

D 5.1 Report on “Strategic advice for enhancing the gender dimension of Open Science and Innovation Policy”

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List of Abbreviations

DORA: San Francisco Declaration on Research Assessment

EC: European Commission

ECSA: European Citizen Science Association

EIC: European Innovation Council

ERA: European Research Area

EU: European Union

FAIR data: Findable, Accessible, Interoperable and Re-usable data

FP: Framework Programme

H2020: Horizon 2020

HG: Helsinki Group

JRC: Joint Research Centre

NIH: National Institutes of Health

OECD: Organisation for Economic Cooperation and Development

OPR: Open Peer Review

ORDP: Open Research Data Pilot

OS-CAM: Open Science Career Assessment Matrix

OS/OI: Open Science/ Open Innovation

OSPP: Open Science Policy Platform

RCUK: Research Councils UK

R&I: Research and Innovation

RFO: research funding organization

RPO: research performing organisation

RRI: Responsible Research and Innovation

SME: Small and Medium-sized Enterprises

SWAFS: Science with and for Society

SWG: Standing Working Group

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Executive Summary

The present report, prepared within the framework of H2020 GENDERACTION project, explores the possible intersections between gender and OS/OI, and should be considered as a starting point for stakeholders to reflect on how the two ERA priorities may create reinforcing synergies. The report also underscores the need for further studies and analyses.

GENDERACTION (GENDER equality in the ERA Community To Innovate policy implementation) is a Horizon 2020 (H2020) project aimed at creating an innovative policy community for the implementation of Priority 4 gender equality and gender mainstreaming in the European Research Area (ERA), by setting up a network of national representatives from EU Member States and Associated Countries to foster policy coordination, best practice exchange and mutual learning. Among its tasks is to provide strategic policy advice on gender in Open Science and Open Innovation (OS/OI) to stakeholders at European and member state level.

Focusing on selected key aspects of OS/OI policies and practices, the report reveals that **most analyses and policy documents related to OS/OI adopt a gender blind approach**, with such an approach being more pronounced in the case of OS policies and practices than in the case of OI. This gender blind approach is not surprising given that while OS and gender are ERA priorities and key topics within H2020, they are **treated as independent topics** with no links between them sought either in the ERA Progress reports or within Horizon 2020. The report argues that the consideration of gender issues in the development of OS/OI policies could have a positive impact on the promotion of gender equality goals and elimination of gender biases.

The analysis of the existing literature and examples of promising practice has informed the formulation of the following sets of recommendations, clustered into five priorities for action, targeting a variety of stakeholders (European Commission, Member States, RFOs, RPOs, innovative firms as well as researchers):

A first priority for action focuses on **gender mainstreaming and creating a policy synergy between the gender equality and OS/OI agenda in order to overcome the gender blindness of the current OS/OI policy making and lack of awareness of gender issues in OS/OI** identified in this report:

- 1.1 European Commission and national policy-making must continue to address Priority 4 gender equality as a self-standing issue while mainstreaming gender concerns to other priority areas. Review of existing policy documents and studies on OS/OI, including those produced by the European Commission in recent years of ERA implementation, reveals zero attention to gender equality. Gender issues thus fail to be addressed as a matter of course in European policy making in OS/OI.
- 1.2 Awareness must be raised in the OS/OI policy and research community on the relevance of gender and ways OS/OI can mitigate against gender inequality and bias in the various aspects of OS/OI. Gender experts and scholars should be invited as members to relevant OS/OI expert and advisory groups.

The second priority for action is **advancing knowledge and awareness** of gender issues in OS/OI:

- 2.1 In order to develop evidence-based, socially responsible policies, further studies are needed to examine gender issues in OS/OI, with special focus on open peer review, altmetrics, open software and open innovation. For example, studies on peer review (single/double blind and open peer review) should focus on examining how different peer review practices mitigate against gender bias.
- 2.2 The European Commission should support this effort and lead by example, by providing disaggregated data by sex on the adoption of open access practices in the next editions of She Figures. In particular, it would be useful to have information on both the sex of the author and whether the publication is open access or not.
- 2.3 European and national authorities collecting data on inventorship are encouraged to disaggregate data by sector, field and country in addition to sex-disaggregating data.
- 2.4 Research funding and research performing organisations are encouraged to examine the adoption of open access practices by men and women.

The following three areas of action offer more specific recommendations and focus on evaluation and assessment practices, publication practices and innovation processes as key areas where gender issues have been previously established.

The third priority for action addresses evaluation and assessment practices in RFOs and RPOs:

- 3.1 The European Commission and its OSPP Expert Group, along with other stakeholders involved in research assessment (such as research performing and research funding organisations) are encouraged to explore how/if the use of new metrics impacts men and women researchers at different career stages and disciplines differently.
- 3.2 Research performing and funding organisations are encouraged to adopt multi-dimensional evaluation criteria that enhance openness and transparency (including visibility and open access to those research outputs with a gender dimension), and contribute in mitigating against gender bias in research assessment/evaluation procedures.
- 3.3 Authorities and organisations at European and national level funding open innovation projects are encouraged to ensure that funded projects integrate sex/gender analysis where appropriate and that the teams respect gender diversity.
- 3.4 Research funding and research performing organisations are encouraged to examine the adoption of open access practices by men and women in order to identify whether OS/OI may continue to perpetuate gender differences in publications and hence evaluation.

The fourth priority for action addresses publication practices of researchers and RPO:

- 4.1 Research performing organisations should encourage the sharing of preprints presenting the results of research on gender (that is, gender as the main focus of the research content) and those with a gender dimension (that is, those integrating sex/gender analysis as a cross-cutting issue).
- 4.2 Researchers are encouraged to adopt the FAIR management of sex and gender data.

The fifth priority for action addresses innovative processes and firms:

- 5.1 Stakeholders engaged in setting up participatory innovation projects should ensure the involvement of diverse groups and gender diversity in line with the finding that diversity overall and gender diversity specifically contribute to identifying innovative solutions.
- 5.2 Stakeholders engaged in setting up participatory innovation projects should ensure the integration of sex/gender analysis in order to guarantee that innovative processes benefit all segments of population without bias.

1. Introduction

GENDERACTION (GENDER equality in the ERA Community To Innovate policy implementation)¹ is a Horizon 2020 (H2020) project aimed at creating an innovative policy community for the implementation of the gender priority in the European Research Area (ERA) by setting up a network of national representatives from EU Member States and Associated Countries, to foster policy coordination, best practice exchange and mutual learning. GENDERACTION focuses on supporting gender equality implementation both at national as well as EU and international levels.

Among its tasks is to provide strategic policy advice on gender in Open Science and Open Innovation (OS/OI) Policy to stakeholders at European and member state level. In particular, Work Package 5 (WP5) “Strategic Policy Advice” (led by the Spanish Ministry of Economy, Industry and Competitiveness) will prepare reports and policy briefs focusing on ways to advance gender equality and gender mainstreaming in European Research and Innovation (R&I). Task 5.2 “Exploring the gender dimension of Open Science and Innovation policy”, led by the National Documentation Centre (EKT), has examined possible ways of strengthening gender issues in OS/OI and of research with a gender dimension through an analysis of the current situation and the formulation of appropriate recommendations. The analysis has informed the present report.

The interest in exploring the ways in which the gender dimension can be strengthened in OS/OI policies stems from the fact that although gender equality and gender mainstreaming and open science are integrated in the Commission provisions for the implementation of H2020 as cross-cutting issues and as specific topics within the Science with and for Society (SwafS) Work Programme of H2020 and among ERA priorities, they are **treated as independent and unrelated topics**. Focusing on selected key aspects of OS/OI policies and practices, the report reveals that **most analyses and policy documents² as well as scientific literature related to OS/OI adopt a gender blind approach**, with such an approach being more pronounced in the case of OS policies and practices than in the case of OI. This report is thus a **first exploration of the interlinkages between gender and open science and open innovation and aims to contribute to increased synergies between these two ERA policy priorities**.

Open science and open innovation have been linked to a more general **openness discourse in society³** including Free Software/Open Source, open access, and open society. This discourse of openness is sometimes argued to have a potential not only to enhance efficiency and effectiveness of value production⁴ but also to

¹ For more see <http://genderaction.eu/>.

² For example, recent reports European Commission 2017d, European Commission 2017e.

³ See Remneland Wikhamn and Knights (2013) Open innovation, gender and the infiltration of masculine discourses. *International Journal of Gender and Entrepreneurship*, 5(3), 275–297; von Hippel and von Krogh (2006) Free revealing and the private-collective model for innovation incentives. *R and D Management*, 36(3), 295–306.

⁴ Chesbrough (2003) *Open Innovation: The new imperative for creating and profiting from technology*, Boston Massachusetts, Harvard Business Review Press.

democratise societal processes, foster diversity and hence contributions from marginalised groups⁵, as well as to **promote civic engagement**.⁶ All these aspects have relevance for gender equality and mainstreaming gender.

The report first examines what the gender issues are in selected aspects of Open Science, for instance through open access to publications and research data or the ways in which open access practices can be embedded in research evaluation/assessment procedures. Given the existing knowledge about gender differences in research publication as well as gender bias in research evaluation and assessment, it is for example pertinent to examine open peer review and altmetrics for potential relevance of gender. The report then goes on to consider the ways in which open innovation practices (such as crowdsourcing and citizen science) can contribute to advancing gender equality and gendered innovations. This section therefore highlights the vital need to address the gender dimension on innovation processes overall, as well as the need to address diversity and gender balance in open innovation processes. In doing so the report formulates recommendations in five priority areas for action addressed to different stakeholders.

The strategic advice is based on an analysis of the existing literature and examples of promising practice as well as on the work carried out in GENDERACTION Work Package 3 by the Austrian Ministry for Science, Research and Economy (BMWFW) and the Austrian Institute of Advanced Studies (HIS), and particularly, in the analysis of the national ERA roadmaps and the links between priorities 4 (gender equality and gender mainstreaming in research) and 5 (optimal circulation, access to and transfer of scientific knowledge). The report also draws on an exploratory workshop “Gender in Open Science and Open Innovation” organized by GENDERACTION in Brussels on 19 October 2017. The workshop attracted 15 participants with expertise on gender issues and/or open science. An early version of the report was presented during the workshop and feedback was received from participants.⁷ A revised version of the report was presented at the GENDERACTION General Assembly meeting held on 30 November 2017 in Brussels and feedback was received from project partners.

