Supporting Research Communications: a guide

Version 1.1

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Prologue

The year is 2050. There are no more publishers, no more universities, just researchers fighting for the remaining scraps of funding from governments or corporations. Our heroes, the research team, have just gained their first grant to work on understanding how companies need greater privacy.

They work alone. There is no library, no data support, no research office to help determine whether the research contract is fair. Success is determined by views and attention, by citations from the army of botnet report authors provided by Wolf Dissemination services. Receiving these citations will depend on what our heroes can afford to buy at the end of the project. In any case, how could they trust anyone else in this world? After all, those who worked together, who didn't pursue their own interests, were the ones that got wiped out.

Is this a future we want? No. Is it possible? Yes. But is this dystopia avoidable? Absolutely.

In our book, we propose a way forward for us as a community to build another possible future that is more desirable on all counts.

Introduction

The story of research communications

New frontiers of knowledge, information, and data: "to explore strange new worlds. To seek out new life and new civilizations. To boldly go where no one has gone before." This is the research enterprise (cue Star Trek music). Two main sectors have emerged in modern times for the production of new knowledge: public and private research institutions, and private companies who aim to turn knowledge into profit. We focus on the former and begin our story with a description of what research communication entails in this arena, its process of production, and its centrality to the contemporary funding and evaluation systems for researchers.[1]

Within each institution, research aims to advance human understanding and knowledge. Communicating the results of research is central to sharing new knowledge, and as such that communication has become a central means by which institutions and funders evaluate the worth of research. The primary means by which research is communicated is through publication in the formal research literature. This involves condensing the ideas, the methods for investigating, the data or evidence generated or used within these methods, the post-hoc analyses of such evidence, the conclusions drawn from findings, and the relationship to existing knowledge.

The reality for many university researchers, beyond the pursuit of knowledge, is the need to secure funding. Funding can

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1.   This description may also apply to systems outside of the Global West, but the authors' direct knowledge and experience focuses on this region.

come from a wide range of sources, including the university it-self (in the form of salaried tenureship, research support, facili-ties, or equipment), government agencies, philanthropic organi-zations, and private companies. Direct public appeals (such as crowdsourcing) are playing an increasing role in funding re-search. In order to obtain any of this funding, the researcher must prove their worth, and this in turn is coupled strongly to modes and models of communication. The rewards for re-searchers, the sharing of their work, and financing future projects, are all bound together. These outputs of researchers' work remain the primary form of currency in the academic sec-tor. Researchers are evaluated on the basis of what they publish and where they publish it.

To publish, the research process for a piece of work is con-densed into a single document, generally a research article or a book. This document is sent to a publisher, where it is evaluated by means of peer review. If the document—eventually—meets the standards of the publisher or journal, it is published online and, to a declining extent, in print. The supporting data, soft-ware, workflows, and other research products may also be shared in connected or disconnected forms as the relevant com-munity practices dictate. But these documents are now emerg-ing as distinct commodities with value in the research enter-prise. In most communities this is far from being fully realized. For some disciplines, data sharing, software sharing, and tool reuse are strong community practices (for example, in astrono-my and particle physics), but for most disciplines the practice is more haphazard.[2]

Some funding bodies have begun to mandate that any re-sources produced as part of a funded initiative are to be made publicly available. However, publishers and communities are not clear on how best these outputs connect to and are to be shared alongside the more traditional published literature. Their role

within the critical gateway processes of tenure review (in North America) and appointments and promotions (elsewhere), grant evaluation, and other important processes, is even more inconsistent. Some publishers and communities have made more progress than others, but the value of this wider range of outputs has yet to be fully realized.

The growing interest in sharing all research products is generally seen as a positive development in how knowledge is shared; how these products are incorporated into the mechanisms of traditional publication is less clear. The publishing infrastructure was developed when print reigned supreme. Unfortunately, it has not yet transitioned, even its most basic apparatus, for the current digitally networked world. These traditional systems are central to research communication - the publication remains the principal output of communication. But these systems often become barriers to change. Any efforts to change or shift behavior will need to be supported by the publication machinery. And as competition increases and funding become more concentrated and specialized, the reliance on producing a continual stream of respected publications intensifies. If a researcher contemporary to this era fails to produce enough publications, they will fail to get additional funding and will ultimately lose their stature and potentially lose their jobs.

Considering the varied ways in which research communications are directly and indirectly tied to the research itself, as well as the researcher's capacity to conduct the research, sup-

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2. See for instance: Borgman, Christine. 2017. Big Data, Little Data, No Data: Scholarship in the Networked World. 1st edition. Cambridge, MA; London: The MIT Press; Tenopir, Carol, Suzie Allard, Kimberly Douglass, Arsev Umur Aydinoglu, Lei Wu, Eleanor Read, Maribeth Manoff, and Mike Frame. 2011. "Data Sharing by Scientists: Practices and Perceptions." PLOS ONE 6 (6): e21101. https://doi.org/10.1371/journal.pone.0021101.

porting research communications is central to the larger enterprise. Today, the research communications system contributes to and creates problems for the research community it seeks to serve. It is the shared fulcrum around which many other issues that affect research turn. It is also a space in which the researchers share a set of values and practices (such as peer review and healthy debate), but at the same time is a space in which substantial differences are also expressed (such as choice of publishing books or articles, practices around sharing ideas and outputs, or the forms of evidence and argument that a community values). While research communications is only one part of the scholarly enterprise, its affects many more aspects of the research enterprise and has touch points across all groups.

Enabling research communications

Research communications entails a many and varied set of parties performing a many and varied set of functions, given the breadth of activities and outputs entailed. In this book, we have given the following name to these parties who enable research communications: *Supporters.* Supporters provide the systems on which the research can be communicated, critiqued, and evaluated. We intentionally exclude the actual work of research itself. Such functions involved here are carried out across many types of organizations, including funders (public and private), publishers, infrastructure providers (commercial and community), citizen scientists, and those affiliated with research institutions.

- Funders - organizations that support research communication through providing financial resources. They usually have the mission of advancing knowledge and they measure success against advances in society or knowledge that speak to their mission. Examples include the National Science Foundation in the US, the European

Commission, and private philanthropies such as the Alfred P. Sloan Foundation.

- Institutions - public and private universities and research institutes that are considered the center of learning within civilizations. They measure their success in terms of prestige, size, and financial security. Examples include universities, the Simons Foundation Flatiron Institute, CERN, and the Woods Hole Oceanographic Institution.

- Publishers - comprised of commercial and non-profit parties who consider themselves the gatekeepers for the quality of knowledge, as well as smaller players, usually from societies or universities. Journals often help influence standards for the quality of research, by selecting to publish only papers that meet their pre-defined standards. Examples include SpringerNature, Wiley, PLOS, American Chemical Society, and MIT Press.

- Commercial infrastructure providers - comprised of corporations who provide the infrastructure to aid in the storage, management, and discovery of knowledge. Examples include Scopus, Web of Science, figshare, Google, GitHub, and Amazon Web Services.

- Community infrastructure providers - a mixed set of projects, organizations and other structures that provide underpinning services or resources. Missions vary depending on the type and scale of resource provided. Their success might be judged by usage, or by the size of collections, or efficiency of service provision. Examples include DataCite, Open Journal System, and NISO.

- Institutional libraries - the main investors in scholarly communications products such as journals and monographs. They have a mission to support researchers

within their own institution, and frequently also support knowledge production and dissemination more generally. Librarians provision access to scholarly publications and archive an institution's research outputs. Success measures vary greatly but might include the scale of budgets, level of support provided to students and colleagues, and the sizes and importance of various collections.

- Researchers - researchers often serve many different roles in supporting research communications. They perform the bulk of peer review in publishing. They perform similar services for funders who seek expert opinion when making funding decisions. Researchers also build systems and/or services that underpin further research, developing tools that are used by others in collecting, cleaning, analyzing data that is shared. They also perform duties at their universities and thus provide administrative support.

Supporters are found in both public and private organizations, and in both not-for-profits and for-profits. We will seek throughout the book to draw attention away from convenient labels that are applied to organizations and seek to focus on the behaviors of actors. Is it supportive? Does it benefit research and researchers or is that a side effect of a commercial opportunity? In both cases, how can relationships with these players be managed best?

Supporting research communications - the work of Supporters - is certainly not materially invisible. But neither is it generally perceptible when the focus is on research. It must be examined, tested and understood by those who depend on it. In that sense it is infrastructural. Like infrastructure, such support is working best precisely when it is invisible because that means it

is trusted and taken for granted. Also like infrastructure, it is most visible when broken.

We believe that research communications is not optimized today. We see signs that the overall system is plainly not as effective, efficient, and robust as it could be in the networked, digital age. Here are just a few glaring and extreme cases - "dead canaries" in the proverbial coal mine:

- SciHub, the black market for free access to all articles, has become the entry point to scholarly literature for a growing population of researchers. While outdated publisher platforms, difficult library toll-gate authentication, and subscription paywalls contributed to the emergence of SciHub, the governance issue is twofold. The most popular resource solving the access problem is one that depends on being outside the rule of law. For users another governance issue is the complete control of a single individual, an issue brought to the fore when the founder blocked access to a website for anyone in Russia for several days[3].

- Researchers have suffered personal and professional loss over retraction scandals as a result of the stigma associated with updating and correcting the scholarly record, and the methods by which journals carry out these corrections. The "publish or perish" environment has become literal, and researchers are incentivized to publish papers at all costs. The retractions process is wrongly bound up with reputational dishonor, and so

3. Page, Benedicte. 2017. "Elbakyan Pulls Sci-Hub from Russia" The Bookseller, September 6, 2017.https://www.thebookseller.com/news/elbakyan-pulls-sci-hub-russia–631281.

when issues arise over the validity and soundness of the results, personal implications are magnified.

- Scientists across the globe permanently lost all access to data and information on the biological resources of the United States on 15 January 2012 when the National Biological Information Infrastructure (NBII) disappeared due to lack of funding for this ongoing service. A large number of international scientific initiatives were affected, including the Global Biodiversity Information Facility (GBIF), Inter-American Biodiversity Information Network (IABIN), Invasive Species Information Network for the Americas (I3N), Pollinators Thematic Network (PTN), Global Invasive Species Information Network, and FishBase for the Americas.

This is certainly not indicative of all research communications projects. Indeed, many have proven themselves capable and useful to the research enterprise. A wide array of players carry out their functions at varying levels of effectiveness, with varying levels of coordination.

A community with shared values

While there is a wide range of Supporters and their projects - organizational and business model, function, size, and effectiveness - many things do tie together those who enable research communications. We, amongst this set of authors, see common attributes in the broader set of activities and those who conduct it. Shared problems, or at least the perception that something is a problem, is one component. Another is the language of research communication, and how it is used and misused. A third is an understanding of what we think matters (i.e., shared values and shared challenges). In practice, these common threads often

emerge from conversations among the various Supporter silos (funders, publishers, infrastructure providers, librarians, administration, and researchers). These conversations focus on issues of finance and funding, of organizational rules and governance, and above all of incentives and rewards structures. Another connection is the shared experience of frustration when we feel how seemingly unproductive these conversations are at times.

Beyond the discrete commonalities that already exist between a large number of those who support research communications, the larger one is the overarching common interest in improving the research enterprise at large. To that end, we believe we can work more effectively together than when alone by drawing on the existing work of others. But more than that, we would be even more powerful as a *community* based on values that come out of this collective interest.

What do we mean with this widely invoked, often overused term, "community"?[4] Function-based communities are made up of the users of and contributors to specific systems or organizations, such as those in research communications. An interest-based definition of community would be centered around a common interest or goal where lack of participation would lead to failures to meet shared aims and objectives. Debates often center on who should have a stake[5], but in general we focus on the set of parties that care enough to claim a stake and to contribute to shared systems. The interest-based community is the type most appropriate to this environment of diverse players across the research enterprise. For the Supporters community to be constituted, it would need to possess shared social norms and values.

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4. "Community." 2018. Wikipedia.https://en.wikipedia.org/w/index.php?title = Community&oldid = 839742101.

We, the authors, call for a community of the willing that identifies with a set of shared values described in greater detail in subsequent chapters:

1. Be as open and transparent as possible

2. Practice what we preach

3. Begin change from within (your workplace)

4. Welcome all participants

5. Recognize and celebrate differences

6. Respect multiple solutions

7. Stick to your scope

8. Leverage our communal wisdom to move quickly

9. Encourage healthy skepticism

10. Collaborate and be stronger together

We can all express those values in each of the choices we make, within our organizations, and in our interactions with others.

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5. For example one might contrast the opening of this piece at Elsevier Library Connect[i] which refers to a "...global community of librarians, researchers, publishers and scholarly collaboration networks..." with the clear exclusion of Elsevier in the opening of this piece from SPARC[ii].

i) Dylla, Fred. 2016. "Article Sharing on Scholarly Collaboration Networks." Library Connect. March 24, 2016. https://libraryconnect.elsevier.com/articles/article-sharing-scholarly-collaboration-networks.

ii) Joseph, Heather, and Kathleen Shearer. 2017. "Elsevier Acquisition Highlights the Need for Community-Based Scholarly Communication Infrastructure." SPARC. September 6, 2017.

https://sparcopen.org/news/2017/elsevier-acquisition-highlights-the-need-for-community-based-scholarly-communication-infrastructure

We can work more effectively with those who do not share our values but nonetheless offer us value by understanding the risks involved and ensuring they are mitigated.

