientific Publications and Open Access to Research Data in Horizon 2020, in order to promote the use of publicly funded research results and maximize their socioeconomic impact, as well as for the purpose of giving an equality of rights to each researcher working in Europe in an harmonized European legal framework, national legislations could give a limited secondary right of free publication, with no commercial purpose and without embargoes for the published version[58], to the authors who published, in a scholarly publication, an article exposing the results of publicly funded research either on European funds or Member States' funds.

[58] The final peer-reviewed author's version - identical to the published version but without the publisher's formatting - should always be made immediately available.

- Look for a way forward to introduce in European law, whenever the opportunity comes up[59], the secondary right of free publication rights for publicly funded research authors, as well as to consider defining research outputs stemming from publicly funded research as a different category of works / contents, subject to a specific type of copyright protection with a default open license.

Inspiration and references

- The French "Loi pour une République numérique".[60]
- The German law on intellectual property rights[61].
- Amendment to the Dutch Copyright Act proposed by MP Taverne entered into force in July 2015.[62]

Expected added value and innovation potential

- Simpler and clearer copyright framework.
- A copyright legislation more in favour of open science.
- Less copyright violations since copyright for publications is not entirely transferred to publishers.

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59 If near-future developments at the European Parliament lead to a profound recast of the current Copyright Directive, there may still be a chance for introducing provisions protecting open science in this policy cycle. If not, Member States should keep a proactive approach towards inserting these provisions in European law in future policy cycles.

60 "LOI n° 2016-1321 du 7 octobre 2016 pour une République numérique (1)", https://www.legifrance.gouv.fr/affichTexte.do;jsessionid=8E0D37B05439B162A194464E7C7DE262.tplgfr23s_1?cidTexte=JORFTEXT000033202746&categorieLien=id (retrieved November 9,2018)

61 "Act on Copyright and Related Rights (Urheberrechtsgesetz, UrhG)", https://www.gesetze-im-internet.de/englisch_urhg/index.html#gl_p0065 (retrieved June 29, 2018)

62 "Wijziging van de Auteurswet en de Wet op de naburige rechten in verband met de versterking van de positie van de auteur en de uitvoerende kunstenaar bij overeenkomsten betreffende het auteursrecht en het naburig recht (Wet auteurscontractenrecht)", https://zoek.officielebekendmakingen.nl/kst-33308-11.html (in Dutch only, retrieved November 9, 2018). More information about this legal provision can be found here: http://www.openaccess.nl/en/events/amendment-to-copyright-act (retrieved June 6, 2018), https://www.rug.nl/library/open-access/faq/faq-oa-copyright/wat-is-het-amendement-taverne_?lang=en and https://www.rug.nl/library/open-access/oa-nieuwsbrief/2018-10-taverne-copyright-law-enforce-open-access (both retrieved November 9, 2018).

Expected challenges/risks

- Copyright legislation is a very complex and sensitive matter. Different interpretations and implementations of the proposed changes across Member States' legal frameworks may raise doubts and introduce exclusions leading to different legal measures that ultimately create obstacles for open science.

RECOMMENDATION 3: DEVELOP AND ADVOCATE AN UNDERSTANDING OF INNOVATION BETWEEN MEMBER STATES THAT IS BUILT ON OPEN SCIENCE

A common interpretation of innovation between Member States would be beneficial for promoting and implementing open innovation linked to open science across the ERA. It would be helpful to find some common ground since a number of actions need coordination and agreement to be effective. Agreeing on the appropriate balance between promoting openness, such as by using open copyright licences, and reserving some other rights[63] would facilitate full development of open science and innovation (including open innovation), and bridging them efficiently.[64]

The problem

- Lack of a coherent approach to innovation leads to different attitudes with regards to finding the right proportion between the potential of open innovation and the protection of business interests.

- Different types of innovation are developed in parallel rather than jointly, creating niches – of open innovation, social innovation, among others. All these types of innovation belong together and this needs to be mainstreamed across policies.

63 "What does "Some Rights Reserved" mean?", https://creativecommons.org/faq/#what-does-some-rights-reserved-mean (retrieved October 26, 2018).

64 Open innovation will be elaborated by SWG OSI Task Force on Open Innovation. See also footnote 4.

Concrete actions

- Directly incorporate the principle of innovation in European legislation, as it is for the precautionary principle, taking into account its benefits (growth, research and economic activity), sharing the value driven by innovation and the protection of people and the environment[65], and taking into account the protection of intellectual property rights. This could also be framed in the context of UN's Sustainable Development Goals.

- Consider a network of open innovation playgrounds in which Member States can share best practice examples of how open innovation benefits from open science.

- Investigate the circulation and exploitation of patents in a more open context.