2. Gender in the European R&I context

Equality between men and women is a fundamental value of the European Union going back to 1957 when the principle of equal pay for equal work became part of the Treaty of Rome. The EU's and in particular the European Commission's commitment to gender equality has been reaffirmed more recently in the “Strategic Engagement for Gender Equality 2016-2019” which stresses the need to maintain the focus on the five thematic priority areas highlighted as important (increasing female labour market participation, reducing gender pay gap/earnings and pension gaps, promoting

⁵ Jeppesen and Lakhani (2010) Marginality and Problem-Solving Effectiveness in Broadcast Search. *Organization Science*, 21(5), 1016–1033.

⁶ Remneland Wikhamn and Knights 2013: 279-280.

⁷ For the workshop agenda see Annex I; for a complete list of participants see Annex II.

equality between men and women in decision making, combating gender based violence and protecting and supporting victims, and promoting gender equality and women's rights across the world). The strategic engagement sets out objectives and identifies more than 30 concrete actions.⁸

With respect to R&I **gender equality is a priority within the ERA and a cross-cutting issue in H2020**. Gender is also one of the key elements⁹ of **Responsible Research and Innovation (RRI)** that aims “to foster the design of inclusive and sustainable innovation”.¹⁰ RRI can be thus considered as an approach where different societal actors (such as researchers, citizens, policy makers, third sector organizations) work together during the research and innovation process to align the process and outcomes with the values, needs and expectations of society. RRI is therefore an approach aimed at reconfiguring the scientific process along the notions of responsibility, public participation and democratization of science.

Within ERA Priority 4 gender equality and mainstreaming in research in particular, the goal is “to foster scientific excellence and a breadth of research approaches by fully utilizing gender diversity and equality and avoiding an indefensible waste of talent”. This goal is expected to be reached through the “development of policies on gender equality, paying special attention to areas where women are underrepresented, promoting approaches to gender mainstreaming and incorporating gender perspectives in research”.¹¹ The ERA 2016 Progress Report, summarizing the state of play on the progress between 2014 and 2016, confirms the progress achieved in a majority of member states towards planning and setting up strategies for gender equality in R&I, a finding which creates expectations for further positive developments in the coming years. The Report notes though that the glass ceiling remains a key challenge that impedes women from reaching higher positions despite the fact that progress (though slow) has been made. It also highlights that the integration of the gender dimension in research programs remains a challenge in many Member States.¹²

In H2020 gender is a cross cutting issue and is mainstreamed into the different parts of the programme. The Commission's guidance on gender equality in H2020 highlights three objectives which are in line with the ERA priority: fostering gender balance in H2020 research teams (to address the gaps in the participation of women in the framework programme projects), ensuring gender balance in decision-making (to reach the Commission's target of 40% of the under-represented sex in panels and groups) and integrating gender/sex analysis in R&I content (to improve the scientific

⁸ European Commission (2015) *Strategic Engagement for Gender Equality 2016-2019*, Luxembourg, Publications Office of the European Union, available at: https://ec.europa.eu/anti-trafficking/sites/antitrafficking/files/strategic_engagement_for_gender_equality_en.pdf

⁹ The RRI thematic elements are the following: public engagement, open access, gender, ethics, science and education.

¹⁰ Responsible Research and Innovation <https://ec.europa.eu/programmes/horizon2020/en/h2020-section/responsible-research-innovation>

¹¹ European Commission (2017a) *European Research Area Progress Report 2016. Report from the Commission to the Council and the European Parliament*, Brussels, European Commission, available at: http://ec.europa.eu/research/era/pdf/era_progress_report2016/era_progress_report_2016_com.pdf

¹² Ibid.

quality and societal relevance of the produced knowledge, technology and/or innovation).

The H2020 SwafS Work Programme specifically supports research funding organisations (RFOs) and research performing organisations (RPOs) in devising gender equality plans with a view to removing barriers that generate gender discrimination in hiring, retention and promotion and integrating the gender dimension in research and innovation

3. Open Science

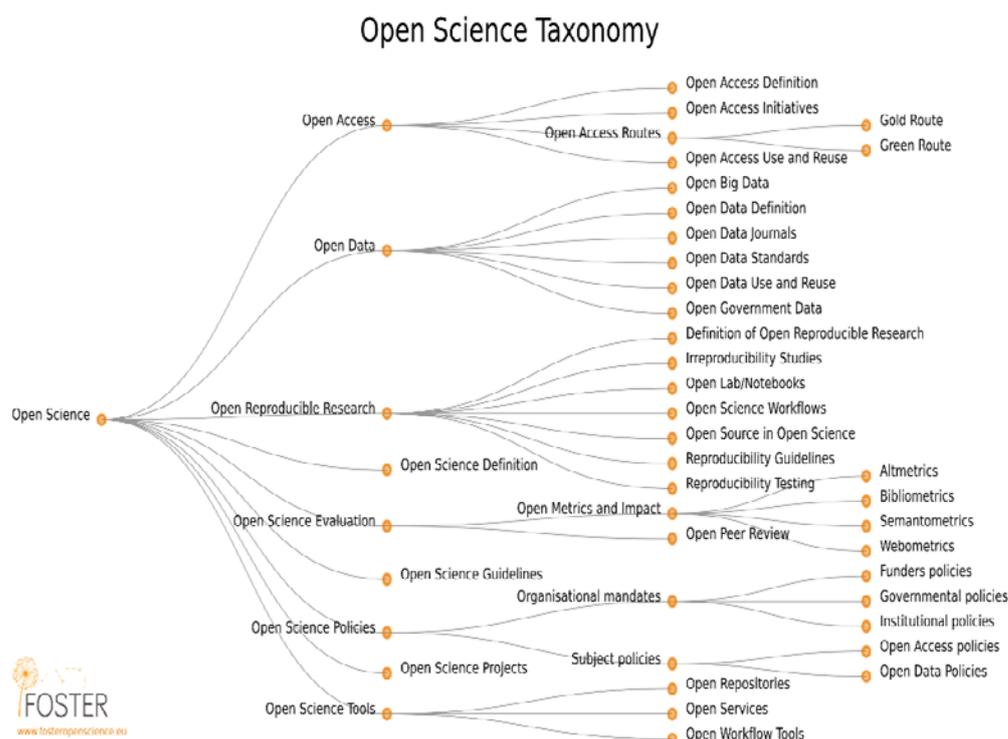
Open Science captures a change in the way science and research are carried out, based on “cooperative work and new ways of diffusing knowledge by making use of digital technologies and new collaborative tools”¹³. It entails ongoing transitions in the way research is performed, researchers collaborate, knowledge is shared and science is organized. It is an approach with deep transformative impacts on the scientific process as it affects the entire research lifecycle: from inception to publication.

“Open Science” is an umbrella term capturing a variety of activities and practices including open access to publications and research data, open peer review, open education, the use of new generation metrics for assessing scientific impact and evaluating research, the increasing use and readership of scientific blogs, or the growing number of citizen scientists participating in research projects. This approach (where different topics are placed under the framework of Open Science) has been adopted both by the EU and the OECD as can be seen in related documents.¹⁴ The figure below presents a taxonomy developed by FOSTER project¹⁵ that aims to capture the variety of topics included under open science.

¹³ European Commission (2016a) *Open Innovation, Open Science, Open to the World-a vision for Europe*, Brussels, European Commission, p. 33, available at: <https://ec.europa.eu/digital-single-market/en/news/open-innovation-open-science-open-world-vision-europe>

¹⁴ Cf. for example OECD (2016) *Open Science, Open Innovation and the Digitalisation of STI-Background Paper*, 24-26 October 2016, OECD Conference Centre, Paris; European Commission (2016a).

¹⁵ FOSTER project <https://www.fosteropenscience.eu/>

Figure 1: FOSTER Open Science Taxonomy

Source: FOSTER project

The changes brought about by this new approach to research also entail an increase in the number and diversity of the stakeholders involved, to include researchers, policy makers, RFOs and RPOs, citizen scientists, enterprises, and publishers.

Within the EU, Open Science forms part of a broader EU strategy and in particular of the three goals for EU research and innovation policy summarized as Open Innovation, Open Science and Open to the World.¹⁶ The EU's interest in supporting Open Science has been confirmed in Council Conclusions on the transition towards an Open Science system adopted on 27 May 2016. The Council acknowledged "that open science has the potential to increase the quality, impact and benefits of science and to accelerate advancement of knowledge" and called on the Commission, the Member States and the stakeholders to "take the necessary actions needed to making open science a reality and to advocate the need for concerted actions".¹⁷

To support further the development of Open Science policy the Directorate General for Research and Innovation (DG RTD) set up an Open Science Policy Platform (OSPP). The platform is intended to provide a forum for a structured discussion with key stakeholders including *inter alia* research funding and research performing organisations, libraries, and scientific publication associations, and give advice to the Commission on the basis of the European Open Science agenda. The latter is

¹⁶ European Commission (2016a).

¹⁷ Council of the European Union (2016) *The transition towards an Open Science System – Council Conclusions*, Brussels, 27 May 2016, available at: <http://data.consilium.europa.eu/doc/document/ST-9526-2016-INIT/en/pdf>

structured around the following themes: 1) fostering and creating incentives for Open Science, 2) removing barriers for Open Science, 3) mainstreaming and further promoting open access policies, 4) developing research infrastructures for Open Science and 5) embedding Open Science in society as a socio-economic driver. These five action lines are in turn translated into eight topics of policy concern, namely: rewards, altmetrics, Open Science Cloud, changing business models for publishing, research integrity, citizen science, open education and skills and FAIR open data. The work of the OSPP is further supported through the Open Science Monitor commissioned also by DG RTD, developed by several partners and led by RAND Europe, an independent non-profit research institute. The monitor is “a pilot project to test the viability and value of assessing Open Science activity in Europe and beyond”.¹⁸

Given the increasing interest and support of the EU to Open Science the following sections explore gender issues in selected key aspects of Open Science and the visibility of publications with a gender dimension. The areas examined in Open Science are not exhaustive and there are other issues that merit attention, such as Open Software where studies have also revealed gender discrimination. For example, a study of open source software repository GitHub showed that women software developers see their contributions of code accepted more frequently by the open-source software repository GitHub than do men but only if they hide their sex. Once their sex is identified, the acceptance rate of software developed by women falls to slightly less than that of men.¹⁹ Other studies examine the ways in which software openness is gendered and exacerbates the exclusion of women.²⁰

3.1 Open Access to Publications

Open Access is likely the most known aspect of Open Science and the most well understood. Open Access refers to “the practice of providing online access to scientific information that is free of charge to the end-user and reusable”.²¹ Scientific information covers both peer-reviewed scientific research articles published in scholarly journals or research data²² underlying publications, curated data or raw data.

