**Providing researchers with the skills and competencies they need
to practise Open Science**
Report of the Working Group on Education and Skills under Open Science

OSPP Working Group initial assessment

The Working Group welcomes the Report, and in particular its recognition that "a radical change of culture and mind-set in the research community and stakeholders is required (26) and that "Open Science skills ... cannot be isolated from recommendations on broader Open Science issues" (28)   We sense however a possible disconnect between the concrete proposals contained within the report and the vision that guides, and therefore wish to point out:

1. We recognise that supporting the development of Open Science skills through education and training is an essential measure to advance a more open science system. However, we question whether an isolated focus on skills can make more than a superficial impact on what is admittedly a **culture change**, requiring new values and modes of valorisation to be instilled across scientific activities.

2. The gap in **awareness** that the report exposes is not merely a result of uncoordinated activity and/or lack of exposure. It is also due to a lack of ownership at European, national and institution level, and a lack of recognition that openness is not a threat to traditional practices, but their next iteration. Other measures to champion recognition of Open Science might be required.

3. In particular a focus on skills will inevitably have a **skewed focus toward early stage researchers**, since they will be the ones directly involved in Open Science education and training embedded in curricula. However, the ability to recognise and reward these skills is in the hands of more advanced researchers, research managers and administrators, who may themselves not have or value them. Therefore it is essential to design and promote appropriate Open Science training for those stakeholders as well.

4. Framing Open Science primarily as a set of skills required by researchers also tacitly places the burdens of Open Science implementation on researchers, thereby hiding the crucial role played by other stakeholders. Specifically: **funders** must fully support and validate this shift with their funding and policies (such as by providing sustainable funding for infrastructure and databases outside of the green/gold OA system). **Policy makers** and **institutions** must set the right incentives and support creating an Open Science mentoring and training environment. Strong support for **professionals engaged in data science and data management, research infrastructures, open access publishing, curation and preservation of research outputs, various aspects of legal issues** is also crucial, which can be achieved through the promotion of good practice exemplars and mentoring programmes. It is unrealistic to expect that researchers alone can cultivate the level of expertise to deliver the entire workflow required to make science open. This involves profound structural changes in **research** budgets, credit allocation systems and level of

recognition for that kind of work - a point that is made in the report, but not as forcefully as it needs to be, in particular in terms of the recommendations. **Research libraries** are also a key partner in this process, and should be taken more into account in the recommendations.

5. The report cites a reference to developing "Skills and expertise to act in and beyond their own scholarly and disciplinary community (p. 27)," as per the Open Science Monitor. This aspect must be strengthened. At the [EOSC summit, the Commissioner insisted](#) on the unlimited potential of **new interdisciplinary questions** able to be asked based on federated open data. We must also train researchers to contribute to this goal at a fundamental level, not only by making their own data/publications/practices open, but also by asking the kinds of synthetic questions this vision is founded upon, driving forward not just the sharing but the reuse of data. Specific support and tools will be needed to enable interdisciplinary open science, and real interdisciplinarity is very challenging, even more so when the negotiation is played out without human interaction. These and other related macro-level issues, including integrity, governance, ethics, etc. should be added to the training and educational propositions.

6. It is necessary to conceptualise the required skill set for Open Science in the context of current research curricula and in particular **career paths**. Putting Open Science activities on top of the current agenda for researchers will not lead to a sustainable open science system. Instead, it is necessary to create and support new (para-academic) career paths and opportunities based upon supporting these skills.

7. The report is not clear enough about **who should be responsible** for training researchers in Open Science. There should be solutions at European level (eg as part of the F9 programme), national level, and institutional level. We think that research institutions are responsible to educate their researchers and align in each case the training with their institutional mandates and Open Science policies, and those with the funders policies and mandates on Open Science. Coordinated support structures to align the different kinds of expertise needed in Open Science practices need to be developed.

8. Finally, we strongly urge greater **integration** between, at a minimum, the HLEG recommendations regarding skills, EOSC, rewards and metrics. Putting the Open Science agenda on top of what currently is part of the curricula and job descriptions will not work: open science must become co-terminous with good science, and to this end we should strive to integrate it properly to create a coherent system.

