Pubfair

A Framework for Sustainable, Distributed, Open Science Publishing Services

Tony Ross-Hellauer, Benedikt Fecher, Kathleen Shearer, and Eloy Rodrigues

Abstract

Over the last thirty years, digitally-networked technologies have disrupted traditional media, turning business models on their head and changing the conditions for the creation, packaging and distribution of content. Yet, scholarly communication still looks remarkably as it did in the pre-digital age. The primary unit of dissemination remains the research article (or book in some disciplines), and today's articles still bear a remarkable resemblance to those that populated the pages of Oldenburg's *Philosophical Transactions* 350 years ago. In an age of such disruptive innovation, it is striking how little digital technologies have impacted scholarly publishing; and this is also somewhat ironic, since the Web was developed by scientists for research purposes.

Pubfair is a conceptual model for a modular open source publishing framework which builds upon a distributed network of repositories to enable the dissemination and quality-control of a range of research outputs including publications, data, and more. Pubfair aims to introduce significant innovation into scholarly publishing. It enables different stakeholders (funders, institutions, scholarly societies, individuals scientists) to access a suite of functionalities to create their own dissemination channels, with built in open review and transparent processes. The model minimizes publishing costs while maintaining academic standards by connecting communities with iterative publishing services linked to their preferred repository. Such a publishing environment has the capacity to transform the scholarly communication system, making it more research-centric, dissemination-oriented and open to and supportive of innovation, while also collectively managed by the scholarly community.

1. Introduction

Scholarly knowledge comes in a variety of formats beyond the article or monograph (e.g. datasets, software, protocols, "grey literature") and all these formats hold the potential to spark new discoveries. As knowledge is continuously evolving (and at an unprecedented rate) and in an age where immediate dissemination via the Web is possible, the concept of a "publication" as a discrete output that follows the completion of research work can be challenged. At the same time, much potential remains to innovate around the traditional article itself; to think beyond the PDF-paradigm and leverage, for example, incremental publishing, live data and interactive figures. The journal format, too, could be reimagined: moving, for example, towards a publish-then-filter model where personalised "playlists" of content (research outputs) are dynamically curated, evaluated and shared by researchers.

This whitepaper outlines a conceptual model for a distributed, international scholarly communication framework, called Pubfair. Pubfair is an open publishing framework, which enriches a variety of research outputs (including preprints, data and software), managed by repositories, with a layer of services that support quality assurance, dissemination and discovery. Pubfair is envisioned as providing fit-for-purpose and sustainable publishing services that enable sharing of a wide array of research outputs, support trusted evaluation and assessment processes, and empower a range of actors (e.g. research communities, funders, institutions, scholarly societies) to create novel dissemination channels for accessing diverse outputs (e. g., articles, data, software). It allows researchers to move more seamlessly from data collection, storage and analysis to publication, quality assurance and dissemination.

The Pubfair concept builds upon and expands major elements of COAR's vision for Next Generation Repositories[1], creating greater interoperability and integration of scholarly communication and data infrastructures. This model was first conceived by a group of European partners through the development of a proposal for an EC-funded project in late 2018 to the call, INFRAEOSC-02-2019 (that was not funded). The model proposes a number of value added services, including assessment, peer review and discovery, on top of a variety of research products managed collectively through the international network of thousands of repositories. It is envisioned that the Pubfair framework contributes to incentivizing researchers to share a broader range of research outputs, and because the Pubfair framework is distributed across many institutions and communities, it could be a more inclusive and sustainable approach to scholarly communication in which the costs of publishing are shared widely.

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[1] COAR (2017). Next Generation Repositories Recommendations
https://www.coar-repositories.org/activities/advocacy-leadership/working-group-next-generation-repositories/