- Exchange experience and good practices about the different innovation related policy mixes between openness and closeness ("as open as possible, as closed as necessary"), assessing the extent to which they maintain the competitiveness at the highest technology readiness levels (TRLs), while also preserving basic research and the fabric of scientific knowledge through open dissemination of research results.

- Organize mediation between researchers and enterprises to maximize the circulation of the interests of each party, for example via Fablab[66] and learning centres for innovation.

- Encourage the Member States to implement, or expand, innovation support policies linked to open science policies.

- Member States should translate paragraphs 14 and 15 of the Council Conclusions on the transition towards an Open Science system (9526/16)[67] into practical guidelines for daily use.

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65 This has already been achieved in some countries.

66 More information about FabLabs here: https://www.fablabs.io/ (retrieved November 9, 2018).

67 See footnote 1.

Inspiration and references

- The Danish example of Smart Polymer Materials and Nano-Composites (SPOMAN) Open Science Framework and the Patent Free playground.[68]
- The Austrian open innovation strategy followed a broad and open national involvement and consultation process.[69]
- OECD definition of innovation.[70]
- EC's European Political Strategy Centre Strategic Note "Towards an Innovation Principle Endorsed by Better Regulation[71]"
- Council Conclusions on the transition towards an Open Science system adopted on 27 May 2016 (9526/16).[72]

Expected added value and innovation potential

- Better understanding of where to draw a line between openness and secrecy raises trust among stakeholders willing to invest in open innovation.
- More industry funding into research.
- Mutual trust building in public-private partnerships.

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68 More details here: http://scitech.au.dk/en/collaboration/business-collaboration/collaboration-on-research-and-innovation/open-science/; https://osf.io/wudyt/ ; https://spoman-os.org/ (all of them retrieved June 28, 2018).

69 See footnote 15. Also, the Austrian pilot project on open research results: https://open4innovation.at/de/ (retrieved June 27, 2018).

70 "Defining innovation", https://www.oecd.org/site/innovationstrategy/defininginnovation.htm (retrieved June 27, 2018).

71 https://ec.europa.eu/epsc/publications/strategic-notes/towards-innovation-principle-endorsed-better-regulation_en (retrieved June 28, 2018).

72 See footnote 1.

- More synergies based on an open layer of knowledge.
- Uptake and stronger engagement of SMEs in innovation and research processes with associated benefits.

Expected challenges/risks

- Changes in the culture of innovators or innovation promoters may be needed to eliminate fears of losing competitiveness.
- Care should be taken so that the uptake of open innovations does not conflict with the competitiveness of Europe in a global setting.
- Patents stimulate innovation but can also be a hindrance, if not established and used in partnership between research and enterprise, especially in disruptive innovation.
- Find a harmonious approach of open innovation which conciliates the need to foster a collaborating method and the protection of intellectual property rights.

RECOMMENDATION 4: DEVELOP END USER SKILLS FOR BETTER APPROPRIATION OF KNOWLEDGE DERIVING FROM RESEARCH

Science should reach out, build trust and engage a comprehensive range of end users, such as the public sector, citizens, NGOs and companies. The expected payoff can be of societal innovation and impact as well as economical. Research can have many different target audiences in mind, but also foresee unintended end users beyond academic practitioners. End users necessary skills, especially in the digital field, can be bolstered for them to become aware of what they can obtain from using research that would help them reach individual or organizational objectives. There is a need then for end users - a whole range of them - to learn how to derive the potential benefits of research into their activities.

The problem

- Benefits and innovation potential deriving from open research may not always be perceived as such or be put into practice by end users due to lack of competences.

- In a world marked by the open availability of research outputs, whoever can make the most out of them will have the edge. European end users could become disadvantaged against other more skilled populations, even if its own research is world-class.

- A related problem is that some lost potential may be occurring since a significant part of European Union's users outside of the research ecosystem already have the skills to extract value from research, but they have no means or it becomes too expensive to access it. For example officials at different authorities, medical staff in health care, project staff in industry, and many more. Withholding them the most recent knowledge that they can use in their everyday life, could limit European competitiveness.

Concrete actions

- Engage with relevant stakeholders from the public sector, citizenry and the industry to identify skills that should be developed to improve appropriation of knowledge deriving from research by end users and devise and agree on the best methods for developing such skills.

- Foster data literacy and consider the development of such skills in all educational contexts, including traditional and different ones (institutional or citizen driven initiatives, lifelong training, labour and entrepreneurial contexts).

- Require dissemination plans for research, including target audience and expected outcomes, and foster methodologies and best practices for the uptake of knowledge by all.

- Make research more attractive, understandable, reusable and inclusive for a wider audience by strengthening existing, and encouraging new communication practices[73].