That is the upshot of this book: *constituting a community of people who practice shared values in their work supporting research communications, in short, a Supporters community.* To get there, we open with a number of observations on the current landscape, including examples of successfully run efforts that support research communications, and descriptions of anti-patterns from the opposite end of the spectrum. Next, we delve into a broad set of core issues, which cut across this work: funding, governance, rewarding, and communication. We dig into each and offer suggestions for how we can do better as Supporters. This is not a comprehensive survey of issues that we could address nor a systematic review of the conversations that connect us. It does not cover all the aspects and functions entailed in enabling research communications, but they are broad enough to shape the larger story of how it is made possible. Our goal is to identify the patterns and opportunities embedded within these issues. We provide some concrete recommendations but we do not expect these to be completely correct or comprehensive. The recommendations given are rules of engagement. But at their core, they are simpler: a call for us to act as a community that shares a set of core values. Coordination is difficult, and this is best addressed not by any set of rules, but by working more effectively together.

The last part of the book lays out the ten shared values (enumerated above) which together most exemplifies what brings us together as well as how we can work more effectively as a community. The consequences of leaving things as they are - the dystopia that *could* result - are grave as dramatized in the prologue. In fact, some are already apparent in today's systems. We wrap with a call to action to fundamentally change the ways in

which we operate internally and with each other so that they embody these community values. The closing epilogue considers what might be possible - a utopia - if we effectively constitute this community to work together as well as remove those blockers identified which prevent us realizing an ideal future.

We bring our unique brand of expertise to this volume. We are a band of senior professionals who have worked across the many parts of both the research and the research communication process. Our experiences include laboratory research, theoretical work in the humanities and social sciences, technology development, infrastructure provision, publishing, data management, funding (private and public), and work within academic libraries, not-for-profit organizations and for-profit private companies. What brought us together was a shared vision that research communication could be better, specifically by considering the opportunities made possible by the web. While we bring an array of different perspectives, the view we have comes from our collective experience of supporting and advocating for research communications.

Our hope is to start a discussion on how the research enterprise is aided by myriad different parties, the helpmates of research - and to rally this group to systematically provide better aid as part of a interest group. We wanted the discussion to be rooted in our individual experiences, make the book practical though not prescriptive. We have taken pains to maintain a conversational voice throughout in order to convey these origins more honestly to the readers. Those who are interested in an in-depth analytical deconstruction of any of the topics included will be better served by other scholarly literature. But we believe this contribution is a useful addition to those discussions - formal and informal - aimed at improving the support of scholarly research communications. We hope our story speaks to all our colleagues across the research ecosystem who also serve this

role as well as to those engaged in the management of research more generally. Additionally, we believe this is of broader interest to others interested in scholarly research writ large.

Landscape observations

We begin with a number of observations about the current landscape. These include examples of successfully run efforts that support research communications and descriptions of anti-patterns from the opposite end of the spectrum. We want to acknowledge and learn from some of the positive examples where a community of supporters have come together to build shared services for research communications. But, as is too obvious for many, dead canaries abound, littering the coal mine floors. We reference them insofar as they are explicit signals of dysfunction and point to deep defects in our current system. In the context of this book, such signals of dysfunction can be seen as failures of support for both old and new forms of research communication in a networked world, since it is in this space that they are manifested and where opportunity for change exists.

Signs of success

Quite commonly, those writing about research communications simply enumerate problems. We will certainly raise issues and point to signals and modes of failure, although we also want to acknowledge the positive examples to provide a fuller picture. None of these examples are perfect, but we can discern patterns of success, and perhaps identify gaps that we need to fill. Some of these choices may be controversial. But each shares some characteristics: strong support within user and contributor communities; demonstrated sustainability or credible sustainability plans; and a form of organization or governance that recognizes or embeds community input in its processes.

CERN

The success of collaborations such as the European Organization for Nuclear Research (CERN) offer a range of lessons and have the advantage of being more neutral than those directly associated with research communications. CERN has a long-term sustainability guaranteed by an intergovernmental treaty. It has a complex and formalized set of governance structures that are suitable to an organization of such scale and expense. It has a clearly defined "community" that supports it, and a well-defined scope and mission. With the substantial support that underpins this large organization, it has been able to advance high standards of research communications practice: data are shared with the public as soon as they are generated through its Invenio-powered Open Data Portal; researchers simultaneously collaborate and compete in the search for new discoveries by means of multiple detectors (which also act to provide controls

for experimental variability, making all findings dramatically more reproducible); researchers' achievements are measured according to a wide range of metrics beyond journal articles; and all findings are published as open access so that everyone in the world is able to read them.

The degree of standardized practices, and the required long-term commitment by national governments, are partly a result of the scale of CERN's undertaking and the large financial investments required for this undertaking. Nonetheless, the CERN example highlights the importance of considering financial, political, management, and experimental arrangements and how they relate to scale, importance, and community. CERN's funding and governance are tightly coupled, and the reward structures for high energy physicists are highly dependent on the success of the whole endeavor. Finding the next particle or the next anomaly in the data is a collective effort dependent on a high level of coordination, which in turn justifies future investment.

Crossref & DataCite

Crossref and DataCite provide critical roles in our system of digital research communications through their roles as DOI registration agencies and providers of core metadata services. Crossref grew from a small project started by a group of publishers into a diverse organization that is a core part of the research infrastructure. It was a project that brought together a set of commercial competitors to solve a collective problem of how to link the content that each of them published. Today, our current systems of research communication to a large extent rely on the underpinning metadata and services that Crossref provides.

Crossref is a membership organization made up of traditional book and journal publishers along with an assortment of entities who serve as agents for the communication of scholarly results: standards bodies, libraries, universities, and organizations such as the World Bank and the US National Institutes of Health. A tax-free industry association under US law, Crossref is governed by a board made up of its members. While its origin as a publisher-focused organization raises concerns for some, and its focus on provision of a particular form of centralized identifier system raises concerns for others, it is reasonable to say that there is very broad reliance upon, and trust in, the International DOI Foundation[6] as well as the DOI and metadata service, which Crossref provides. It remains the case that Crossref is a place where even the most commercial competitors can come together to solve common problems. Its members pay a range of fees which, along with the income from services to non-members, has sustained the organization for over 17 years.

DataCite was born out of a necessity in 2009 to address the need for metadata and identifier services focused on data citation and discoverability. Like Crossref, DataCite provides identifiers for research content. Also a global agency for the registration and identification of research, DataCite primarily serves data objects and a community of users and contributors. It provides researchers with a means to register their datasets with a formal identifier that can be linked to the published research article. DataCite is a membership organization composed of multiple stakeholders with the goal of increasing the visibility of data, software, and other non-traditional research outputs. DataCite's

6. International DOI Federation (IDF) is a not-for-profit membership organization that is the governance and management body for the federation of Registration Agencies providing Digital Object Identifier (DOI) services and registration. Crossref and DataCite are IDF members.(https://www.doi.org)

strength is rooted in its active membership, and its Board is drawn from its members. The global community of members from more than 24 countries includes data centers, libraries, government agencies, research institutions, and more. Like Crossref, DataCite provides a centralized service for DOI creation and management. All of its content is open and downstream use is encouraged.

For both Crossref and DataCite, a membership model is coupled to representation in governance systems. The shared problem of coordination defines a community of interest (publishers in one case, data repositories in the other), and the financing and governance models are tied to that community. The rewards for the organizations are tied to enhancing membership, and the rewards for the relevant communities are the increased discovery enabled by identifier infrastructure. That is, governance, funding, and reward structures are aligned with the interests of the community.

Open Library of Humanities & Knowledge Unlatched

In the raging debate over funding and transition models for open access publishing, a relatively quiet and still small-scale success has gone somewhat unnoticed in overcoming an apparently impossible problem: persuading a group of organizations to pay a subscription to fund the dissemination of new content which is made openly accessible.

Open Library of Humanities (OLH) is a UK-based charity that collects subscriptions from a growing number of universities to fund open access for a growing set of humanities journals. With the OLH model, universities can move from simply purchasing limited access to content for their campuses to a model where they can repurpose allocated funds towards making content

open to all. Subscribing universities vote on the addition of new journals to the pool. They are also able to choose not to renew a subscription if they are not getting what they want, although very few organizations have done so to date. The system is crucially reliant on trust amongst the community of subscribers at this early stage. While this works well at a small scale, the challenge for the OLH will be in maintaining the sense of trust and control as the movement grows.

Knowledge Unlatched is also a system that provides a parallel collective funding model for open access monographs, although the model is somewhat different. Content is offered in collections to which institutions subscribe. A maximum price per collection for each contributor is set. If a sufficient number of contributors (determined by dividing the total cost of publication by the maximum price) commit, then the collection is "unlatched", i.e. made open access. This model is a form of assurance contract, since the contribution is only triggered if sufficient other players also commit funds. The financial contribution is contained and localized while trust in the system is built up. Knowledge Unlatched has offered a steadily larger set of collections which has been matched by a growing number of contributors. The maximum scale for growth is a question that remains unclear, but they have demonstrated success in coordinating a collective action that makes content freely available.

In both cases, Knowledge Unlatched and OLH have coupled a new form of incentive for subscribers to a model of financing and governance that is sufficiently aligned. Any subscription model for open access content has to deal with a fundamental question: What is the incentive to subscribe if the content is freely available to anyone? The answer here appears to be that the subscriber is seen as a supporter or sponsor of the availability of content. Success for subscribers – being associated with the release of increasing quantities of high value content –

aligns with success for these providers, as they aim to grow the content they release. In both cases the governance model gives subscribers a direct role in the content selection. For OLH, subscribers are involved in the selection of new journals to include. For Knowledge Unlatched, subscribers choose to support a specific collection or not. Finance, governance, and incentives are all connected and aligned for the providers and for the subscribers.

Human Genome Project & Bermuda Principles

Data production on a large scale that involves multiple players requires effective coordination. The large genome projects, most notably the Human Genome Project, are particularly exemplary because they demonstrate the ability to collectively shift a community's behavior with regard to data sharing. The community of laboratories involved in the Human Genome Project agreed collectively to release the data being generated in near real time. This agreement, called the Bermuda Principles, bound the participants, but also tied the continuity of funding for the laboratories to the public release of data. This meant that the members of the consortium were bound to engage in a particular form of communication, which by its very nature made it easy to track compliance, and was tied to strong sanctions, potentially including the withdrawal of funding. The success of the Human Genome Project was a result of a wide collaboration of researchers and institutions - still the largest biological collaboration in history - but spurred by competition from a parallel effort by a private enterprise run by Craig Venter.

The Human Genome Project spawned the Encyclopedia of DNA Elements (ENCODE) and other projects which have continued the tradition of rapid data sharing in public repositories. The public nature of their outputs has become part of their internal culture, with continuing development of new modes of

communication often focusing on wider public engagement. The primary findings of the ENCODE study were published in a number of different scientific journals from different publishers who collaborated to develop a portal by which to explore the findings across the different research articles, all made available to the public through full open access or hybrid publishing options.

These projects are a particularly interesting case of the link between incentives, governance and finance. The incentives for researchers are high for being the first to provide data of such central importance to biology, but so are the costs. This gives funders leverage to demand rapid data release. But a key insight is that the community bound itself to these rules, agreeing that funding would be tied to data release. Access to resources was a key motivator that drove the coordination, and that led to maximizing both success and rewards for those involved.

Patterns of failure

We have sketched out a small group of specific successful efforts in research communications. Although these examples were by no means exhaustive, the list of anti-patterns far exceeds this group. Rather than catalog all the "dead canaries", however, we highlight examples of failure modes by linking them to their systemic problems: poor alignment of governance, financing, and incentives across different organizational structures (single academic institutions, multi-institutional projects, community-governed organizations, and private organizations).

Single institutions

Academic institutions have often recognized the need to invest in and support research communications by supplying facilities and infrastructure (e.g., access to content through libraries, data management systems and cloud storage, but also archives and physical stores in some cases) as well as services (e.g., a university press, data support services, and even the research support office) for faculty and researchers operating within their university. These investments are solely made by the institutions and are intended to support the needs of their local researchers. Of course, the collaborative nature of research means that there will be users outside the host institution that become reliant on these resources. But by providing local services, institutions are investing specifically in local research. And governance, management, policies, and fee structures, are therefore tied directly to the mission of the institution, lowering overhead associated with collaboration and coordination.

What is the impact of building these types of local services given today's need for globally connected research? Researchers have always worked across institutions. Researchers identify and collaborate more within their discipline than within their own institution. Today's research enterprise transcends organizational, geographic, and institutional boundaries as well as funding structures of individual institutions. So where control is vested entirely in one institution, community governance is at best weak and at worst impossible.

It is rare that institutionally-supplied services adequately support researchers to collaborate across organizations due to policies, practices, and closed funding systems. There is also a high degree of competition between institutions, leading to a lack of desire, trust, or incentive to (re)use the infrastructure created by a competing institution. As such, the financial incentives for institutions tend towards a desire for control. From the perspective of providing support to a well-defined community operating across institutional or disciplinary boundaries, incentives and finances can easily be in tension with community governance and control.