The two main routes for providing open access to publications are:

- Self-archiving (also known as the Green Route) where the author deposits the published article in an online repository before, simultaneously or after publication and through which the author provides open access

¹⁸ Open Science Monitor, available at <http://ec.europa.eu/research/openscience/index.cfm?pg=about§ion=monitor>

¹⁹ Terrell, J., Kofink, A., Middleton, J., Rainear, C., Murphy-Hill, E., Parnin, C., & Stallings, J. (2017). Gender differences and bias in open source: pull request acceptance of women versus men. *PeerJ Computer Science*, 3, e111. <http://doi.org/10.7717/peerj-cs.111>.

²⁰ Nafus, D. (2012) “Patches don't have gender’: What is not open in open source software. *New Media & Society*, 14(4), 669–683. <http://doi.org/10.1177/1461444811422887>.

²¹ European Commission (2017b) *H2020 Programme. Guidelines to the Rules on Open Access to Scientific Publications and Open Access to Research Data in Horizon 2020*, version 3.2, 21 March 2017.

²² Open access to research data will be discussed in the following section.

- Open Access Publishing (also known as the Gold Route) where the article is published directly in an open access mode.²³

The open access movement is closely associated with changes brought about by the internet. Over the course of the last three decades important initiatives like the Budapest (2002), the Berlin (2003) and the Bethesda (2003) declarations have contributed in establishing open access as a desirable practice by providing a public definition of open access and the principles for open access to scholarly journal literature. The uptake of open access has been further strengthened by the uptake of related policies and mandates from research funding and research performing organization in Europe and beyond such as the EU (under H2020 examined in the following paragraphs), the UK Research Councils (RCUK), the National Institutes of Health (NIH) in USA etc. The uptake of open access is also linked to the development of appropriate infrastructure (namely repositories) supporting the transition to the open access paradigm.

Within the EU, the European Commission has been an active supporter of open access based on the notion that “there should be no need to pay for information funded from the public purse each time it is accessed or used”.²⁴ Open access (both to scientific publications and research data) is expected to contribute in generating growth through greater efficiency, faster progress and improved transparency of the scientific process through the involvement of citizens and society. In relation to the benefits that open access has for researchers these are associated with the positive impact on the visibility of research outputs and thus on an increase in usage and impact.²⁵ As stressed in the UNESCO Report (2002) open access does not lead to increased citations, but rather increases the audience size so that articles worth citing become visible.²⁶

The support provided by the EU to open access has been further strengthened through the Council of the European Union conclusions of 27 May 2016. The Council recognized that the exponential growth of data, the increasingly powerful digital technologies, together with the globalization of the scientific community and the increasing demand for addressing the societal challenges contribute to the ongoing transformation and the opening up of science and research which is referred to as “open science”. It called on Member States, the Commission and stakeholders to remove financial and legal barriers and agreed to promote the mainstreaming of open access to publications by continuing to support a transition to immediate open access as the default by 2020.²⁷

²³ The Gold Route contains three distinct subcategories: Gold with Article Processing Charges (APC) that refers to publications in journals that make their content open access via the payment of an APC, Gold without APC that refers to publications made in open access journals that do not charge APCs and Gold-Hybrid that refers to publications in subscription based journals that make content openly available following the payment of an APC. In the case of Horizon 2020 funder projects APCs are considered as eligible costs.

²⁴ European Commission (2017b).

²⁵ Gender and citation will be discussed in the following section.

²⁶ UNESCO (2002) *Policy Guidelines for the Development and Promotion of Open Access*, Paris, United Nations Educational, Scientific and Cultural Organisation, <http://unesdoc.unesco.org/images/0021/002158/215863e.pdf>

²⁷ Council of the European Union (2016).

Within H2020 programme (the biggest EU research and innovation programme with nearly 80 billion of funding for the 2014-2020 period) open access is one of the obligations with which grantees have to comply. The open access principles are translated into specific requirements in the Model Grant Agreement²⁸ and in the H2020 work programme. Open access is also together with the promotion of gender equality in research and innovation one of the cross-cutting issues of SwafS.

In the context of the ERA open access is discussed under Priority 5b: “Open access to publications and data in an open science context” (Priority 5 “Optimal circulation, access to and transfer of scientific knowledge”) and headline indicator 5b- “Open Access”. On the basis of the indicator used to track performance and progress for sub-priority 5b- “Open access” (share of papers in open access) approximately 52% of publications in the EU-28 are available in open access.²⁹ As also highlighted in the same report, the green route makes a more significant contribution to the overall levels of open access compared to the gold route as almost 2/3 of papers are made available through the green route. Depositing in repositories is important as articles are easily discoverable through search engines and retrievable.

However, while open access and gender have been discussed within the context of ERA and the H2020 SwafS programme, no link between them has yet been made. They are to be regarded as cross-cutting, yet parallel topics. This is also evidenced in documents and other related reports published to support the transition to open science/open access paradigm that do not discuss the gender impact of these policies, adopting what can be regarded as a gender-blind approach. For example, both the ERA Progress Report and a similar report by Archambault et al. (2014) which examine open access practices disaggregate findings by open access type (green open access, gold open access, other open access), scientific field and country, but do not provide any sex-disaggregated information. The Archambault et al. (2014) report shows disciplinary differences related to open access practices. The fields with the greatest proportion of papers in open access are general science and technology, biomedical research, mathematics and statistics, and biology.³⁰ This is tied to the typical publication format in these disciplines, the scientific paper.

The absence of links between the two ERA priorities has been also confirmed in the analysis of national ERA roadmaps conducted under WP3 “ERA roadmap priority 4 benchmarking” undertaken by the Austrian Federal Ministry of Science, Research and Economy (BMWF) a GENDERACTION project partner based on a survey that aimed at acquiring additional information on the development and implementation of the ERA national action plans and roadmaps. The analysis showed that only two countries (Israel and Portugal) reported a link between priorities 4 and 5; yet, in both cases the form of exchange is under development and thus not yet established. This

²⁸ Article 29.2 of the Model Grant Agreement mandates that “Each beneficiary must ensure open access (free of charge, on line access for any user) to all peer-reviewed scientific publications relating to its results”.

²⁹ European Commission (2017c) *ERA Progress Report 2016*. Technical Report, Brussels, European Commission, p.99, available at: http://ec.europa.eu/research/era/pdf/era_progress_report2016/era_progress_report_2016_technical_report.pdf

³⁰ Archambault, E., Amyot, E., Deschamps, P., Nicol. A., Provencher, F., Rebut, L., & Roberge, G. (2014) *Proportion of Open Access Papers Published in Peer-Reviewed Journal at the European and World Levels- 2006-2013*, Deliverable D1.8, version 11p., p. 19.

may explain for example why the Portuguese ERA roadmap makes not reference to this link.

The 2015 edition of the She Figures includes an indicator on publications with a gender dimension. According to the report publications with a gender dimension ranged from virtually zero in agricultural sciences, engineering and technology and natural sciences to 6.2% in the social sciences.³¹ Yet, the report does not provide any information about the extent to which these are open access publications, raising again the issue of how open access can boost the visibility of research with a gender dimension. It is of interest that Deutsche Forschungsgemeinschaft (DFG) funded a project between 2011 and 2012 on Gender Research and Open Access. A Publishing Model for an Inter-/Transdisciplinary Research Field. The project analysed the opportunities and challenges of OA publishing in gender research.³² Its results show that disciplinary considerations must be taken into account when considering the potential spread of OA publishing.

Turning to the contribution of women and men in research (scientific publications) and innovation outputs (patents), the She Figures 2015 report shows that in the EU-28, 31% of publications had a woman corresponding author between 2011 and 2013, while 8.9% of patent applications registered a woman inventor. This percentage varies largely from one sector to another (university, enterprise, research centres...), from one disciplinary area to another, and from one country to another.³³ In certain areas such as chemistry or pharmacy their presence is higher, while in mechanics their presence is the lowest. Furthermore, the presence of women inventors is lower in those countries with a more developed innovation system. Therefore, the authors recommended that data be disaggregated by country, sector and area. In terms of publications, women and men corresponding authors publish their scientific papers in comparatively influential journals. This means that even though women corresponding authors account for fewer publications, on average they publish their results in journals of equal prestige. The data provided do not distinguish between open access publications and publications in subscription journals³⁴.

In discussing open access to publications, attention should also be paid to preprints. The latter are receiving increasing attention as they are considered an integral part of the scholarly process. Preprints are manuscripts that have not yet undergone peer review for formal publication. Preprints should not be confused with

³¹ European Commission (2016b) *SHE FIGURES 2015*, Luxembourg: Publications Office of the European Union.

³² The project results are ambivalent. On the one hand, all the technical and legal means of implementing an exemplary quality-assured OA publishing offering exist. On the other hand, opportunities for independent, non-commercial solutions that are adapted to the demands of smaller scientific subject areas have shrunk. OA publishing and electronic publishing workflows bring additional challenges, for example clear assignment of roles, clarification of rights, and adaptation to transdisciplinary and transnational standards. These additional demands are often considered to be excessive. In this case, it is advisable to initiate "beacon projects" and to gradually introduce the community to new forms of publishing, rather than focusing on large centralised solutions. (Source: <https://open-access.net/DE-EN/open-access-in-individual-disciplines/gender-research/>, access: 30 Jan 2018).

³³ Busolt, U., & Kugele, K. (2009) The gender innovation and research productivity gap in Europe. *International Journal of Innovation and Sustainable Development*, 4(2/3), 109.

³⁴ Since She Figures obtains the data from the Web of Science, it is possible that in the future reports can include this information, at least in the case of publications with a gender perspective.

“publish before print” articles. In disciplines like physics making preprints available through repositories (such as arXiv in physics and other related disciplines) goes back to the early 1990s, while other disciplines soon followed. The practice of making preprints available is related to benefits like faster dissemination of research outputs and increased visibility of one’s work, sharing important outputs that would otherwise disappear, and faster evaluation of controversial results.³⁵

3.2 Open Access to Research Data

More recently, discussions on open access have expanded from publications to encompass research data as well. Defining research data is not always easy, since “any material used as foundation for research can be classified as research data”.³⁶ The OECD uses a wide definition that includes any kind of resource useful to researchers,³⁷ while the European Commission defines as research data, that which “may be numerical/quantitative, descriptive/qualitative or visual, raw or analysed, experimental or observational”.³⁸

Within the EU, the open access mandate under H2020 covers scientific publications and research data through the Open Research Data Pilot (ORDP). Since January 2017, the ORDP has been extended to cover all thematic areas, making open access to research data the default option.³⁹ However, as not all data can be open, there is the possibility for opt-out. Therefore, the Commission’s approach is described as “as open as possible, as closed as necessary”.

