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Editorial

The Democratization of Science: Blue Ocean or Chimera?

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Knowledge builds on itself. Scientific progress is achieved through piecewise advances, and is based on the enlightenment of prior evidence and discoveries. Accessing prior information has been a tremendously complex venture for centuries, and restricted to the privileged few. Technological progress and namely, the advent of Internet have opened a world of possibilities, including the instant sharing and diffusion of information. Reaping the full benefits of technological advances has however been prevented by the prerogatives of the publishing industry, which have been increasingly challenged over the last two decades. Major historical milestones include the creation of ArXiv.org, an online repository of electronic preprints in 1991; the launch of SciELO in Brazil in 1997 and its extension to 14 countries; the foundation of PLOS by the Public Library of Science, established as an alternative to traditional publishing and nowadays known as PLOS ONE, which is by far the world's largest series of journals with over 30,000 papers published in 2015; the Budapest Declaration on Open Access in 2002; the campaign Access2Research and the US Fair Access to Science and Technology Research Act, a foundational piece in the establishment of Open Access in the USA; and the initiative of the European Commission to require all research publications funded under Horizon2020 to be openly accessible, free of charge. All these initiatives converged towards the same aim: fostering free and unrestricted access to publications, so as to ensure the widespread and rapid diffusion of research findings within, across and outside scientific communities.

The two original pathways to Open Access (OA), namely the Green and Gold routes, are increasingly complemented and even superseded by the hybrid model. The Green route refers to the online access to peer-reviewed and published papers, usually via a repository and after some embargo while the Gold route entails the immediate, unrestricted online access to peer-reviewed published papers, free of charge for the readers. The hybrid model offers authors in subscription journals the possibility to give free access to their individual articles against a pre-publication fee. Such a model has raised concerns of "double dipping", as payment can occur twice, i.e. through the subscription paid by institutions and the fee paid by individual authors. This model is seen as a potential transition for the publishing industry, and appears to be lucrative for publishers as a recent study by the Research Council UK points out. The review of the

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implementation of the RCUK policy on open access unveils that the average Article Processing Charge (APC) charged by hybrid journals is significantly higher than the APC charged by fully open access journals, stressing the double dipping concern as hybrid journals still benefit from a stable revenue stream from subscriptions. This study further reveals that the expenditures of a sample of 20 Higher Education Institutes in the UK, trebled between 2013 and 2014, both in terms of APC spending and in terms of absolute number of articles subject to a publication fee. Concomitantly, expenditures for subscription increased. These numbers reveal an increased compliance with the open access policies applicable to publicly funded research, which is certainly laudable. Yet, in times of tightened public funding for research, the question of the efficient use of resources should be raised and a cost-benefit analysis of adopting the hybrid model might bring stimulating insights to shape future publication strategies.

In parallel, numerous repositories and platforms have emerged, offering typical social media features: following peers and being followed, tracking updates, sharing questions, documents, providing feedbacks, etc. Beyond the digital storage functions, these profitable private ventures also provide data analytics and compute, relying on proprietary algorithms, impact metrics and represent a core component of the new ecosystem for researchers, as individuals, for organizations and for the promotion of research findings. The convergence between this segment of the social media industry and the publishing firms, and the subsequent acquisitions, is self-explanatory and raises the question of the attainability of the strategic intent of free dissemination of knowledge, as new business models flourish. Are we shifting from subscriptions-based journals to access and disseminate knowledge to a subscription-fee for a social media network membership?

The growing awareness towards open access publication strategies is also exemplified by the development of tools to monitor the penetration of and compliance to OA policies. The Registry of Open Access Repository Mandates and Policies (ROARMAP), which defines itself as "a searchable international registry charting the growth of open access mandates and policies adopted by universities, research institutions and research funders that require or request their researchers to provide open access to their peer-reviewed research article output by depositing it in an open access repository" (ROARMAP website), nowadays records about 800 mandates and provides interesting visualization tools showing the policy alignment to H2020 of individual institutions and countries. The European Commission reports that 54% of all scientific peer-reviewed publications produced during the lifetime of FP7 are open access and estimates that the target of 60%, set to be achieved in 2016, is well underway (DG Research and Innovation). The proportion of papers downloadable for free reaches 76% in Brazil, and 70% Switzerland, while these numbers revolve around 65% in the USA and Canada. As reported by Archambault et al., out of 4.6 million scientific papers from peer-reviewed journals indexed in Scopus during 2011-2013, 2.5 million were available for free in April 2014. Significant disparities across fields exist, with clinical medicine, biomedical research, physics and astronomy taking the leading positions (Archambault et al., 2014). Another noteworthy finding of this study is the huge citation advantage to publishing in Green OA, as opposed to the citation disadvantage on average for almost all fields for the Gold OA model.

From the broader perspective of the entire lifecycle of research, OA publication is

providing answers to the dissemination of scientific findings, and is thus focusing exclusively on the outcome phase of the research process. OA publication is undeniably essential to foster faster diffusion and re-use of scientific results, yet facilitating the stepwise, incremental process of generating new knowledge requires more: Open Data and Open Research Data. Over the last few years, open data initiatives have been flourishing, with the launch of open data portals such as the European Open Data Portal (https://data.europa.eu/euodp/en/data) embracing datasets on topics ranging from employment and working conditions to agriculture, forestry and fisheries; the opendata.swiss portal records almost 1200 open datasets, the US data.gov portal offers access to almost 200,000 datasets, and the Queensland University of Technology promotes the Research Data Finder, which provides descriptions about shareable, reusable datasets available via open or mediated access (https://researchdatafinder.qut.edu.au/).

