The Future is Open:
Evolution of Scholarly Research in the Information Age

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F1000

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“ By encouraging science to be more connected to societal needs and by promoting equal opportunities for all (scientists, policy-makers and citizens), Open Science can be a true game changer in bridging the science, technology and innovation gaps between and within countries and fulfilling the human right to science.”
UNESCO

What is Open Science?

Open Science is, in essence, about returning to the "core values" of science, which date back to the very first scientific journals in the 1600s. In those early days, it was deemed essential that all the elements of a scientific discovery should be published and questioning, so that results could be repeated and validated.

In today's context, Open Science broadly means maximising the dissemination of knowledge via research workflows and communication channels that are more transparent and collaborative. It encompasses the free availability of content, data and software.

Open Access (OA) is the process of making content freely and openly available, with clear licensing that enables reuse. The different types include:

- **Gold OA** – articles are freely available immediately on a journal's website, and may be shared and re-used under license
- **Green OA** – articles published in a subscription journal are also self-archived in a repository, and may be made freely available by the publisher after an embargo period
- **Hybrid OA** – articles published in a subscription journal but available freely

Why Open Science?

In the digital age, Open Science is even more pertinent. Scientific research depends more and more heavily on the sharing and understanding of not only text, but also data, opening the doors to further advances. As a result, the Open Science movement is gaining momentum. The work of researchers and funders around the world is becoming increasingly aligned with fully reproducible science which is freely accessible to all.

> *"I would say the pandemic has really accelerated these Open Science trends."*
> **Robert Kruse**

For research professionals, Open Science, and the ability to publish Open Access, increases the impact of their work and enhances opportunities to advance their careers.

- OA allows them to publish their work more quickly, which is a great advantage when it comes to grant applications and promotions.
- It increases usage – many studies have shown that open access articles are more widely viewed and cited[2]. According to a recent international survey of early career researchers, increased visibility and bigger/wider audiences are the strongest draw to Open Access publishing.[3]
- There are many articles published proving the link between social media and career advancement for researchers. Being able to show who has read or shared your articles helps at the promotion committee.[4]
- With no paywall, increased visibility facilitates collaboration, and builds connections between researchers and institutions, even across disciplines. This openness increases competitive advantage, as it's possible to locate potential collaborators and competitors with greater ease.

Based on contributions to the webinar **Open Science Trends: Opportunities for Research Development & Innovation**, February 24th 2021.

Dr. Kimberly Eck

Dr. Kimberly Eck is President of the National Organisation of Research Development Professionals (NORDP). She is Associate Vice President for Research at Emory University, where she helps develop and implement university-wide strategies to advance the research enterprise. She earned her PhD in Epidemiology at SUNY University at Albany.

Dr. Robert Kruse

Dr. Robert Kruse is a physician scientist at Johns Hopkins University School of Medicine, in the Department of Pathology. He gained his MD and PhD at Baylor College of Medicine.

Dr. Brad Fenwick

Dr. Brad Fenwick (1955-2021) was the Senior Vice President of Open Science and Innovation at Taylor & Francis Group, the parent company of F1000. Dr. Fenwick was an award-winning scientist and leader in science policy globally. He held degrees in Veterinary Medicine, Pathology and Comparative Pathology.

Jamie Burns

Jamie Burns is a Senior Research Analyst on the Competitive Intelligence (CI) team within Research Development at Arizona State University (ASU). She gained her Master's in Public Administration from Columbia University, and is a certified NCI from the Strategic and Competitive Intelligence Professional Organization.

" It [Open Science] builds more connections that are unexpected."
Robert Kruse

" We can really help our faculty by knowing in depth who's conducting research on a particular topic."
Jamie Burns

- Sharing the data and methods - the whole process - behind the research is a further demonstration of a researcher's capabilities and calibre.

  " We all know that if you're going to be successful in winning proposals, you need to have preliminary data."
  Jamie Burns

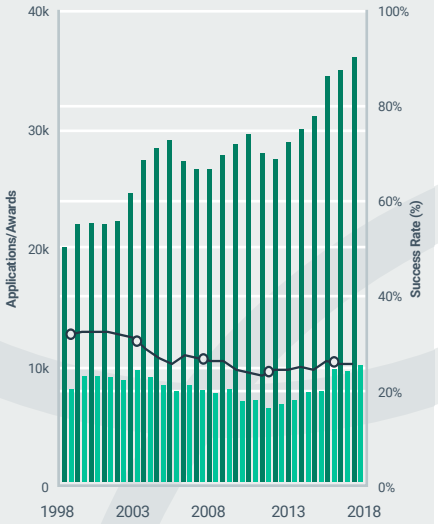
- In the US, researchers increasingly value OA publishing as a superior mechanism for disseminating research findings, even if they're not entirely aware of how to do so. In a recent survey of faculty and doctoral students at a high research output (R2) institution in the US, researchers found that a large majority of respondents – 76% – agreed that publishing their work Open Access would benefit readers interested in their work and as many as 75% agreed or agreed strongly that their research should be made freely available to audiences.[5]

Research Funding in the United States – How it Works

Academic research is both publicly- and privately-funded.