The European support is also evidenced in the Council Conclusions of 2016 where the European Commission, the Member States and all relevant stakeholders are encouraged to set optimal reuse of research data as the point of departure taking into account the underlying principle “as open as possible, as closed as necessary”. The Conclusions also emphasise that the optimal reuse can be realised if data are consistent with the FAIR principles (findable, accessible, interoperable and re-usable).⁴⁰

³⁵ In relation to this point, there is an example from biomedicine and the publication of information in 2016 indicating the increase of cancer rates in animals from cell phone radiation. Because of the controversy surrounding the statement NIH released all data, along with internal reviews to facilitate further review of findings an approach that would not have been possible had the traditional process of publication been chosen. While the controversy was not solved, it certainly made the process more open and transparent (see also Bourna, P.E., Polka, J.K., Vale, R.D., Kiley, R. (2017) Ten simple rules to consider regarding preprint submission. *PLoS Comput Biol* 13(5) e1005473.

³⁶ Sveinsdottir, Th., Wessels, B., Smallwood, R., Linde, P., Kalaitzi V., and Tsoukala, V. (2013) *Stakeholder Values and Ecosystems*, D1.1 RECODE Project, 30 September 2013. http://RECODEproject.eu/wp-content/uploads/2013/10/RECODE_D1-Stakeholder-values-and-ecosystems_Sept2013.pdf.

³⁷ OECD (2007) *Principles and Guidelines for Access to Research Data from Public Funding*, Paris, OECD, available at: <http://www.oecd.org/sti/sci-tech/38500813.pdf>

³⁸ European Commission (2012a) A Reinforced European Research Area Partnership for Excellence and Growth, COM(2012) 392 final, Brussels, 17.07.2012, available at: <https://ec.europa.eu/digital-single-market/en/news/reinforced-european-research-area-partnership-excellence-and-growth>

³⁹ The related provisions are described in Article 29.3 of the Model Grant Agreement.

⁴⁰ Council of the European Union (2016).

According to the European Commission “open access to scientific research data enhances data quality, reduces the need for duplication of research, speeds up scientific progress and helps to combat scientific fraud”.⁴¹ Open access to research data is related to discussions on the reproducibility of research⁴² that is gaining increasing attention and relates to concerns regarding the extent to which academic research findings may be incorrect. A recent survey by Nature among 1,576 researchers on the reproducibility of research showed that more than 50% of researchers have tried and failed to reproduce other scientists’ experiments, while more than half have failed to reproduce their own research.⁴³ Echoing the same concerns the European Commission states that “mostly due to current methods capture and data malpractice, approximately 50% of all research data and experiments are considered not reproducible, and the vast majority (likely over 80%) of data never makes it to a trusted and sustainable repository”.⁴⁴ Opening up of research data thus leads to increased transparency and better science.

The issue of reproducibility is of interest for gender research as one of the factors highlighted as contributing to low or no reproducibility is the existence of prejudices in a scientific field. In her recent book *Inferior: How Science Got Women Wrong- and the New Research That’s Rewriting the Story* Angela Saini shows how sexist notions have not only entered scientific research but continue to exist within the scientific community fuelling the idea of women’s inferiority. In her book, Saini tackles issues related to the reproducibility of research showing that research claiming sex/gender differences failed the reproducibility test at a later stage thereby questioning not only the conclusions of such research but more importantly the techniques and tools on which these were based.

For instance, sex and gender data are particularly important in evidenced-based medicine as their absence can lead to gender biased research with implications both for science and for patients.⁴⁵ This approach is linked to the historical bias of the scientific study of males and the assumption that results apply equally to men and women. Yet, excluding females from animal and human studies or failing to report data on sex has important implications on identifying differences between men’s and women’s health and on research findings that in turn inform health programs and policies but also in the design of future studies. Typical examples of this bias in practice are the low participation of women in cardiovascular clinical trials (with only one third of women participating as subjects in such trials) and lung cancer trials

⁴¹ European Commission (2012b) Recommendation on access to and preservation of scientific information, C(2012) 4890 final, Brussels, 17 July 2012. Available at: http://ec.europa.eu/research/science-society/document_library/pdf_06/recommendation-access-and-preservation-scientific-information_en.pdf

⁴² Cf. Ioannidis, J., P.A (2005) Why most published research findings are false? *PloS Medicine*, 2:8: e124.

⁴³ Baker, M. (2016) Is there a reproducibility crisis? *Nature*, 533: 452-454.

⁴⁴ European Commission (2016c) *Realising the European Open Science Cloud*. First report and recommendations of the Commission High Level Expert Group on the European Open Science Cloud, Brussels, European Commission, available at: https://ec.europa.eu/research/openscience/pdf/realising_the_european_open_science_cloud_2016.pdf.

⁴⁵ On gender bias in clinical reports see: Allotey, P., Allotey-Reidpath, C., Reidpath, D. (2017) Gender bias in clinical case reports: A cross-sectional study of the “big five” medical journals, *PLOS One*, 11 May 2017.

even though cardiovascular disease is the number one killer of women in the USA, while lung cancer is killing more women than other types of cancer.⁴⁶ Yet “these differences need to be defined in order for guidance to reflect the social context of disease”.⁴⁷ Initiatives such as those of the NIH to train young scientists to include sex and gender in research is definitely a positive step, and should be adopted by other research funding agencies and organisations.

Given that sex/gender analysis is important not only in medicine, but also in other fields like engineering etc., where also the results cannot be generalised to female/women, this bias also raises questions about the extent at which journal editors are aware of this and take necessary measures to tackle it.

Other areas related to Open access to data also merit attention from the gender perspective. For example, studies may use both males and females in their samples but do not report results by sex; data reuse could be an avenue to obtain results segregated by sex/gender as relevant and contribute to understanding sex/gender differences in various disciplines. Another aspect relates to citizen science initiatives⁴⁸ that consider the gender perspective and/or focus on issues relevant to women’s health and lives. These studies are often produced by non-profit organizations and are not published in peer-reviewed or impact-factor English-language publications while addressing pressing local societal challenges.

3.3 Open Peer Review

The She Figures 2015 report shows that at EU-28 level women and men corresponding authors publish on average their results on journals of equivalent prestige, even though women corresponding authors account for fewer scientific publications than men.⁴⁹ Women not only publish fewer papers, but are also less likely to be listed as first authors and even though these disparities have decreased they have not disappeared. In addition, as shown in the She Figures 2015 report, the percentage of publications with a gender dimension remains low (with the highest score being 6.2% in the social sciences). Both issues might partially be related to journal editorial policies and gender bias in particular during the review process. This section will therefore look into if and how open peer review can tackle gender bias in peer review.

Peer review lies at the heart of the scholarly communication system. Peer review can be defined as a process whereby “experts are invited to assess the quality, novelty,

⁴⁶ Westerveld, A. (2015) The medical research gender gap: how excluding women from clinical trials is hurting our health, *The Guardian*, Available at: <https://www.theguardian.com/lifeandstyle/2015/apr/30/fda-clinical-trials-gender-gap-epa-nih-institute-of-medicine-cardiovascular-disease>

⁴⁷ Holdcroft, A. (2007) Gender bias in research: how does it affect evidence based medicine? *Journal of the Royal Society of Medicine*, 100(1):2-3.

⁴⁸ A quick look at a collection of Citizen Science guidelines and publications published by European Citizen Science Association shows that gender equality is the least addressed key area of RRI. Available at <https://ecsa.citizen-science.net/blog/collection-citizen-science-guidelines-and-publications>, access 30 January 2018.

⁴⁹ European Commission (2016b), p. 149.

validity, and potential impact of research by others”.⁵⁰ The origins of the scholarly peer review process can be traced back to the 17th century and the existence of national academies; however the editor-led process gained increasing importance in the post-war period.⁵¹ Despite its central role in the scholarly system, the traditional peer-review process has been criticized for being sub-optimal, unreliable, taking too long, enabling bias and lacking incentives for reviewers.⁵²

In relation to gender bias in peer review processes, a recent study by Frontiers⁵³ showed that women are under-represented in peer-review and that editors operate with same-gender preferences.⁵⁴ The editors’ preference for reviewers of the same sex could be a reflection of the way social networks are constructed (i.e. the tendency to associate with people with similar qualities) but also to the existing disparities in academia.⁵⁵

An example of the ugly side of gender-bias⁵⁶ in the review process took place in 2015 when two female authors who had submitted their paper in PLOS ONE received the following comments: “*It would probably also be beneficial to find one or two male biologists to work with (or at least obtain internal peer review from, but better yet as active co-authors)*”⁵⁷

The study of the operation of peer review⁵⁸ is not limited to scholarly communication, but is also relevant in funding processes both of which have important effects on a researcher’s career prospects (such as access to funding, promotion and tenure decisions).⁵⁹ Turning to the study of gender bias in grant peer review a study confirms the existence of gender differences resulting in men having greater odds of approval compared to women of about 7%.⁶⁰

⁵⁰ Tenant JP, Dugan, JM., Graziotin, D., et al. (2017) A multi-disciplinary perspective on emergent and future innovations in peer review, *F1000 Research*, 6:1151 (last updated 12 September 2017).

⁵¹ Ibid.

⁵² Ross-Hellauer, T., Deppe, A., Schmidt, B., (2017) *OpenAIRE survey on open peer review: Attitudes and experience among editors, authors and reviewers*, OpenAIRE.

⁵³ The study includes only data sets of men and women who reviewed the papers and not on those who were originally asked to do the reviews nor do they consider people’s willingness to respond to review requests which ultimately leads to a different pool of people. Ross (2017) Gender bias distorts peer review across fields, *Nature News and Comments*, Available at: <https://www.nature.com/news/gender-bias-distorts-peer-review-across-fields-1.21685>

⁵⁴ Helmer, M., Schottdorf, M., Neef, A., Battaglia, D. (2017) Research: Gender bias in scholarly peer review, *eLife2017*, 6:e21718.

⁵⁵ Ross (2017).

⁵⁶ Bias is defined as the violation of impartiality during the evaluation of a submission.

⁵⁷ Cochran, A. (2015) Sexism in Peer Review, *The Scholarly Kitchen*, Available at: <https://scholarlykitchen.sspnet.org/2015/05/07/sexism-in-peer-review/>

⁵⁸ For an overview of the peer review process see Ali, P.A., and Watson, R. (2016) Peer review and the publication process, *Nursing Open*, 3(4): 193-202.

⁵⁹ A recently published LERU advice paper looks into the implicit bias in academia <https://www.leru.org/publications/implicit-bias-in-academia-a-challenge-to-the-meritocratic-principle-and-to-womens-careers-and-what-to-do-about-it>

⁶⁰ Bommann, L., Mutz, R., Daniel, H-D., (2007) Gender differences in grant review: A meta-analysis, *Journal of Informetrics*, 1(3): 226-238.