2. Background

The Pubfair concept builds on the idea to overlay publishing functionalities on repositories or preprint servers. The arXiv repository (https://arxiv.org/) has facilitated the early electronic sharing of working papers in Physics (and later other domains including Mathematics and Computer Science) since 1991. As early as 1994, arXiv's creator, Alan Ginsparg, saw the potential for such preprint servers to disrupt scholarly communications, imagining "a relatively complete raw archive unfettered by any unnecessary delays in availability", on top of which "[a]ny type of information could be overlayed … and maintained by any third parties", including tools for validation, filtering and communication (Ginsparg, 1994). In 1997, Ginsparg foresaw organisations like scholarly societies curating "high-quality peer-reviewed overlays" in place of journals (Ginsparg, 1997). Ginsparg's vision of a distributed ecosystem of de-coupled publishing services was given further elaboration in the original call for interest in what would become the *Open Archives initiative* (OAi, http://www.openarchives.org/), whose initial aim was to provide a forum for repositories and preprint servers to define the technical and social specifications for an open scholarly publication framework which would form "the fundamental and free layer of scholarly information, above which both free and commercial services could flourish" (Ginsparg et al., 1999). OAi achieved success in providing community-led solutions for specific elements of repository interoperability, particularly through its Protocol for Metadata Harvesting (OAI-PMH) and Object Reuse and Exchange (OAI-ORE) standards.

Since then, there have been many proposals for how such an ecosystem could function (Boldt, 2010; Fecher et al., 2017a, 2017b; Perakakis et al., 2010; Priem and Hemminger, 2012; Ross-Hellauer and Fecher, 2017; Smith, 2000, 1999; Van de Sompel et al., 2004; Wang and Zhan, 2019), as well as the creation of individual overlay journals (e.g., the journal Discrete Analysis by field medal winner Tim Gowers) and some limited prototyping of wider overlay systems, including the RIOJA project (Moyle and Lewis, 2008). However, Ginsparg's original vision of a flourishing wider ecosystem of publishing services based on preprint servers and repositories has remains largely unrealised. Such services have yet to become a mainstream alternative to journal publication, and no widely adopted protocols or platforms for overlay services have been developed.

Several converging factors suggesting that now is the time to pursue this vision:

- **Dysfunctionality of the publishing system:** There are a number of well recognized problems with the current system of scholarly publishing. These include, but are not limited to, a lack of transparency in peer review, quality issues/retractions, western biases, long lag times from submission to publication, etc. The current reward structures, which incentivize researchers to publish in traditional publishing venues and high impact factor journals, perpetuate these problems and greatly stifle innovation in scholarly communications.
- **Increasing vendor control of scholarly publishing:** In an economic sense, the prices for both subscriptions and APCs continue to rise at rates far exceeding inflation (Bosch et al., 2019; Khoo, 2019). In addition, there is very little transparency in the pricing of scholarly journals because many publishers require organizations to sign non-disclosure clause. Given the publishing infrastructure of the Internet, there are many questions regarding the legitimacy of the costs that publishers charge for their

products (Stern, 2017). This is in large part related to the oligopolistic control of the market by a few large commercial publishers, in which the top five publishers control over 50% of the market and above 70% in some disciplines, have profit margins in the order of 28-38.9% (Lariviere et.al. 2015). At the same time, in seeking to diversify their portfolios, large publishers are acquiring other services and tools across the scholarly communication lifecycle, provoking fears of a new kind of vendor lock-in where services are bundled or otherwise made selectively interoperable (Posada and Chen, 2018; Schonfeld, 2018).

- **Rise of preprints:** In recent years, there has been significant growth in interest regarding preprints. The arXiv, established in 1991, is by far the most used preprint server (for physics, mathematics, computer science, quantitative biology, quantitative finance, and statistics). Although not as central to their disciplines, other preprint servers have begun to appear, such as bioRxiv (life sciences - since 2013), ChemRxiv (chemistry - since 2017), Earth and Space Science Open Archive (ESSOAr – since 2017) and so on, as well as cross-disciplinary repositories for preprints such as PeerJ Preprints, Zenodo, and Preprints (a multidisciplinary preprint server subsidized by MDPI). This growing interest in sharing preprints by the research community, creates the potential of adding layers of peer review and publishing services on top of that content (Eisen, 2018; Ginsparg, 2016; Gowers, 2015; Hindle and Saderi, 2018; Pulverer, 2018; Ross-Hellauer, 2017; Stern and O'Shea, 2019; Tennant, 2018; Tennant et al., 2017).