[73] This should include the development of researchers' capacities to engage with citizens.

- Support researchers to monitor the dissemination and impact of their research among end users (e.g. via altmetrics).
- Engage with all kinds of public media, including social media.
- Value science communication professionals and educators and consider and include their contributions in the research workflow.

Inspiration and references

- Report of the EC's Working Group on Education and Skills under Open Science "Providing researchers with the skills and competencies they need to practise Open Science"[74]
- The Campus Engage National Network is led by the 7 Irish Universities and DIT. It has been set up to promote civic and community engagement as a core function of Higher Education on the island of Ireland, by better enabling Higher Education Institutions (HEIs), their staff and students across all disciplines, to engage with the needs of the communities they serve. Civic engagement is understood as a mutually beneficial knowledge-based collaboration between the HEIs with the wider community through, among other activities, capacity-building.[75]

Expected added value and innovation potential

- Better reuse of knowledge derived from research.
- More knowledgeable and demanding end users.
- Multiply ways to derive economic and social value out of research.
- People-centred, inclusive and sustainability-oriented information technology.

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74 See footnote 56.

75 "About Campus Engage", http://www.campusengage.ie/about-campus-engage (retrieved October 25, 2018).

Expected challenges/risks

- Important stakeholders may fail to see a value in this, thus hampering the full development of capabilities for the appropriation of knowledge.
- Greater accountability of researchers and their work.

RECOMMENDATION 5: FOSTER INVOLVEMENT OF CITIZENS IN SCIENCE

In a context of growing obscurantism, explosion of fake news especially in social media, and development of ”post-truth”, there is a risk of reaching a point marked by a high level of general mistrust between citizens and science, compared to the current situation where said mistrust is rather specific to some technological innovation issues (like GMOs or nanotech). To overcome this, it is absolutely needed to revisit and update the ways and the mechanisms that allow citizens to be informed of and take part in science activities, hence the need to enhance citizen science. A broader definition of citizen science, meaning deep consultation and engagement of citizens in science, is adopted for the purpose of this document.

It should be noted that some of the problems referenced below have been identified by the European Commission and some of the proposed actions were also undertaken and funded through projects of the Horizon 2020 “Science with and for Society” (SWAFS) Work Programme 208-2020[76]. However, the involvement of citizens in science should be taken as an ongoing mission, to foster a sustained dialogue between research and society.

[76] Horizon 2020 Work Programme 2018-2020 “Science with and for Society”, http://ec.europa.eu/research/participants/data/ref/h2020/wp/2018-2020/main/h2020-wp1820-swfs_en.pdf (retrieved December 12, 2018).

The problem

- Engagement of citizens in research activities is mostly an exception[77].
- Researchers and citizens sometimes seem to be out of touch with each other.
- There is a lack of incentives for researchers to engage in citizen science.
- Simplistic or misleading narratives are easier to propagate than careful and honest efforts to describe complex phenomena. The current media culture of immediacy is not in favour of science communication either. This can lead to disbelief in research and science in general.
- Societal support to research and fully reaping its benefits is dependent on its credibility and general understanding of scientific methods and the difference between evidence-based claims and opinions.

Concrete actions[78]

- Take stock of the results and recommendations produced in the sphere of the H2020 SWAFS projects[79], use them as examples and, where relevant and applicable, implement those recommendations and actions in other contexts, such as for national policy making.
- Set up an observatory at European level to better document citizen science processes and exchange best practices.

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77 As detailed in the "Network Analysis of Civil Society Organisations' participation in the EU Framework Programmes" report, commissioned by DG Research & Innovation of the European Commission, available here: http://ec.europa.eu/research/swafs/pdf/pub_public_engagement/ki-04-17-578-en.pdf (retrieved December 12, 2018)

78 The listed actions should be open to modifications and interpretation depending on the results of research on citizen science currently being made under the scope of the SWAFS work programme. Meaningful results are expected, in particular, under Topic SwafS-17-2019 that conducts research on citizen science, including benefits/impacts, and SuperMoRRI, funded under SwafS-21-2018, which will look at impacts of public engagement and science education on research and innovation.

79 See footnote 76

- Ensure that citizen science projects are part of a global vision and can be supported through national and European R&I funding programmes, as well as other public funding streams, including local ones.

- Launch consultations at national and European levels[80] in order to involve citizens in the setting of research agendas.

- Make sure that all young people in Europe are educated towards science through innovative methods involving researchers themselves.

- Organize more systematically debates on key R&I topics involving citizens, experts and policy-makers.

- Seize the opportunity presented by citizen science projects to learn for European capacity building: they provide the right base for learning how societal actors can evaluate societal impact of research.