Despite the criticism, the peer review is regarded as an element that benefits scientific communication.⁶¹ To combat gender bias in the publication process several solutions have been proposed including diversifying editorial boards and review pools, adopting peer review processes that protect authors from bias like double-blind peer review and the introduction of Open Peer Review (OPR). Double blind review (where both the author and reviewer identities are concealed) has been used as a method to reduce bias in the review process. A study on the journal of Behavioural Ecology showed an increased representation of female authors following a change in its editorial policy and the adoption of double blind review in 2001. At the same time, they also note an increase in female representation in another journal (Biological conservation) that did not use double-blind review.⁶² A different study that reanalysed the previous study's data using a generalized mixed-effect approach did not confirm a detectable positive effect of double blind review and argued for the need to adopt more targeted-oriented action to support female researchers.⁶³

A more recent approach to peer review is the use of Open Peer Review (OPR). OPR is an umbrella term including a variety of elements such as open identities, open reports (with review reports being published alongside the article), open participation, open interaction, open pre-review manuscripts, open final version commenting, open platforms. Even though support for OPR is not as strong as that for Open Access to publications and research data, it is nonetheless moving to the mainstream, while major journal like the *British Medical Journal* encourage its use.

Proponents of OPR argue that it contributes to increased transparency and accountability as everything is done in the open, thus leading to better quality reviews and more constructive comments.⁶⁴ Opponents, by contrast, claim that a known identity may lead to less critical and rigorous comments.⁶⁵ It should be noted that until now, OPR has been primarily used in manuscript peer review, rather than grant peer review.

An OpenAIRE study⁶⁶ presenting the findings of an online survey shows that more than three out of four respondents reported having had an experience with OPR. The OpenAIRE study presents further interesting findings: while the majority of respondents were in favour of OPR, enthusiasm was lower when compared to that regarding open access to publications or research data which are the most known and familiar aspects of Open Science. Respondents also thought that most aspects of OPR would improve the peer review process with one notable exception, open identities, which 50.8% respondents thought would make the peer review process worse or much worse. Respondents seemed more in favour of open interaction encouraging the direct discussion between author(s) and reviewer(s) and/or

⁶¹ Ibid.

⁶² Budden, A.E., Tregenza, T., Aarssen, L.W., Koricheva, J., Leimu, R., and Lortie, C.J. (2008) Double-blind review favors increased participation of female authors, *Trends in Ecology and Evolution*, 23(1):4-6.

⁶³ Engqvist, L., Frommen, J.G. (2008) Double-blind peer review and gender publication bias, *Animal Behaviour*, 76(3): e1-e2.

⁶⁴ Cochran, A. (2015).

⁶⁵ Ali, P.A and Watson, G. (2016).

⁶⁶ Ross-Hellauer, et al (2017).

reviewer(s). The findings are of interest, yet one does not fail to notice that the issue of how gender may impact on the review process was not touched upon in the survey.

3.4 Rewards and Skills

Open Science represents a new approach to the scientific process that is based on cooperative work and a shift from publishing to sharing and using available knowledge from the early stages of the research process. This new approach affects the scientific process, and has in parallel wider implications for research assessment and evaluation procedures. The discourse on Open Science has triggered in particular discussions on how Open Science practices can be embedded in research evaluation procedures related to recruitment, career progression, and grant assessment to reflect better the changes brought about by the emergence of alternative systems of establishing scientific reputation, the need to provide proper acknowledgement to the original creator of data, use of blogs, etc.

Echoing this need, in 2013 the American Society for Cell Biology along with other scientific journals launched the San Francisco Declaration on Research Assessment (DORA) aimed at putting an end to the practice of using the journal impact factor as the single measure of academic/research impact⁶⁷ with the latter also hiding inequalities in citation practices.⁶⁸ Among the issues highlighted in the declaration is the need to broaden the type of outputs being evaluated to include datasets and software, challenging the current focus on publications as the core indicator of research quality. In addition, the declaration argues for the need to encourage responsible authorship practices and the provision of information regarding the specific contribution of each author touching in this way on issues relating to research integrity which form part of the RRI approach discussed in previous sections. Nevertheless, while a significant number of research institutions and individuals have signed the declaration, only a small number of them have put it into practice as the widespread use of bibliometric parameters in research assessment does not contribute to the adoption of Open Science practices or the equal valuation of women scientists.

Acknowledging the need to recognize open access practices as a formal criterion in career progression procedures the RECODE project⁶⁹ formulated related recommendations including the development of policies and initiatives that offer researchers rewards for open access to high quality data and the need to support the transition to open research data through curriculum-development and training.⁷⁰

⁶⁷ European Commission (2017d) *Evaluation of Research Careers fully acknowledging Open Science Practices. Rewards, incentives and/or recognition for researchers practising Open Science*. Luxembourg, Publications Office of the European Union, available at: https://ec.europa.eu/research/openscience/pdf/os_rewards_wgreport_final.pdf#view=fit&pagemode=none

⁶⁸ Lariviere, V., Ni, C., Gingras, Y., Cronin, B., Sugimoto, C., R. (2013) Bibliometrics: Global gender disparities in science, *Nature*, 504(7479) <https://www.nature.com/news/bibliometrics-global-gender-disparities-in-science-1.14321>.

⁶⁹ RECODE project <http://recodeproject.eu/>

⁷⁰ RECODE (2015) *Policy guidelines for open access and data dissemination and preservation*, RECODE Project, Deliverable 5.1, <http://recodeproject.eu/>

While the above recommendations focus on research data they could well apply to other Open Science aspects, like open access to publications.

More recently, the report on rewards, incentives and/or recognition for researchers practicing Open Science provides a framework called “Open Science Career Assessment Matrix (OS-CAM)”.⁷¹ The proposed framework “represents a possible, practical move towards a more comprehensive approach to evaluating researchers through the lens of Open Science” and thus covers diverse Open Science activities and possible evaluation criteria. The OS-CAM proposes a variety of criteria such as publishing in open access journals, using FAIR data principles, full recognition of the contribution of others in research projects, including collaborators, co-authors, citizens, open data providers, being a role model in practicing open science. The use of a wide range of indicators is important for encouraging and incentivising the adoption of open science practices by researchers, but more importantly as an approach that allows to better reflect the plurality of research outputs and dissemination channels, beyond the focus on the journal publication as the main publication type. As stated in the report, it is important to frame the discussion not simply in open science terms, but to put it in the wider context of the evaluation of researchers that uses multi-dimensional criteria for evaluation. This new approach is also expected to provide a framework that acknowledges the collaborative nature of current research that cannot be served by the focus on the impact factor which places emphasis on the individual effort. It also seems that a multi-dimensional approach might better avoid indirect gender discrimination in the allocation of rewards to OS practices, but research on the gender impact of different OS incentive policies is needed to inform the decision-making on these policies.

3.5 Altmetrics and New Generation Metrics

Traditional metrics used in research assessment focus on the number of publications and the number of citations a publication receives. Citation rates, i.e., the average number of citations received by a group of papers published in one research field in each year,⁷² have been commonly used to assess the academic performance of an individual researcher thus having important implications on promotion and tenure procedures and the ability of a researcher to attract funding (see also the discussion in the previous section). As research assessment and evaluation have increasingly relied on (quantitative) metrics concerns have been raised about the extent at which this heavy reliance on metrics might have flaws.⁷³ Concerns relating to the use of traditional metrics stress their focus on aspects that can be measured (at the expense of those that cannot), on their impact on researchers’ choice on publication venues or the aspects of their CVs researchers place focus on and the distortion of

⁷¹ European Commission (2017d).

⁷² The citation rate is calculated by dividing the total number of citations received by all papers in the group (defined by research field and publication year) by the total number of papers in the group.

⁷³ See also the discussion of the previous section on rewards and skills.

incentives this approach creates.⁷⁴ These concerns are also related to increasing pressures for evaluating public spending on research and higher education.

Over the past years, various efforts have been made to explore the strengths and limitations of both the current metrics system and the use of alternative metrics. The Leiden Manifesto is such an attempt aimed to guide research evaluation by proposing ten principles.⁷⁵ The Manifesto raised concerns regarding “the pervasive misapplication of indicators to the evaluation of scientific performance” and the existence of various rankings that may be based on inaccurate and arbitrary indicators. Among the principles for guiding research evaluation, the Leiden Manifesto urges for the need to account for the variation of publication and citation practices by field, the need to base assessment of individual researchers on qualitative judgement and not limit evaluation to quantitative criteria and the need to scrutinise and update the indicators used.⁷⁶

Usage metrics that constitute a step forward from traditional metrics usually rely on the number of views or downloads of an item: the latter is not limited to traditional journal publications but can also encompass non-traditional forms like posts, blogs etc. Recent years have witnessed also the rise of altmetrics that are based on social media applications like blogs, Twitter, ResearchGate and Mendeley and which have been used to measure the broader societal impact of scientific outputs by allowing more diversity in relation to the outreach of an item by including aspects like downloads, likes etc. Their strength lies in their “potential in the assessment of interdisciplinary research and the impact of scientific results on the society as a whole, as they include the views of all stakeholders and not only other scholars (as with citations).⁷⁷ At the same time concerns are raised about the extent to which altmetrics may introduce a new form of competition that is not based this time on scientific quality. The Report of the European Commission’s expert group on Altmetrics stressed also the limitations of altmetrics and called for complementing them with metrics and frameworks that are more aligned with open science priorities. The expert group therefore underscored the need to underpin next generation metrics by an open, transparent and linked data infrastructure.

In its recommendations, the next generation metrics group of the OSPP points to the need to assess the benefits and consequences from the introduction of new metrics on the evaluation criteria. This recommendation should be expanded to incorporate the impact of new metrics on gender equality, given the existing findings related to gender bias in evaluation and citations practices.

⁷⁴ European Commission (2017e) *Next generation metrics: responsible metrics and evaluation for open science*, Luxembourg, Publications Office of the European Union, available at: <https://ec.europa.eu/research/openscience/pdf/report.pdf>

⁷⁵ Hicks, D., Wouters, P., Waltman, L., de Rijcke, S., Rafols, I. (2015) Bibliometrics. The Leiden manifesto for research metrics, *Nature*, 520: 429-431 (23 April 2015).

⁷⁶ Ibid.

⁷⁷ European Commission (2017e) op. cit., p. 11.