The natural tension between researchers and their home institution can lead to dysfunctional results. Researchers want their institutions to help provide them with things they need. Institutions focus on things that can scale and are consistently applied. The two do not always align, leading to friction and animosity when particular issues flare up over the efforts of each party doing their job. Researchers often feel they lack the technology and administrative support they need or they chafe at the perceived lack of freedom to find adequate solutions to the officially sanctioned tools and services found lacking. At the same time, institutions often face academics who build their own subsidized support fiefdoms of postdocs, lab staff, and undergraduates, spending absurd amounts of time attempting to

maintain an ever more convoluted and fragile amalgamation of customized servers, services and applications. This all comes to light once issues arise (e.g. a grant ends, some critical system fails, an overworked postdoc leaves, etc.) and the institution is expected to try and fix them. These tensions are exacerbated when the researcher needs to share systems and tools with their closest collaborators at a different institution. Here, institutional solutions prove to be even less adequate.

Multi-institution projects

To address both issues of increasing scale and issues around single institutional support systems, funding agencies have made large-scale investments in discipline-specific services. These projects have made the right step in pulling together a diverse group of stakeholders with a range of expertise. By doing so, control and governance are moved outside of a single institution. This allows for cross-collaboration. It can also make more efficient use of development funds, expertise, research infrastructure, and services. However, these initiatives come with their own specific challenges relating to sustainability plans, governance, and the connections between them. Most of them are time-limited without a clear path towards long-term sustainability. The governance, development, partners, and services are dictated by the terms of the grant and are essentially a contract between a funding agency and the funding recipient.

First, the governance structure of the grant is subsumed by the Principal Investigator (PI) acting as "CEO" and co-investigators with the funding agency as the de facto Board. The community may have little say in how the project is governed, with advisory boards sometimes playing a perfunctory role. Naturally this can be addressed by planning an effective governance structure, but this may work against the interest of the controlling institutions. The PI has little interest in addressing the chal-

lenges of establishing long-term governance or sustainability, due to time limits imposed by grant cycles.

Typically, the work and the deliverables of the grant are fixed long before actual work on the grant begins, precisely because multiple institutions are involved and collaboration agreements are complex, especially when large sums of money are involved. Within the third or fourth year of a five year grant, one can expect that technology, community needs, and strategies have changed substantially. Because of the contractual nature of the grant, PIs have a difficult time stepping back, recalibrating, and changing deliverables. This inflexibility and the risks involved in trying to re-allocate resources between institutions mid-project mean that the goals of the project (delivering on the mission as it evolves) can be in direct opposition to the interests of the participating institutions.

The nature of funding allocation for these initiatives, often a competition based on an request for information (RFI), also tends to impede cooperation. Success in funding accrues to the lead institutions and PIs. The scale of funding requires that PIs are asked to address a "grand scientific challenge", and as a result, service provisioning becomes a side effect. Perhaps more importantly, the scale of funding creates a lack of incentive for collaboration and participation. A winner-take-all mode of funding creates a perception that those participating should not bring a community with them to build a better solution. Fundamentally, these funding models generate competition between PIs to deliver new results, rather than to collaborate to build the best systems that serve a community in the long term.

Community-governed organizations

Community-governed organizations that are independent of research institutions are a natural response to the challenges of

managing support systems and infrastructures within universities. Many of our most traditional support systems, including publication systems of scholarly societies, take this form. The advantages for such organizations are that they can be focused on their specific mission independent of any conflicting goals which may arise from a larger institution. The desire to spin out these organizations is common for projects that have developed within research institutions but no longer find this home hospitable.

The single most common problem for such organizations is sustainability. Research institutions provide underpinning support, salaries, buildings, internet access, even electricity, that a separate organization must provide for itself. This in turn requires revenue sources, often focused on membership models or service provision. Governance is often left to one side and not considered seriously enough, but even where it is, there is a frequent tension between governance systems and the evolving finances of an organization as it experiments with finding the right revenue model. At the core is a frequent tension between the interests of the community of contributors and users – who after all founded the organization so as to have greater control – and ways of raising the money that is intended to serve those interests.

A common criticism of certain community-governed groups as they scale their publishing operations is becoming "too corporate" in their focus on ensuring stable revenues. In some cases, a community may have the opposite criticism, of a community organization being insufficiently focused on revenue generation. In either case the tensions that arise in finding a viable sustainability model, based on revenues that align with both the organizational mission and community interests (which may themselves not precisely align), becomes a challenge. Generally, organizations of this form that fail do so either because the gov-

ernance structures in place are not sufficiently robust to manage these difficult discussions or simply because of insufficient revenue.

Private organizations

The slow processes and lackluster management of many academic and government-led services mean that researchers often adopt tools developed in the private sector. Developers rely on GitHub to manage software. Research evaluation teams rely on data from Scopus or Web of Science to determine what their own researchers have published. And researchers are more and more dependent on Google Scholar for literature discovery.

However, there is a risk in relying on private sector solutions. These are solutions provided by groups with different motivations and obligations. The private sector provides research support to fulfill a business need and commercial opportunity. There is no governance by the research community. The space of possible commercial models means that data, software, and systems are rarely open. The long-term commitment to the research infrastructure is not guaranteed and the community can become dependent on services that they have little control over. We see examples of communities expressing anxiety routed in their lack of control in recent reactions to Microsoft purchasing GitHub, Elsevier purchasing bepress, Atypon purchasing Authorea, and so on.

The incentives for private providers may vary but the primary motivation is revenue. Desire for control over revenue is directly at odds with the goals of community-led decision-making. Many of the financial models for new private providers work by increasing the number of users through provision of free levels of service in addition to fee-for service. Here, researchers have no stake in long-term decision-making as such decisions are not

directly tied to the company's bottom line. This is not to assert that private provision is necessarily or intrinsically harmful to the research enterprise. But the gap between the core goals and values (and the financial reality) of the community and those of a commercial provider are more likely to be large. If they are not currently so, continued alignment is far less likely when governance falls wholly into the hands of a private owner (or set of owners). The growing trend of startups whose business model is essentially to generate users/data and then get acquired by one of the big players is yet another worrisome part of this shift.

What this teaches us

What can we determine from these examples, and what patterns emerge? What underlines each example is the degree of trust that the respective constituencies have in their organizations to perform those roles which support the sharing of research. These are spaces where trust is built on reliability (e.g., Crossref and DataCite), on continuous monitoring or public commitment (e.g., Human Genome Project), or on the ability to withdraw (e.g., Knowledge Unlatched).

Trust is built through governance arrangements that are appropriate to the scale and risk of the effort being undertaken. Trust is then reinforced by monitoring, which is tightly tied to using the service in best cases. Publisher members of Crossref might choose to stop registering DOIs, but the importance of DOIs in search and discovery, and therefore usage, is so great that this would be an extraordinary risk. The Bermuda Convention Principles linked the public release of data to ongoing funding. In the case of Knowledge Unlatched, the collection does not proceed unless sufficient players contribute.

The successes above often start small with a group that can more easily reach consensus on how to proceed, before growing. Even in the case of massive infrastructures such as CERN, the actual group of important funding actors is small -- a set of countries that generally number from 10-20. Crossref began with less than 10 members, DataCite by nine institutions, and OLH with a small number of initial subscribers. This is predicted by classical collective action economics.[7] They also all show the importance of building relationships that help to solve coordina-

tion problems, and have all successfully combined the positive aspects of collaboration and competition to advance knowledge, proving that the two are not mutually exclusive.

Another pattern is that each of these efforts creates communities that others necessarily sit outside of, and this usually leads to criticism from those parties. Other disciplines are critical of the amount of money spent on CERN or ENCODE. Some critics of Crossref focus on its roots as a publisher organization. Those journals not selected for inclusion in OLH are likely to be critical about the selection process. There is an outside and an inside, which inevitably creates tensions. At the same time, the existence of an inside and an outside is a sign of success. It means a community with shared goals is contributing to a coordinated set of systems.

Above all, the emerging pattern is one of a set of systems in which governance, financing, and incentives are aligned in such a way to build trust amongst user and contributor communities. This is achieved through ensuring sustainability, and through providing governance structures that help the organizations and their communities to work.

We will continue to return to the patterns for success and rules which support productive interactions and relationships throughout the book as we dive into four core issue areas for research communications - funding, governance, rewards and communication - broad enough to shape the larger story of Supporters.

7. Neylon, Cameron. 2017. "Sustaining Scholarly Infrastructures through Collective Action: The Lessons That Olson Can Teach Us." KULA: Knowledge Creation, Dissemination, and Preservation Studies https://doi.org/10.5334/kula.7.

Supporting Research Communications

Funding

The means of financing Supporter work is central to what gets done and how well research is supported. Here we broadly define funding to include the set of "inputs" needed to achieve a set of results. It is generally thought of as money or grants, but may also include other non-monetary support such as labor (paid or unpaid), equipment, or materials. The "results" we refer to include undertaking work, running an organization, completing a project, or delivering a service. Funding might apply to a single project with a concrete terminus, or to an organization that runs an ongoing service or set of services.

Those who provide such resources are loosely aggregated into a group we call "funders." While some commonalities exist between them, funders are not a monolithic group. They vary by mission, constitution (public versus private), organizational structure, budget, areas funded, geography, and other factors.[8]

There is a significant range of variation in these funders' policies and processes for seeking funding, including protocols for requesting funding, duration of funds, reporting requirements, and the potential for follow-on funding.

As a result of these differences, funders may adopt different approaches to achieving their mission and apply any number of mechanisms to supporting their funding recipients. Grants are a common vehicle for monetary support used by national agen-

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8.   The Crossref Funder Registry has records for more than 17,000 funders. https://www.crossref.org/services/funder-registry/

cies, non- and inter-governmental organizations, private philanthropies, private industry, and some professional societies. Universities and research institutes provide "funding" via personnel allocation or provision of facilities or supplies, and internal grants or awards. In some cases, users (researchers or others) "pay" into the system directly and contribute to funding by paying memberships, contributing software code, undertaking peer review (publications, grant review, conference submissions, etc.), time and labor contributions, and person-hours for other things.

As with research projects, projects that support research communications are also limited by funding availability and are at least partly driven by financial rewards, even if those are indirect. Most Supporter organizations, researchers, and project teams struggle with funding at some point and have strong opinions about how funding should work. Funders therefore are often the target of complaints. However, we want to focus on issues in funding here, regardless of whether the source of money is considered primarily a "funder." While many of these issues therefore do relate to funders, they should be considered more generally in the context of all those who finance support systems.

Current funding structures

Any support system needs to have either funding or a model for bringing in revenue. Here we focus on non-commercial organizations or projects since they are often most in need of support. In academia, this often comes from an external funding organization providing resources and financial backing to projects. While this works well for most research projects with a finite lifespan and clear end goals ("one-offs"), it works less well for groups successful enough in building a service that addresses

ongoing needs (those we consider part of the infrastructure of research communications).

Organizations often attempt to address the sustainability challenges by going through repeated funding cycles. Historically, funding bodies rarely award grants for infrastructure, primarily because demonstrating impact is challenging. (Also, return on investment in ongoing operations is difficult to quantify.) They end up cobbling funding in a piecemeal effort from multiple sources without any long-term sustainability plan. This precarious position is made more tenuous when taking into account the significant administrative overhead to secure and manage grants. In light of these factors, the fundamental uncertainty of the future looms large, directly hampering existing efforts. This is the problem of "sustainability" for infrastructure, as distinct from project funding.

Others have sought alternative routes to creating renewable income streams, such as membership models help to spread out costs. However, this has led to "membership fatigue" where parties relying on such services end up having to join and manage a bewildering number of memberships. It has also resulted in establishing or reinforcing exclusionary lines (insider-outsider boundaries), which can prove to be pernicious for infrastructure intended to serve everyone.[9]

Not only do resources face an ongoing threat from the same funders, but any change in funding source can create different threats. As such, organizations lack control of those factors which directly support their capabilities and therefore continually risk of loss of services. This results in a volatile environment, which in turn elevates the risk level for those directly and indirectly connected to them in the scholarly ecosystem. We enumerate a number of dysfunctions in how research communica-

tions projects are funded today, which lead to suboptimal support for research writ large.

Chasing novelty at the expense of what exists

There is more attention given to the new rather than to the familiar. This can particularly be an issue for funders with a mission focused on innovation or novelty, but can be equally true of spending from publishers, institutions, and research communities. In a world where research support systems depend on continued funding, critical systems can be unfunded so as to support the new service. Support systems that are growing in adoption can be in a race to grow too big to fail before they become too familiar to be assured of further funding.

A related problem is the tendency to seek out the most interesting, sexy projects that bring fame to the funding organization or individual funder. This tendency leads to a lack of support for some of the most critical aspects of research communication infrastructure, including maintenance, documentation, code reviews, quality checks, and other more mundane tasks that are critical for success but which do not capture interest. It also tends to result in individuals and projects seeking funding to tai-

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9. This problem has led to debilitating results. As noted, the loss of the National Infrastructure for Biological Information shut down due to lack of funding. Many smaller community efforts last a few years beyond the project that created them only to rapidly shut down when funding finally runs out. The community of Arabidopsis researchers faced a crisis when the project funding for the community data repository was cut. To save The Arabidopsis Information Resource (TAIR), the community gathered around to address the crisis, developing a new model based on membership subscriptions. This has assured the ongoing existing of TAIR but at the cost of some reduction of public access. In other cases, key resources have disappeared permanently or for an interval of time. In either case, the disruption and impact on research progress is massive.

lor their grant applications to what they think will be easily funded, and using scraps from these projects to undertake the less glamorous but necessary aspects of the project.