- **Policy drivers for open science:** The trend towards openness continues to gain strength, and governments and research funding organizations have adopted a proactive stance seeking to steer and support their funded researchers to follow these practices. Open access to publications is now a mainstream requirement in many countries and open science, broadening sharing beyond publications, has also become an important policy driver. This reflects a growing recognition of the benefits of sharing research outputs including publications, research data, code, and other objects. Doing so fosters reproducibility and verification of research results, as well as integration and re-use of content for new discoveries or applications of knowledge.

- **Promotion of the knowledge commons, and academy-owned infrastructure:** In part as a response to concerns over costs and commercial interests, the last few years have seen a growth in discussions related to community-based approaches to scholarly communications infrastructure. In 2017, the FORCE11 Scholarly Commons Working Group published its principles for the scholarly commons identifying the need for common agreement via practices, global commitment to sustainability, openness by default, and freedom for all to participate (FORCE11 Scholarly Commons Working Group, 2017). Similarly, the Next Generation Repository report called for a distributed governance for scholarly resources, without which a small number of actors gain too much control and can establish quasi-monopolistic position (COAR, 2017). And more recently, the report of the EC's Expert Group on the Future of Scholarly Publishing and Scholarly Communication (European Commission, 2019) specified the need for scholarly communication to "rest on a distributed infrastructure based on open standards to ensure access and interoperability". In a similar vein, Stern and O'Shea have proposed a "publish first, curate second" approach where "authors decide when and what to publish; peer review reports are published, either anonymously or with attribution; and curation occurs after publication" (Stern and O'Shea, 2019), while Brembs has made a call for a "modern information infrastructure that is governed by

> scholars … [which] would allow renewed focus on scientific reliability, with improved sort, filter, and discovery functionalities, at massive cost savings" (Brembs, 2019).

Taken together, these trends present us with an opportune moment to reimagine the scholarly communication system. While there have been many statements, principles, and piecemeal investments over the past decade, these activities have not yet had a significant impact on the traditional concept of scholarly publishing, in large part because they address the needs of only one single community, or do not have sufficient enough scale to change the current system. What has been missing from these efforts is a shared vision around which all stakeholder communities can coalesce, and overarching architecture that defines an international framework for scholarly communication.

To that end, we propose here a conceptual model for a distributed, international, community-based ecosystem that builds on existing infrastructure investments, called Pubfair.

COAR Confederation of
Open Access Repositories

3. Pubfair overview, aims and objectives

Pubfair is an open, modular, publishing framework which enables submission, quality assessment, and access to a variety of research outputs, with the added functionality of enabling users to create dissemination channels for various stakeholder groups (see figure 1). Pubfair's unique distributed and modular approach to scholarly communication facilitates greater online sharing and collaboration, while also supporting transparency and confidence in the research outputs disseminated through the services.

Pubfair builds on the Next Generation Repositories (NGR) vision, presented by COAR. In 2017, a working group of technical experts experts convened by COAR, published their vision for 21st century repositories. In articulating this vision, the group endorsed the original OAi aspiration, and extended it as follows: "To position repositories as the foundation for a distributed, globally networked infrastructure for scholarly communication, on top of which layers of value added services can be deployed, thereby transforming the system, making it more research-centric, open to and supportive of innovation, while also collectively managed by the scholarly community." The NGR vision promotes new technologies which support, machine-friendly, resource-centric, networked repositories that manage access to diverse research outputs, making resources the focus of services. It specifies new behaviours, as well as the specific technologies, standards and protocols that enable repositories to serve as the basis for added-value publishing services, including social networking, peer review, notifications, and usage assessment (COAR, 2017).

Pubfair envisions novel services for review, dissemination and assessment of all repository-hosted research objects through development of an open source software that supports added-value publishing and review services, and enables a range of different users to develop and curate personalized channels related to their interests.

Specifically, the **aims** of Pubfair are:

- **Innovation:** Pubfair facilitates innovative services that address key aspects of the research lifecycle to provide intelligent quality assurance, linking and discovery of all research outputs. Linking the content in repositories to this suite of publishing services drives collaborative open science workflows and speeds up the dissemination of research to a range of stakeholders, including industry and wider society. Enabling scientific dissemination beyond the academic journal opens new horizons of uptake and re-use of all kinds of research outputs.