4. Open Innovation

Innovation defined as “the adoption of something new which creates value for the individual or the organisation that adopts it” is regarded as a key element for economic development. In discussions on innovation, the focus has recently shifted from innovation to open innovation. Open Innovation was coined by Henry Chesbrough in his book *Open innovation: The New Imperative for Creating and Profiting from Technology* arguing that “open innovation is a paradigm that assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market” (2005: p. XXIV). A more complete definition was proposed in 2014 by Chesbrough and Bogers defining open innovation “as a distributed innovation process based on purposively managed knowledge flows across organizational boundaries, using pecuniary and non-pecuniary mechanisms in line with the organization’s business model”.⁷⁸ Open innovation stands in contrast to the paradigm of closed innovation which puts the concept of control at its centre. Within this model firms are self-sufficient as they are in control of their own ideas, production, marketing and other processes. Innovation has nonetheless always been open to some extent, while the recent increased interest in open innovation can be associated with the efforts of researchers to synthesize related ideas and analyse the benefits that can accrue from it.⁷⁹

The European Commission describes open innovation as the opening up of the innovation process to all active players allowing knowledge to circulate more freely and be transformed into products and services. The European Commission highlights two elements as key in recent conceptions of Open Innovation: users (with the term “open” in this content being equivalent to “user centric”) and a well-functioning ecosystem where all relevant stakeholders work together to co-create solutions to socio-economic and business challenges.⁸⁰

The interest of the EU in open innovation is also attested through the establishment of the European Innovation Council (EIC) pilot. The latter was launched in October 2017 with the aim to support top class innovators, entrepreneurs, small companies, and researchers.⁸¹ Between 2018- 2020 the EIC pilot will provide around €2.7 billion to breakthrough, market-creating innovations using the Small and Medium-sized Enterprises (SME) instrument, the Fast Track to Innovation, Future and Emerging Technologies (FET) Open and the EIC Horizon Prizes. The Helsinki Group underscored in its position paper on the EIC “the vital need for integrating gender dimension in technological design and innovation” and pointed out that the EIC

⁷⁸ Cited in European Commission (2017f) *Europe’s Future: Open Science, Open Innovation, Open to the World*. Reflections of the RISE Group, p. 127. Available at: https://www.fct.pt/noticias/docs/Europe_s_future_Open_Innovation_Open_Science_Open_to_the_World.pdf

⁷⁹ Dahlander, L. and Gann, D.M (2010) How Open is innovation? *Research Policy*, 39(6): 699-709.

⁸⁰

⁸¹ European Innovation Council (EIC) <https://ec.europa.eu/programmes/horizon2020/en/h2020-section/european-innovation-council-eic-pilot>

should ensure that innovation funded is not gender blind and that results reflect the needs and interests of women.⁸²

More recently, a new paradigm shift has been witnessed: Open Innovation 2.0 which is in turn based on the “principles of integrated collaboration, co-created shared values, cultivated innovation ecosystems, unleashed exponential technologies, and extraordinarily rapid adoption”.⁸³ The European Commission has embraced Open Innovation 2.0 highlighting the central role of users in value creation and as targets of innovation.⁸⁴ The central idea behind the concept of openness is that firms cannot innovate in isolation and therefore the adoption of this new model results in the boundaries between firms and their environment becoming more permeable. Within this ecosystem, stakeholders are expected to collaborate along and across industry in providing solutions to socio-economic and other challenges.

Firms adopting the open innovation approach can benefit from two different types of openness: outbound openness whereby firms reveal information or sell technology to the outside environment and inbound openness in which external sources are used (with the latter type being of more interest to our analysis).

Despite the stress on openness, collaboration and intuition in Open Innovation discourses, analyses have so far largely failed to address gender issues in Open Innovation. Of 771 papers published in ISI Web of Science only one included the word gender in the title, keywords and/or abstract⁸⁵. Significantly, the recent World Economic Forum report⁸⁶ claims that 57% of jobs that will be eliminated by 2026 due to technologization will be women’s jobs. The report argues that because of this, the progress toward gender equality will be stalled.

The following sections will look into the role of women and gender in open innovation: in particular they will examine the role of women and gender in (open) innovation.

4.1 The role of women and gender in (open) innovation

Despite long standing attention in gender and feminist scholarship to gender barriers in technology and innovation, mainstream policy discussions on innovation did not address gender issues until recently, a fact that may be related to the absence of focus on the role of the innovator in the process and the lack of gender analysis integrated in the innovation cycle. While this seems to be changing – as the positive impact of gender diversity and the integration of the gender dimension in innovation is being acknowledged⁸⁷ – the She Figures 2015 confirms the underrepresentation of

⁸² Helsinki Group on Gender in Research and Innovation (2016) Position Paper on the European Innovation Council, Prepared for ERAC Steering Board meeting of 28 June 2016.

⁸³ Curley, M., and Salmelin, B. (2013) *Open Innovation 2.0: A New Paradigm. A White Paper*. Available at: <https://ec.europa.eu/digital-single-market/en/news/open-innovation-20-%E2%80%93-new-paradigm-and-foundation-sustainable-europe>

⁸⁴ Ibid. p 128.

⁸⁵ Harris, Morello and Raskino 2007: 276.

⁸⁶ World Economic Forum (2018) *Reskilling Revolution: A Future of Jobs for All*. Geneva.

⁸⁷ Alsos, G.A., Hytti, U., Ljunggren, E. (2016) Gender and Innovation-An Introduction, in Alsos, G.A., Hytti, U., Ljunggren, E. (Eds.) *Research Handbook on Gender and Innovation*, Cheltenham, Edward Elgar.

women in innovation outputs (which is more pronounced in patent applications for inventions compared to scientific publications). The report shows strong underrepresentation of women as inventors at EU-28 level with just 8.9% of patent applications being registered between 2010 and 2013 by a woman inventor.⁸⁸ It should be noted also that while the She Figures report provides data on the women to men ration of inventorships, it does not provide any information regarding innovations with a gender dimension.

Further interesting insights regarding gender and innovation are found in the European Studies on Gender Aspects of Inventions report which shows a more diverse picture in Europe than what the aggregate data reveal at first sight. A key finding of the report is the negative correlation between the proportion of female inventors and the development of a country's national system of innovation. The report also confirms that women's inventing activities are in line with their work preferences: they tend to prefer technology fields like chemistry and health-related disciplines. The above findings suggest the need for the She Figures and other related reports to disaggregate data by country, field and sector and to consider the importance of providing time series.

Acknowledging this gap, the European Commission established in 2011 the Expert Group "Innovation through Gender". The group's aim was twofold: "to provide scientists and engineers with practical methods for sex and gender analysis, and to develop case studies as concrete illustrations of how sex and gender analysis leads to new ideas and excellence in research".⁸⁹ The work of the Expert Group can be traced back to 2009 when related work was initiated at Stanford University and where the term "Gendered Innovations" was coined by Londa Schiebinger in 2005. As described, gendered innovations "offer sophisticated methods of sex and gender analysis to scientists and engineers". As such, they are expected to add value not only to research, but also to society (by integrating better social needs) and businesses (by developing new ideas, patents and technology).⁹⁰ The Report of the Expert Group and the progressively updated Gendered Innovations website⁹¹ present an extensive number of case studies and methods of sex/gender analysis through which new insights in various domains like basic science, health and medicine etc. are provided (while reflecting the priorities set in the Horizon 2020 programme). An illustrative example comes from the development of biofidelic models as tools for improving automobile occupant safety. As these models tended to be less inclusive of lighter people (mostly women) and heavier people (mostly men) researchers have been working on developing more advanced and representative models of the human body.⁹²

Some studies also take into consideration the role of women and gender diversity as a factor affecting the innovation capacity of firms. This goes beyond the business arguments considering diversity as a factor contributing to equal treatment or to

⁸⁸ European Commission (2016b).

⁸⁹ European Commission (2013) *Gendered Innovations. How Gender Analysis contributes to Research*, Luxembourg, Publications Office of the European Union.

⁹⁰ Ibid.

⁹¹ Gendered Innovations, <https://genderedinnovations.stanford.edu/>

⁹² European Commission (2013).

arguments related to political decisions seeing gender diversity as a measure to promote the integration of women in the labour market. Gender diversity is associated with wider economic benefits that go beyond the individuals, enterprises or regions.⁹³

A recent study on the impact of gender diversity on innovation in manufacturing and service firms provides an overview of the studies that consider gender diversity. According to the review, the positive impact relates to the diversity of skills and viewpoints that a gender diverse team brings, leading to more alternative solutions and to more realistic decisions.⁹⁴ In looking into how gender diversity affects innovation capacity at firm level (and how this relates to team size) it also found that gender diversity in teams increases the probability of innovation. Furthermore, it showed that this is positively related to team size (with gender diversity having a larger positive impact on larger firms than smaller ones). Size effect is also shown to be of great importance when a distinction is made between the manufacturing and service sectors.

A different study highlights the fact that despite the positive relation between technological diversity and innovation, few studies have looked into the human capital dimension with those doing so focusing predominantly on the top echelons. Looking in 1,648 Danish firms the study finds that firms with more balanced gender composition were more likely to innovate compared to those with high concentration of one gender.⁹⁵

In discussing the role and significance of gender diversity in innovation practices the open innovation approach brings to the discussion an additional interesting dimension. As firms are increasingly relying on external sources for the development or modification of their products and services (what has been described as inbound openness), gender diversity of contributors needs to be considered, given that it is no longer confined to firm level. It should also be noted that the open innovation approach is by now of interest not only to firms but also to the scientific community as concepts such as co-creation, crowdsourcing and citizen science can have a positive impact on the quest for solutions to specific challenges. Encouraging the participation of women is also expected to contribute in advancing the UN sustainable goals, especially that of gender equality and the empowerment of women. Acknowledging the need for integrating the gender perspective the Nordic countries have developed several initiatives that encourage not only gender diversity but the integration of the gender perspective in innovation milieus.⁹⁶

⁹³ Danilda, I., and Thorslund, J. G. (eds.) (2011) *Innovation and Gender*, Vinnova <https://www.vinnova.se/contentassets/747b7b67e1594982be45942f5db53222/vi-11-03.pdf>

⁹⁴ Teruel, M., Parra, D.M., Segarra, A. (2015) Gender diversity and innovation in manufacturing and service firms, *Document de treball no15-2015, CREIP Working Papers*, <http://www.recercat.cat/bitstream/handle/2072/249234/201515.pdf?sequence=1>

⁹⁵ Ostergaard, C., Timmermans, B., Kristinsson, K. (2011) Does a different view create something new? The effect of employee diversity on innovation, *Research Policy*, 40(2011):500-509.

⁹⁶ Danilda, I., and Thorslund, J.G. (2011).