Supporting the familiar and locking in financial resources

The opposite can also be true. Once support systems become part of the background, and have their budget line in place, there is little impetus to tension that funding against newer options. If those systems financed by funders are most prone to the novelty effect, it is those with institutional backing, from publishers or research institutions, that are most prone to lock-in. The issue is less with the identity of financial supporters than with the modes of funding. Examples include subscription funding and membership organizations where the barriers to entry can make it challenge for newer players to challenge incumbents. Structural funding can be too safe and this can lead to stasis, or at least the tendency for supported organizations and projects to have a strong interest in protecting their revenue streams from new challengers.

Putting too many eggs in a single basket

A combination of both of these is also possible. Every few years a new star appears on the scene and often garners a large portion of available funding. This can limit the space for a more diverse set of explorations and experiments, lock in a particular view of how systems should be built or managed, or limit the development to the perspective of a single discipline or geography. But there can also be serious consequences. If projects become the center of attention, they may not obliged to develop strong sustainability and governance plans up front. Often these efforts will fall into the project-to-project cycle, but with larger projects

and revenue sources. The target then becomes too big to be allowed to fail. New experiments and efforts might be neglected and the pressures of fundraising can distract attention both from strong governance and taking a supportive role in the community, for instance by recommending the use of other tools or services. This scenario is most likely when a funder makes a large unilateral funding decision. Sometimes this is for a new player, but equally it can arise out of frustration. While success needs support, the role of a funder is also to ensure a healthy ecosystem that new efforts can grow from.

If little attention is paid to achieving sustainability, to being good community members, or to the broader impact on research infrastructure as a whole, this can produce an insular project that tends to focus on its own success and next funding opportunity. Typically this leads to a failure to promote the use of any tool connecting to an external platform for fear the project will appear weak. In the worst case, a lack of scrutiny and focusing of resources can produce a bad citizen that fails to comply with community norms or does so to a far too narrow community. Although this approach might certainly result in success, there is a real danger of creating a destabilizing impact on the long-term viability of other projects, tools, and infrastructures as it ignores the many existing efforts already established in the community.

Passing the buck

Who is responsible for providing monetary support for the projects and infrastructure that underpin academic research and its communication? Many funders are not interested in supporting infrastructure for the long term, taking the position that projects should have clear sustainability models in place that do not rely on grant funding. Researchers are often encouraged by funders and institutions to include costs associated with sharing

their work in grant budgets, however, this is often referred to as an "unfunded mandate" since budget sizes are not necessarily increased to accommodate these costs. Institutions are consistently low on funds and facing shrinking budgets, and are often hesitant to take on new fees associated with research communication. Finger pointing among these three groups (funders, researchers, and institutions) leads to a stalemate.

Working in silos

A problem for many funders, but also research institutions and publishers, is that their thinking is limited to specific disciplinary or geographic silos. The form of support systems is often defined by geographical boundaries more than functional needs (for instance the divergent systems of SciELO, Pubmed Central and OpenAIRE) or by disciplinary silos, which in turn are defined by funders (for example the divergent approaches of the National Science Foundation and National Institutes of Health in the USA).

Avoiding coordination

Often projects and individuals seeking funding are frustrated by the perceived lack of communication among individual funders, and rightly so. However, the many differences among funders (see above) make coordination challenging. This is problematic when diverse streams of funding do not focus work towards similar goals. Research is increasingly global, but funders don't have a mechanism to effectively bring international teams together or coordinate joint awards at the funder level.

Most community members agree that a more useful strategy would be for funders to coordinate with one another to achieve the most efficient use of resources; however, in practice, this would require an immense amount of additional work on the

part of the funders. The different approaches to grantmaking, variable grant time scales, and mandates to support different disciplines are among the most prohibitive issues for coordination. More complications arise from the fact that the largest funders in the US are federal agencies, whose staff are often prohibited from discussing internal processes.

Providing bridge funding via grants

As a matter of common practice, grants should be used to fund discrete projects that have identifiable short-term goals, rather than to sustain projects for the longer term. Often projects or organizations find themselves running short on funds, or projects wait until six months before funding runs out before beginning discussions about what happens next. Then they turn to funders to provide some interim funding (i.e., bridge funding). The intention of this funding is to sustain the organization long enough for them to establish a more long-term sustainability strategy. When the alternative to funding is for the project to collapse, funders are hard-pressed to turn the organization away. Too often, this bridge funding results in only a short reprieve before the funding again runs low.

Overlooking the hidden costs and contributions

Any honest accounting of project expenses relies on a real assessment of true costs. But too often, costs associated with supporting research communications are obscure. This may not be intentional, but it remains a widely pervasive practice and will continue without an expressed acknowledgment of its importance. One example of this is peer review where the validation and vetting process entails unpaid labor from experts (researchers and practitioners). Another example is costs associated with storage—of data, documents, and other digital materials.

More generally, maintenance costs are often overlooked. This needs to be a shared burden, and regarding it as someone else's problem, or treating it as a hidden cost to be ignored, is not good community practice.

Loss of community control

Researchers have increasingly begun to rely on third (often commercial) parties to provide them with "free" tools and services. But this route is also fraught because the interests of the third parties are likely to be out of alignment with the researcher. "If the product is 'free' then you are the product" has become a well-known refrain for describing the otherwise hidden trade-off using internet services that are free-of-charge. Use of these services often entails an implicit trade—the researcher hands over rights, or data, or metadata, to the service for unrestricted use, in return for being able to use the "free service". Rather than continuing to use free and easy solutions provided by these third parties, we need funds and investments in infrastructure with similar goals and aligned with the community's interest.

Better ways to fund and be funded as a Supporter

While our concern here is largely with the long term stability that provides trust in support systems and the work of Supporters, there are some changes that can also be made in short term project funding. We enumerate them in the first three principles below. Most importantly, the distinction between short-term and long-term arrangements should be clear. Alongside this project should deliver reusable outputs, and be encouraged to re-use existing systems. Supporters need to follow and analyze

how changes in project- and short-term funding are affecting our ability to deliver long-term sustainability and benefits for our user and contributor communities.

Long-term funding is equally critical as Supporters require stability and more importantly predictability over time. Often the approach is to stretch project-based funding models to fit by extending grant terms. However this can lead in some cases to renewal processes that are a formality, making it less of a grant and more of a subscription. Alternately this can lead to sudden death scenarios where funding that had previously been assured over the long term suddenly is cut off, sometimes due to external political or other issues at the funder.

A substantial change in funding mechanisms in the short term is unlikely. However we can say that where long-term funding is provided, it should support organizations, systems, or projects that are themselves configured for long-term sustainability. Funding needs to guide organizations towards sustainability in a practical way. Rather than simply withholding funding, or requiring sustainability, funders could provide a set of templates or shared principles used to test the progress of organizations based on community value and trust, reliability, and so on.

1. Provide input on what's needed

How should funding be allocated to ensure maximum benefit to the community? The individuals best poised to answer this question are community members—researchers and Supporters both. This may take the form of a group of individuals that serve as the central hub for information or a set of principles to which projects are expected to adhere in order to secure support (or both).

2. Create and share frameworks for identifying needs

Coordination requires frameworks through which different stakeholders can communicate. In the UK the government-funded Research Councils have a range of internal committees and processes through which they interact. By contrast, in the US, federal funding agencies sit under separate government departments, reporting to different congressional committees making any coordination more informal. Frameworks might take many forms and be more or less formal depending on context, but mechanisms for coordination can be very valuable.

3. Consider the bigger picture

Funders are uniquely positioned to think long-term and have a broad perspective on the ecosystem of projects and organizations. The greater good is sometimes served by a future-facing vision that may be difficult to achieve when working at the project level. Funders may increase their effectiveness by developing a greater awareness of how they support moves downstream, and what effects this has in the larger research environment.

4. Ensure time-limited funds are used for time-limited activities

Day-to-day operations should be supported by sustainable revenue sources. Grant dependency for funding operations makes them fragile and more easily distracted from building core infrastructure. Equally this requires that both project and ongoing revenue sources are available. Funders in particular, where they want to see membership models grow, should consider pump-priming activities, perhaps through becoming members.

5. Generate surplus

Organizations which define sustainability based merely on recovering costs are brittle and stagnant. It is not enough to merely survive - it has to be able to adapt and change. To weather economic, social and technological volatility requires financial resources beyond immediate operating costs. Funders need to allow for this and not reduce funding as soon as an organization reaches break even.

6. Create contingency funding to support operations for 12 months

Not all systems need to be designed to be sustainable in the long term, but they do all need to be designed to be closed down in a manner that will not disrupt the communities that use them. Exit strategies could include rolling up into other services, archiving, or being put into stasis until a new round of funding is obtained. A high priority should be generating a contingency fund that can support a complete, orderly wind down (12 months in most cases). This fund should be separate from those monies allocated to covering operating risk and investment in development. Funders could consider subsidizing such funds as a collective resource to pump-prime growing efforts.

7. Generate revenue in a way that is consistent with the mission

Potential revenue sources should be considered for consistency with the organizational mission and not run counter to the aims of the organization. Sustainability is of paramount importance, and so organizations need to seek channels for funding. But not all channels are equal and funding needs to come from sources and mechanisms that serve the larger community well.

8. Generate revenue based on services, not data

Data related to the running of the research enterprise should be a community property. Appropriate revenue sources might include value-added services, consulting, API Service Level Agreements, or membership fees.

9. Consider long-term stability

Collective funding models or shared endowments may represent more reliable models for sustaining certain services and projects. Furthermore, universities have a long history of supporting research infrastructure (libraries, equipment and facilities, information technology and other personnel support). Engaging these institutions may prove valuable in ensuring sustainability.

Conclusion

While many of these changes are the purview of specific players (funders and policy makers), Supporters in general have an important role to play in advocating for change as well as holding themselves to account where funding is provided. They review funding proposals and comment on their continuation. They seek funding for research efforts, often in competition with other Supporters. By holding themselves to a higher standard they can also encourage good practice by various players, and in particular where they interface with research and development communities who are developing the innovations that will underpin the next generation of support systems.

Governing

Supporters routinely work within the same governance struc-
tures as researchers, though not exclusively. Many models of
governance and differing organizational forms are observed,
some of which have been covered in the "Landscape observa-
tions" section. The processes of interaction and decision-making
within an organization play a direct and material role in its pur-
suit of fulfilling its mission. A core set of questions for any dis-
cussion of governance is based around the "community": who is
engaged, how they are engaged, what systems of rules and
obligations are in place, and what are the consequences and side
effects of community actions. As with the issues surrounding
how research communications are funded, a number of current
issues related to how these efforts are governed are highlighted
here, and suggestions for good governance are provided.

Current issues with governing

Insular governance

The research institution has traditionally been considered the
preeminent support structure for research. Historically, this is
because that institution has physically housed researchers, their
labs, and the libraries on which they depend. But as researchers
increasingly collaborate across institutions and countries, they
have come to depend on digital support tools that work across
these institutional boundaries as well. Governance of scholarly
communications projects has not always kept up with the new

era of interconnectedness and the siloed decision-making around these projects has become problematic.

This institutionally-focused governance can be seen in early attempts to address the serials crisis[10] through the promotion of open access, which tended to be institutionally focused. The institutional repository (IR) was viewed as a natural place for researchers to archive copies of their research outputs. When the institution's researchers balked, some institutions even resorted to mandates. But even these mandates met with limited success. One of the reasons for this is that responsibility for IRs has often resided with the institution's library—and in most cases the library has very limited influence on researchers and their behavior.

In contrast, disciplinary archives like arXiv, RePEc (Research Papers in Economics) and PubMed Central (PMC) have achieved far greater success. Institutions work with other parties to establish norms important to the success and uptake of these efforts. With arXiv and RePEc, the respective research communities (physicists and economists) had strong expectations that their repositories would be used and those who didn't conform to that expectation would face community opprobrium. In the case of PMC, funders set strong expectations that researchers should use the archive. Professional peers and funders have formal and informal, direct and indirect sway over researchers.

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10. The term serials crisis has become a common shorthand to describe the chronic subscription cost increases of many serial publications such as scholarly journals.
https://en.wikipedia.org/wiki/Serials_crisis

Project-based

Project-based funding has been the traditional path for creating and sustaining research communications support projects. For this type of work, the structure usually focuses on securing funding for a set of work and then turning attention inwards on project execution. This structure makes it difficult to build capacity for adoption-focused engagement to the broader community. To compound the issue as the projects progress, because the existing funds had been secured for previously defined work, project-governing groups usually lack the structure to adjust their scope or requirements to meet the needs of outsiders. This puts the focus during a grant period on the individual work packages and specifically on the administration for a specific "fundable" unit of work, rather than on the end users of the funding or the long-term sustainability of the project. This creates project-based "infrastructure" with a built-in hurdle which hampers it becoming true community infrastructure.

Better ways to govern as a Supporter

There are challenges when governing any project or initiative. Institution-focused governance, even when it is expanded into multi-institution projects, is frequently misaligned with those of the broader communities of users and contributors. Project-based projects may help a community to step at least partially outside their organizational structures. But they are time-limited by nature and the service is often separated from researcher needs as the focus is on achieving project goals.

Effective Supporters provide expertise, experience, and good models of operation as they enable the communication of research. Good governance is thus key, and constituent communities need a say. When a project or service forms a community

around it, it is time to adopt better processes of interaction and community decision-making. Such processes will need to support community governance and control, financial accountability, and to build trust.