- Stimulate the integration of the citizen science dimension in national open science roadmaps.

- Take engagement in citizen science activities into account while assessing researchers.

- Implement open access and open research data in citizen science projects.

80 As it was done by the Cimulact project for the Horizon 2020 Framework Programme, http://www.cimulact.eu/ (retrieved November 9, 2018).

Inspiration and references

- The Dutch process of citizen agenda setting for research at national level in 2015.[81]
- The Cimulact project - Citizen and Multi-Actor Consultation on Horizon 2020 (funded by H2020).[82]
- Portugal's Ciência Viva Agency[83], the national agency for the promotion of initiatives for the public awareness of science and technology in Portugal, whose associate bodies include public institutions and research laboratories.
- European Citizen Science Association's 10 Principles of Citizen Science.[84]
- European Commission's proposal for the next research Framework Programme, Horizon Europe, explicitly addresses citizen science for responsible research and innovation agendas.[85]
- KLOSS – Knowledge Exchange and Learning About Strategic Collaboration Swedish is a project of higher education institutions in Sweden enhancing their strategic abilities in collaborating with society.[86]

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81 More information about this process can be found here: https://www.nwo.nl/en/policies/dutch+national+research+agenda (retrieved November 9, 2018).

82 See footnote 80.

83 http://cienciaviva.pt/home/index.asp?accao=changelang&lang=en (retrieved June 28, 2018).

84 https://ecsa.citizen-science.net/sites/default/files/ecsa_ten_principles_of_citizen_science.pdf (retrieved August 13, 2018).

85 "Proposal for a Regulation of the European Parliament and of the Council establishing Horizon Europe – the Framework Programme for Research and Innovation, laying down its rules for participation and dissemination", https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1540387631519&uri=CELEX%3A52018PC0435 (retrieved October 25, 2018). Horizon Europe states that "the Programme should engage and involve citizens and civil society organisations in co-designing and co-creating responsible research and innovation agendas and contents, promoting science education, making scientific knowledge publicly accessible, and facilitating participation by citizens and civil society organisations in its activities".

86 More details here: https://www.kth.se/en/samverkan/arenor/kloss/kloss-kunskap-och-larande-om-strategisk-samverkan-1.441579 (retrieved September 27, 2018).

Expected added value and innovation potential[87]

- Improved dialogue, communication and interaction between researchers and citizens/society leads to greater trust, increased interest and openness.
- Increased openness and cooperation with the surrounding community reinforces the legitimacy of research.
- Researchers who are open to embrace other types of knowledge and inputs, really engage citizens and also may benefit from different perspectives and approaches in their research.
- Enhancing an evidence-based, scientific approach among citizens, allowing them to be more critical toward fake news and information in general.
- Increasing the interest of young people in science activities.
- More innovative products from citizen science.
- Increased skills levels of the labour force.

Expected challenges/risks

- Non-acceptance of the involvement of citizens in science by part of the research community.
- Risk of bringing in agents who do not want to contribute positively to getting science and citizens closer together.
- Countering the impact of simplistic narratives is very difficult.

[87] See also "Monitoring the evolution and benefits of responsible Research and Innovation, Summarising insights from the MoRRI project – Study", available here: https://publications.europa.eu/en/publication-detail/-/publication/fdd7dd10-c071-11e8-9893-01aa75ed71a1/language-en/format-PDF/source-79950051 (retrieved December 12, 2018)

RECOMMENDATION 6: ADJUST ASSESSMENT, REWARD, AND EVALUATION SYSTEMS

The academic career system doesn't sufficiently support or reward researchers who participate in a culture of openness. Even if some institutions integrate and apply open principles in the evaluation procedures, implementation of European open evaluation guidelines at national level is still lacking. Stronger incentives are needed to associate reputation to intrinsic quality and collaboration/openness of the research.

The problem

- The assessment, reward and evaluation systems of today typically reward research outputs which are not open, or do not adhere to the FAIR principles mainly because these systems merit the Impact Factor of the journals where the research publication is made rather than the quality, openness and the diversity of the research outputs themselves.
- Researchers often feel that open and FAIR research outputs other than articles published in international top journals are disregarded or not sufficiently valued in comparison.
- There is fear of scooping among researchers if they engage in open science, which is a problem if you are trying to create new knowledge/products.[88]
- Bibliometrics based assessment practices tend to feedback into the evaluation systems, i.e., researchers whose careers progressed in this cultural context tend to assess their younger colleagues according to it. This is also true at international level since most benchmarking exercises in research and university rankings are at least in part based on the very same bibliometrics, and do not take open science into account in any significant way.
- Related to this, researchers also worry and avoid directing efforts towards actions that are not rewarded (and thus do not advance own career).

