



Designing a Preparedness Model for the Future of Open Scholarship

Final Report

July 2021



Designing a Preparedness Model for the Future of Open Scholarship

Report commissioned by:
Invest in Open Infrastructure

<https://investinopen.org>

Contact:
Kaitlin Thaney
Executive Director, Invest in Open Infrastructure
kt@investinopen.org

Report authors:
Saman Goudarzi (University of Toronto)
Katrina Pugh (AlignConsulting; Columbia University)
Vanessa Rhinesmith (UCLA Center for Critical Internet Inquiry)
Heather Staines (Independent Contractor)
Kaitlin Thaney (Invest in Open Infrastructure)

Report DOI: 10.5281/zenodo.5151774

Report dated: July 2021

This report is made available under a [Creative Commons Attribution 4.0 International License](https://creativecommons.org/licenses/by/4.0/). Users are free to share, remix, and adapt this work. (Please attribute Invest in Open Infrastructure in any derivative work.)



Funding for this research was provided by:

University at Buffalo, SPARC, North Carolina State University, Indiana University Bloomington, Iowa State University, the Center for Research Libraries, the Libraries of the BigTen Alliance, the Wellcome Trust, Chan Zuckerberg Initiative, the Wellcome Trust, and Stanford University.

Executive summary

The culmination of decades of resource deficiency and over-reliance on commercial solutions, scholarly infrastructure systems across the globe were unprepared to adequately respond to the pandemic when it hit. For many in this ecosystem, this experience has cemented the need for sustainable change. [Invest in Open Infrastructure](#) (IOI) believes any worthwhile change must consider improving the adaptive capacity of the academic community so it can not only deal with future crises but also evolve and improve with its changing circumstances. Central to this change is the development of a robust preparedness model that can inform mitigation and response strategies in events of socioeconomic stress or disaster.

For any preparedness model to be successful, it must consider the strengths and capabilities of the stakeholders committed to making it a success. In the face of sweeping budget and staffing cuts, increased demand and strain on core shared infrastructure, and heightened concern over the stability of the infrastructure scholarship relies on, IOI mounted a participatory research effort to support decision makers looking to employ, support, and sustain open technology and systems that advance research and scholarship.

Over the past year, we have interviewed and worked with institutional decision makers, infrastructure providers, and funding bodies to better understand key decision points, costs and funding models to maintain, sustain, and scale open infrastructure projects, and thresholds for change. We spoke with 128 institutional leaders, press directors, infrastructure providers, societies and scholars in an effort to better understand the challenges they've encountered in furthering open scholarship (including the use of open infrastructure) in their communities, and to subsequently map a path forward.

This work focuses on open infrastructure and its relationship to the future of open scholarship. We believe that for open scholarship to thrive, we need to ensure that the software, systems, and tooling that enable knowledge production and dissemination are also tended for and aligned with the values of the community, with adequate resourcing, support, and oversight.

The findings highlighted below are about choice and tensions, product and people, and costs and benefits. They also demonstrate the ways in which the structuring of the current system has impeded responsiveness to current events.

They include:

- ***A call for aligning our existing systems*** by examining the challenges in “local first” development, customisation, the relationship of “build vs. buy” decisions to time and resourcing, effects on staffing and maintenance, and interoperability of shared systems.
- ***Aligning power and influence to enact change*** by recognizing the power and opportunity for collectives to drive change — from accountability and vendor reciprocity to increased investment by consortia and existing funding programs through coordination.
- ***Rethinking funding mechanisms*** by exploring the tenets underlying collective investment models — examining existing funding mechanisms and unpacking where additional needs lie.

We recommend a series of practical interventions to address the social, technical, and financial challenges that have surfaced over the course of this work.

IOI

These recommendations include:

- Building for increased modularity and compatibility of common infrastructures;
- Designing shared service and support models to drive resources and staffing support;
- And, establishing an Open Infrastructure Technology Oversight Committee, providing a foundation for sharing best practices, aligning power, and calling for broader system change including negotiating with vendors on pricing, reciprocity, and values-alignment.

This report is accompanied by supplemental briefs, costs and benefits models, session materials, and presentations. These include:

- Supplemental Reports:
 - Costs & Benefits of Collective Investment
 - [Interactive modelling tool](#)
 - Open Monograph Ecosystem Impact Analysis
- [Project recommendations and theory of change](#)
- [Shared project folder](#)

Table of Contents

[Executive summary](#)

[1. Introduction](#)

[1.1. Disaster response as an opportunity for change](#)

[1.2. The need for coordinated action in the face of uncertainty](#)

[2. Research overview](#)

[2.1. Interviews](#)

[2.2. Participant community calls](#)

[2.3. Workshops](#)

[3. Key findings](#)

[3.1. A call for aligning our existing systems](#)

[3.1.1. “Local first” and the curse of customisation](#)

[3.1.2. “Build vs. buy” and the notion of time](#)

[3.1.3. A need for increased long-term investment in staffing](#)

[3.1.4. Investing in interoperability of shared infrastructure](#)

[3.2. Aligning power and influence to enact change](#)

[3.2.1. A call for consortia to support and steward open infrastructure](#)

[3.2.2. Aligning around a shared agenda for open infrastructure](#)

[3.2.3. Advancing accountability and shared values through collective approaches](#)

[4. Rethinking funding mechanisms for open infrastructure](#)

[4.1. Understanding the power of collective investment](#)

[4.2. Examining existing funding models](#)

[5. Recommendations](#)

[5.1. Near-term interventions \(<1 year\)](#)

[5.1.1. Explore knowledge exchange models to foster cross-system interoperability and resilience](#)

[5.1.2. Establish an Open Infrastructure Technology Oversight Committee](#)

[5.2. Medium-term \(1-2+ years\)](#)

[5.2.1. Design collective service and support models](#)

[5.3 Longer-term \(3 years+\)](#)

[5.3.1. Piloting a Rapid Response Fund for project maintenance](#)

[5.3.2. Test feasibility of a collective funding model to meet community needs](#)

[6. Next steps](#)

[7. Appendix](#)

[Appendix I: Full list of participants](#)

[Appendix II: Participant demographics](#)

[8. Briefs for the Future of Open Scholarship Ancillary Projects](#)

[9. References](#)

[10. Acknowledgments](#)

1. Introduction

The Future of Open Scholarship research effort was born out of conversations with a number of institutional leaders grappling with a confluence of crises stemming from the pandemic. Having entered a period of sustained financial hardship, these leaders saw a heightened demand for openness in and access to research, scholarship, educational materials, and for increased levels of service. As institutions rushed to respond to the needs of their scholarly communities and to their new economic reality, corporate publishing stood ready to offer short-term solutions.