Comments of Specific Recommendations

Recommendation 1: Open Science Policy	
In order to mainstream skills for Open Science, such that they are considered an integral component of the regular education, training and career development of researchers (and also other levels of education), the following should happen:	
All ERA policies and, in particular, the ERA partnership within the Open Science Agenda	We agree Policies must be modernised and updated (it is a fact) For example the "Innovative"

should be fully embraced. If necessary, policies must be modernised and updated in order to ensure compatibility with Open Science of certain tools already in place, such as the Charter and Code, the HRS4R and the Innovative Doctoral Training Principles.	doctoral Training Principles (IDTP, from June 2011) must be reviewed and include Open Science, attached to Research Excellence .
A call for proposals should be introduced in the H2020 programme Science with and for Society (SWAFS) to fund RIA and CSA activities on the development of Open Science skills. This includes, but is not limited to, curriculum development, certification, accreditation, standards and qualifications.	We strongly agree, but would extend the list of items given to cover more of the issues we raise above, including fundamental issues of interdisciplinarity, career structures, academic values as well as data management, legal issues related to open science, handling sensitive data, etc. We also feel the risk of duplication and fragmentation in this space should be carefully managed, and that the time scale for SWAFS may be too slow to meet current needs and timelines.
Open Science skills should be an integral part of the Work Programme 2018 – 2020 and also of the next framework programme (FP9) with dedicated actions and funding to support and promote Open Science.	We agree, although how this should be integrated is an important detail, and in any case this must be done with care, so as not to in any way disadvantage researchers or disciplines that have not been widely exposed to Open Science principles as of yet.
European, regional and national funders, as well as private foundations, should mandate that all researchers funded through their programmes have access to Open Science skills training as part of their training and professional development.	We agree, but find this statement far too broad. Specific responsibility must be taken for giving, validating and recognising and skills acquired through OS training. We welcome the encouragement to national, regional and private funders, but such organisations must ensure their coverage is complete, for example covering their HR function as well as their researchers.
Recommendation 2: Guidelines to Implement Open Science At European level, the existing guidelines on research careers and training should be adapted to integrate Open Science, specifically:	
A revised European Framework for Researcher Careers that identifies the specific Open Science skills for researchers at all levels should be implemented.	We agree with all of these individual measures, with the caveat that such measures not become a pressure placed on young researchers only. We would therefore like to also see a line of action added at the level of research institutions, funders and professional organisations to determine how an improved appreciation of Open Science

	can be developed in independent, senior researchers as well. [1]
The HRS4R should integrate Open Science skills as part of researcher career development.	We agree particularly: embedding Open Science in the HRS4R will also help embed Open Science practices. But it must be underlined that the HRS4R happens at institutional level, so the institutions need to train their researchers in Open Science.
A revised version of the Innovative Doctoral Training Principles that integrates Open Science should be adopted.	We agree. As with the EFRC, the IDTP date from 2011, and they do not include Open Science at all. The first principle, for example, "Research excellence" should be "Research excellence in an Open Science ecosystem.
Create a European Qualifications Matrix for Open Science (as described in 4.3 above).	That matrix should be a "standard evaluation framework" for researchers all over EU. A common and standardized definition of such an important instrument will be needed. [2]
Greater coordination across stakeholders providing Open Science Skills training is recommended to combat the issue of fragmentation and possible duplication of such training in Europe.	We agree and would further propose that in addition sharing best practices is required. The fragmentation and duplication of efforts will be avoided if there were a clearer alignment of the EFRC, the IDTP, and the new single European Qualifications Matrix in an Open Science Ecosystem
Given the importance of professional institutional environments for researchers' skills and expertise development, it is recommended that research funding and research performing organisations develop an	We agree, although this is not the best or only mechanism for achieving cultural change. Equal attention must be extended to reward systems, so that research evaluation are done in conformity with Open Science principles.