88 "Who's afraid of Open Data: Scientists' objections to data sharing don't stand up to scrutiny.", http://blogs.lse.ac.uk/impactofsocialsciences/2015/12/16/whos-afraid-of-open-data-dorothy-bishop/ (retrieved June 5, 2018).

- The fragmented European landscape in this domain hampers a smooth transition of researchers between assessment systems, which may keep researchers from aiming for innovative research outputs, if expected to face a situation where they are evaluated differently than they are used to.

- All this makes it very difficult to change researchers' attitudes and practices so that they fully embrace open science.

Concrete actions

- Funders should value that researchers cite the FAIR research outputs of previous research activities during grant applications as a way to give credit to open science practices. For instance, it could function as a tie-breaker between proposals with similar scientific merit.

- Funders should look at valuing that researchers' publications have been subject to open peer review and should take into account as valuable and FAIR research output themselves open peer review activities undertaken by researchers.

- Funders should value that researchers create and disseminate open, FAIR educational resources as an important research output to help bridge the gap between research and training/education.

- Engage stakeholders (researchers, professional societies, general public, funders and institutions) to be creative and devise ways to identify and endorse research outputs with societal impact, either economic outcomes, public policies or good practices in different activity sectors resulting from the produced knowledge, least of all impact in other researchers work, basic research being the main engine for scientific progress.

- Advance the culture of openness through evaluations of openness in the activities of different organisations.[89]

[89] As exemplified by Finland in its "Evaluation of Openness in the Activities of Research Organisations and Research Funding Organisations in 2016", https://openscience.fi/openculture (retrieved October 17, 2018).

- Reference to publications' bibliometric or other journal level metrics should be dispensed from any assessment process. More generally, quantitative and qualitative assessment of research should be in line with the DORA and the Leiden Manifesto principles.

- The EC's H2020 Policy Support Facility[90] can stimulate cross European exchange for auditing/peer review on the maturity of organizational processes that stimulate open science. E.g. what are the strengths and weaknesses in diverse institutional settings: research performing organizations, research funding organizations, research libraries, universities and higher education institutions.

- Promote at European level a common agreement on a lowest common denominator evaluation framework that acknowledges and rewards open science and innovation practices by all parties.

- The use of existing managerial tools that have been developed in a European context should be investigated for the implementation of open Science roadmaps, and where relevant, applied and broadened to cover the full spectrum of open science (open science indicators in U-Multirank[91], open education in OS-CAM[92], etc.).

- The future EC Open Research Europe[93] publishing platform should be used as a driver in open science implementation, and be supported by the national research funders and performers.

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90 The Horizon 2020 Policy Support Facility is a new instrument that gives Member States and countries associated to Horizon 2020 practical support to design, implement and evaluate reforms that enhance the quality of their research and innovation investments, policies and systems. See https://rio.jrc.ec.europa.eu/en/policy-support-facility (retrieved November 9, 2018).

91 U-Multirank is the user driven and multidimensional ranking of universities, partly funded by the Erasmus + programme. It takes into account several dimensions and indicators of performance but, since there is nothing that relates to open science, it would be useful if it had open science related indicators or an open science dimension. See: https://www.umultirank.org/ (retrieved October 26, 2018).

92 Developed as an output of the EC's Working Group on Rewards under Open Science and presented in its final report "Evaluation of Research Careers fully acknowledging Open Science Practices", https://ec.europa.eu/research/openscience/pdf/os_rewards_wgreport_final.pdf (retrieved October 26, 2018)

93 See footnote 38.

Inspiration and references

- The Open Science Career Assessment Matrix (OS-CAM)[94], a practical move towards a more comprehensive approach to evaluate researchers through the lens of open science.
- The example provided by Finland in evaluating openness in the activities of research organizations.[95]
- The San Francisco Declaration on Research Assessment[96] and the Leiden Manifesto for Research Metrics.[97]
- Report of the EC Policy Support Facility Mutual Learning Exercise on Open Science – Altmetrics and Rewards – "Incentives and Rewards to engage in Open Science Activities (Thematic Report No 3)", prepared by the independent expert Sabina Leonelli.[98]
- Report "Evaluation of Research Careers fully acknowledging Open Science Practices – Rewards, incentives and/or recognition for researchers practicing Open Science" written by the EC Working Group on Rewards under Open Science.[99]

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94 See footnote 92.

95 See footnote 89.

96 https://sfdora.org/read/ (retrieved May 29, 2018).