We believe that there's an urgent need to invest now in a coordinated approach for the future of open scholarship and research at the institutional level. In doing so, institutions have an opportunity to collectively explore cost-effective and sustainable solutions outside of commercial interests to address immediate needs at their institution. They also have an opportunity to play an active role in furthering a larger and systemic shift towards open, community-owned and -operated infrastructure at the institutional level to support scholarship and ensure research continuity.

Open infrastructure for the purposes of this project represents the systems, protocols, and software that research and scholarship rely on. Additionally, we focus on infrastructure that has openness engrained at the operational and design level, systems and tools that are enablers for communities to deliver collective benefits, and facilitate the creation and dissemination of open knowledge.

Scholarship is at its best when communities of researchers, scholars, and knowledge workers can share, discover, and collaborate. However, the needs of these communities are not well served by the existing scholarly communications infrastructure, which is dominated by commercial vendors whose missions and values often run counter to that of the scholarly community. This involves motives that prioritize profits over knowledge sharing, equitable participation, and affordable access. When the business models of these vendors favor lock in, consolidation of power, and monopolistic control, they risk harming the ecosystem by limiting the opportunity for healthy competition. We believe open, community-owned and -operated infrastructure is needed to ensure the values and needs of the scholarly community are prioritized and addressed.

Additionally, there is increasing recognition that if academic libraries are to ever mediate the tensions that have haunted them since the 1980s, coping techniques overwhelmingly reliant on powerful commercial actors are insufficient (Hawkins, 1998; Miller, 2000; Fyffe & Kobulnicky, 2000). Many consider this reliance as facilitating the deterioration of academic libraries' agency over their information future.

This report outlines the work conducted over the past nine months examining a number of dimensions of the challenges faced by the scholarly ecosystem brought to the forefront by the current public health, economic, and racial crises. This cross-institutional effort models the scenarios, costs, and actions necessary to ensure research and scholarship not only persist, but thrive amidst sweeping budget cuts and economic turmoil.

Below we outline the framework underlying this project. This is followed by a brief overview of our observations from the pandemic. Then we outline our research methods. Lastly, we share a number of key findings, interventions and recommendations to inform the building of broader resilience, more effective alignment of resources, and better utilization of collective power to drive lasting change for research and scholarship.

1.1. Disaster response as an opportunity for change

Realizing that moments of pronounced social stress provide opportunities for transformative change, this work draws inspiration from “preparedness modelling”, frameworks commonly employed in planning for [public health](#), [climate change](#), and [other disasters](#) to coordinate and organize individual, organizational, and community action in response to a disaster.

These models traditionally [call for](#):

- (1) A comprehensive understanding and evaluation of risks based on existing vulnerabilities. This can include the gathering of risk information and the modelling of potential risks,
- (2) A stakeholder analysis to determine the needs, wants and roles of all stakeholders in regards to preparedness,
- (3) Multi-dimensional scenario planning for the management of risk,
- (4) Coordinated action on behalf of the identified common goals to serve a broader aim or agenda;
- (5) And, a focus on building towards system resilience throughout these processes (FEMA, 2016).

These sorts of models, [drawing from disaster recovery efforts](#) at the national, state, and local levels, are designed to balance the need for near-term crisis-response action with long-term resilience and sustainability planning. These models are designed to enable rapid-response decision making in the immediate term while considering the case of a crisis resurgence in the long-term. In addition to a coordinating framework, these models also facilitate shared, coordinated action in times of crisis and radical change.

1.2. The need for coordinated action in the face of uncertainty

Institutions around the globe have been forced to radically adapt and re-evaluate current ways research and education are conducted and delivered in the face of COVID-19. The sudden shifts to online and distributed work have brought strains on existing infrastructure and business models, exposing areas of fragility, risk, and instability.

The economic volatility of the past year — which continues to this day— paired with sweeping furloughs and hiring freezes have left many to stretch existing resources while ensuring research continuity and a level of service to their faculty and students. This is only exacerbated for those relying on and/or developing open infrastructure solutions where key personnel are often donating time in-kind or on slim budgets for things such as software development, project support, and product direction via shared governance. Projects often lack dedicated funding at the institutional level, instead relying on vended services, shared development resources across other project member institutions, or on residual budget to support project maintenance.

While the pandemic has provided a new set of challenges for those across the research ecosystem, for many, the pressures they face as a result of these challenges aren’t completely new. Decision makers we spoke to described the current moment as an exacerbated continuation of the economic and political pressures that have been plaguing them for decades.

IOI

At the same time, we are seeing past investments in community infrastructure pay off in real time. Academic libraries have in many ways been on the leading edge of digital transformation for the past two decades, and as a result, were in a better position to quickly shift research operations, collections, and teaching online in the face of a crisis. Over a decade of cross-institutional investment in offerings, such as [HathiTrust](#) paid off overnight — enabling 150+ member institutions to make vast swaths of their otherwise print-only collections available digitally with the quick initiation of the “[Emergency Temporary Access Service](#)”.

In the months since we initially started this work, we’ve also seen the emergence of robust discussions surrounding Controlled Digital Lending and the launch of Library Futures, following on the [Internet Archive](#)’s [National Emergency Library](#), as well as efforts such as the [Controlled Digital Lending Implementers Group \(CDLI\)](#) and [Project ReShare](#) examining ways to ensure enduring — not just temporary — access to online resources and library materials.

The ability to quickly make decisions to benefit the bottom line of the academic research community was made possible by a number of institutions — recognizing a decade ago the need for a community-controlled copy of the books digitized by Google — invested in a shared solution, the HathiTrust. The current pandemic has also made the case on a global scale for platforms that facilitate the rapid dissemination of open research, such as medical preprint servers [medRxiv](#) and [bioRxiv](#), open, rapid review services such as [Outbreak Science](#), and cross-institutional open research datasets such as the [CORD-19 dataset](#).

The pandemic has reaffirmed for many that reliance on solely commercially-controlled content and services leaves the academic community and its information future vulnerable. We are currently in a moment that calls for a similar sort of upfront investment and cross-institutional planning to ensure that the research community is prepared for the future, and invested in ensuring the underlying infrastructure relied upon is developed and sustained in a way that aligns with the values of the scholarly community. This work was designed as a first step towards this vision.

It aims to address forecasted infrastructure consolidation and collapse across the research ecosystem, identifying the opportunities, leverage points, costs and approaches that could be employed to enable:

- The creation of a shared set of principles to help assess solutions based on a values-based framework;
- Support systems that addresses the heightened demands on universities as they shift operations online and transform the way they serve their communities;
- Coordinated scenario planning that strategizes for a radical shift towards open scholarship and a convergence on existing open tools and services;
- The development of methods for the pooling of resources and risk to maximize cost-effectiveness and minimize system failure;
- The creation of a shared action plan to facilitate coordinated decision-making that ensures research continuity;
- The bolstering of researcher productivity, continuity, and growth in both the near- and long-term.