Too often these perspectives are framed in terms of corporate versus non-profit. Our focus on community involvement and stakeholder engagement is not intended to equate to being anti-corporate. Commercial organizations have an important role to play in offering services to match defined community needs. Our point is that the researcher communities which drive particular forms of research communications should have a central role in governing the services they depend on and need to trust.

Finding a balance between different perspectives is important. In the following principles, adopted from the Principles for Open Scholarly Infrastructures[11] , we will focus our attention on the foundational support systems in which supporters have the greatest stake.

1. Coverage across the research enterprise

It is increasingly clear that research transcends disciplines, geography, institutions, and stakeholders. In the same manner, Supporters often work in ways that extend beyond those same borders. As described above, siloed approaches based on location (institution) and time (project) do not work well. If an organization itself does not have such reach, coalitions then become effective ways to achieve this and increase the footprint to bet-

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11. Bilder, Geoffrey, Jennifer Lin, and Cameron Neylon. 2015. "Principles for Open Scholarly Infrastructures-V1." Figshare.http://dx.doi.org/10.6084/M9.FIGSHARE.1314859.

ter align the service with the way in which modern research operates.

HathiTrust is a positive example. It was set up at the genesis of mass digitization projects from Microsoft, Google and Internet Archive. Instead of each institution building and governing separate silos, many joined forces to form a single, community-governed organization as a collective body to administer the digitization process, to preserve all resulting digitized content, to work closely with commercial entities, and to ensure the open availability of the content to bibliometricians and researchers. It was this cross-enterprise alliance of commercial organizations, librarians, and researchers around the world that has ensured what could have been a single project has instead become long-term, open provisioning of support services.

2. Stakeholder-governed

It is essential to build governance structures as close to the constituents as possible. This is the only way to clearly align with an audience and conduct consistent user-focused decision-making.

A good example of such a project is DataCite. DataCite is a membership organization that issues DOIs for datasets, software, and other non-traditional research outputs. They run a system expressly developed to support data citation and discovery. At the time of its creation, Crossref already existed in the publishing space. The two organizations have similar mandates, DataCite's core stakeholders were not publishers. Instead, they represented data centers, research projects, and national libraries. To ensure that the services represented organizations they serve, DataCite formed a board with members from across the data landscape to make sure their stakeholders were repre-

sented. This was key to ensuring the unique needs of the data community were being met.

3. Non-discriminatory policies

For supporter efforts to work, organizations need to follow a clear policy of non-discrimination. The process of representation in day-to-day governance must also be inclusive and reflect the demographics of the membership so that all stakeholders who express an interest should be welcome. Special rules made for special groups only codify dysfunctional interactions that become barriers to working together. This isn't to say that rules cannot apply to stakeholder i.e. membership fees/models. However, rules that do apply must apply to all stakeholders (including price/charges).

ORCID illustrates this well. While ORCID Inc. works to integrate as many universities and tools builders as possible, they have remained clearly driven by their core stakeholders (researchers). They maintain a consistent threshold of participation for researchers. The same is true for their technology integration partners. All partners have access to the features and service guarantees.

4. Transparent operations

For Supporter projects to be successful, the organization's governance must be seen as trustworthy. One essential way to achieve this is through transparent processes and operations in general. Organizations should select representatives for governance groups that will support transparency, and all work should made available to the stakeholder community to ensure alignment of organizational direction. (Limited exceptions such as privacy laws may apply.) This can be a challenge, especially for organizations housed within the private sector, government

agencies, or academic institutions. Many times these groups are not transparent and/or resist the openness that creates trust.

With transparency, community decision-making capabilities are strengthened when the organization's operational direction is considered. Without transparency, they are compromised. This occurred with the recent transition of PURLs (Persistent URLs). The governance structure was not close enough to the users of PURLs, and the operations were too opaque. When the service required support and needed a new home, the community was not adequately equipped to assist. They could not see how these decisions were made and the parties who made them. As such changes seemed strange, the community's trust in them suffered.

5. Cannot lobby

To amplify trust in Supporter projects, there must be a clear differentiation between the organization and those who take part in the projects or the community they serve. One area where this plays out is in political lobbying. While it is important for communities to voice their opinions and advocate for regulatory change, an organization's role is to provide a base for others to work from. It remains the responsibility of the underlying community to support the creation of a legislative environment that affects it.

This principle may not be universally applicable to all Supporter projects, say those which directly entail regulatory change. But where it does, it has caused severe trust issues in the past. One example was the role of the American Chemical Society in lobbying to close down PubChem[12]. It is unclear whether the underlying community would have agreed with the interests of the society itself to oppose the creation of a new publicly funded database. Such political acts run a very substan-

tial risk of splitting the constituent community and undermining community trust. The risks are even worse when such lobbying is done in places where the community is expected not to notice. Those organizations which provide strong value can rely on their constituencies to advocate for regulatory change on their behalf, rather than diverting time from provisioning their service(s) to do so themselves.

6. Living will

A common issue with institutional and project-based governance structures is the lack of long-term planning. Institutionally-governed Supporter services often rely on the longevity of the host organization. The latter does not directly translate to the longevity of the service itself, even while it is essential to have the support of academic and government institutions in the research communications support space. In addition, the grant cycle exacerbates the situation in project-based structures and leaves little incentive for long-term sustainability planning.

A living will for each Supporter organization can serve as a powerful vehicle for creating trust. It publicly describes a plan for addressing the condition under which an organization would be wound down, how this would happen, and how any ongoing assets could be archived and preserved when passed to a successor organization. Successful examples of this exist throughout the preservation space where back-ups and redundancy are commonplace. Preservation repository networks like LOCKSS (Lots of Copies Keeps Stuff Safe) and DPN (Digital Preservation Network) have clearly laid out succession planning for the oper-

12. https://osc.universityofcalifornia.edu/2005/05/american-chemical-society-calls-on-congress-to-shut-down-nihs-pubchem/

ation of preservation services. This is essential for new organizations which rely on this infrastructure because it signals that all involved will honor this same set of principles.

Conclusion

Supporters can also bring experience of what happens when one governance model has reached its limits. Projects and services have life cycles in which they develop, grow, and ultimately come to the end of their lives. Many start as research projects then become adopted by an institution, or are spun out into community organizations. Because Supporters need to operate more effectively and efficiently within the research community but also provide support for research in ways that touches many other communities, they need to be highly sensitive to the appropriate models and requirements for governance. To be successfully aligned with the research enterprise that is served, governance structures need to be reframed. Too often the focus is on institutions or grant-funded projects to drive governance. Instead, Supporters can create structures that are transparent and open to different perspectives, with missions that are supported by agreed-upon rules created and understood by the community.

Rewarding

The system by which researchers receive credit for their work underlies the entire scholarly endeavor. And research communications are at the heart of this: researchers progress their career by sharing their findings with their peers. Activities and outputs that are not shared are not valued. The rewards and incentives in the research systems are the social complement to financial and economic constraints and motivations on one side, and the formal limitations, regulations, and powers provided by governance on the other.

By virtue of their specific role in enabling research communications, Supporters *per se* are not explicitly involved in rewarding researchers. (As explained in the Preface, Supporters are made up of a vast group, including funders and research institutions who do directly reward researchers as part of the broader set of functions they serve, including funding, awards and prestige, jobs and promotions.) But Supporters are materially involved, because research communications form a significant basis of the rewards system. An object, process or claim cannot be valued and rewarded if it is not communicated, or at least visible to the rewarding community. Supporters gather, store, and disseminate these objects. They count them or evaluate them in some form. They report on those counts and evaluations.

To understand how this system came about, let us return to the original motivations of researchers when entering into the profession. For some it is a burning desire to cure a disease, or to try to change society by exposing injustice. For others, it is a baser need to satisfy their curious minds, or to simply advance

knowledge wherever there is opportunity. Or for a busy clinician, it may be a requirement foisted upon them by their hospitals to publish research to advance their careers - perhaps despite having no time to do the research or training in how to perform it.

These differing motivations - some intrinsic to researchers, some imposed from outside - are all susceptible to distortion. Someone who wants to cure disease will need to show advances along the way to justify continued funding, which can lead to over-inflation of their findings. Those just interested in asking questions might look for the question that has the most opportunity for funding, regardless of interest and, often, expertise. Those subjected to systems focused on the individual may seek to maximize their individual credit for collective work. And those expected to do research when they have had neither training nor time, may turn to nefarious means, including plagiarism, data theft or paper mills.

Supporters do not aim to "change researchers" as their ultimate aim, but they are often at the sharp end of seeking to change practice and behaviors. Supporters operate many of the systems (publishing houses, archives, libraries) that are at key touchpoints and they understand that incentives and rewards matter. They understand that they are tightly coupled to the traditional modes of sharing - in many ways the more traditional, and therefore the more coupled to our existing legacy publishing processes, the better. In some cases Supporters may be tempted to conflate the proximity to these levers with the power to change the system. The work Supporters do, however, helps them to understand the complexities that researchers face, and to appreciate how their own systems parallel those of researchers, what tensions there are, and how to address those tensions, where possible by improving the systems of both Supporters and researchers.

Current incentive structures

The importance of incentive structures lies in their power to or-
ganize and shape interactions between the many players in-
volved. Research communities can differ widely in what they re-
gard as important and what they reward. Since financial incen-
tives are strongly coupled to social incentives, funders are clear-
ly important. Furthermore, the individuals within these commu-
nities are based inside institutions made up of relationships
which offer some level of consistency across their staff and in-
ternal divisions.

Very few incentive structures are designed from scratch.
Rather, they come about by means of a need to create shortcuts
and proxies for people too busy to spend the time needed for
research to be adequately assessed. The measure has become
the reward. The Journal Impact Factor, for example, was de-
signed to be a tool to inform librarians about the relative impor-
tance of journals in a field when making their subscription deci-
sions. Now journal impact factors have become a currency for
which research is performed. Despite being a broad average of
the rate of citation of a particular journal, these factors are now
a proxy for the quality of any one paper within a journal. It is not
uncommon to see researchers listing the impact factor of the
journal they have published in their CV, despite the glaringly ob-
vious fact that the average citations of a journal have almost no
bearing on the number of citations any one article will have.
Similarly, for a humanist, the question may not be "who has read
your book" but "who published it", with the publisher standing in
as the mark of quality.

The problem with journal impact factors, journal title, or pub-
lisher name, as a proxy of quality is well documented[13] and ef-
forts are underway to find alternatives. But these alternatives

are often tweaks to the system of citation counting, or predicting future citations, rather than considering more fundamental changes to the way in which credit is assigned. The purpose of citation should not be to assign credit to other researchers, but rather to simply provide evidence in support of a claim. The fact that refutations are counted in the same way as confirmations when citations are counted up, shows the potential folly of the existing system. Some papers published in high impact journals are cited many hundreds of times by authors feeling the need to refute the claims of a highly publicized article, yet every time these negative comments cite the original work, the author's H-index goes up.

And so the incentive to demonstrate high citations leads to some interesting and extraordinary behavior in researchers. Some use their capacity as reviewers or journal editors to recommend additional citations to their own work. Others form "citation cartels" across multiple journals as a means of getting around the newly adjusted Thomson Reuters/Clarivate practice of removing self-citation from the Journal Impact Factor. Other practices include journals deliberately publishing controversial work knowing that the resulting debate will increase citation counts.[14]

13. Brembs, Björn, Katherine Button, and Marcus Munafò. 2013. "Deep Impact: Unintended Consequences of Journal Rank." Frontiers in Human Neuroscience 7. https://doi.org/10.3389/fnhum.2013.00291; Moore, Samuel, Cameron Neylon, Martin Paul Eve, Daniel Paul O'Donnell, and Damian Pattinson. 2017. "'Excellence R Us': University Research and the Fetishisation of Excellence." Palgrave Communications3 (January): 16105; Brembs, Björn. 2018. "Prestigious Science Journals Struggle to Reach Even Average Reliability." Frontiers in Human Neuroscience 12. https://doi.org/10.3389/fnhum.2018.00037.

New measures, old practices

The more fundamental question raised by the focus on citations is the way that we continue to reach for systems and approaches rooted in journal and book publication to support new forms of research communication. The focus of current efforts on data and software citation is to transplant existing reward systems into these new spaces. The challenges that arise from this raise some important issues and supporters have an important role in bringing expertise relating both to the characteristics of these new forms of communication and to the issues and challenges of the traditional measures and incentives.

Our tendency to reach for familiar solutions, such as citation, centered around journal publication, runs the risks of recapitulating the problems that we have seen in publication. The economic incentives for service providers are to grow towards monopoly and control the flow of information so as to maintain market share. But countervailing interests have pushed towards a greater diversity of outputs, modes of evaluation, and ways of communicating the value of what we do. These issues can also be seen in the growing area of alternative metrics. While early enthusiasm for how a diversity of new measures based on social and formal media has faded a little as the hard work of understanding what these measures can tell us has progressed, the adoption of these numbers into the arsenal of quantitative evaluation has proceeded apace.[15] As with citations, the problems of

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14. See for example: Heneberg, Petr. 2016. "From Excessive Journal Self-Cites to Citation Stacking: Analysis of Journal Self-Citation Kinetics in Search for Journals, Which Boost Their Scientometric Indicators." PLOS ONE 11 (4): e0153730. https://doi.org/10.1371/journal.pone.0153730; Davis, Phil. 2016. "Visualizing Citation Cartels." The Scholarly Kitchen (blog). September 26, 2016. https://scholarlykitchen.sspnet.org/2016/09/26/visualizing-citation-cartels/and references cited in (11) above.

applying apparently objective numbers in appropriate ways have already started to creep into research evaluations within universities and some funding agencies. Again, the problems raised by the uncritical use of measures based on opaque or unavailable data, processed through unknown means into scores that may or may not be meaningful is well rehearsed.[16]

Focus on the individual

The fundamental problem most frequently raised with reward structures remains the focus on the individual and the contributions to novelty. Collaborative and collective work, the work of maintenance, and of filling in the gaps, are consistently undervalued. This is evident when the appropriation of citation counts for co-authored works translated into personal measures such as the H-index or lifetime citations. It is also seen in the way that funding decisions and awards are announced.[17] And it is visible in the fundamental structures of our institutions. Researchers are appointed to personal positions, in which they direct groups. Projects may be collaborative but they always have a "lead". Indeed projects with more collective management structures or research groups with multiple leads can sometimes be viewed as suspect. Often this is a tension where a research project becomes a support system and needs to be handed over to managed in the longer term by a team.