- The federal government is by far the largest source of research funding in the US, providing 53% of total research funds, over $42 billion, in 2018. Academic institutions funded more than a quarter of academic research, along with non-profit organizations, industry, and state and local governments.
- More than 90% of this federal support comes from six agencies - the Department of Health and Human Services (HHS), the Department of Defense, the National Science Foundation (NSF) funded 13% at $5.3 billion, the Department of Energy (DOE), the National Aeronautics and Space Administration (NASA), and the Department of Agriculture (USDA).[5]
- One of the US government's largest sources of academic research funding is the NIH, which funds over $40 billion annually in medical research.[6]
- The Howard Hughes Medical Institute (HHMI), the US's second wealthiest philanthropic organization, has a $22.6 billion endowment, awarding grants of about $825 million for biomedical research and science education every year.[7]

Open Science: Why it matters now



R01 – Equivalent Grants: Competing Applications, Awards, and Success Rates[1]
NIH Data Book Report ID: 29
Applications Awards Success Rate (%)

Science has never before been so competitive. In the US alone, there has been a steadily rising uptick in the number of research applications going to federal agencies. In this context of increasing competition, Open Science is a potential game changer, enabling researchers and institutions to distinguish themselves and their research to funders.

For more information on how **F1000** publishing solutions can support your institution, contact partnerships@f1000.com or visit think.f1000.com/f1000-gateways

Policy leads the way

- Open Science is a policy priority for the European Commission and the standard method of working under its research and innovation funding programmes, as it improves the quality, efficiency and responsiveness of research.
- From 2021, Plan S, launched by cOAlition S, an international consortium of research funding and performing organisations, requires scientific publications resulting from research funded by public grants to be published in compliant Open Access journals or platforms.
- As President Biden commits to restoring leading scientists, as well as science-policy and science-diplomacy specialists, to positions of responsibility and influence[8], the US is now considering a national Open Access policy.[9]

The increasing adoption of Open Science by research organizations and funders

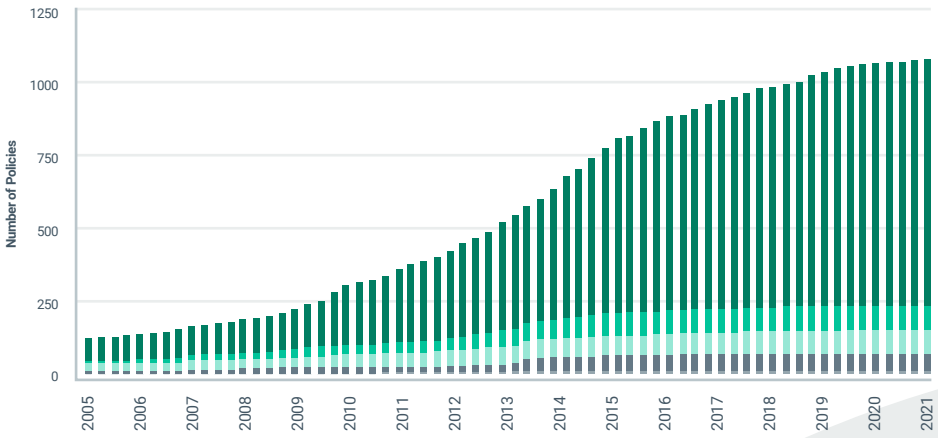


Figure 1: Policies Adopted by Quater [10]

Research organisation | Funder | Sub-unit of research organisation | Funder and research organisation | Multiple research organisations

As highly influential stakeholders in the research ecosystem, large private and public funders are increasingly requiring funded research to be made openly available for public consumption after publication.[11]

- As of 2022, HHMI will mandate that research funded from its grants be published open access.[12]
- Since 2016, it has been a requirement that information from NIH-funded clinical trials be made publicly available.[13]
- UNESCO's 2021 draft Recommendation on Open Science aims to build a coherent global vision of Open Science and a shared set of overarching principles and shared values.
- Research funders signed up to Plan S include the WHO, the Bill & Melinda Gates Foundation, and the Wellcome Trust.