2. Research overview

The Future of Open Scholarship project took a community-centered approach to the examination and exploration of needs across the open research and scholarship landscape. This approach aimed to understand the impact of the unfolding pandemic as well as the ongoing needs in open research and scholarship. This community-oriented approach was selected as a means to surface community needs, and collaboratively explore solutions and interventions, while ensuring this work remained responsive, iterative, and inclusive.

This approach included three specific buckets of participant engagement: (1) interviews, (2) community calls, and (3) workshops.

The result of taking this approach was a compelling iterative engagement that surfaced community-driven needs and solutions. The following sections provide a more detailed look at the approach and each of the three specific categories of participant research engagement.

2.1. Interviews

We conducted over 95 interviews with the project's 115 participants over the duration of this work — both in group settings and individual, based on interviewee preference. The calls ranged from 50-60 minutes, and followed a discussion guide ([available here in English and in French](#)). Calls were recorded with the participants' permission, and a qualitative analysis was conducted.

These calls served a few core purposes:

- They helped establish a baseline understanding of the realities our participants were operating under
- They allowed us to glean a sense of their current priorities, concerns, perceived risks/threats, and histories/dependencies on open infrastructure
- They surfaced areas for future exploration, as well as models to investigate (and in some cases, avoid)

Questions were deliberately open-ended to help us understand the range of issues relating to the relationship of scholarship and technology in the current crisis.

2.1.1. Participants

Participation in this work to date has been self-selected and voluntary, meaning that those who have signed on to join have done so at their own volition and without us directly soliciting a set number of representatives from each area we are keen to explore. We reserve the right to expand our current list to bring in additional perspectives or expertise, on an as needed basis.

For more about the demographics, visit [Appendix II](#) of this document.

2.2. Participant community calls

IOI

Following interviews, participants were invited to attend regular community calls. The purpose of these calls was to offer a consistent mechanism for engagement with the project, research findings, and recommendations.

These monthly community calls typically followed the following agenda:

- Introduce participants (individuals and organizations)
- Share out of relevant preliminary and or synthesized findings
- Assess the status of the project as a whole and identify next steps
- Share out of the completed and or upcoming workshop session

Participant community calls took places on:

- September 2, 2020
- September 30, 2020
- November 10, 2020
- November 11, 2020

The community calls not only offered a mechanism for staying connected with the participants, but they also enabled us to engage in real-time feedback to complement the more in-depth workshoping sessions.

All call materials can be found in this [shared project folder](#).

2.3. Workshops

In addition to the monthly community calls, we also held a series of participatory workshops to explore more in-depth issues surrounding collective decision making and alignment, as well as funding and service models. These workshops provided a means for participants to learn with and from one another, as well as participate directly in the project.

Materials for each workshop, including slide decks, notes, and artifacts (such as distillation documents) can be found in this [shared project folder](#). We also held comment periods between workshops to gather additional (asynchronous) feedback from participants on shared documents, such as the [Decision Making Frameworks document](#).

Each workshop was held twice to accommodate participants' timezones and working hours (standard times were 11am Eastern and 7pm Eastern). They ranged in length from 90-120 minutes, and additional facilitators and notetaker volunteers were present to support IOI staff.

The September workshop focus delved into the ways in which participants defined and measured values and principles in practice when it came to collective decision making. We were joined by Nicky Agate, co-principal investigator for the HuMetricsHSS project and Associate University Librarian for Research Data and Scholarship at Penn State Libraries, who gave a short presentation on how she explores values-alignment in her work. This was followed by a series of facilitated breakouts where we explored participants' own guiding values (and that of their employers and organizations). That helped us gain important insight into where participants' were approaching this exercise from, before delving into a discussion on prioritization, the effect of power in decision making, and implementation challenges.

Notes from that work [can be found here](#). Additional details about this work can be found under the “[Advancing accountability and shared values through collective approaches](#)” section later in this report.

Our October workshop presented three funding models to examine in more depth: membership-based models, portfolio-based collective fund models (sometimes referred to as a “mutual fund approach”), and rapid response funding mechanisms. We examined with participants in a series of smaller breakouts what worked about these models, what these models were useful to fund (ie., rapid prototyping, maintenance, development support), and where barriers to implementation existed. This surfaced a sense of what gaps remained in collective funding models, informing our recommendations to further explore a framework of aligned funding models rather than a one-size-fits-all approach. These workshops also provided us with critical information regarding implementation barriers, areas that need further clarification, and needs that the community have surfaced that we hope will help inform future design of funding mechanisms in the sector.

Notes and materials from those workshops [can be found here](#). We also further detail this work under the “[Rethinking funding mechanisms for open infrastructure](#)” section later in this report.

This methodological approach has led to the identification of a rich set of key findings that are community-driven. In addition, the approach has also highlighted the need for continued community conversations beyond the lifecycle of the project. Community calls will continue in 2021, led by IOI.

3. Key findings

The findings below illustrate the complexity and fragility of the current structure for supporting open scholarship, exacerbated by some of the most significant pressure tests of recent years. This research effort provided a unique opportunity to work with decision makers navigating a system under extreme duress, a system that in many ways hindered responsiveness when it was needed most.

Over the course of our research, we heard a number of technical concerns regarding underlying infrastructure, its durability, issues regarding interoperability and how that relates to the resilience of a system to withstand increased demand at times of crisis. We also heard about the economic realities and concerns brought about by, in many if not all cases, significant impact on budgets and resources to support core infrastructure and staffing needs.

Our scenario planning focused on the framing of near-term needs and interventions — looking at working within our existing systems and investments in systems to support open scholarship to enact practical change. In addition to looking at near-term solutions, however, we also saw a need to explore additional dimensions over a longer timescale (1-3 years+). These deeper areas of work are anchored in collective action and structural transformation — examining the ways in which we can align power and influence across existing networks, funding programs and empowering institutional leaders to take a more active role in enabling a more resilient system for open scholarship.

Our findings have been organized into two sections along these dimensional fault lines. The first section focuses on the key challenges and considerations respondents shared in regards to this infrastructure both prior and during the pandemic — with a focus on the latter. The second section focuses on the larger

political economy underlying these decisions, highlighting opportunities and considerations for structural change.

3.1. A call for aligning our existing systems

At the core of this research are the technologies, systems, and people that enable the flow of knowledge and scholarship. In some cases, these underlying technologies are 20+ year-old open source projects with distributed development, governance, and support structures. This is often cited as a strength of open source: the ability for many to contribute, be it to a common codebase, project, or version that evolves off of one for more targeted needs.