[1] We particularly support the recommendation of a review of the EFRC: the document from 2011 does not include any aspect of Open Science. We agree upon the envisaged Open Science competencies for each Stage (R1-R4) but at R1 besides information literacy, it should be included also Data literacy. Actually Research Data Management and Research Data infrastructures must be included at all levels (R1-R4). A deep review of the EFRC is needed, including as well "interdisciplinary research" and new ways of scholarly communication and new generation of metrics. It is needed to consider that R4 required skills on Open Science probably need a training from scratch, since senior researchers do science in the old closed science ecosystem..

[2] This document on skills name it as "European Skills and Qualification matrix for Open Science" and the Document on rewards name it as "Career Evaluation Matrix" (CEM for Open Science and also "Open Science Career Assessment Matrix (OS-CAM). It is needed to align: The European Qualifications Matrix for Open Science with The Open Science Career Assessment. The qualifications needed, should be the assessed ones, and all the way round: institutions must train their researchers in the skills that are going to be evaluated for.

integrated Open Science roadmap available to all students, researchers and staff. Such national, regional and institutional Open Science roadmaps are essential in order to address the requirements for the effective practice of Open Science in a coherent way.	One more time, we need a new clear, single European Qualification Matrix that inspires all the training initiatives around Open Science. This matrix will be also used to update the ESCO vocabulary on skills and competences.
As part of this roadmap, we strongly encourage FAIR institutional and/or funding guidelines on Open Science practices be implemented, particularly for Open Access and Open Data.	We agree. Open Data / FAIR research Data and Infrastructures should be included at all career levels (R1-R4).
Recommendation 3: Raising Awareness of Open Science	
In order to equip researchers with the appropriate skills to facilitate Open Science, it is crucial to first promote more awareness of Open Science practices, particularly Open Access, Open Data, Open Education, Open Peer Review and Citizen Science.	We agree, although awareness alone will not be enough, researchers and other systemic actors must also be facilitated to accept OS as their responsibility and a systemic value. It is needed to define concrete actions to "raise awareness." In general, we feel this is the weakest section of the report, and will require further consideration and detail to be useful.
Researchers should be made aware of Open Science policy initiatives such as Open Innovation, Open Science, and Open to the World, the European Open Science Cloud, OpenAIRE, the FOSTER project, and the Open Access Button and Logo.	We agree in part. These are important policy drivers and resources, but not all of them will be equally applicable for all researchers. The communications must be targeted, or the goal of awareness raising could be pushed backwards instead of forward. Initiatives like unpaywall, Impactstory, Publons, will continue to proliferate in the near future. It might be better to recommend: "Researchers should be made aware of Open Science policies, infrastructures and initiatives" as they develop and become accepted by the community.
Researchers should also be made aware of existing institutional and funding agency guidelines as well as existing training and development courses for Open Science.	We agree, transparency in these things is key, even the Open Access policies of publishers are not always shared in a proactive and positive manner. The key issue here is who is responsible to train researchers in Open Science skills? We would recommend that it is more proactive to include the training inside institutions,

Researchers should lastly be made aware of the value of Open Science practices, both at the personal level with respect to career opportunities and professional development, as well as the value of Open Science to society as a whole.	We agree, in principle. If the value is real and widespread, the researchers will move toward it. We need to ensure that there is real, recognised value there.

Recommendation 4: Training Researchers for Open Science
Recognising that there are already developments in Open Science skills provision, future activity must focus on improving the quality and relevance of skills for Open Science. Under this umbrella, the qualification frameworks for Open Science skills may need to be adapted or modernised. To facilitate this, institutions should offer and promote both traditional and/or online career-level appropriate Open Science training courses for researchers:

The OSPP WG notes the infelicity of the implied opposition between Open Science and traditional science. Great care is required to ensure openness can be adopted by researchers without feeling it is antithetical to their traditions.