Open Science: The Evolution

1990s
The Serials Crisis

1991
Archives for preprints launches – arXiv.org

2000
First OA publisher, BioMedCentral, launches

2002/3
Budapest Open Access Initiative and Berlin Declaration on Open Access

2003
First native OA journal – PLOS

2005
Wellcome Trust mandates depositing Wellcome-funded research with PubMedCentral

2012
UK Finch Report recommends Gold OA for publicly-funded research

2015
Gates Foundation mandates Gold OA

2016
NIH mandates OA for its research funding

2016
Wellcome Trust launches F1000 Platform

2017
Gates Foundation launches F1000 Platform

2018
Plan S launches, supported by European cOAlition S research funders and performers

2019
Transformative agreements - read and publish/publish and read agreements

2022
Howard Hughes OA mandate comes into effect

Global adoption of Open Science

Open Science has dramatically increased over the past few decades. Figures from 2016 show that the UK published the greatest proportion of its research output OA – over 52%. This has doubled since 2000, a pattern seen across most of the world.

The US consistently leads contributions to global OA output, at nearly 18% of global OA output.

Figure 2: Digital Science, 'The Ascent of Open Access', 2019[14]

The value of new metrics in OS

> *" A big trend is the desire to promote people based on metrics other than the name of the journal, or the impact factor of the journal. If you show page views, tweets, retweets - these are the new types of metrics to track Open Science. Ultimately it leads to more engagement with collaborators, and then a greater contribution to overall science. And it can help you get more grant money, which is what we all want to help our research."* **Robert Kruse**

Open Science and the power of social media

Social media, although still unfamiliar territory to some researchers, is an invaluable tool. Knowing how to write about their work and engage with the scientific community raises researchers' profiles, and training in this area should be a priority. This greater visibility gives them an advantage with grant committees and can ultimately help them win grants.

> *" There's still a gap in researchers' knowledge on how to leverage the power of social media… you're selling yourself and your brand, in addition to selling your science, and that's certainly not a skill many faculty have."*
> **Robert Kruse**

> *" A lot of people would do what's called a tweet-orial. They'll do a thread of 5 or 6 posts where they explain the gist of their paper, and they'll have screenshots of the important figures. It definitely helps share work… the average person's not going on PubMed to find something, so it helps engagement, and presentation. And even now, a lot of journals require images as abstracts, and those can be easily shared and people can see them."*
> **Brad Fenwick**

Funders and Open Science – the Driving Force

Funders are increasingly mandating that the output of publicly-funded research be made freely available on completion. Open Science is opening up the channels of communication in unforeseen ways. With research openly accessible online, funders are able to see what is being shared, and track expertise. As a result, it's now possible for funders to skip traditional processes and approach authors directly.

> *" I think funders will take on the challenge of reaching out and funding somebody directly, as I was able to do as a chief scientist, saying "You're doing great work, we've kept an eye on you. We need some progress in this area, are you willing to undertake that?"*
> **Brad Fenwick**

> *" I was once getting off stage after giving a presentation, and this person walks up and asks me "Have you ever had enough money to support your research?" The answer, of course, was "No, but I'm going to write a grant". And then he said, "I don't want you to spend your time writing a grant. I want you to spend your time doing research. I'll give you the money."*
> **Brad Fenwick**

The Future of the Research Ecosystem

Valuing research content over journal reputation: paper metrics vs journal impact factors

With the advent of paper-specific metrics, many in the scientific community hope that the value of publishing in an individual journal will erode – **it's not where you publish, it's what you publish**. The paper itself is the unit of recognition, and the metrics supporting that will become increasingly important. Usage and downloads are becoming the dominant criteria because it reflects the public consumption of science. Impact is the next pillar when it comes to getting funding, and is already starting to speed up the funding process.

> *" There will always be a very small number of individuals who will make the effort to cite your work, but there may be literally tens of thousands of people and organizations that will consume your research and it will have an impact on their lives."*
> **Brad Fenwick**

Open peer review

Increasingly, journals are starting to offer open peer review, including BMJ, BMC, Royal Society Open Science, Nature Communications, eLife, and the PLOS journals. Openness and transparency would improve the quality of reviews, but first the community must overcome the politics involved in being on record for criticizing someone else's work.

Routes to funding

With the opportunities offered by Open Science, funders are already taking on the challenge of reaching out and funding researchers directly. According to Dr Brad Fenwick, there's a growing trend of "we're speeding up scientists", with funding bodies speeding up their decision-making and their distribution of resources to keep up. This would not be possible without the metrics and transparency available as a result of more open communication channels.