The findings below detail where historical approaches to the development, customization, and adoption of open scholarly infrastructure present points of friction from a technical perspective. These challenges are not new, but take an investment in aligning existing open infrastructure systems to create more durable, reliable, and sustainable systems for producing and disseminating open scholarship.

3.1.1. “Local first” and the curse of customisation

A number of participants noted the complexity in prioritizing “local first” development of tools and technology versus converging on fewer foundational offerings (with the aim of that approach providing additional stability, sustainability, and shared infrastructure). The arguments for building locally centered around the benefits of customization and integration with the specific university environment; needs and systems that participants believed didn’t generalize more broadly outside of their institutions (e.g., research intelligence services, HR, procurement). Participants also referred to the history of some of these infrastructure services, catering to local hosting and development (e.g., repository services such as Fedora, DSpace and others fit this mould).

In academic settings, customization of open technologies and infrastructures is commonplace, especially to local systems like procurement, human resources, and other institutional systems or specific services. That customization is often done to increase the local efficiency of a specific infrastructure to advance institution-specific use cases. On the downside, the customization and retooling that happens as a result, can often lead to fewer, or slower upgrades to the system, for fear of a connector breaking and causing a disruption or outage in the service. This reticence can lead to infrastructures languishing two to three versions behind, and increase the likelihood of vulnerabilities, dated systems, and raise compliance issues. The effects on the reliability of the product over time can be significant and costly, while also often slowing the evolution of a distributed, open infrastructure product with wide adoption competing other commercial offerings on a product-level.

Customization can also act in direct opposition to aims to support shared, open infrastructure, as competing needs on the local level — particularly as they relate to technical and budgetary needs — can fail to reconcile with the needs and prioritization of the global community. That tension is one that we heard arise regarding “institutional individualism”, where an institution’s needs are perceived as “too unique” or specific for the broader community’s benefit and gain.

Challenges varied from blockers based on an institution's loyalty, to a particular homegrown solution and sense of “individualism”, to the institution or department’s history of innovation and open source (both good and bad). Many participants shared their desire to choose open source solutions as they align

IOI

with the interests, values and mission of the institution (and the broader aims of open scholarship), but also stories of failed development, with significant investments of staff and funding in a project to sunset. They also shared their concerns over how to “sell” a move towards an open infrastructure solution when open solutions are often perceived as more time-consuming, less reliable, and less efficient.

Some noted an impact on service, speed, and ability to upgrade technical solutions as key downsides to highly customized technical solutions. This applied whether highly customized solutions were locally hosted or hosted by a vendor, with some partners falling years behind on critical upgrades. (In some cases, the challenges outside of the academy are the opposite — lack of agency and control over centrally hosted infrastructure that’s difficult to implement and host independently also arose as a counterpoint).

This, we would argue, makes discussions about converging on shared, open infrastructure a challenge, especially when that may mean migrating off of one institution’s system to another for broader collective benefit or gain.

Institutional individualism also impacts the pursuit of collective funding and support models, such as broader subsidies for sustaining shared infrastructure, given the proliferation and redundancy of offerings, loyalty to certain solutions, and deeply ingrained and customized infrastructure in institutional systems. “Picking a winner” is a complicated and often deeply politicized matter in open source when choice and freedom are at stake. Discussions about deprecation, migration, and merging need to be carefully navigated, while also explicitly outlining incentives and resourcing for supporting change management.

3.1.2. “Build vs. buy” and the notion of time

We also heard from participants that time is also a key deterrent in choosing open infrastructure, especially in times of heightened demand or urgency as we witnessed over the past year. This includes the time needed to survey and assess infrastructure options and vendors, the time needed to make a case for budget and resources amidst increasing restrictions on spending, as well as the time needed to deploy and scale an open solution in an institutional context to meet pressing needs. The time and prioritization pressures often act in direct opposition to the desire to invest in more values-aligned, community-governed infrastructure, especially when a solution needs to be rapidly deployed with minimal friction.

This “build vs. buy” dynamic is one that commonly affects decisions about infrastructure solutions, especially when limited time, resources, and/or staffing are at play. Even prior to the pandemic, most respondents faced pressure : (1) to meet the demands of administrators and patrons for the rapid delivery of information anywhere and at any time, (2) to keep up with an ever-evolving and increasingly complex technological landscape, and (3) to achieve all this on largely stagnant budgets.

This tension of whether to “build or buy” brings into stark relief a number of product-level concerns regarding ease of use, reliability and durability of open infrastructure that quickly complicate (and in some cases override) a more nuanced, values-aligned decision about underlying technologies when immediacy and scale are factors.

IOI

However, academic libraries are nothing if not resourceful. Spending decades having to juggle growing expectations for content in the face of economic volatility and rapid technological change, they have developed an arsenal of coping tactics. While some of these developed tactics have been directed towards their internal management (such as redefining library budgets and redesigning internal workflows) they have also involved the development of acquisition strategies that favour the availability of information over the development of sustainable collections (Fyffe & Kobulnicky, 2000; Rossmann & Arlitsch, 2015).

This model is heavily reliant on commercial publishers and vendors for the content and infrastructure necessary to facilitate rapid information delivery (Rossmann & Arlitsch, 2015). The result: decisions to roll out commercial, for-profit, closed solutions that provide levels of service to meet specific needs while often compromising core values and principles such as the privacy of users, ownership of data, and locking institutions into contracts and terms that can be inflexible, costly, and counter to their mission or aims.

We heard from respondents that especially with the budget cuts of the past year and timely demands for increased levels of service and access to scholarship, that advocating for a multi-year build of a system was not only challenging, but untenable.

As a result, some institutions have doubled down on this specific acquisition model — considering commercial service providers and vendors as a means of stability and research continuity — by, for example, signing on with large for profit-publishers offering attractive deals such as no-cost extensions.

These sort of strategies pose immediate governance challenges as they relate to product roadmaps as well as process and cost transparency. They also risk the loss of values-alignment as intermediary vendors are introduced.

However, there are also concerns that the long-term impact of these strategies will facilitate further corporate control of academic knowledge and infrastructure — by driving individual institutions into deeper lock-in, subject to predatory surveillance practices (that require them to tradeoff user privacy/ownership or control of data, for example) or other corporate strategies characteristic of disaster capitalism.

In our discussions about costs and benefits of investing collectively in open infrastructure, further outlined in [this report](#), we heard from participants the challenge in articulating the return on investment of open solutions in comparison to commercial alternatives. We also heard the need to move from thinking of open solutions as cheaper and more available to a framing where open infrastructure solutions are the reliable, competitive choice.