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15. Haustein, Stefanie, Isabella Peters, Judit Bar-Ilan, Jason Priem, Hadas Shema, and Jens Terliesner. 2014. "Coverage and Adoption of Altmetrics Sources in the Bibliometric Community." Scientometrics 101 (2): 1145–63. https://doi.org/10.1007/s11192-013-1221-3.

16. See (11) and (12) above

17. https://twitter.com/tomgauld/status/808268915335897088

Rewards, awards, positions, and prestige accrue to individuals in the research world. Collaboration is often a value that researchers hold, and the value of meeting and exchanging ideas is highly regarded. But at core, the research world revolves around individuals. Supporters are not going to change this directly, but can be aware, in the systems they build and manage and in the ways in which they operate, of how this plays out. They also need to be aware that they are just as guilty of these behaviors as researchers.

Better ways to reward as a Supporter

While the broken incentives system can also seem to be a broken record in Supporter conversations, the frequency of these discussions is also a reason for optimism. Research communities, institutions, funders, and governments are engaging actively with these issues. The myriad of reports and expert groups offering guidance, while confusing, is a positive development. The growing availability of new proxies for the reach and use of research, in particular beyond the academy, is also encouraging. Supporters are involved in many aspects of this process, from managing the objects being evaluated, to working with researchers to make them more useful, to doing the counting or acting as experts on what indicators are available and how they can and should be used. The challenge lies in providing systems and processes that help to keep the focus on the values, not the measures.

Support new modes of sharing

A primary driver of the incentives structure is, of course, money. As a result, funders have been under the most pressure to change reward systems, and they have done so with varying levels of success. For example, the lack of availability of data under-

lying research papers has long been known to be an issue both for the lack of reproducibility, and the lack of meaningful follow up research in a particular field. And so a number of funders now require a Data Management Plan (DMP) to be submitted alongside any grant application. But if publication is the unit of currency for scholarship, and all the while usage statistics, citations and impact have been criticized as perverse incentives, what other options are available?

Supporters can think more purposefully about how the systems built for new modes of sharing support richer and more nuanced evaluation and therefore rewards. Being aware of the pitfalls of existing systems facilitates better design for each iteration or each new form of sharing. Too often, technologists focus on building a new system without considering how it will be used as part of a broader systems of communication and formal evaluation.

Pay attention to community differences

An important recurring motif in this guide is sensitivity to the differences between communities and the modes and mechanisms in which they communicate their work, and the relative importance of each, whether those are disciplines, stakeholder groups, and geographies. There is a tendency to talk about a single "scholarly community." Even the assumption that researchers can be treated as a single group is dangerous. There is substantial diversity within all of these communities and across the different stakeholder groups. The incentives, rewards, and outputs can be very different for different communities. Those differences need to be understood and discussed, and the common patterns and principles need to be identified. There are shared values and goals that may be important. Scholarly and support communities share goals of advancing knowledge, and often these are celebrated across group boundaries.

In the context of the link between incentives and communi-
cation, a good way to identify differences is in the valuing of
outputs. Which outputs are considered important and which are
valued by differing communities, as well as how they are valued,
do differ (c.f. State-standing paper). In some disciplines, re-
searchers are rewarded for early sharing of documents. In some,
this reward is only conferred to those considered final outputs
after peer review. Some disciplines value data sharing or code
sharing, and mechanisms for usage tracking and evaluation of
importance may be useful here. Others, including large swaths
of the humanities, resist the notion that "data" is something that
they deal with at all.

Understanding the rewards and incentives that an individual
perceives requires their examination in context in a community.
Collective benefits often arise from coordination that emerges
from cultural roots, viz. community members adopt common
practices because they want to show they are part of a commu-
nity. Engaging in peer review is one example of this at a large
scale, but this occurs at all scales from disciplinary communities
that adopt a standard to research groups with an in-joke, spe-
cific mode of record keeping, or traditional form of celebration.
If communities are defined in large part by shared tensions or by
the differences they perceive between themselves and other
communities, then performing the "repertoire" of their home
community is important.[18] This class of practices, which arise as
part of building identity within a community, and how they re-
late to incentives and rewards, are under-explored and not well
understood.

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18. Ankeny, Rachel A., and Sabina Leonelli. "Repertoires: A Post-Kuhnian Per-
spective on Scientific Change and Collaborative Research." Studies in History
and Philosophy of Science Part A 60, 2016: 18–28

Encourage use of existing systems so as to avoid waste

When building incentives for researchers, consider the amount of resources wasted while encouraging the development of new systems. The focus of funders is traditionally on new innovation, rather than on sustaining and maintaining well-used systems, which is in turn reinforced by and reinforces the individual focus on attention and prestige. If the mode of apportioning attention is centered on individuals, and this in turn drives the assessments tied to resource allocation, which drives more attention, then the system as a whole is structurally biased towards the building of local systems. These systems may be locally applicable, but will likely not be either sustainable or indeed well built.

In addition, the mode of funding and the focus on the provision of generic research labor (such as research assistants, graduate students, and postdoctoral contract researchers) also contributes to the tendency to build locally. PIs frequently allocate grant funds on research labor to address issues of "plumbing" that arise. While expensive, labor is likely to be the most flexible resource within the context of any given active project. A classic example is that of locally-built scripts that process and manipulate digital data. These scripts underpin a massive amount of the data processing that underpins scholarly publications today. Yet they are rarely validated, poorly documented, and often the product of generations of tweaks by highly skilled researchers with no real experience in software design.

Supporters can change this phenomenon and push researcher choice and engagement in a direction that moves towards shared understandings and shared systems which can enable validation, dissemination, and reuse in other contexts. This

rebalancing implies a shift between abundant resources (generic labor) and those that are scarce (time to deliver the immediate project needs). It also affects the way in which rewards are coupled to very specific sets of outputs. Diversifying output types is one way forward, but as noted, simply "observing" new forms of outputs does not necessarily make them "count" as far as any specific community is concerned. There is need to more closely examine how funding streams operate (i.e., types of activity funded) and how they are allocated (i.e., who or what is funded) as they reinforce the focus on individual, short-term rewards and incentives or more collective, long term benefits.

Acknowledge group efforts

For many researchers, rewards are focused on individuals. Sharing the glory, or simply putting the effort into building the trust in a collaboration, can be an issue for a research group but also for a research institution. In a world where authority and prestige are driven by attention, whether that is attention in social or formal media or in the scholarly literature signaled by citations, few incentives exist for working with others, or with existing standards or system. The objects of concern and the ways in which they are valued may differ, but the underlying issue, that of a focus on individual success rather than collective benefits, remains.

Similar to incentives that encourage sharing, Supporters can consider incentives that take into account the group nature of doing research. Rewards are often focused on individuals and on achieving prestige. This can be as true for an editor, infrastructure provider, or funder as it is for a researcher. While the choice to adapt existing systems in collaboration with others or build an entirely new one will endure, Supporters can attend to the potential benefits of the former in the manner in which

their role enabling research communications shapes the behaviors of researchers.

On the flip side, Supporters are just as prone to these same issues driven by a focus on individual rewards rather than working collectively. To be seen as the architect of a new system or process, to get credit for an innovation in editorial workflows or technology, is as much a driver for Supporters as it is for the individualistic researcher. Systems, both financial and incentives-based, are needed to encourage Supporters to engage more fully with others on what has already been done.

Conclusion

Incentive structures are based within this context and on items that can be counted. At the moment, rewards are based on traditional outputs and traditional roles such as citations and authorship. However, Supporters can improve this. They can invest in promoting or building new systems that support a variety of research outputs and account for the variety of contributor roles.

Communicating

Introduction

Language is an important part of any community; shared language defines who is "us" and who is not. This is a challenge for the community interested in research communications, precisely because we all come from different places and use differing language. In the context of research content, when we say two things are the same, we are actually talking about the same pattern of bits replicated in two different locations - not the exact same memory addresses on the exact same machine. When we use phrases like "identical" and "the same", we clearly do not use these phrases literally. These phrases are a shorthand for saying - "for our particular purpose these things should be treated as interchangeable."

It is ironic, but true, that Supporters are regularly challenged to communicate with researchers and non-researchers alike about the communication of research. While they understand the complexity of the research process, they struggle to find the appropriate terms to describe the complexities of the situation. It is through these challenges that Supporters can they "prove their worth." They are translators and implementers but they do more than convert words and give meaning. They also embrace complexity and give context. This means understanding when to use language that is more nuanced and context-dependent, but also when to embrace generalities. The question of their particular purpose both involves what it is that is being done by Supporters, and who they are talking to about it.

Current language structures

Supporters regularly discuss the importance of outreach to researchers, and routinely misdiagnose the problems of research communications and/or solutions through the use of shorthand phrases for complex issues. How ironic that the language Supporters use to communicate would play a role in failures in research communications! Terms that signal equivalence between two objects are often used even when they are not literally the same, and despite some awareness of the complexity of the scenario and its importance. Here are a few examples:

Example 1

Data has to be shared to ensure research is reproducible. If a researcher had a result that relied on a computation, and they handed you a binary to which you could provide the same inputs, and it returned the same outputs, then would you have technically "reproduced" their result? And what does that "prove?" When people say they want science to be more reproducible, what is generally meant is that they want researchers to show their work and show how outputs were produced. When the term "reproduce" is used, all research is reduced to an unrealistic picture of plug and play equations when, in reality, "reproducibility" requires that a second researcher or research team must follow the logic and process of an earlier researcher, and with very closely similar outcomes achieved, validates the conclusions/assumptions underlying the original research. To truly express these kinds of aspirations, research communicators must focus on the showing of work and validating of the researcher's process.

Example 2

An article can be cited in XML, EPUB or PDF formats because they are "all the same". When we say two or more file formats for the same content are "the same", what we mean depends on the purpose of comparison. If, for example, we are checking to see that a binary application has not been tampered with, then "the same" would mean that we should be able to calculate the same hash value for each copy of the binary. On the other hand, if our purpose is to check the wording is the same, or to cite the article, we could be reading either the PDF or the HTML version of the article and it shouldn't matter. Furthermore, if we are discussing the line numbers of a flowable EPUB or HTML document versus a paginated PDF, it's all relative - the "same" page can be differently numbered but the text will be the same. The challenge arises when we get into the complexity of formats of record, reference, and citation. There are times when the context of citations carry the intended meaning, and there are times where the two files being byte-identical is intended.

Example 3

Publishing issues can be resolved with this new preprints server. At a purely brute level, the meaning of a "preprint" is clear across disciplines—it refers to documents made available prior to submitting to a publisher for formal peer review and consideration for publishing. The term "preprints" has caused a great deal of controversy, however, partly because the term embodies both "state" (not yet published) and standing (what level of reliability one assigned to it). The term "preprints" is overloaded in different disciplines (X has become synonymous with Y). For example, historically, when 'X' has been preprint and the context is "the life sciences", then the term preprint serves as a shorthand (Y) for "un-vetted" along with the unvoiced caveat emptor. On

the other hand, that same X in the context of Physics or Economics means something quite different. In this case Y establishes the priority of claims and discoveries and indicates that the content "is considered appropriate for discussion and thus citable." Basically, challenges arise because the language used is not sophisticated enough. Terms are conflated by talking about "state" (X) and meaning "standing" (Y). In the case of preprints, this is tricky when discussing innovation opportunities in publishing.

Example 4

All data management plans (DMPs) should be machine readable. However, the term "machine readable" is often confused with the term "machine actionable".

The term "machine actionable" refers to information that is structured in a such way that computers can be programmed against the structure. But the term "machine actionable" is often used synonymously with the term "machine readable." This is problematic considering the criteria for making something machine "actionable." The first technique is to make data "machine readable" and the second is to make data "machine identifiable." Machine readable is often very complex and expensive to implement while machine identifiable can often be done simply and inexpensively. This is because machine readability is designed to handle complex use-cases with open-ended rule-sets, while machine identifiable is designed to handle a discrete set of pre-defined use-cases and rules. In most cases, we mean "machine actionable" though we revert to language that signals a more expensive option.

Better ways to communicate as a Supporter

An honest appraisal shows that Supporters are pretty terrible at communicating overall. They use impenetrable acronyms, local jargon, and common words in uncommonly specific ways. They do this to mark territory internally (ex: "Do you favor XML or JSON, did you come from technology or from the library?") and also to show the importance and complexity of their work to outsiders. There will always be some exclusion, but Supporter work is to connect and translate, and to do so with accuracy and integrity.

