Vision Paper

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1 Introduction

Science is currently undergoing a transformation, which implies the rethinking of its boundaries and of how it is organised. We are currently at the beginning of a transition phase in which traditional structures, processes, value systems, and means of science communication are brought into question. New strategies and models under the label of "open" are being explored and partly implemented.

The transition from the traditional science system to a more open science is still in the early stages, and in most cases it is not clear which approaches will prove to be successful. The stakeholders (mainly scientists, science institutions, research funders, science publishers, and policy makers) are divided into enthusiastic adopters, attentive observers and those who actively reject the notion of Open Science.

In the current situation, we are facing the discrepancy between a growing necessity and interest in more open, web-based science practices and a lack of reward or approval of Open Science efforts in the system currently in place. Additionally and despite of the growing acceptance of the value of integrating internet and Web 2.0 tools in research, a number of related insecurities remain and need to be addressed (Vignoli et al. [2015]).

It's our belief that Open Science approaches will become - if not a standard - a central element of good scientific practice. However, such fundamental paradigm shifts do not happen over night and some guidance in order to be successfully implemented is needed. To support the transition to a more open science system it is necessary to create a framework for training and supporting Open Science activities. Supporting and preparing the global research community appropriately is a key factor for an organised and targeted transition and will help the science community to embrace and apply Open Science in a near future.

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2 Scenario: Open Science in 2030

2.1 Scenarios

In the same way as the stakeholders of Open Science today are divided into three categories, we can imagine three possible general scenarios regarding the impact of Open Science on the world of science by 2030:

A: Open Science is fully integrated with research practices, institutionalized and even supported by the public authorities.

B: Open Science practices gained participants at the same rate as the corresponding tools provided through the growth of Web 2.0, though the phenomenon did not revolution the world of science as expected.

C: Open Science has not taken off and the world of science still relies on the traditional practices of the last 50 years.

Scenario A is the most ambitious and interesting scenario as it envisages a close future which is significantly different when compared to the present day, and thus, it is the one to be developed in the present publication.

2.2 Impact on the World of Science

By 2030, new communication paradigms based on Web 2.0 platforms, tools and services will be fully implemented and well-adopted by the society. In this scenario the global research community will be more interconnected and used to exchange information via these channels. As a consequence the increased visibility of individual experts from all over the world will help them finding and being found by other experts or managers, and research groups may become more distributed. On research and business networks like ResearchGate[1] or LinkedIn[2] it can already be observed that individuals and companies both successfully use these networks to search for potential employees or collaborators.

Similarly, in science, these and similar networking platforms may help gathering distributed teams of experts independently from their location and, potentially, more projects will be led by consortia consisting of experts distributed all over the world. Thus, as a consequence of the increased use of Web 2.0 networking platforms there may be even more extended cooperative projects than today.

It is foreseeable that more researchers will extensively use online collaborative tools[3] in a near future. This possibility makes the above mentioned scenario even more likely. Web 2.0 platforms and tools may enable distributed teams to communicate and collaborate by means of virtual research environments. Key research workflow steps could be transferred or translated to a virtual environment, where the experts can analyze, discuss, review, etc. the research process and results online. First attempts to create virtual research environments have been done, e.g. by using the MediaWiki software[4]. Other tools and services for

[1] http://www.researchgate.net/

[2] https://www.linkedin.com/

[3] For a current progress report on online collaboration infrastructures in research see Udell [2015].

[4] E.g. the Austrian project Lexicon Leponticum http://www.univie.ac.at/lexlep/wiki/Main_Page

online collaboration are already in use today (e.g. Open Science Framework[5], Genome Compiler[6]. However, in general there is still the necessity to create e-infrastructures adapted to fulfill the needs of scientists. E.g. the European Commission is already funding projects developing such infrastructures[7].

In 15 years, a larger number of studies and best practices of Open Science will be available. Successful approaches to Open Science will become standards and be adapted to specific research fields. For instance, different research workflows may require different documentation standards (e.g. required metadata). The growing implementation of Open Science and related success stories will - hopefully - convince more researchers from different areas to practice Open Science in a near future, which will lead to an increased Open Science community in 2030.

Alternative peer-review systems using the possibilities offered by Web 2.0 features will be more and more developed in the next decades. Similarly to future projects, future Open Peer-Review will involve more and distributed peers, and foster a more (or maybe totally) transparent review process. Current examples of platforms with Open Peer-Review services in place are Libre Liberating Research[8], F1000 Research[9], and PeerJ[10].

A defined set of criteria could reinforce the reliability of both non peer-reviewed and peer-reviewed research results published online, thus increasing trust in and credibility of the sources. To name of a few, we could think of:

- publish the peer-reviewers' comments along with the publication,
- visualize the number of citations,
- enable comments from any viewer,
- enable authors to edit/correct their content after publication,
- make related data sets available,
- link other media published by the same or other author(s) on similar topics.