97 Available through the following webpage: http://www.leidenmanifesto.org/ (retrieved May 29, 2018).

98 Available here: https://rio.jrc.ec.europa.eu/en/library/mle-open-science-altmetrics-and-rewards-%E2%80%93-implementing-open-science-strategies-experiences (retrieved June 5, 2018). See also Mutual Learning Exercise: Open Science — Altmetrics and Rewards.(Final report), available here: https://rio.jrc.ec.europa.eu/en/library/mle-open-science-altmetrics-and-rewards-final-report (retrieved June 5, 2018).

99 See footnote 92 and https://cdn1.euraxess.org/sites/default/files/policy_library/os-rewards-wgreport-final_integrated_0.pdf (retrieved June 29, 2018).

- Portugal: FCT's funded research institutions assessment regulation which states that the procedure will favour quality instead of quantity and calls on institutions to identify their most significant scientific production to the detriment of presenting exhaustive lists of publications or references to bibliometric indicators.[100]

- Recommendations of the Deutsche Forschungsgemeinschaft (DFG) Commission on Professional Self-Regulation in Science "Safeguarding Good Scientific Practice" Memorandum.[101]

- Report of the EC Expert Group on Altmetrics "Next-generation metrics: Responsible metrics and evaluation for open science".[102]

Expected added value and innovation potential

- Provide incentives and rewards to researchers to practice open science.

- Encourage publishers to diversify their offer in relation to open access.

- Learn from peers/countries with similar problems but different (eventually better) solutions.

- Deeper exchange of ideas between European countries.

- More innovation in the area of education and educational tools and practices, strengthening the knowledge triangle both at national and European level.

- Removal of the main barriers to open science and innovation between different national assessment systems, increasing trust in researchers that their open practices will be coherently accepted and rewarded across the ERA.

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100 "Regulamento de Avaliação e Financiamento Plurianual de Unidades de I&D", https://www.fct.pt/apoios/unidades/avaliacoes/2017/docs/RegulamentoAvaliacaoUID20172018.pdf (only in Portuguese, retrieved June 6, 2018).

101 http://www.dfg.de/download/pdf/dfg_im_profil/reden_stellungnahmen/download/empfehlung_wiss_praxis_1310.pdf (retrieved June 6, 2018).

102 https://ec.europa.eu/research/openscience/pdf/report.pdf (retrieved June 29, 2018).

Expected challenges/risks

- Assessment systems[103] can be very specific to the national contexts and respond to different, specific needs but research is gradually and progressively transnational, and the career paths of researchers, particularly early stage scholars, are increasingly marked by strong mobility requirements. Early career researchers will need clarity on how their efforts to engage in open science will be recognised internationally. It may be hard to find a lowest common denominator approved by all countries that is effective in the promotion of open science and innovation.

- Assessment systems can be cumbersome, difficult to change and will need time to adjust.

- Changes would preferably have to be made within a given limited time frame so as not to hinder coordination and job mobility all over the ERA.

- When trying to promote innovation, it can be challenging to perceive and fairly reward innovation within basic research. There are many examples of basic research that ends up fostering crucial innovation, even if it is not initially aiming to that and it may take time.

- Consideration needs to be given as to how funders rank and reward open science in relation to all other EU priorities, such as gender.

103 Including all kinds of assessment such as funding proposals, researchers job application/promotion and institutional assessments.

RECOMMENDATION 7: FOSTER OPEN PEER REVIEW AS THE DEFAULT LEGITIMATE APPROACH FOR SCIENTIFIC VALIDATION

This is to be integrated in a broad publication system in which reviews and recommendations are public and published on a web site, mirroring (and enabled by) the fact that a great proportion of reviewers are researchers paid by public institutions who perform their work for free. It may not necessarily imply identifiable reviews and a stepped approach may be adopted towards completely open, non-anonymous reviewing. This would address concerns regarding backlash of writing critical reviews, particularly (but not only) for junior scholars, but also help people overcome discouragement to write reviews in the first place. Given that this is still a new approach, notably in some disciplines, open peer review should be implemented with caution and critically reviewed.

The problem

- Peer-reviews of articles are not always fair, and do not always achieve the objective of making the text better.
- Peer-reviewing is rarely valued or rewarded, even though it can take a lot of time (when done properly).
- Predatory publishers misuse the double blind peer review methodology.
- Editorial policies of the journals concerning reviewing and quality control should be more clear and more easily verified.

Concrete actions

- Consider a framework with standardized open peer review processes, preferably together with the new EC Open Research Europe Publishing Platform[104], developed with input from the researchers' communities, which all Member States and research communities will use.

- Provide funding, infrastructure, technical or in-kind support to journals or other research publications that adopt open peer reviewing and apply the FAIR Principles to their publications.

- Propose research performing institutions to include peer review and editorial activities as information to be reported in annual evaluations, with a distinction of what activities are open/FAIR.

- Consider open peer reviews as FAIR research outputs.