Greater importance needs to be placed on communications, both internal and external. After all, communication is key both to the Supporter role and to the idea of being a community. In some ways this is not new, the challenges of "reaching the researcher" or "engaging users" are ones that Supporters deal with on a regular basis. Particularly those in academic libraries, in data management support roles, who are in contact with researchers, both junior and senior, on a regular basis and who know that precise and contextual communication matters.

Avoid simplistic sloganeering

The discussion of "reproducibility" is a good example of this. It is hard, at least in the sciences, to argue against the concept of reproducibility in the broad sense. It is the founding value of empiricism. But, as noted above, its meaning in computational sciences is very different from that in experimental sciences. Even within each of these, there is a difference between directly repeating a process or re-implementing a similar process. In the charged political environment of the research community, the important details of what matters in a particular case can be

lost. Worse, whole disciplines can be left out of the discussion. The importance of laying out a clearly constructed argument, and marshaling the appropriate evidence, is just as important in the humanities as it is in the sciences. But a focus on "reproducibility" with a discussion of tools and techniques can easily exclude valuable contributions from other disciplines.

Employ precision in speech

By its very nature, terminology comes into being when there is a generally agreed upon meaning within a group of speakers. And it is imbued with the underlying values of that community. Often these terms are used across communities, however, and the object which the term refers is mixed up with the respective, unspoken values of each party. This leads to confusion and worse yet, emotional conflict, when the discussion gets into normative waters (what "should" happen, what "ought" to occur). The term "preprints" is one such example.[19] Different disciplinary communities can better express what they care about by focusing on the "state" of a research object, the characteristics it has and the processes it has been through, and separating this from its "standing", the value granted to it by specific communities. This is actually quite general for the examples covered above. Supporters can often have a much more precise conversation by talking about the affordances of a system or object, that is, what can be done with it, and separating that from a discussion of who cares and what value they give it.

Supporters can have more deliberate ways of speaking that distinguish the characteristics of the object, its "state", from the

19. Neylon C, Pattinson D, Bilder G and Lin J. On the origin of nonequivalent states: How we can talk about preprints [version 1; referees: 2 approved]. F1000 Research 2017, 6:608 (doi: 10.12688/f1000research.11408.1)

subjective "standing" granted to it by different communities, and that will also be more sensitive to the difference in practices between communities. These will allow them to deliver more productive conversations and facilitate negotiation, as well as sharpening the focus on the role of different stakeholders or how to collectively improve the process of scholarly communications not only for preprints, but also for other forms of scholarly contributions.

In each case, Supporters are called to be more precise in speech about what something is and what it can support, and to be more aware of who cares. As has surfaced regularly in this book, this is a question of both appreciating what is common and held to be important across research communities, and what is different. In this case the sharing of some research outputs and some expectations of their discoverability and utility, is a commonly held value. All researchers "publish" in some sense. But which objects count, and what they are expected to do, differs widely across communities.

Translate and define

Supporters often play the role of translator. They sit between research communities or between stakeholder groups with widely different language styles. They bring their own language - native and any number of those adopted - into this function, based on the communities they have been a part of. They are well poised to be attentive to the ways in which language is used in the context of research communication.

To turn language an effective and powerful tool, rather than a blocker or even worse, a destructive force, Supporters can collectively develop, define, and use common language in their interactions with others. Taking greater care of the precision of the language used and the important characteristics of various

objects and systems referred to, Supporters can help associates to articulate ideas more accurately and think more clearly. This would contribute positively to the day-to-day support for researchers.

Conclusion

The challenge for Supporters to communicate well and to facilitate effective exchange of information is no more difficult nor any more facile than for any other group. Language - slippery and malleable - can obscure as much as it can illuminate and catalyze positive change, and precise and contextual communication matters. We all need to expend more effort on our language: avoiding simplistic sloganeering, employing precision in speech, taking care as we translate and define ideas in our engagement with researchers or others who support scholarly communications.

A way forward

As we have attempted to illustrate throughout this book, Supporters come from any number of groups, including researchers, funders, libraries, data centers, publishers, and research institutions. This set also includes a whole tranche of tool builders from large technology and service providers to individual app makers. Increasingly the community of Supporters stretches beyond the traditional research support system and includes lay collectives such as citizen scientists and patient advocacy groups. This diversity is a given reality, and a strength as well as a challenge. In this closing chapter, we propose ten values for Supporters. If everyone embodies these values, the closer we get to the ideal vision, a "utopia." If no one (or too few) followed them, we would end up in a dystopian environment. In light of these scenarios (made more extreme for illustrative purposes), we invite all Supporters to consider how these various recommendations would operate in their organization. And to join us in taking up the values in their work, making the small changes that can make a big difference in aggregate.

Research community values

In truth, the sheer size of the global research enterprise demands myriad players to support all its myriad functions. Between these parties, there are numerous complex interactions, each of which enable the research enterprise in a very specific way. A single centralized service may be effective for the global foundational infrastructure needs (e.g. ORCID), but a more distributed arrangement may be beneficial at other times, especially where local needs prevail (e.g. disciplinary data repositories).

The metaphor of an ecosystem is useful in the context of such natural heterogeneity. In a vibrant ecosystem, members are able to self-organize, expand, change functions and traits, coevolve with others through competition and cooperation, adapt to changes in the local habitat or at large, merge with others, and undergo speciation. An ecosystem mindset takes an overtly integrative and holistic perspective. In contrast, an organism mindset is one that thinks of an organization as a bounded entity, complete unto itself. While individual functions might place us in a silo (geographic, institutional, disciplinary, or otherwise), this form of group identification is harmful once it makes us blind to others. If we are aware of our own identifications as well as those of others, we can better understand how to move away from discrete, isolated approaches to tackling the solutions which often lie inside as well as outside the organization. Many individuals in the ecosystem work with multiple groups and take on different roles in their organizations. An ecosystem mindset builds awareness of all the interconnected bits so as to not inadvertently undercut the efforts of other groups (or your own when you wear multiple hats).

Tension will always exist between parties, but this can reflect a healthy and resilient ecosystem. Competition, conventionally taken to be made up of zero sum interactions, may be useful as long as it's open and doesn't incentivize secrets. It doesn't square easily with collaboration. This tension between single/multiple approaches is a part of a healthy and diverse ecosystem. This metaphor is a powerful way to understand our workspace as being comprised of a wide group of different members who support research together while being separate entities. Some may ally with each other (e.g. coalition) without necessarily agreeing on every term and condition (e.g. consensus). Tension also exists for members when deciding between community relevance versus building a "universal" system, i.e., whether to build a service for single project (custom-fitted, perfectly adapted) or a global and consistent underpinning infrastructure that benefits everyone. But at bottom, diversity is essential to the health of an ecosystem over time as it increases productivity and stability, decreases risk, and increases sustainability.

While the Supporter community is not a homogenous group, it remains united around common interests in pursuing this vision. As noted previously, viable communities must abide by certain rules and shared conventions in order to advance common interests. Shared social norms and values are at the basis of the community's interactions. To help steer the Supporter community towards a more productive and effective path, a set of ten aspirational norms and values is offered. Rather than put forward a list of prohibitions, these describe a positive view of what is possible.

These shared values are built from the authors' experiences and find inspiration from many places. The first few are loosely inspired by Robert Merton's canonical four norms for doing modern science: universalism, communalism, disinterestedness,

and organized skepticism.[20] The conduct of research as an analytical methodology for self-critique is broadly applicable and also germane to the work of those supporting the scholarly research enterprise. These values are followed by others that apply more directly to the nature of the undertaking as well as to the relationships between the various players in this community.

1. Be as open and transparent as possible

While those who work in scholarly communications may value openness and transparency as concepts, these two words also act as rallying cries. To the research community, these are not empty statements or passing fads. They are not single aspects of our work or principles used for our side projects. Instead, they are guiding principles and undergird the shared values that define us as a community.

  "Open" and "transparent" are not simply words describing ways of partaking in the mechanics of Supporters' work. These values offer a structure for conveying the underlying principles for how our work is done and what is valued. To put it simply, Supporters "show their work." That is, for Supporters, "open" is the default behavior in research communication because it enables trust, re-use, and better communication of ideas. "Transparency" is the default behavior because it creates a collective value that benefits the broader ecosystem without necessarily precluding personal or organizational gains. Put together, these offer a process for helping decisions, projects, conclusions, statements, and such like to be fully understood by the widest

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20. Merton, Robert K. (1973) [1942], "The Normative Structure of Science", in Merton, Robert K., The Sociology of Science: Theoretical and Empirical Investigations, Chicago: University of Chicago Press.

possible audience. They are the guide to action and the code of conduct Supporters strive to live by.

Regardless of the organizational structures in which Supporters work, they look to utilize the input of stakeholders and form broad coalitions to move projects forward. Regardless of the funding models, Supporters look to create long-term sustainable projects that can earn the trust from the research community for the long term. Regardless of the intellectual property perspectives, they seek to make all research content as broadly available as possible and to follow the same rigor that is expected from researchers. They want to show their work, expose their decision making, create accessible audit trails, etc. because they want to showcase the evidence behind our decisions and conclusions.

2. Practice what we preach

In the preceding chapters, common scenarios from the research communications space were examined, and how the Supporter community can find better ways forward was considered. Too often Supporters are stuck thinking about the benefits to a single project or person or institution when there is need to be thinking bigger. Supporters are change agents within a shared interest group working towards better research communications. The bigger picture needs to be kept in sight as a context for individual project goals or needs.

Supporters share a common passion for openness and transparency. They know that working with these guiding principles is a better way of communicating research. To ensure collective success, a key value they all strive for is to remember they are part of a community.

Supporters are not alone. Framing actions in this collective mindset relies heavily on allowing Supporters to be vulnerable to each other. Yet they must stay true to the belief that honesty and integrity among community members encourages and rewards the entire research enterprise.

3. Begin change from within (your workplace)

Knowing that the Supporter community shares common values is essential for staying grounded and focusing on common goals. However, Supporters are active within the context of a bigger picture that, quite often, is a local workspace. It is in these function-based settings that Supporters create real change.

In plain terms, this means Supporters strive to do their jobs well, creating a strong base and foundation within funding organizations, publishers, data repositories, libraries, technology groups, etc. They work to be good at their jobs and fully assimilate into a host organization. Their credibility as members of a supporter community wanes if colleagues see them as poor contributors or outsiders. Furthermore, their passions are not just to build a supporter community. They are also aimed at building up individual spaces (publishing, libraries, technology, etc.). Change begins locally.

This can also be framed in terms around change management with its emphasis on changing from within. To get an organization and colleagues to care about openness and transparency, Supporters as change agents need to have the appropriate street cred . Each project or organization occupies a distinct niche in the community and supporters need to communicate effectively within that niche and with one another, ensuring connectivity and integration whenever possible. Not all Supporters think or act alike, and that is not inherently problematic;

instead the focus should be on creating bridges and cultivating understanding between groups.

4. Welcome all participants

Diversity and inclusion are popular buzzwords in academia. However within the space of a community of Supporters, they have special importance and meaning. Supporters are tasked with assisting in the communication of scholarship, which is ground zero for ensuring inclusivity and participation in knowledge systems. This means constantly striving for inclusivity and continually recognizing the role that power and privilege have in academic space. Supporters exist within the power dynamics of the broader research community and the world, and this is taken into account when creating services, making decisions, building software, and funding projects.

Merton's principle related to welcoming all participants is phrased as "objectivity precludes particularism" and "free access to scientific pursuits [as] a functional imperative." To be objective, Supporters work to level the playing field for all participants in their space. They can not only help people who are interested to join the community, but should also actively pursue people of different and diverse experiences to join and contribute ideas. Sharing interests does not (and need not) mean that everyone has the same ideas, backgrounds, and perspectives.

5. Recognize and celebrate differences

Welcoming all interested participants to the community does not require that all will agree on all things. However common goals are critical to advancing scholarly communication. Supporters recognize allies within and external to the community, and forge partnerships based on those common goals. They also

recognize those individuals that are not allied around a particular mission, and respect their differences. It's easy to judge people and their ideas if they don't conform to a particular worldview, but it might be more productive to recognize the disparity and look for ways that goals might overlap and enable working together.

Discussion and argument are a healthy part of any community but need not prohibit the group from moving forward. Supporters respect others, allow new and different ideas to flourish, and refrain from judging or thinking in absolutes. Some of the most powerful collaborations in history have been when two seemingly disparate groups have forged alliances; being able to look past differences may result in faster progress towards common goals.

Supporters represent myriad sustainability models, organizational frameworks, and user bases. Rather than passing judgment, Supporters should engage others and discuss both overlaps and differences in how they approach their support models. For example, a for-profit business model is not necessarily bad, and a not-for-profit is not inherently good. Diverse communities require that the members focus on commonalities to work towards achieving shared goals. Collaboration and competition may be in tension in certain contexts, but they can be healthy attributes as parties interact with each other.

6. Respect multiple solutions

It is easy for Supporters to advocate and promote their favorite projects, software, and systems for research communications. But there is need to recognize that the community benefits from multiple players coexisting (and competing). Single frameworks or services that promise to solve all problems are modern-day snake oil and oversimplify the complexity of problems. No one

idea, project, or person will "save" us—instead our strengths are our distributed interests, diversity of ideas, and promotion of competition.