Opening up *research* data to wider exploitation, mining, dissemination and reuse is the new frontier. The benefits of Open *research* data are multifold: reproducibility and replicability of research, acceleration of the pace of discovery, catalyst for cooperation, multi-stakeholder involvement, avoidance of duplication efforts, fraud prevention and integrity, to name a few.

Open research data has been progressively introduced as a requirement under the H2020 funding scheme, with the ultimate goal of achieving FAIR (findable, accessible, interoperable and re-suable) data sharing as the default for scientific research by 2020. An ongoing pilot initiative under H2020 showed a lower adhesion level to open research data than to OA publication, with 65% of projects in the selected thematic areas opting-in (DG Research and Innovation). Open research data is also opening up a wealth of opportunities: the formalization of new skills and expertise, and the emergence of professional "Core data experts" as coined by Mons et al. in the report "A cloud on the 2020 Horizon" (2016), the development of new service offerings for professional open data management plans, new business ventures combining extensive data mining capabilities and content provider as illustrated by the recent partnership between IBM Watson and PLOS. Such partnerships are certainly desirable, and should be fostered as long as they do not jeopardize academic freedom and restrict research exclusively to profitable ventures. Open research data is also perceived as a means to foster citizen engagement and facilitate science- and evidence-based policy making.

Moving further upstream of the research process, Research Ideas and Outcomes, also known as RIO, was launched in September 2015 and aims to publish proposals, experimental designs, data and software, thus covering "research from all stages of the research cycle" (Nature, 2015). Sharing experiences and publishing information about research failures may now be the next frontier.

Open Access and Open Research Data constitute two cornerstones of Open Science. As a key element of the Digital Single Market strategy in Europe, Open Science is defined as "the transformation, opening up and democratization of science and research through ICT, with the objective of making science more efficient, transparent and interdisciplinary, of changing the interaction between science and society, and of enabling broader societal impact and innovation" (European Commission). In "Reinventing Discovery: the New Era of Networked Science", Nielsen depicts Open Science as "the idea that scientific knowledge of all kinds should be openly shared as

early as is practical in the discovery process". While Open Science has undeniable benefits for society, it entails a paradigm shift in the way research is conducted, researchers collaborate and knowledge is disseminated. It also requires revisiting the traditional evaluation and appraisal models, departing from the metrics currently used for assessing candidates for funding, appointment and tenure, as well as the performance of institutions themselves.

The democratization of science will hardly be ubiquitous as long as individualistic appraisal models and proprietary-based publishing metrics prevail. The definition and progressive adoption of Altmetrics, and more globally of responsible metrics, as well as the reshaping of incentives and rewards mechanisms should support the transformation towards Open Science. In the long run, we argue that Open Science, and its underlying practices of OA and Open Research, will blossom conditional upon their ability to build *credibility*, to perform *selectivity*, to guarantee *autonomy*, to benefit from *interconnectedness* and to achieve societal *impact*. Credibility will be gained through the application of stricter, more rigorous, and positively discriminating mechanisms and systems. DOAJ recently delisted some 3,300 titles from questionable and inactive publishers, as part of its effort to tighten its standards for inclusion, is a noteworthy development in building OA legitimacy and credibility (Nature, 2016). In an era of plethoric amount of information, selectivity is key. Yet, selectivity should not imply following a closed club rules, and should be exclusively assessed based on the merits of the proposed content, in terms of originality, novelty, and rigor. Autonomy is an essential prerequisite to perform unbiased research, driven by intellectual curiosity and cross-fertilization of ideas, and is a value that should always be nurtured. Interconnectedness is part of our daily lives, with its benefits and its pitfalls. Sharing feelings, perceptions and emotions at the very moment these are experienced is now commonplace, and will inevitably further influence the way research is performed. Building on technological capabilities, research ideas can benefit from instant confrontation with a broad audience. Generating a sustainable impact should be the target of every research initiative, whether the intended impact is in the foreseeable future or pertains to the longer term.

The Journal of Innovation Management constantly embeds these criteria in its development and in its operations. Credibility is built through a rigorous peer-review process conducted by a large multidisciplinary panel of associate editors and editorial board members, to whom, along with all reviewers, we would like to address our sincere and deep gratitude. Selectivity is achieved through the implementation of quality criteria, and their appreciation with regards to different fields, areas, and domains of applications. Autonomy is secured through independence, both intellectually and financially. The use of social networks to promote our publications spurs fast, wide dissemination and interconnectedness. Impact is reflected in the latest statistics, accessible on our website, and through the increasing penetration of the Journal of Innovation Management in different academic, industrial and policy spheres. Striving for Open Science to deliver its best and flourish for the greater benefits of society, we wish you a rewarding and fruitful reading of this Summer Issue.

Innovatively Yours,
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Editors

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