2.3 Possible Implications for (Young) Researchers

Assuming that Open Science will become more important within the next 15 years, it is crucial for the individual researchers to be aware of its implications and to have the possibility to get an appropriate training for implementing Open Science practices. Once this is given, probably more researchers from different research areas will become active Open Scientists.

We see four key aspects of practicing Open Science on the level of individual researchers: openness, science communication via the Web, interdisciplinarity, and reward.

The transition to Open Science is attached to a cultural change encompassing collective practices, habits, and mindsets by the research communities

[5] https://osf.io/
[6] http://www.genomecompiler.com/
[7] http://ec.europa.eu/programmes/horizon2020/[...]european-research-infrastructures-including-e-infrastructures
[8] http://www.lib-res.org/
[9] http://f1000research.com/
[10] https://peerj.com/

(Vignoli et al. [2015]). Especially the aspect of being more open about one's own research practices and results (e.g. also publishing negative results) is heavily connected to the cultural context of the research communities. Researchers will need to broadly accept the new open approaches before actually practicing them. Another important step in the cultural change lies in the willingness to expose one's work to peers familiar to the topic as well as to a larger public, and receiving comments or critics from both groups.

In terms of communication, next to a more traditional science communication language, which will still be important for journal papers and other scientific publications, researchers will more and more need to contribute to blogs, wikis, etc. This means that individual researchers will need to train their writing and communication skills tailored to the Web 2.0, which encompasses a more popular writing style to reach a larger audience. Publishing beyond traditional channels will also lower the threshold of research maturity before publishing results. This will allow, for instance, to publish unsuccessful approaches or lessons learned from unfinished projects, enabling other researchers to avoid similar mistakes.

Another skill, which will probably be required even more in future, is the ability to communicate between different disciplines. Open Science may boost new interdisciplinary approaches to existing research results and processes. It will become more accessible to build up a network out of one's specific scientific field.

In future, researchers will probably be working in bigger and more distributed teams, and specific tasks may be split between the different experts, thus creating new niches. The high-level communication skills required to communicate research processes and results to a wider public may be left to specifically trained researchers. It can also be foreseen that, to face the variety of communication channels that Open Science will provide, Open Science experts will be available at institutional levels to guide the researchers throughout the research projects.

Another key aspect is getting reward for Open Science achievements. Currently, reward and prestige in terms of academic promotion depend mainly on "quantitative measures used in the evaluation of academic effort" (Kieńć [2014]). To make Open Science work, by 2030 alternative indicators of impact (e.g. Altmetrics[11]) should be included in the assessment of researchers. Without appropriate incentives it will be less appealing for researchers to actually practice Open Science. It should be mentioned that any involvement in Open Science activities (such as blogs or comments, for instance) represents a considerable time investment which, if not accounted in working hours, would not be widely adopted.

3 Conclusion

The sketched scenarios and implications for (young) researchers make clear that some innovative tools and services but also some fundamental changes are needed in order to implement Open Science.

An important requirement for the collaboration of distributed research teams via virtual research environments is the availability of reliable, interoperable tools and services with good usability. The tools should be adapted to the

[11] http://altmetrics.org/manifesto/

requirements and workflows by the research communities of specific research fields. Different research workflows may require different tools (see [Kraker, 2013, p. 47]).

Another requirement next to the tool landscape is, of course, having the required funding programmes enabling the funding of such international, distributed teams.

It is not realistic to expect researchers to be excellent both in scientific communication and in a more high-level communication adapted to the public as both require specialized personnel. Thus the integration of science with Web 2.0 opens up new possibilities for defining curricula and positions for researchers.

The increasing number of researchers [European Commission, 2014, p. 5] will lead to an increased need for researcher posts. Open Science could open up new ways for creating posts for researchers as well as new expert roles. Of course, to support that appropriate education, funding strategies and contracting are needed.

The growing transparency and public communication of science workflows and results may boost the creation of alternative assessment procedures for science work. We hope that by 2030 alternative indicators of impact like Altmetrics will be included in the assessment of researchers. Next to that, we think that it would be crucial to include qualitative measures like peer-review comments/statements in researcher assessment as well.

Finally, it is important that current and future generations of researchers are being trained how to apply and integrate Open Science strategies into their daily research workflows. Trainings for developing and learning the necessary science communication skills as well as strategies for applying Open Science approaches should be included in basic education programmes (e.g. at Universities) and in supplementary courses (e.g. further education programmes for early career and advanced researchers). In the future it will be important to include Open Science training early on in the education of researchers (e.g. see McDowell et al. [2015]). We can foresee that a good practice of Open Science from an early step in a researcher's education will provide a much faster progress in one's career and reputation.

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