As a community, the shared values are part of what unites us. We are all interested in similar things (supporting all forms of scholarship, encouraging reuse, enabling faster communication, etc.), but we need not agree to one solution or one set of solutions. In fact, we posit that healthy competition is a valuable part of our ethos, and projects with similar end goals can—and should—coexist. Shared values and shared goals do not necessarily require 100% agreement on solutions. Research communications will be better supported if new ideas are explored and experimentation is encouraged. This means the community is growing and evolving, and is likely to better meet needs moving forward.

7. Stick to your scope

When designing a project or implementing an idea, Supporters are careful to define the mission and identify the problem to be solved. This definition takes into account existing tools, projects being developed by others, and expected future conditions that might impact their work. By then building to that mission, Supporters maximize the utility of their work. They constantly revisit the mission to maintain perspective on the solution being created and where it fits into the broader ecosystem.

Using product design as a model, an individual project's scope is defined and opportunistic scope creep is avoided. This is part of being a good community member —remaining focused on the work and also supporting those that remain focused on their work. No getting distracted by new funding calls, potential partnerships, or other siren songs that muddy goals and slow progress towards goals.

Ensuring that projects are opportunistic without scope creep is a matter of building for interoperability. This implies the importance of agreed upon community standards and the value of compliance with these standards.

8. Leverage communal wisdom to move quickly

Supporters re-use resources (code, ideas, frameworks, etc.) when possible, instead of assessing existing resources and determining that their use case differs sufficiently to "reinvent the wheel." This does not preclude development of unique products that are ideally suited for a given discipline or group; instead it suggests that some due diligence on assessing the landscape may make the resulting products more interoperable and reusable.

Reuse can take many forms, and in the Supporter community it's more likely to be reuse of ideas, frameworks, or wisdom than reuse of code or technology. The Supporter community is full of unique perspectives and individuals with diverse background and experience. Supporters leverage this knowledge and share their skill sets. This may take the form of formal review of each others' work (code reviews, peer reviews, evaluation of proposals etc.), or a mentoring or learning network for sharing challenges and solutions.

Although leveraging wisdom can lead to faster progress, this isn't always the case. The close proximity to academia might make it tempting to overindulge in asking for input and opinion. It is tempting to seek buy-in from everyone and ensure all avenues are explored before proceeding, when in fact some projects may need to focus on moving forward quickly towards their goal. The purpose of leveraging communal wisdom is to maximize gains; it is not done simply as a lip service activity or as a way to be inclusive without improving productivity.

9. Encourage healthy skepticism

Supporters are closely tied to the research community. One of the basic ways that research advances is peer review, and the subsequent revision based on this community input. This is known as "organized skepticism" in the Mertonian framework. Supporters encourage skepticism within their community, encouraging productive debate and continually working to improve arguments and justifications. This does not mean that everything is questioned; nor does it mean that there must always be agreement. But peer review of projects through robust dialogue can ensure a healthy ecosystem of reuse.

What does healthy skepticism mean in practice, and for projects within research communication? In general it means creating a safe space for people to ask questions and request clarification. It also means we should all work towards using productive words when we offer critique. We strive to be kind, removing offensive language and encouraging discussion. When on the receiving end of skepticism and questions, we should avoid feeling defensive, check our egos, and keep in mind that the research community has a set of common goals. The adage that "no question is stupid" applies here; we are research-adjacent, and should encourage an environment of learning.

At the community level, Supporters continually question whether current ways of doing things are the best, and whether there are ideas or solutions not being considered because of habit or ego. Individuals outside of the scholarly communications space are frequently seen engaging, contributing ideas, and offering up technology and solutions. While it is easy to be skeptical about unfamiliar projects and people, this skepticism needs to be kept in check so it does not prevent us from hearing and internalizing good ideas. Sometimes change is good, and

sometimes the best ideas are from those with fresh perspectives.

Another aspect of healthy skepticism is the "healthy" part: it's important to recognize when skepticism is not yielding productive dialog. In these situations, Supporters would do better to devote energy to more useful conversations (and share this book with the detractors).

10. Collaborate and be stronger together

Supporters work in diverse settings: for corporations, academic tool builders, nonprofits, entrepreneurs, large commercial actors, etc. Each has different drivers and aims for their work. In some cases, career prestige is tied directly to the work done in research communications. Because of the high stakes of career advancement, this can create a tendency to turn within and focus on personal gain. But because individual goals value and require collaboration, the Supporter community resists this urge.

Supporters look for opportunities to look outward, to reach across sectors, and to collaborate. Everyone should take pride in their work, but part of being a good supporter is being willing to share credit and promote other community members. Supporters value jumping in with eyes wide open and with an open heart. They are not risk averse. They work towards greater productivity through collaboration, openness and transparency.

Conclusion

Collectively, these norms and values may instinctively make sense. None of these are silver bullets; neither are they totally new. Together as a set, they represent Supporters as inclusive and made up of individuals who show their work, avoid bias, and

question assumptions. They practice the dictum to "know thy-self" and to be true to it. Where every Supporter works within a network of organizations, the values also get at standard norms of playing well with others, starting with getting outside of our heads to look around, not judging based on labels, and building with others - off of what exists and collaboratively. Contrary to a "moral code," this set represents practices which support pro-ductive working relationships in an interconnected web of players.

A the beginning of the book, CERN, Crossref, DataCite, Open Library of Humanities, Knowledge Unlatched, Human Genome Project & Bermuda principles all portray many of these values. But no party embodies all of them at all moments in time. They are aspirational, lived out to varying degrees in the most chal-lenging settings. With this entire grouping in mind, however, Supporters can more powerfully work together to transform re-search communications. And since change is constant and given, individual norms will be expressed in an indefinite number of ways over time in our research communications environment. Mandates, people, and missions all change so it makes sense to stay alert to these changes and be open to evolution. Even the collective of Supporters will change, and new additions will be welcomed with gentle nudges towards following ideal communi-ty practices.

Supporters, unite!

Supporters are a new classification of participants in the research enterprise, but we have argued in this volume that they have always played an important role in research communications. The book has outlined structural problems facing the research enterprise and argued that what seem like small issues can have profound effects on the accuracy and trustworthiness of scholarly research. A set of values and norms was offered for Supporters to live out as they engage in activities to carry out their work (secure funds, govern, incentivize, and communicate) within this incredibly diverse environment. If these rules of engagement and principles of behavior are collectively adopted, what would actually happen? What is the target state that we are trying to achieve and what would it look like?

No one would argue that a utopia exists. And yet by its very nature, utopia is aspirational and thus formally possible. We can sketch out some of its characteristics, where aspirational norms are fully lived out and that better world allows us to achieve our visions. It would have little or no barriers for either a new player or an established stakeholder to build something that makes research work, and be rewarded, more fairly. That is, it would be possible for a new Tim Berners-Lee to create a world wide web that prioritizes truth over fake news. The rewards system would reflect rigor and robustness over novelty and glamour. Novelty would be important in the context of rigor. High standards of reproducibility or data and code sharing would be rewarded, but poor standards would also be highlighted and marked down. Open Science would become just, Science. Researchers would understand the traits of good practice so intrinsically that they

notice when they are absent. Researchers would not just have existing forms of published output simply more readily available to them, but they would be fully accessible across all the varying types of discipline with all the cutting-edge technological innovations available at every point in time.

Supporters would share loads more effectively and act more collectively, preventing unnecessary repetition. At the same time they would have a better appreciation of where it is appropriate to modify existing systems, workflow, or tools for local needs. In a perfect world the exploration and adoption of new modes of sharing or new research outputs would be supported, and as the need, or a technological opportunity, arose, there would be coordination amongst the new centers of innovation to identify how a shared support system might work. Supporters would build neither too fast, hardening in the assumptions and processes made early on, nor too slow, creating a space that would naturally be filled as a market need. (The web was rapidly adopted by academics as they explored how scholarly content might go online, and there was coordination between some players, but a gap gradually emerged which was eventually filled by commercial players.)

This is a world in which the recognition that shared storage could underpin many activities would lead to a situation where commercial players provide services, but the content itself would be contained on a shared infrastructure owned, in some sense, by the research community, with Supporters providing storage, identifiers, metadata and links between these objects (assertions) that are stable and universally shared. These would have long term funding. At the same time, they would not prevent scrappy new players from entering the space. Indeed, at its best, the ecosystem would support both stability and tension with the need for change. The innovators and the underpinning

would support collaboration even in a milieu where each pursues their own aims.

At bottom, our world is one that is optimally coordinated, especially between local needs and the benefits of global sharing. Coordination enables shared systems, more sharing of objects, and more re-use, resulting in better allocation and better use of resources in an ideal state. In utopia, every party find points of commonality - whether we see those as shared values, principles, or rules of engagement - and appreciates the points of difference.

But if we acknowledge that we can't systematically change everything to achieve the state of utopia, then how are we to proceed, particularly if we are Supporters? How do we build the consistency and coordination that is currently lacking? These are classic collective action problems, but it is clear that many of the blockers are our inability to build the right systems at the scale that they are needed.[21] We can't address all of those issues, and we can't necessarily achieve a perfect world either, but if we start to work to manage those risks, and be more thoughtful in the relationships we form and our efforts to understand what else has already been built, we will make progress.

In that sense our charge is inward looking. We do not believe that "changing researchers" or "changing research" or other top-down approaches will work. There is perhaps an aspiration for a change in culture that rebalances the rewards and incentives for

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21. Dystopias arise because we do not think about the consequences of how we manage our relationships, or because we do not consider the risks inherent in a lack of collaboration or coordination. At bottom are fundamental issues of trust. Coordination at scale requires mechanisms of assurance and resource allocation that require many players to trust each other to behave consistently and correctly.

researchers, but also for other stakeholders, away from individual gains and towards celebration of and rewards for effective re-use and coordination. But this will be a slow process.

We can make individual choices, as supporters, including supporters who are also researchers. It is those choices that we have sought to highlight. Tweaks to the way in which funding works. Different ways of talking about the problems we face that emphasize an appreciation of value of coordination. Holding each other to account through a set of shared rules and principles. All of these are things that can be done unilaterally or bilaterally. And each of them, we assert, will enable an individual or an organization to build more productive relationships with those that they depend on.

There are small changes that can make a big difference in aggregate. To ask questions of how "adoptable" a system or approach is, rather than a focus on sustainability. How has a project built on existing underpinning support structures that are shared across communities? How has it been designed to allow for adaptation by other communities? How is it structured so that it is cost effective? How transparent are the accounts, and what other efforts is it competing with. Is the balance of competition and collaboration right?

We can move away from a language of absolutes, and the straw-person arguments that they engender in response towards language that recognizes that decisions are difficult, that tensions need to be used to find an optimal point, not necessarily resolved. If we are purposeful in the way we talk about support and what it is intended to do, that it is something that should engage researchers, not be done to them.

We have not sought to be prescriptive or define a roadmap which "the community" should follow. Not only is "the commu-

nity" a thing too diverse and too contested to be useful, but this is the case because we hope that our suggestions become a point of consensus for a community that chooses to work in this way. A commitment to acting more collectively is far more important than arguing over the details of one of our proposed rules. These are aspirational, a direction of travel.

Supporters, unite! We call all those who also see themselves in this volume to join us under the banner of Supporters and take up in your work the values we offered in this book (and/or engage in discussions about their fitness). This is not a rallying cry for sameness. We celebrate the diverse set of skills and resources that different groups bring, and the different experiences that underpin them, all the more between local and global groups. We are also making a case that, as a community, we need to be open, to encourage debate, and we need to embrace tensions and contradictions. This can make it difficult to define the community that should frame our governance, and makes it harder again to define what governance mechanisms are appropriate for our systems. But by identifying, articulating, and acting on a set of things that are truly shared, we can better benefit from the diversity at the same time. Collectively, we will start to make the changes that mitigate the risks of dystopia and extend utopia, the no-place, to a place here and now.

Epilogue

If we can build the right systems, we can enhance global knowledge, citizen engagement, make knowledge production more agile... what would this world look like? Does it even exist if "utopia" - what we typically use to refer to an ideal world - literally means No-place in Greek? In the honored tradition of authors who have also yearned for a better world, we present an exchange borrowing from the rhetorical style of Sir Thomas More's 1516 political satire Utopia:

I met a traveler from a far-off land who told me of a country where academic pursuit was prized above all other endeavors, where researchers were the real celebrities, where the people trusted the word of scholars, but were free to question and criticize based on their own reading of the evidence.

"How is this trust built?" I asked.

"Through various outlets all tied together by a single underlying structure that supports all forms of data, graphs, text and bibliographic evidence. Everything is available to everyone. Discussion is as valued as discovery, so scholars spend less time trying to find new things, and more time discussing the findings of others. Those discoveries that are made are usually found to hold truth, through the collective expertise of the participants, wherever they happen to reside".

"And who judges where to focus resources? Who pays for these systems?"

"We all do. We constantly test and refine what is needed. It is not planned but where a community sees a need they get to work. It is not just the collective expertise of the researchers

that is brought to bear, but of all the supporters and systems that underpin their work"

He was losing me at this point. "But how do you know who is the best researcher?"

"I understand not your question, Thomas. They are all the best researchers, through their collective aspiration to discover, and share in one another's discoveries. Those who steadfastly review, assess and critique the discoveries of others are held in as high esteem as those who make giant leaps in understanding, because they all know that one cannot exist without the other."

"Yes but how do you PAY for it, Raphael?"

"I grow weary, Thomas, and must to my bed hasten. We shall discuss that matter tomorrow".

I never saw the man again.

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Colophon