3.1.3. A need for increased long-term investment in staffing

As budget freezes and cuts swept higher education globally, the impact was especially felt by the existing adopters of and contributors to open infrastructure — particularly at the institutional-level. Hiring freezes turned staff departures into long-term staffing losses, putting even more strain on library staff due to an inability to re-hire. This, in addition to sweeping furloughs, left remaining staff with additional responsibilities while also working to address increased demand for support and services from students, staff and faculty.

IOI

The true cost of the staffing models for open source efforts like open repository services remains difficult to fully account for, given their distributed nature. These efforts often involve multiple institutions and/or organizations contributing to the development, the governance, the staffing and resourcing at the institutional level.

It can be difficult to glean a sense of the true cost of staffing and resourcing, with many of those costs either accounted for in generic “overhead” budget lines, or unaccounted altogether. Further complexity arises when infrastructure project costs are shared across institutional departments, with portions covered by libraries, university IT, and research departments — each with their own accounting systems.

For some open infrastructure projects, decision-making about product roadmaps and the prioritization of needs happen in multi-institutional governance calls, where limitations on time, availability, and outright human capacity in the midst of a global pandemic can bring a project to a standstill.

The human cost of budget cuts, furloughs, and layoffs also affect overall maintenance and resiliency of the systems that open scholarship rely on. Active, ongoing attention, development, and stewardship of open infrastructure are needed to ensure systems maintain levels of service, and can withstand periods of heightened demand, like we’ve seen over the past year.

Furthermore, there has been increased attention to the idea of “maintenance” as it relates to open communities across scholarly publishing, research, and open source technology more broadly. Information maintenance, as defined by the global, interdisciplinary research network [The Maintainers](#), refers “to the work that sustains and repairs information, information systems, and information communities, as well as the many actions that keep our sociotechnical world going” (Lassere, 2019, para. 3). They reference the work of Lee Vinsel and Andy Russel, two of the project’s co-directors, that expand on this notion, suggesting that the “mundane labour that goes into sustaining functioning and efficient infrastructures” is more important and impactful often than the innovation itself (Russell & Vinsel, 2016, para. 1). These elements, they emphasize, are often overlooked and under-resourced.

Our participants shared a variety of perspectives on the staffing and reallocation concerns as they relate to maintenance, given the realities many institutions worldwide faced this past year due to the pandemic and economic crisis. In addition to staffing for maintenance and ongoing development to support operational needs, there were also a number of points raised about decision-making, and its relation to time, resourcing, and resilience.

The governance models employed by many of the core open infrastructures mentioned in initial interviews are grounded in community representation, and, especially for those infrastructures supported by membership models, led by institutional leaders and library staff. Much, if not all, of this participation in collective decision-making for shared infrastructures is unpaid labor, done in addition to full-time jobs held in higher education. The strain of increased demands and staffing shortages directly affects the ability of key stakeholders — be they in project governance roles, development, project management, or stewardship positions — to allocate additional time and human resources. We recognize the challenges in models that fail to account for the unpaid labor and in-kind contributions of staffing and resourcing especially in times of scarcity.

3.1.4. Investing in interoperability of shared infrastructure

IOI

Over the last few years, varying projects and institutions active within the open knowledge space have perceived a need to bring new thinking, new funding models, and new commitments for the promotion of sustainable and interoperable infrastructure. But when we talk about what “interoperability” looks like on a technical and implementational level, the conversation often gets complicated.

The events of the past year have illustrated more concretely why interoperability of our open systems and infrastructure is needed. The global pandemic and subsequent economic and racial crises have led to an increased demand for more streamlined, and equitable access to research and knowledge to support shifts to online learning and research. As a result of this massive shift, we’ve also witnessed the strain on shared open infrastructure underpinning the research enterprise and scholarly communication, such as content and data repositories.

Additionally, with the economic volatility experienced over the past year, the risk of infrastructure collapse due to budget cuts and drops in membership and grant support was more acutely felt than in the past two decades. This added additional urgency to the discussion of interoperability and the need for open standards as well as a potential shift from compliance to risk management. It also highlighted the importance of ensuring that if a content or data repository offering suddenly shuttered, that there were measures in place to enable efficient knowledge transfer to a new platform. It should also be noted that content and data migration at an institutional scale comes with significant costs in terms of labor, as well as disruptions in access.

Standards and interoperability specifications can, when thought of systematically, help enable access to knowledge across our systems, as well as provide resilience and redundancy should a service go down. But additional clarity as to what standards to implement and what counts as an “open knowledge system” is needed if we are to make progress towards a more equitable and resilient means of sharing knowledge across institutions.

Investments in cross-platform interoperability, especially the use of open standards and protocols like the [Oxford Common File Layout](#) (OCFL), should be viewed as essential next steps in reducing risk should future crises arise. These steps also more efficiently facilitate cross-platform exchange of content and data, for which we’ve seen increased need and demand.

We identify a need for further investment and coordination to advance the underlying interoperability of the existing open systems powering scholarship as a means to better sustain and further strengthen shared core infrastructures. The past year has exposed known (and also new) vulnerabilities in how existing infrastructure performs in high demand, high pressure situations, and the fragility that exists due to inherited staffing and resourcing models. The sections below further detail findings that focus on alignment, resourcing, and enacting change.

3.2. Aligning power and influence to enact change

In his analysis of the American medical system's response to the covid-19 pandemic, the physician and author Siddhartha Mukherjee (2020) explained that there are two key metrics worth noting in times of system collapse: (1) *time to survive* — the length of time a firm can survive amidst the shortage of a critical good — and, (2) *time to recover* — *the length of time the firm will take to come back online given that particular shortage*. These metrics of resilience, taken from studies of supply chain collapse, are indicative of paths forward for planning the navigation of a crisis and preparing for the future.

At the core of Mukherjee’s argument is the notion that in the quest for short-term efficiency, we’ve sacrificed flexibility, an essential resource in times of change and crisis. Parallel observations have been made about the acquisition methods of academic libraries, that have shifted from traditional collection-centered models that dominated the early and mid- twentieth century — focused on building local and self-sufficient collections — to access models that focused on information delivery when the user needs it over the modality through which the information is supplied (Fyffe & Kobulnicky, 2000; Rossmann & Arlitsch, 2015).

The Future of Open Scholarship project intentionally focuses on the time to recover variable, soliciting participation from institutional leaders, members of scholarly societies, presses, open access publishers, infrastructure providers, researchers, and advocates aligned in identifying the need for the scholarly system to adapt, evolve, and change away from the exclusive utilization of the access model.

This involves building resilience in our systems through coordinating efforts across institutional players and not accepting the current status quo as the way it must be for decades to come. It means partnering with other institutions and organizations to better navigate uncertainty in the near-term, assess risk and immediate needs, then map out a plan that best mitigates those dimensions for long-term gain. It’s about coordinating response and building preparedness and resilience for the long-term into our system for access and dissemination of research.