- **Openness:** Pubfair enables sharing, access and reuse of a wide range of research outputs by providing a framework that incentivizes researchers to contribute their work, adds value to the content in the distributed network of repositories, and provides user friendly dissemination channels.

- **Quality:** Pubfair supports a variety of transparent assessment methods that can be applied to different types of research outputs, leading to a trusted framework that ensures quality control of content. Research communities and other stakeholders can be consulted and contribute to the development of assessment methods and processes to ensure community standards are applied.

- **Empowerment:** Pubfair gives power to the research community by creating user-friendly, open source tools and services for (and beyond) sharing, assessing, rewarding and disseminating research outputs. It allows relevant stakeholders to participate in the definition and extension of intelligent modules by applying agile development and co-design methods.

- **Sustainability:** Pubfair represents a model of open and innovative public infrastructures for scholarly communication, by providing a high-quality yet low-cost services. It builds on and adds value to existing infrastructures and services that are already being supported by institutions around the world. Pubfair ensures that the technical architecture and governance models reflect community requirements.

- **Integration:** Pubfair breaks down institutional, regional and domain silos. Through the adoption of common behaviours, standards and protocols as defined by the COAR Next Generation Repositories work, repositories provide access to content allowing the development of value added services, and leading to an integrated ecosystem with relationships expressed between diverse research object that are managed in a distributed manner.

The **objectives** of Pubfair are:

- **Fit-for-purpose publishing services across the full research lifecycle:** Pubfair is a modular, flexible, open source publishing framework for articles, data and other kinds of research objects that enables scholarly societies, funders, research institutions, and scientists to link existing infrastructures to create their own cost-efficient dissemination channels for FAIR research outputs.

- **Open source software toolkit:** Pubfair is designed as an open source software toolkit that can be integrated with existing systems. By integrating and adding value and to existing open source repository and publishing systems, this contributes to the sustainability of the software and contribute to the development of an active open source community of collaborating institutions and developers, and maintained, developed appropriately over time.

4. Pubfair community design process

Pubfair engages key stakeholders in the design process and in defining the functional requirements of the system. An agile, user-centered technical development and implementation could be applied in the development of Pubfair in order to ensure a publishing ecosystem that is responsive to user needs. This reflects Star and Bowker's notion of research infrastructure, which is not absolute, but relative to a scholar's working conditions, meaning that it should never stand apart from the people who design, maintain and use it (mostly the researchers). Star and Bowker (2006) argue that effective infrastructures blend into current practices and should, if working, be invisible. For this reason, infrastructures are often neglected in the study of scholarly and scientific communication. According to Star and Ruhleder (1996), the salient features of infrastructures are it's embeddedness, transparency and spatial and temporal scope. Infrastructures only become visible in moments where they do not work, either due to breakdown or overload (e.g., a traffic jam on a highway) or instances of disruption (e.g., new transportation vehicles that make cars obsolete). Several scholars have conceptualized this scenario of disruption as infrastructural inversion (Bowker, 1994; Star and Ruhleder, 1996; Kaltenbrunner, 2015; Atsuro (2017). The digital transformation and transition to open access can be regarded as such infrastructural inversion for scholarly communication. It creates the conditions to reexamine the infrastructure for scholarly communication and imagine novel solutions to current shortcomings.