These courses should be tailored for and delivered to researchers at all career stages (from R1 to R4). All Open Science skills courses should have career level appropriate accreditation and could also be modularised. In the case of R1 and R2 researchers, it should be mandatory for universities and research organisations to offer these as part of their training.	We agree with the importance of engaging at all career stages. It is crucial that the institutions are committed to ECR's training, making the courses mandatory, but we are somewhat suspicious that R4 researchers will engage in formal courses. Also, skills are needed far beyond the researcher cohort, among librarians, research managers and funding agencies.
In order to narrow the Open Science skills gap, researchers will need training and development to acquire and improve the following skills: Skills and expertise necessary for Open Access publishing and utilising Open Access repositories. Skills and expertise regarding Open Data and particularly data management (analysis, use, and reuse of data), metadata, and data dissemination (sharing and granting access to data). Open Science skills enabling professional research conduct which include research management skills, research integrity and ethics skills, and IPR and legal skills.	We agree, although we would like to see OS skills less as their own skillset and more integrated into other research activities. We would also like to see meta-level issues, such as working with shared data and asking widely interdisciplinary questions be included. We also question the completeness of list of skills given, as there could be others (open peer review, open methods, open software…)

Skills and expertise resulting from a general and broad concept of Citizen Science, where researchers interact with the general public (either directly in collaboration projects or indirectly through scholarly communication) to enhance the impact of science, research and innovation in society.	We agree, though the broad use of citizen science could be confusing.

Recommendation 5: Providing Support for Open Science
Training courses are not enough to help researchers do Open Science but must be complemented by adequate support for Open Science. Institutions should:

The OSPP WG notes the exceptional status of these recommendations as aimed at institutions, despite the fact they are largely related to infrastructures and support. The training must be aligned with the required/existing infrastructures in the organization and beyond.

Provide the technical infrastructure for Open Science (high-speed data centres, data repositories and virtual platforms).	We agree, although we also need long-term funding and support for local infrastructure as well as central, such as discipline or collection specific resources. Not all investment can be centralised, and sustainability depends on recognising this.
Provide the technical tools to facilitate researchers in doing Open Science (software for data creation, storage, and sharing).	We agree, but the intellectual tools are harder to develop than the technical tools (and the former should drive the specifications of the latter).
Provide professional support staff for general and specialist support for researchers (data stewards, IT technicians, data scientists, legal experts, discipline specific data managers and librarians).	We strongly agree, this point cannot be made strongly enough. We also need to align these individuals and their careers with relevant rewards and advancement, so as to recruit and maintain valuable people to these roles.
Implement and promote the use of data management plans in all research projects.	We agree, although the requirements will vary among disciplines. Here the responsibility is the funder. At institutional level, it must be stated that the Institution will help to create and accomplish the Data Management Plans required by funding agencies. The institutions might require, through Doctoral Schools, to have a Data Management Plan at thesis level.
Ensure a legal framework is in place for the secure, legal, and ethical sharing of data.	We agree, although the requirements will vary among disciplines and among countries. More than "ensure a legal framework"... at

	institutional level we should require: All institutions should have a Research code or research good practices that ensure a code of conduct at legal and ethical level for the practice of Open Science
6.7. Recommendation 6: Career Development for Open Science The acquisition and practice of Open Science skills should be an integral part of researcher professional training and career development. In this context: *The OSPP WG notes that these recommendations in particular must be aligned with those of the Rewards HLEG report to be meaningful.*	
European and national public and private research funders should recognise and reward Open Science activities as part of grant evaluation criteria. For example, in the Marie Skłodowska Curie Actions, the provision of Open Science skills training should be integrated into the evaluation criteria.	We strongly agree, and would point out that the ERC in particular should be sensitive to this.
In the next framework program (FP9), an action should be developed for Open Science placements for R1 and R2 researchers, either within or separate from the Marie-Skłodowska Curie actions.	We agree
Institutions should lastly recognise and reward Open Science training and Open Science track record in the research and career evaluations of researchers.	We agree, though it is people, not institutions, who make these decisions in the end, and the variation among institutions (eg between research institutions and funding bodies) will drive what is possible and desirable and how. Concrete measures will be needed to instill the value of open science and a component of good science, not a competitor. Finally, training should not be rewarded per se, but instead the good practice of Open Science.

OSPP Working Group Membership: Manuela Epure, Natalia Manola, Jennifer Edmond, John Wood, Michela Vignoli, Kristiina Hormia-Poutanen, Michela Bertero, Sabina Leonelli, Eva Mendez