Community resilience, often referenced as a core capability in preparedness modelling, is at its heart about the *“ability of a community to use its assets to strengthen [its] systems and to improve the community’s physical, behavioral, and social health to withstand, adapt to, and recover from adversity”* (HHS, 2015, para. 1). More simply put, it’s about utilizing collective power to advance shared needs for community benefit.

Collective action in open scholarship is not a new phenomenon. In the early 2000s, as the Open Access movement gained momentum, we saw a shift in negotiating power take place. Prior to Open Access mandates at the institutional and funder level, it was not uncommon for a scholar to append an “author’s addenda” to their journal submission stating that in accepting their submission, the publisher would grant certain licensing permission to the author and/or permission to put a copy of the submission in a repository of their choice. It pitted an individual scholar against major publishers, the latter being significantly more resources, powerful, and incentivized to control copyright of submissions and charge for access to the scholar’s work.

There were a number of factors that led to institution-wide Open Access mandates. At Harvard, prior to the passing of their Open Access mandate for the Faculty of Arts and Sciences, a professor had led an effort to unbundle duplicate subscriptions to Elsevier content across Harvard’s 70+ libraries as a cost-saving exercise. Expectations of significant savings were met with a Harvard-specific increase, minimizing the obvious savings and protecting the publisher’s profits.

The Open Access mandate aided in shifting the negotiating stance with Elsevier for rights to self-archive submitted articles from an individual scholar to the entirety of the Faculty of Arts and Sciences. And that model, building off successes in Australia, Belgium, France, India, Portugal, Russia, Switzerland, Turkey, and the United Kingdom at the time, was soon replicated across the United States and more broadly, shifting through collective action rights of scholars to make their works available under open licenses.

IOI

We believe there are similar opportunities to align power and influence through collective action to advance the health, affordability, adoption, and sustainability of open infrastructures for open scholarship.

Increasing and sustaining open infrastructure investment at an ecosystem-wide level calls for global cooperation and coordination, among governments, funding frameworks, library consortia, and aligned programs and initiatives working to advance openness and equity in research and scholarship. This also is an opportunity for institutions to shift their engagement with vendors and service providers who are deriving financial value off of open infrastructure systems to those that call for more explicit alignment with values and business practices that center equity and reciprocity, transparency and openness, and stakeholder engagement as a matter of gaining their business.

This work is crucial so that further attention and resourcing can be dedicated to shared infrastructure needs. It requires identifying areas for collective investment and action, as well as coordination strategies to illustrate the importance of this work to institutional leaders, and budget holders. It also requires leading decision makers outside of existing open advocacy circles and inviting them to participate.

This involves recognizing the interrelationship and interdependence of broader agendas to further Open Access to scholarly materials with the need to converge on, invest in, and sustain corresponding open infrastructure. It also requires an examination of where power lies in relation to decision making and funding, and where coordination and collective action can drive cost reduction, more values-aligned business practices, and efficiencies at scale.

3.2.1. A call for consortia to support and steward open infrastructure

In our interviews, we spoke with a number of consortia leaders as well as those represented in their membership to gain a better sense of existing roles in supporting and/or supplying core infrastructure services and hosting. Responses shed light on both the complexity and opportunity that existed in more explicitly calling for consortia to support open infrastructure financially as well as in-kind with staffing and hosting support as a core service to their members.

Library consortia have historically been rooted in collective action, from negotiating pricing, services, and providing membership with additional support on the local, state, and national level, with some consortia focusing even more specifically on who they serve. We learned that no two models are exactly the same. Some state-wide consortia like the Metropolitan Library Council (METRO) have a notably more technology-focused approach to serving their key stakeholders, while others, like in the state of Florida have shared frustration at the changes to support for key state-wide scholarly infrastructure given budget cuts and legislative constraints.

We surveyed an array of consortia members as well as key leaders at groups such as METRO, the Association of Research Libraries, the Big Ten Academic Alliance, SPARC, Center for Research Libraries, the Council of Australian University Librarians, and more. Many noted the historical focus on print and digital collections, and some spoke to conversations that have begun over recent years about the role of library consortia in supporting and advancing independent, open infrastructure that research and scholarship rely on.

IOI

Given the interplay and diversity in how consortias operate and serve their members, we don't believe it needs to be one or the other, especially given the overlapping representation many libraries have. For example, one could imagine the Libraries of the Big Ten Academic Alliance, Association of Research Libraries, the Center for Research Libraries and/or SPARC augmenting existing consortial supports like OhioLINK, Greater Western Library Alliance (GWLA), Triangle Research Libraries Network (TRLN) or Ivy Plus Libraries Confederation to advance adoption and sustainability of open infrastructure systems to further shared needs and advance scholarship.

3.2.2. Aligning around a shared agenda for open infrastructure

The aims of this work on a system-wide scale call for a state change in how the scholarly community operates. It challenges assumptions around access, efficiencies, and whose needs get prioritized. It also seeks to call for those benefiting from open scholarship and the infrastructure that supports it to give back, and foster a more reciprocal, vibrant and equitable ecosystem to support this work.

In our interviews, the notion of “who pays” for open infrastructure project development, usage, and maintenance took a number of forms. It ranged from examining membership models and discussions of which institutions were donating time and funding to provide free access for other member institutions, and whether a balance was being maintained. We heard from others calling for vendors who profit from providing services that help institutions develop, host, and run open infrastructure to give back to the project in more significant ways financially or with dedicated staff time for shared needs. We also noted the variance in expectations from leading stakeholder groups about who they view should be contributing to sustaining open scholarly infrastructure who may not be investing yet (and why).

There are a wide variety of ways participants themselves (or their institutions and organizations) contribute to advancing open infrastructure in their day-to-day work. Some are contributing staff, membership funds, or investing time to support development. Others are supporting core needs for their constituencies, needs that overlap with many articulated throughout this research, but limited either by geographic lines or project scoping.

We believe a shared agenda for investing in core infrastructure for open scholarship would enable better coordination across existing parties to further this infrastructure's sustainability. This includes shifting existing consortial models and exploring intersections with existing funding and support models (such as that of the [French National Fund for Open Science](#), the Dutch Research Council's recently announced [Open Science Fund](#), [SCOSS](#), partnerships like [Coalition Publica](#) in Canada, [European Commission's Horizon 2020 program](#), among others).

An aligned vision and agenda would not only facilitate further coordination at the global level, but also ensure that the burden of supporting and sustaining open infrastructures is shared across parties. This calls for greater communication and collaboration so that core principles and needs are met on the local level while also working to address holes in resourcing that could also benefit the broader research community. Done right, this would maximize existing investments and work at the local level, while also increasing efficiency of resourcing, global coordination, and increased impact.