Inspiration and references

- Publons is an organisation who incentivize open peer review by helping researchers get recognition for their reviews.[105]

- Report paper "Survey on open peer review: Attitudes and experience amongst editors, authors and reviewers" by Tony Ross-Hellauer et al.[106]

- The "Peer Community in" (PCI)[107] is an alternative model of peer reviewing created and managed by the French National Institute for Agricultural Research, INRA[108]. It is a non-profit scientific organization that aims to create specific communities of researchers reviewing and recommending, for free, unpublished preprints in their field (i.e. unpublished articles deposited on open online archives like arXiv.org and bioRxiv.org).

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104 See footnote 38.

105 https://publons.com/home/ (retrieved May 25, 2018).

106 http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0189311 (retrieved June 6, 2018)

107 https://peercommunityin.org/ (retrieved June 29, 2018).

108 http://www.inra.fr/ (retrieved June 29, 2018).

- Open platforms that offer a model of open peer review, such as Ireland's Health Research Board Open Research portal[109], Wellcome Open Research[110] and Gates Open Research[111].
- The Royal Society Open Science journal has an option for open peer review.[112]

Expected added value and innovation potential

- Higher quality of reviews, more transparent scientific record.[113]
- Higher quality of research papers submitted to open peer review.
- Open Peer review will help impede predatory journals.
- More collaborative research culture.
- Improvement of the reproducibility of the science.
- Open peer review would make reviewing work more visible.

109 "Referee Guidelines: HRB Open Research's peer review model", https://hrbopenresearch.org/for-referees/guidelines (retrieved October 26, 2018).

110 "Referee Guidelines: Wellcome Open Research's peer review model", https://wellcomeopenresearch.org/for-referees/guidelines (retrieved October 26, 2018).

111 "Referee Guidelines : Gates Open Research's peer review model", https://gatesopenresearch.org/for-referees/guidelines (retrieved October 26, 2018).

112 "Open peer review in Royal Society Open Science", http://rsos.royalsocietypublishing.org/open-peer-review (retrieved June 29, 2018).

113 "Pilot designed to help reviewers win recognition leads to better quality reviews, say editors", https://www.elsevier.com/editors-update/story/peer-review/pilot-designed-to-help-reviewers-win-recognition-for-their-work-leads-to-better-quality-reviews,-say-editors (retrieved in April 24, 2018).

Expected challenges/risks

- The open peer review approach may be perfectly adapted to the cultures of some research disciplines and less so to others' cultures. In view of its experimental stage of today, testing and analysing its consequences is required.

- A communication challenge: making this option attractive to the research actors at the international level.

- A challenge to the value of publications: a research output evaluated by an open peer review system has as much (or even more) value as another published in a journal making use of traditional blind peer review.

- A financial challenge: additional funding could be necessary to support open peer review services.

- A challenge of economic equilibrium: relations in the scientific publishing community may become unstable; a coexistence of the two systems is possible when the need of a blind peer review process has some valid justification.

- An ethical challenge: the authors and reviewers will have to declare a lack of conflict of interest against the content of the publication.[114]

- The publication and its entire metadata and underlying data must be available.

[114] As it should be the case for blind peer review.

RECOMMENDATION 8: REQUIRE THAT INFRASTRUCTURES, PROCESSES AND WORKFLOWS UNDERPINNING THE EUROPEAN RESEARCH SYSTEM ADHERE TO AND ADOPT OPEN STANDARDS

Many commercial service providers have placed themselves at the core of important research workflows, for instance, by providing easy methods for tracking or monitoring research outputs and associate them with their authors and funders.

The problem

- Although these are valid contributions on their own and provide advantages for the efficient management of research (such as in assessment processes), there is a risk that these highly important services could only be provided in an uncompetitive setting by a limited number of companies, compromising sustainability, market competition and freedom and making public research systems dependent on them.

Concrete actions

- Agree that critical services and infrastructures underpinning the ERA have to adhere to and adopt open standards.
- Require at European level that contracts with providers of said critical services and infrastructures provide ideally open solutions, or at least interoperable and portable solutions rather than solutions based in non-portable technology.
- Incentivise publishers and information service providers that offer modular applications to the scientific workflow, to include options for openness instead of only offering the whole system (from CRIS to journal to lab notebook).

Inspiration and references

- Rules governing the contract for the Horizon 2020 Open Research Europe publishing platform for open access.[115]
- "Finland's Strategy and Roadmap for Research Infrastructures 2014–2020".[116]
- Rules of engagement with the GO-FAIR[117] initiative, as laid out in the "Principles of Open Scholarly Infrastructure".[118]

Expected added value and innovation potential

- Independent, truly open and sustainable research system.
- Diversification of the market would make it more sustainable (based on strong standards).