The Pubfair model proposes a configuration of research infrastructure that facilitates current and emerging scholarly communication practices, supported over the long term by distributed research institutions from around the world. Aspects such as (i) citation and interlinking of literature, datasets, software, services, (ii) reproducibility of science, and (iii) transparent evaluation of science, can be supported by reliable community paradigms and services. To that end, Pubfair supports public trust and greater use of scientific outputs beyond the academy through the development and adoption of transparent standards and practices developed by the communities it serves in order to validate findings. It is a central fact about infrastructures that they are not just the technical architecture but represent people's discursive and work practices. As such, the research community and other stakeholders are integral to the design of the Pubfair services.
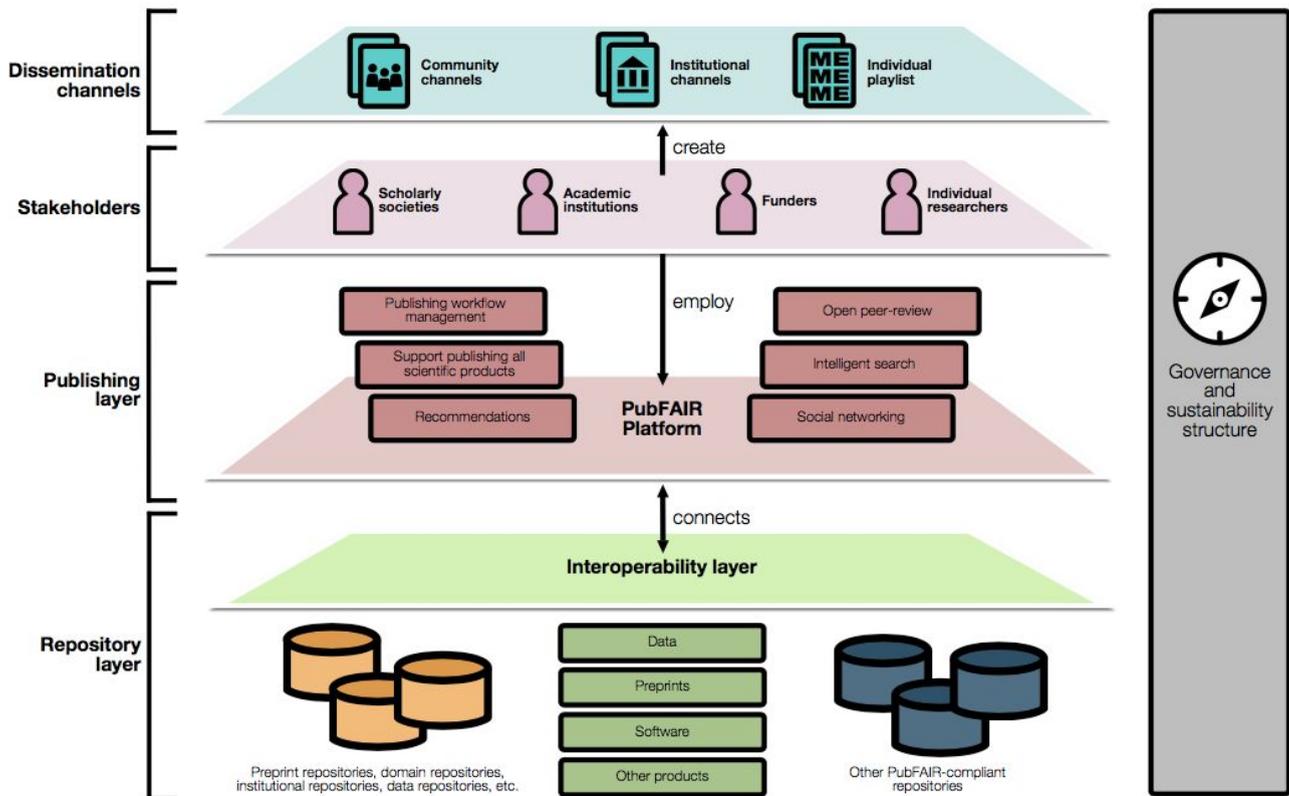
5. Pubfair architecture

Figure 1 - Pubfair high level architecture

5.1. Repository layer

Pubfair positions repositories as the foundation for a distributed, globally networked infrastructure for scholarly communication, on top of which layers of value-added services can be deployed (publishing layer). Repositories ingest, manage and provide access to a variety of research outputs, creating the infrastructure layer to support sharing a diversity of contributions to the scholarly record. Much of the repository layer is already in place, and sustained by research institutions and libraries. To support cross-repository publishing and assessment services, common technology, standards and protocols are needed. Many of these have already been defined in the COAR Next Generation Repositories report, and the most widely used repository platforms are in the process of adopting them in their software.

5.2. Publishing layer

Pubfair layers some of the core functionalities of publishing (submissions, editorial workflows, review and assessment) on top of research objects in repositories. This involves decoupling of the traditional publishing functionalities, with the content remaining in the repository system were it is managed and archived, and the peer review and certification functionalities

undertaken in the publishing layer. Related objects such as articles, their peer review, and the underlying data, could be connected to each other through standard protocols, creating distributed, yet integrated ecosystem. Pubfair requires an interoperable layer between publishing and repositories that is currently being profiled by the COAR Next Generation Repositories Expert Group.