4.2 The co-creation process

The inbound openness referred to above can take a variety of forms ranging from a general collection of ideas to finding solutions to specific and complex tasks or to interacting with experts and other stakeholders outside the firm in the context of what is known as a co-creation process. Crowdsourcing is one form of such external sourcing: under crowdsourcing firms launch open calls to a group of external contributors in the context of a specific project or innovation challenge. This type of open innovation benefits greatly from the new possibilities opened by the internet which allows firms to reach to a broader pool of contributors. In the scientific field crowdsourcing can be used by scientists to reach out to other scientists or non-scientists to collate data or collaborate with experts and non-experts. It can also mean that scientists and experts contribute to specific questions. These forms of collaboration are also used by firms.⁹⁷

Citizen science is another type of open innovation. Citizen science describes the support and involvement of non-experts in the research process. This can take a variety of forms ranging from the mobilisation of the public in the collection of data, to their involvement in the analysis and interpretation of data. The JRC in his report highlights six steps of using citizen science which include: data gathering, data validation and quality control, data analysis and interpretation, connecting citizen science with established policy processes, informing citizen scientists about policy-related actions and monitoring policy impacts.⁹⁸ An example, and probably the most known on line citizen science project is the Galaxy Zoo where volunteers are asked to help in classifying galaxies and in this way assist professional researchers.

The increasing interest in citizen science relates among others to the potential of citizen's contribution to policy making and an increase in the effectiveness of policies in addressing societal challenges. Citizen science is regarded by the European Commission as both an aim and enabler of Open Science and thus forms an integral part of the Open Science agenda and is supported by a dedicated group within the OSPP.⁹⁹ The EU's interest in citizen science is also acknowledged in the H2020 interim evaluation stating that "involving citizens, customers and end users in the programme agenda setting (co-design) and its implementation (co-creation) leads to more innovation by stimulating user driven innovation and the demand for innovative solutions".¹⁰⁰

Acknowledging the increasing importance of citizen science, a series of organisations have developed toolkits and produced reports to enhance good practice. For

⁹⁷ Schildhauer, T., Voss, H. (2013) *Open Innovation and Crowdsourcing in the Sciences*, in Bartling, S., Friesike, S. (eds.) *Open Science*, Springer, Cham.

⁹⁸ European Commission (2017g) *Using new data sources for policy making*, JRC Technical Reports, Luxembourg, Publications Office of the European Union, [http://publications.jrc.ec.europa.eu/repository/bitstream/JRC109472/jrc109472_final_online\(1\).pdf](http://publications.jrc.ec.europa.eu/repository/bitstream/JRC109472/jrc109472_final_online(1).pdf)

⁹⁹ European Open Science Policy Platform, <https://ec.europa.eu/research/openscience/index.cfm?pg=open-science-policy-platform#>

¹⁰⁰ European Commission (2018) *Horizon 2020 interim evaluation: maximizing the impact of EU research and innovation*. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, Brussels, 11.01.2018, COM(2018)2 final, available at: <https://ec.europa.eu/transparency/regdoc/rep/1/2018/EN/COM-2018-2-F1-EN-MAIN-PART-1.PDF>

example, the European Citizen Science Association (ECSA), a non-profit association to improve citizen science in Europe, has published a set of ten principles that underlie good practice in citizen science. Among them the need to control potential limitations and biases could be of relevance to this report in terms of gender imbalance in the composition of citizen science teams, for example.¹⁰¹ A further example is the citizen science toolkit. In discussing issues to take into consideration while building the community, the toolkit stresses the need to consider socio-cultural issues. In relation to gender, ensuring that women also assume leadership roles in citizen science projects and are not constrained from participating in certain areas is of great importance.¹⁰²

Citizen science is also linked to RRI which is in turn defined as an “approach that anticipates and assesses potential implications and societal expectations with regard to research and innovation, with the aim to foster the design of inclusive and sustainable research and innovation”.¹⁰³ A key element in achieving RRI is the involvement of citizens (public engagement). The RRI Tools project has also developed a toolkit on setting up a participatory research agenda with one of the five key steps identified being “integration”. Integration is understood as the inclusion of “the perspectives of diverse stakeholder groups via dialogue meetings with representatives from all relevant parties to develop an integrated agenda”.¹⁰⁴ In doing so, this process raises attention to the asymmetries between stakeholders and points to the need for giving every stakeholder group a voice, while also ensuring equal representation between the different stakeholder groups.

4.3 The user centric innovation

An additional aspect of importance relates to the role of the user within the innovation process. In the past the dominant role in determining the needs and specifications of a product or service was placed on the manufacturer; yet more recently this has changed. The user is now regarded as having an important role to play in the process: user involvement can lead to a better understanding of user needs and requirements, thus helping the development of better products or the modification (improvement) of existing ones and ultimately enhancing competitive advantage. As far back as the 1970s Von Hippel showed that some 80% of the scientific instrument innovations he studied had been invented and initially tested by users rather than by product manufacturers.

Other studies have also indicated that successful innovations have benefited from external sources¹⁰⁵ with the latter accounting between 34 to 65% of the input. Von Hippel’s user innovation theory puts the user and consumer at the centre of the

¹⁰¹ ECSA (2015) *Ten principles of citizen science*, September 2015, London, https://ecsa.citizen-science.net/sites/default/files/ecsa_ten_principles_of_citizen_science.pdf

¹⁰² Federal Crowdsourcing and citizen science toolkit, <https://crowdsourcing-toolkit.sites.usa.gov/howto/>

¹⁰³ Responsible Research and Innovation <http://ec.europa.eu/programmes/horizon2020/en/h2020-section/responsible-research-innovation>

¹⁰⁴ RRI Tools – Setting up a participatory research agenda, <https://www.rri-tools.eu/how-to-stk-pm-set-up-a-participatory-research-agenda>

¹⁰⁵ Sources include a variety of stakeholders including users, suppliers, academia etc.

innovation process and as such identifies four external sources of knowledge and innovation: suppliers and consumers, university, government and private laboratories, competitors and other nations. According to this approach new products and services are co-developed by these users. Yet, while women influence 80% of consumer spending decisions, 90% of products and services are designed by men.¹⁰⁶ This finding suggests that by involving more women in the process could result in more competitive products as well as in products that do not conform to a single stereotype of the male consumer.

A similar approach to open innovation methodologies is that of Living Labs. The latter emerged in 2000 and have grown since, placing emphasis on user centred approach. Among their principles openness and empowerment are considered as key. The openness principle places emphasis on opening the innovation process as a way of supporting user driven innovation, while the empowerment of user is also seen as central in bringing the process towards the desired direction. In opening the process, it is important to ensure that the diversity reflects that of the surrounding community which is not always easily achieved.

5. Recommendations

The analysis of the existing literature and examples of promising practice has informed the formulation of the following sets of recommendations, clustered into five priorities for action, targeting a variety of stakeholders (European Commission, Member States, RFOs, RPOs, innovative firms as well as researchers):

A first priority for action focuses on gender mainstreaming and creating a policy synergy between the gender equality and OS/OI agenda in order to overcome the gender blindness of the current OS/OI policy making and lack of awareness of gender issues in OS/OI identified in this report:

- 1.1 European Commission and national policy-making must continue to address Priority 4 gender equality as a self-standing issue while mainstreaming gender concerns to other priority areas. Review of existing policy documents and studies on OS/OI, including those produced by the European Commission in recent years of ERA implementation, reveals zero attention to gender equality. Gender issues thus fail to be addressed as a matter of course in European policy making in OS/OI.
- 1.2 Awareness must be raised in the OS/OI policy and research community on the relevance of gender and ways OS/OI can mitigate against gender inequality and bias in the various aspects of OS/OI. Gender experts and scholars should be invited as members to relevant expert and advisory groups.

¹⁰⁶ Harris, K., Morello, D., Raskino, M. (2007).

The second priority for action is advancing knowledge and awareness of gender issues in OS/OI:

- 2.1 In order to develop evidence-based, socially responsible policies, further studies are needed to examine gender issues in OS/OI, with special focus on open peer review, altmetrics, open software and open innovation. For example, studies on peer review (single/double blind and open peer review) should focus on examining how different peer review practices mitigate against gender bias. Gender bias in the peer review process is still not adequately addressed and has important impact not only on a researcher's publication record, but also on issues related to access to funding, promotion and tenure procedures. As new forms of peer review (like OPR) are being introduced it is important to examine how different practices impact on gender bias and explore ways of adequately addressing them.
- 2.2 The European Commission should support this effort and lead by example, by providing disaggregated data by sex on the adoption of open access practices in the next editions of She Figures. In particular, it would be useful to have information on both the sex of the author and whether the publication is open access or not.
- 2.3 European and national authorities collecting data on inventorship are encouraged to disaggregate data by sector and country in addition to sex-disaggregating data. As highlighted in various studies, aggregate data conceal important differences on the uptake of innovation practices between sectors and across countries between men and women. Being able to combine sex disaggregated information with data on activities by sector, field and country could prove extremely useful in the design of innovation policies that encourage gender diversity in innovation teams and integrate better sex/gender analysis in the innovation process.
- 2.4 Research funding and research performing organisations are encouraged to examine the adoption of open access practices by men and women.

The following three areas of action offer more specific recommendations and focus on evaluation and assessment practices, publication practices and innovation processes as key areas where gender issues have been previously established.

The third priority for action addresses evaluation and assessment practices in RFOs and RPOs:

- 3.1 The European Commission and its OSPP Expert Group, along with other stakeholders involved in research assessment (such as research performing and research funding organisations) are encouraged to explore how/if the use of new metrics impacts men and women researchers at different career stages and disciplines differently. The choice of metrics during research assessment/evaluation procedures has important implications on researchers' priorities and strategies, their choice of publication venue and the way they present their CVs. In developing a more sophisticated approach it is important to prevent indirect sex discriminations, and therefore to examine how men and women make use of new channels for disseminating their research at different stages of their research career and how this may impact on their career prospects.

- 3.2 Research performing and funding organisations are encouraged to adopt multi-dimensional evaluation criteria that enhance openness and transparency (including visibility and open access to those research outputs with a gender dimension), and contribute in mitigating against gender bias in research assessment/evaluation procedures. Research performing and funding organisation should embed in their research assessment and evaluation systems incentives and rewards to practices that enhance openness and transparency such as providing open access to publications and research data and depositing of preprints (with particular attention to those which highlight the visibility if the gender dimension as a main or as a cross-cutting issue), including also those that enhance research integrity like the recognition of the contribution of co-authors, collaborators, citizens etc., and the acknowledgment to the original creator of data, as well as trainings on unconscious gender bias in research assessment/ evaluation procedures and on the integration of sex/gender analysis into research content.
- 3.3 Authorities and organisations at European and national level funding open innovation projects are encouraged to ensure that funded projects integrate sex/gender analysis where appropriate and that the teams respect gender diversity. Gendered Innovations have highlighted the importance of integrating sex/gender analysis in research (explaining how and to what extent the analysis is relevant to the proposed project as well as justifying the inclusion in research teams of partners with related expertise). Research funding organisations and agencies are encouraged to follow the steps of funders such as the European Commission (under the Horizon 2020 programme) or the Gates Foundation which have incorporated this in their calls, including those of particularly innovative strands like the SME Instrument, by asking applicants to integrate sex/gender analysis in their proposals and their research. Some of the outputs of the [GENDER-NET](#) ERA-Net¹⁰⁷, provide specific recommendations targeted for Research Funding Organizations (as well as other recommendations targeted toward grant applicants, and toward peer-reviewers/evaluators), as is the case of the *Manuals with guidelines on the integration of sex and gender analysis into research contents, recommendations for curricula development and indicators*¹⁰⁸, and the *Online IGAR Tool on Recommendations for Integrating Gender Analysis into Research*.¹⁰⁹
- 3.4 Research funding and research performing organisations are encouraged to examine the adoption of open access practices by men and women in order to identify whether OS/OI may continue to perpetuate gender differences in publications and hence evaluation.