Expected challenges/risks

- A concerted, coherent and attentive approach is required from all Member States and stakeholders.

115 See footnote 38. Also see the EC "Information Note towards a Horizon 2020 platform for open access", https://ec.europa.eu/research/openscience/pdf/information_note_platform_public.pdf (retrieved May 29, 2018).

116 https://www.aka.fi/globalassets/awanhat/documents/firi/tutkimusinfrastruktuurien_strategia_ja_tiekartta_2014_en.pdf (retrieved June 27, 2018).

117 See footnote 39.

118 http://dx.doi.org/10.6084/m9.figshare.1314859 (retrieved June 6, 2018).

RECOMMENDATION 9: FACILITATE FULL TRANSPARENCY FOR TERMS AND CONDITIONS OF SUBSCRIPTION AGREEMENTS AND OPEN ACCESS DEALS

The high cost of access to read is a barrier for the circulation and uptake of research results but also publishing costs may become a barrier in the future, if there is no market transparency. Institutions and researchers should organize and gain control over costs for publishing and reading scholarly content.

The problem

- The fragmented access to information on the cost of subscriptions and open access publishing only benefit the business models of the publishers, not the universities or the researchers.
- The opacity and lack of agreed criteria for setting prices for subscription agreements and open access deals reinforces the dysfunctionality and non-competitive nature of the scientific publishing market.
- The price for reading (through subscription fees) or publishing (through APCs), in international journals seems to be related to the Impact Factor of the journal rather than the quantity or the quality of the services provided by the publisher to the author or the user.
- Big APC[119] deals earmark budgets for a limited number of large publishers and prevent funding to be available for high added value, innovative, dedicated and likely smaller and cheaper publishers.

[119] As well as big subscription deals.

Concrete actions

- Develop a platform for presenting terms and conditions of subscription agreements to create more international competition in the publishing market.

- Establish an open access fund for European negotiating consortia, which administrates funding agencies spending on APCs and other publishing expenditures.

- All Member States should propose an action in the Open Government Partnership Program (OGP)[120] in favour of a transparent monitoring mechanism related to the financial conditions of subscriptions agreements.

Inspiration and references

- Germany: Discussions of the European High-Level summit meeting on open access negotiations promoted by the German Rectors' Conference.[121]

- France: the engagement of France in the OGP includes an action - "Set up a transparent expenditure monitoring related to acquisitions (subscriptions and articles processing charges) with the publishers".[122]

120 For more information on the Open Government Partnership, see: https://www.opengovpartnership.org/ (retrieved November 9, 2018).

121 "European High-Level summit meeting on Open Access negotiations", https://www.hrk.de/press/press-releases/press-release/meldung/european-high-level-summit-meeting-on-open-access-negotiations-4364/ (retrieved May 25, 2018).

122 "Pour une action publique transparente et collaborative: Plan d'action national pour la France 2018 - 2020", https://www.etalab.gouv.fr/wp-content/uploads/2018/04/PlanOGP-FR-2018-2020-VF-FR.pdf (only in French) and Commitment 18 "Developing an "open science" ecosystem" stated in the French government's current action plan to the OGP, https://www.opengovpartnership.org/commitment/18-open-science (both retrieved November 9, 2018).

- Finland: publication of subscription costs by the Finnish Open Science and Research Initiative.[123]

- The Open APC initiative releases datasets on fees paid for open access journal articles by universities and research institutions.[124]

Expected added value and innovation potential

- Strengthened bargaining power for national or library consortia which are negotiating the terms and conditions of subscriptions with main publishers.

- More transparency on the services offered by the different publishers.

- A more open market for the publishing industry, not only in regards to the publication of articles but also to the emerging market that relates to the provision of services and tools throughout the cycle of production, dissemination and evaluation of research.

Expected challenges/risks

- Some stakeholders may consider such concerted actions as undue interference in the market, even though it is widely acknowledged that the scientific publishing market is not a competitive, well-functioning market.

- Risk of inadvertently legitimate the APC-based model of gold open access as a standard for publishing when the concept of APC-based publishing itself has many inherent associated problems (including the very risk that authors without sufficient funding may become excluded of publishing valuable research, and the likely prospect that APCs will be mostly sponsored by public funding, where subscription fees were paid by both public institutions and the industry).

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123 "35 million euros spent on scholarly e-resource subscriptions", https://openscience.fi/-/35-million-euros-spent-on-scholarly-e-resource-subscriptions and "Academic publisher costs", https://avointiede.fi/web/openscience/publisher_costs (both retrieved June 6, 2018).

124 For more details see: https://treemaps.intact-project.org/ (retrieved June 27, 2018).