5.3. Dissemination channels

A core innovation of the Pubfair model is its dissemination functionality, which supports multiple channels for scholarly outputs catering to a variety of stakeholders, in particular research communities, scholarly societies, research funders, academic institutions, and individual researchers. A key exemplar for this innovation is that of digital music, and especially services like Spotify. In the age of digital streaming, users are no longer required to purchase and listen to an album, when they only really want one or two songs from that collection. They can pick and choose the content of interest and create their own playlists, based on a huge collection of available songs. Pubfair enables different user communities to develop their own unique dissemination channels, based on the content in the thousands of repositories around the world. On Spotify, this role is served heavily by "playlists", where the platform or its users curate collections of music, usually according to a genre or theme. These can then be shared or followed. Pubfair proposes a similar publish-then-filter model. Content is uploaded to repositories. Users can then curate distinct collections of that content according to subject-area or theme via Pubfair using its review processes to maintain quality. We envisage three kinds of channels, but others may also emerge based on the distinct needs of different users:

- **Community channels:** Analogous to current journals, community dissemination channels will be maintained by communities of interest (e.g., according to disciplinary focus). Repository-hosted research objects, including datasets, software, or preprints can be curated, reviewed via the platform and brought together into collections via the Pubfair platform.
- **Institutional channels:** Institutions, including research funding and performing organisations, that wish to enable Open Access channels for their researchers can set up and maintain their own channels.
- **Individual channels:** Individual users can curate content, bringing together mixtures of research objects according to, e.g., research theme. Users can then follow each other to receive alerts to each other's playlists.

6. Conclusion

Open Science is setting a new paradigm for both how research is conducted, and the way that outputs are disseminated and published. Yet, in large part due to our reliance on commercial publishing and a narrow set of measures for assessing research contributions, there has been very little innovation in scholarly publishing. In order to achieve a large scale shift towards sharing of a broad range of research outputs, we need to build both the technical architecture, as well as the social norms and practices that support such an ecosystem. Despite the promotion of data sharing by research funders and policy makers, for example, data is often withheld due to lack of repositories, lack of standards applied to data, or researchers' concerns about being scooped. In addition, for such services to be accepted by scholarly communities, robust forms of quality assurance and peer review are required and researchers must be confident that these contributions are recognized in the academic reward structures that govern so much of the competitive research environment.

Pubfair offers a blueprint for bringing together existing technologies with emerging dissemination practices in scholarly communication. With Pubfair, we are proposing a framework that has the potential to significantly transform scholarly communication by leveraging the power of the networked environment. The Pubfair framework enables different research communities to develop new workflows for peer review and novel approaches for assessing a range of research outputs. This advances the development of more formal, community defined assessment methods for many different types of research contributions. In addition, the dissemination functionality of Pubfair supports multiple user channels catering to a variety of stakeholders, in particular research communities, scholarly societies, research funders, academic institutions, and individual researchers.

The idea of Pubfair is not to create another new system that competes with many others, but rather to leverage, improve and add value to existing institutional and funder investments in research infrastructures (in particular open repositories and open journal platforms). Pubfair positions repositories (and the content managed by repositories) as the foundation for a distributed, globally networked infrastructure for scholarly communication. It moves our thinking beyond the artificial distinction between green and gold open access by combining the strengths of open repositories with easy-to-use review and publishing tools for a multitude of research outputs. Building on a distributed network of institutions and repositories, the Pubfair model spreads the costs of publishing across participating institutions, leading to a more sustainable and inclusive system of funding scholarly communication while ensuring quality control and trust.

While many of the technologies, standards and protocols to support the Pubfair framework have already been identified through the Next Generation Repositories report, there is still profiling that needs to take place to define the architecture and workflows for this framework. In addition, because repository systems worldwide are at different levels of development, one of the major challenges with the Pubfair model will be to get a critical number of repositories at the level that can support the new functionalities proposed through Pubfair. COAR continues to advance the work related to these challenges by profiling the Pubfair framework through the NGR Expert Group, while at the same time, begin to pilot some value added services, support the adoption of new technologies into repository platforms, and help the international community to upgrade to more modern repository systems.

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