We recommend further work to explore common areas of alignment, communication, and opportunities for coordination of funds to most effectively address pressing needs and advance the creation and dissemination of knowledge.

3.2.3. Advancing accountability and shared values through collective approaches

There has been an active drumbeat building calling for more value-aligned investments and adoption of open infrastructure, to combat the increasing commercialization and monopoly control of core tools and technologies, selling of user data, and misaligned motives of for-profit enterprises when it comes to open scholarship. We have also seen in the past year, with the sudden shift to online research and learning as universities and research institutions closed their doors, the harm and risk technologies can cause when accountability, oversight, and community-governance are not factored into the decisions about which software or system to roll out.

In September 2020, we conducted a series of participatory workshops to explore how values and principles can and should affect decision making when it comes to the core infrastructures research and scholarship rely on — building on a body of work from the Educopia Institute, the French Ministry, and other leaders in the field advocating for transparency, values alignment, and better business practices.

This work also examined power as it relates to community members and their role in decision making.

We asked the following questions:

- What values and principles guide your individual work when assessing open, collaborative solutions?
- What values and principles guide your organization?
- How do you prioritize principles?
- Have you had to choose one principle over another? If so, when, and how did you choose?
- What principles are more often in conflict when having to make a decision or decisions?

We also asked for examples of values and principles frameworks that successfully guided decision-making. The distillation of this exercise can be found [in this collaborative document](#).

Resources from the workshop [can also be found here](#), including the presentation from Nicky Agate of HuMetricsHSS and Penn State Libraries.

As we worked to further move towards alignment on shared values, taking into consideration the points of tension that surfaced in this exercise, we moved towards a recommendation focused more on a mechanism that would provide a means for decision makers to seek support, share knowledge, and discuss accountability as it relates to this work — rather than contributing to an already robust list of frameworks (and risking repeating work that'd already been done thoughtfully by others in this space.)

Our recommendation following that work was to establish an Open Infrastructure Technology Oversight Committee — a committee of key stakeholders across the research landscape dedicated to furthering transparency, accountability, and advocating for investment in open infrastructure solutions to ensure equitable, affordable, and reliable access to research and knowledge. This draws from examples of Technology Oversight functions in institutions, communities, and in corporate settings, that are traditionally designed to advise on the strategy, adoption, and implementation of technologies to serve particular communities.

IOI

In this case, we're recommending this structure as a means to provide decision makers and members of the community with a dedicated place for knowledge sharing, conversations, and oversight to ensure our aspirations for values alignment are being reflected to the fullest extent in the technology choices made as a community.

This comes out of concerns raised in our September workshop over whether implementation of values-based frameworks on an institution to institution basis were sufficient to address systemic issues regarding control, lock-in, accessibility, and equity.

The aims of that work are to foster a trusted peer network to empower institutional leaders to take a more active and vocal role in driving adoption, pricing, setting of terms for vendors and service providers, and working collectively to examine and work to address issues warranting additional oversight. This includes assessing whether a project furthers monopolistic control or is working against community aims, examining whether a project maintains means for others to contribute to the project, and other issues surrounding privacy, surveillance, and lock-in.

4. Rethinking funding mechanisms for open infrastructure

There has been a long heritage of investing in open infrastructure within the academy. While the impact of this heritage is hard to calculate, it has certainly been felt by participants during the pandemic in the form of open solutions for provisioning, publishing, and managing research and educational resources.

Many participants rely on community-developed and/or -supported infrastructure in some form. These include: [HathiTrust](#), [DSpace](#), [Fedora](#), [Blacklight](#), [Samvera](#), [Dataverse](#), [Open Journal Systems](#), [JSTOR](#), [Project Muse](#), [Vufind](#), [Janeway](#), [Editoria](#), [Invenio](#), [Hypothesis](#), and [PubPub](#). They also rely on open infrastructure developed by satellite communities in the form of software ([Jupyter](#) products, [Wordpress](#), [Concrete5](#)), standards and open software components (such as data models, languages, libraries, and APIs).

However, while many participants have acknowledged their reliance on academy-developed or -supported infrastructure during the pandemic, they are wary and critical of these projects' long-term sustainability. If the pandemic has emphasized the importance of open infrastructure, it has simultaneously highlighted the ways current approaches to their development have been inadequate.

During our conversations with participants, we quickly came to realize that a practical first step towards durable open infrastructure is the development of sustainable funding models for these projects. As a result, we sought to better understand the current use and/or potential of prominent funding mechanisms for open infrastructure.

Through a series of workshops, we explored the varying funding mechanisms that are or can be employed in this space — ranging from those most commonly referenced and employed in funding open infrastructure projects to advance scholarship, to those from adjacent sectors that may address gaps and inefficiencies in current funding approaches.

We contracted the development of a costs and benefits model — informed by a series of listening sessions and participatory workshops with participants — to provide a starting point for conversation about the collective benefits gained by investing in shared infrastructure solutions.

We also noted that in addition to the funding mechanisms themselves, broader questions arose around who should be contributing to these projects (who may not be already) and at what levels. This surfaces a call to expand and diversify the pool of funders beyond our historical notions of how open infrastructure is supported, moving beyond institutions, philanthropy, and government-grant-based support to look at the roles of consortia and industry in contributing to the health of the ecosystem.

Additionally, we heard from participants that there was a need for values-aligned service providers to address resourcing and product reliability concerns, in addition to funding and capital to sustain the status quo. We believe that while funding models can address many of the concerns about a project's viability, that additional research is needed to explore service models that further the collective aims of open scholarship and open infrastructure, rooted in values shared by the communities served.

4.1. Understanding the power of collective investment

The funding models below illustrate a variety of approaches to collectively funding infrastructure. To better understand the situational context for various collective funding models and infusions of capital, we contracted Kate Pugh of AlignConsulting and Columbia University to map the costs and benefits of collective investment in open infrastructure solutions at an institutional level. This project was not only designed to better understand the varying approaches to collectively funding infrastructure but to also facilitate the development of a quantitative tool for casemaking for which many participants expressed significant need.

This built on the explorations of funding models detailed below in section 4.2., and was designed to spur the following uses and explorations by participants:

1. **A communication tool for budget holders** looking to make a case internally for investment in a particular open infrastructure solution (e.g., migrating off a commercial, closed solution, looking to augment their casemaking with data and support of a model)
2. **An assessment lens** for those looking to better understand the impact of their own contribution to open infrastructure (e.g., cash, staffing, other forms of in-kind support - how does that affect rates, returns, collective benefits)
3. **A planning tool for broader collective action** to examine rates, efficiencies gained, and areas for additional investment (e.g., consortial investment in a shared solution, means to map various funding scenarios and strategies to support shared infrastructure)

This [working financial model](#) is designed to enable users to better understand productivity and quality improvements from an open source development model for infrastructure. This model also captures discounts from cooperative buying, improved sustainability as well as reduced risk from resource smoothing or single-provider reliance. It also explores future economic scenarios for the collective (e.g., cash infusion, contributions from members and how that affects costs and benefits, and subsidies).