¹⁰⁷ GENDER-NET, ERA-NET <http://www.gender-net.eu/?lang=en>

¹⁰⁸ GENDER-NET Report (2016) *Manuals with guidelines on the integration of sex and gender analysis into research contents, recommendations for curricula development and indicators*, available at: http://www.gender-net.eu/IMG/pdf/GENDER-NET_D3-11_Manuals_with_guidelines_on_the_integration_of_sex_and_gender_analysis_into_research_web.pdf

¹⁰⁹ GENDER-NET, IGAR Tool, <http://igar-tool.gender-net.eu/en>

The fourth priority for action addresses publication practices of researchers and RPO:

- 4.1 Research performing organisations should encourage the sharing of preprints presenting the results of research on gender (that is, gender as the main focus of the research content) and those with a gender dimension that is, those integrating sex/gender analysis as a cross-cutting issue). Encouraging researchers to submit preprints of their manuscripts to appropriate platforms is expected to benefit the scientific process. Preprints allow faster evaluation of results which could prove particularly important in the case of contested results and impact on the design of interventions and the development of guidelines and policies, especially in cases where sex/gender difference have an impact on the design of policies.
- 4.2 Researchers are encouraged to adopt the FAIR management of sex and gender data. Opening and sharing sex and gender data used in research or publications through institutional or other appropriate data repositories (while respecting the FAIR guiding principles for research data management and stewardship) enhances openness and transparency in the scientific process and serves as a quality control mechanism. Opening sex and gender data in particular is expected to contribute in tackling research bias and to better science and benefit to patients.

The fifth priority for action assesses innovative processes and firms:

- 5.1 Stakeholders engaged in setting up participatory innovation projects should ensure the involvement of diverse groups and gender diversity in line with the finding that diversity overall and gender diversity specifically contribute to identifying innovative solutions. Projects placing emphasis on public participation and engagement (like citizen science and crowdsourcing projects) are encouraged to ensure equal opportunities to both men and women in terms of participation in such projects. Attention should also be paid in encouraging and ensuring leadership roles within such projects to women. In doing so, the ECSA principles and the citizen science toolkit can provide useful and practical guidance to those involved in initiating such projects and also contribute through their own experiences to advancing gender diversity.
- 5.2 Stakeholders engaged in setting up participatory innovation projects should ensure the integration of sex/gender analysis in order to guarantee that innovative processes benefit all segments of population without bias.

6. Conclusions

The present report has explored ways gender issues is several key areas of Open Science and Open Innovation. The interest in exploring this topic stems from the fact that while both OS/OI and gender are among the ERA priorities and a cross cutting issue in the H2020, they are treated as parallel and independent topics. **The most important finding therefore is that current OS/OI policies and expert studies tend to be gender blind and do not in any way address gender issues. The report should be considered as a starting point for stakeholders to reflect on how these two issues could create reinforcing synergies. It also points to the need for further analysis in this topic.**

Having as a starting point the belief that mutually beneficial synergies can be found between the two topics, the report examined selected aspects of OS/ and formulate recommendations aimed at enhancing these links further. The report can be thus considered as an effort to mitigate against gender inequality through the adoption of OS/OI practices as the latter place emphasis on concepts such as “openness”, “transparency”, “empowerment”, and “public participation” and could thus contribute to enhancing the visibility of women and gender.

We present here eleven recommendations that aim to facilitate and support gender equality implementation at national as well as European and international level. The recommendations target different stakeholders, with a key role in the design, implementation and monitoring of OS/OI and gender policies such as national authorities, research funding agencies and research performing organisations, as well as research teams and individual researchers. The recommendations propose practical ways of increasing the role of women and gender within OS/OI ecosystem. In some cases, the recommendations encourage the inclusion of the gender dimension in existing practices: for example, while research performing organisations and agencies collect information on publications arising from the projects they fund, the report recommends disaggregating them by sex and thus collecting information on how men and women practice open access. In other cases, based on current (established peer review processes) and emerging practices (the adoption of open peer review) the report recommends the examination of the extent to which current and new practices impact on gender bias.

The report has also contributed in highlighting that OS/OI should not be gender blind as is usually considered. On the contrary, the analysis has shown that examining the impact of these policies on men and women (for example does the inclusion of open access practices as an indicator within career assessment procedures benefit men and women to the same or different extent) and also by taking into consideration the gender dimension (for example ensuring gender diversity in citizen science projects and giving leadership to women in public participatory projects) could be beneficial not only for women, but to society and science as well.

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8. Glossary

Article Processing Charges (APCs): fees that some open access scholarly publishers charge to authors of academic papers to publish their paper

Double blind peer review: a review process whereby both the reviewer and author identities are concealed from the reviewers, and vice versa

FAIR Data principles: FAIR stands for Findable, Accessible, Interoperable and Reusable. Data are findable when they are assigned persistent identifiers, they are accessible when they can be retrieved by their ID through a standard protocol, interoperable through the use of formal, broadly applicable languages, and reusable when they have rich accurate metadata, clear licenses.

Gender: a socio-cultural process referring to cultural and social attitudes that together shape and sanction “feminine” and “masculine” behaviours/ products/ technologies/ environments/ knowledge.

Gendered Innovations: processes that integrate sex/gender analysis into all phases of basic and applied research

Gold Open Access/ Open Access Publishing: via publishing an article in a journal. The journal may be an open access journal (pure open access), or a subscription based journal (hybrid open access) that offers an open access option

Green Open Access/ Self-Archiving: when the author self-archives (deposits) a research output in a repository

Open Access: the practice of providing online access to information that is free of charge to the end user and reusable

Open final versioning commenting: a reviewing or commenting on the final version of the publication

Open identities peer review: a review where authors and reviewers are aware of each other's identities

Open participation peer review: a review process that allows the wider community to contribute to the review process

Open platforms peer review: a review facilitated by a different organizational entity than the venue of publication

Open pre-review manuscripts: manuscripts that are immediately openly accessible (via the internet) in advance, or in parallel with, any formal peer review procedures

Open reports peer review: a review where reports are published alongside the relevant article

Preprint: a manuscript draft that has not yet been peer reviewed for formal publication

Repository: an online archive. They can be institutional; subject-based or centralised

Sex: refers to biological qualities characteristic of women [females] and men [males] in terms of reproductive organs and functions based on chromosomal complement and physiology

Annex I Workshop Invitation and Agenda

EXPLORATORY WORKSHOP
GENDER IN OPEN SCIENCE AND OPEN INNOVATION
Permanent Representation of the Czech Republic to the EU
(15, rue Caroly - Brussels)
19 October 2017

Scope

GENDERACTION is a Horizon 2020 project aimed at creating an innovative policy community for the implementation of the gender priority in the European Research Area by setting up a network of national representatives from EU Member States and Associated Countries to foster policy coordination, best practice exchange and mutual learning. GENDERACTION focuses on supporting gender equality implementation both at the national level as well as EU and international levels.

Since both Gender and Open Science and Open Innovation are cross-cutting priorities in European R&I Policy, GENDERACTION is organizing an exploratory workshop with the intention to provide valuable inputs for facilitating intersectionality and goal achievement in both areas.

The double aim of this exploratory workshop is to:

- 1) present the gaps and opportunities identified by the Horizon 2020 project GENDERACTION regarding the gender dimension in Open Science and Open Innovation (OSI); and
- 2) facilitate high-level discussion on possible measures and recommendations to guarantee that the gender cross-cutting priority is taken into account in all the key topics within OSI policies, with the aim to increase both the visibility and participation of women in R&I **as well as** the visibility and integration of the gender dimension in R&I.

The main conclusions will be included in a GENDERACTION policy brief on *Strategic Advice for enhancing the Gender dimension of Open Science and Innovation Policy* will be published in 2018.

Invited participants

Representatives of the European Commission, the European Parliament and ERAC Standing Working Groups together with other relevant experts and stakeholders willing to participate in a constructive dialogue and mutual learning exercise between the Open Science and Open Innovation expertise/interests and the Gender in Research and Innovation expertise/interests.

AGENDA

09:30 Registration

10:00 Welcome and introduction to GENDERACTION and to the workshop objectives

10:10 GENDERACTION draft report on Strategic Advice for enhancing the Gender dimension of Open Science and Innovation Policy: main conclusions and recommendations

10:40 Debate I: The gender dimension in Open Science

Moderator: Marina Angelaki

The discussion will focus on specific aspects of the Open Science policy (e.g., open access to publications, FAIR data, open peer review, citizen science, skills, rewards, etc.) and how to strengthen the gender dimension in them.

11:40 Coffee break

12:00 Debate II: The gender dimension in Open Innovation.

Moderator: Marcela Linkova

The discussion will focus on how to better integrate the gender dimension in Open Innovation policy issues (e.g., consumer engagement, collaborative product design and development, innovation networks, European Innovation Council, etc.), and to formulate appropriate recommendations.

13:00 Conclusions and next steps

13:15 Closure and light lunch

Annex II List of Participants

Explanatory Workshop on Gender in Open Science and Open Innovation

NAME	SURNAME	ORGANISATION
Marina	Angelaki	National Documentation Centre/ Greece
Tine	Brouckaert	Ghent University/ Belgium
Almudena	Carrero	Spanish Foundation for Science and Technology/ Spain
Martina	Fucimanova	Centre for Gender and Science/ Czech Republic
Michaela	Furdova	SLORD/ Slovakia
Magdalena	Chrobak-Tatara	Ministry of Science and Higher Education/ Poland
Marcela	Linkova	Centre for Gender and Science/ Czech Republic
Maija	Locane	European Commission
Katrien	Maes	League of European Research Universities
Michal	Meszaros	SLORD/ Slovakia
Silvia	Neumann	BMVIT/ Austria
Ana	Puy	Ministry of Economy, Industry and Competitiveness/ Spain
Silvia	Recio	Young European Research University Network
Kalypso	Sepou	Research Promotion Foundation/ Cyprus
Roberta	Schaller-Steidl	Ministry of Science, Research and Economy/ Austria
Nada	Sirotic	Permanent Representation of Croatia to the EU