It's all about collaboration

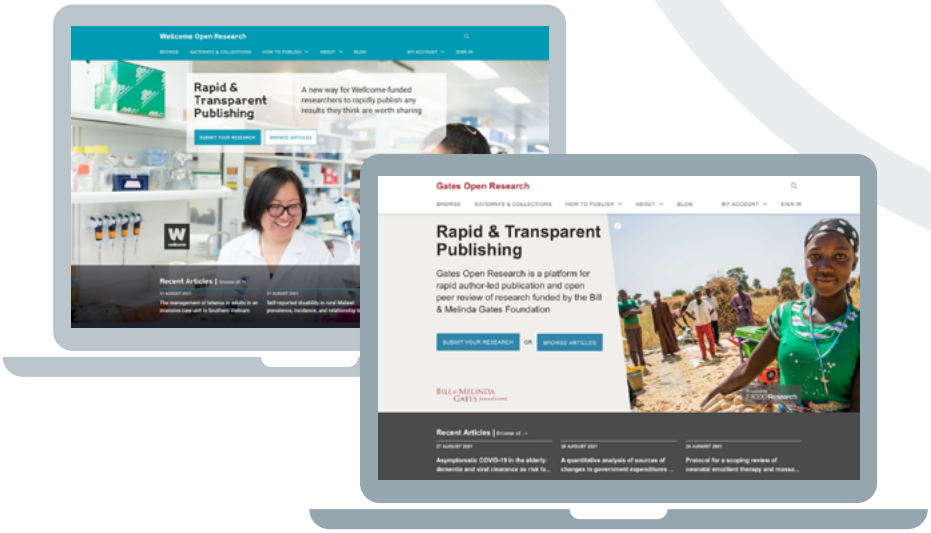
This more open world enables collaboration with other researchers around the world who would previously have remained unknown. Cold connections warm up very quickly if there's science to be done which is difficult to do on one's own.

Open Science also offers a way forward with interdisciplinary collaboration, which institutions find hard to value, reward or incentivize. The increased transparency makes it possible to determine exactly what individuals contribute personally to multi-disciplinary work.

> *" I work on the competitive intelligence team at ASU. What Open Science really allows us research development professionals to do is scan the landscape of research and get a very in-depth view of what's going on. We can help our researchers identify collaborators, and as funding is very competitive, we can identify who the competitors are as well. We look at where we have strengths at ASU, or is there opportunity for growth based on what's happening, what research areas are growing? With Open Science we can help our faculty and institution be really strategic. It broadens the number of possible collaborators and our positioning – it really just opens up a realm of possibilities."*
>
> **Jamie Burns**

F1000 and the role of Open Science

In an ideal world, researchers would want to publish fast, openly, and without restrictions. F1000Research is a beyond OA Open Research publishing platform for scientists, scholars and clinicians aiming to achieve just that – the rapid and citable publication of articles and other research outputs without editorial bias.



Like an online journal, but a more robust publishing solution, F1000 offers white-labeled end-to-end publishing solutions to research institutions, funding organisations and societies such as the Wellcome Trust, the Gates Foundation and the European Commission. F1000 Platforms feature low-cost Article Processing Charges (APCs), a simple, one-page submission processes and transparent post-publication peer review. F1000 also elevates the status and discovery of other research outputs, including data sets, posters and related materials.

Aligning with the shift towards Open Science, an F1000 Platform maximizes the potential for the use and reuse of research by:

- Accelerating access, reach and impact
- Enabling reproducibility and reducing research waste, an important issue for funders
- Supporting early career researchers, and allowing them to share their work easily
- Employing responsible, comprehensive article-based metrics

F1000 Gateways are dedicated, branded hubs on the F1000Research platform for institutions to showcase their researchers' publication outputs with immediate discoverability through F1000Research.

F1000 Platforms are fully independent and customized open research publishing outlets, allowing an institution's researchers to publish a wide range of article types and other research-related outputs openly and rapidly using the F1000Research infrastructure and editorial services.

> *" I was lucky to publish on the F1000R platform early on during the pandemic. Among the many reasons I chose it was the fact that it would be the fastest way to get online and share my research. With the traditional process, it's online maybe 8 or even 12 months later, which is not feasible for researchers and their careers, and certainly not feasible in a pandemic setting. With F1000 it's much faster. You put your paper up and you can actually read the peer review as it happens on the website, and respond and update your manuscript live. Once it's accepted it's automatically uploaded onto PubMed."*
> **Robert Kruse**

Open Science – the Future Journey

The most important factor in accelerating the shift towards Open Science is talking about it, and bringing these conversations back to our institutions. The status quo needs to be challenged, and research development professionals are ideally positioned to highlight the benefits for institutions and society as a whole.

> *" Clearly there needs to be a culture change. If you reward people based on being published in a specific journal, then they will aim for that. We need to break the system, with direct funding, because right now people on the grant panels are basing their decisions on these old metrics. So if you have funders, particularly non-profits outside the NIH system, the NCI or the NSF, they will value these other metrics better and the field will shift."*
> **Robert Kruse**

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In memory of BRAD FENWICK

1955 –2021