This work was designed in collaboration with project participants over a series of listening sessions and participatory workshops centered on building a costs and benefits model to inform further work on our end on building investment guidance for institutional and funder audiences.

In addition to participant workshops, we also consulted with a number of industry experts in domains adjacent to those represented by the participants of this project. These interviews provided a foundation for developing the model detailed above and supplied additional examples of business models, implementation challenges, and forms of cooperation to explore for this effort. They included experts from industry open source program offices, as well as experts involved in the creation of cooperatives, standards bodies, and perspectives on “buy vs. build” scenarios.

At the core of this work was the notion that collective investment to support and sustain open infrastructure for open infrastructure is rooted in co-creating economic and social benefits like those listed below.

1. **Innovation and production.** Build and develop open infrastructure products and services.
2. **Horizontal cooperation.** Applying the scale, buying power, intellectual strength, and collective reputation to purchases, standards, and influence.
3. **Member support.** “Just-in-time” support for members, troubleshooting, and peer-support.
4. **Translation and adaptation.** Exploring transferability of ideas from institution to institution, domain to domain, as well as outside the collective to inside the collective.

The first two are economic benefits, and the second two are about sense-making. For a collective, these translate into different ways of engaging, creating psychological safety, and staffing.

The [full report](#) and [accompanying public model](#) provide participants with a means to test out various infusions of capital, from seed grants to early development funding, ongoing subsidy, and/or independently-funded projects. The model and report are designed to augment the findings below, where we explore in more detail what participants see as core needs and challenges with existing funding models utilized today.

4.2. Examining existing funding models

In October 2020 we ran a series of 2-hour workshops for participants to explore three different funding models: one represented a mix of commonly utilized and familiar business models (membership), a second represented aspirational and commonly referenced models (a portfolio or “mutual fund” approach to a collective fund), and the last was inspired by other rapid response efforts of the past year that addressed concerns from participants about timeliness and responsiveness of funding needed to support project maintenance (rapid response funds).

In these workshops we explored, in a series of focused breakouts, what participants thought worked with these models, what they thought they were best positioned to fund, their perceived obstacles to these models’ implementations, and any questions or concerns they had.

We heard a variety of responses that illustrated the complexity in finding a collective solution that met all needs voiced for sustainable support for shared open infrastructures. We also noted participants articulating needs for various sorts of funding capital such as startup funds, support for ongoing development and maintenance, shorter-term bridge funding, as well as “change capital” which speaks to financial support for migrations from one solution to another or to incentivize collaboration. Not all funding mechanisms can accommodate the diversity of needs mentioned here or their timelines. As a result, we explored with participants a number of models that represented different rates of speed in

IOI

allocating funding (i.e., rapid response model vs. portfolio-based collective fund), types of funding, and diversity of needs supported.

Below are details on a few models discussed in the workshops, as well as additional funding approaches raised over the duration of this project.

Membership model. Participants were the most familiar with this model given its prevalence in supporting open infrastructure initiatives. “Members” are asked to contribute financially, some also contributing in-kind staffing and software development support. Membership levels are typically modest, ranging from \$500 to \$20,000+ USD, with funds offsetting operational costs for developing and maintaining shared infrastructure.

The distributed nature of the funding and contribution also distributes risk across membership. Membership based models are typically community-based and governed, dedicated to a core need or technology offering.

Sustainability is based on scale and breadth of financial contributors and adopters, as well as continued value of the core offering to the membership. Development and improvements can be slow, with shared needs for the broader good of the community often getting prioritized after individual institutions needs. Governance and transparency are key elements of this model, but can also become unwieldy, slowing the responsiveness on a product-level to meet evolving needs of the membership.

Resourcing for membership based models, while diverse, distributed, and reflective of the needs of the community, often operates on lean margins, relying on additional donations of time and staffing from members in-kind and grant-based funding to augment gaps in technical development and product expertise.

This model was one we frequently heard cited in our initial interviews as a point of frustration, and especially over the past year, one that was seen as directly contributing to fears of infrastructure collapse given the cuts to university budgets. These memberships were also noted as some of the most vulnerable budget line-items up for review in 2020, driving our further exploration into how to support institutional leaders in making the case for investment in open solutions when budgets were constrained if not shrinking.

For some projects in particular, there were situations where if two or three leading members pulled their support, the project might go into maintenance mode or warrant a migration to another service. That fragility is one of the key challenges we see with this model, even when there’s an otherwise diverse and distributed base of supporters at lower funding levels. The effect of a few larger supporters (at \$20,000+ USD funding levels, in many cases) can be significant.

Participants did say that this model was great for targeted efforts, especially in markets with little commercial interest, experimentation or competition, and particularly suited for infrastructure projects that do not require “hyper speed development”. Key concerns with this model included funding research and development, responsiveness to quick moving situations, and capital intensive activities (especially if membership grows slowly or membership amounts are modestly set). Institutional buy-in in high numbers and diversity in funding streams were listed as leading needs to improve this model's effectiveness in supporting open infrastructure projects, as well as a clear return on investment.

Participants also mentioned safeguards were needed to hedge against loss of critical mass (as noted above) and economic turbulence. Continued growth and legitimacy, including administrative and sales support, were also named, alongside safeguards against membership inequalities (varying levels of engagement, elitism/concentrations of power and influence, and the “free rider” problem were singled out by participants in particular).

Grant-based investment or subsidy. Many infrastructure projects utilize philanthropic or government funding in the first three to five years of existence to prototype and test tools and solutions to support open scholarship. These funds are time-limited by nature, and core operational funding typically shifts around the 3-5 year mark, with additional support prioritizing new development and iteration leading to feature creep, unmet maintenance needs, and product bloat. Institutional support can provide a more stable long-term home for projects at this stage, with many shifting to a mix of an institutional subsidy or membership-based model, with additional grants to support special programs or targeted development to meet specific needs that align with funder priorities.

Mixed support. As mentioned above, these models typically blend institutional and grant-based funds, potentially providing projects with a path towards longer-term sustainability — with grant-based funds especially beneficial for newer, higher risk, experimental projects and ideas, and institutional funding supporting adoption, integration, and longer-term participation and commitment.

We also explored a number of models that are currently in discussion at various stages as alternatives to addressing the inefficiencies and friction points in current funding structures, as well as others inspired by models in adjacent sectors that may aid in increasing investment from various actors, operating on a different timeline for funding needs, and also in addressing potential gaps in service.

Portfolio-based collective fund model. This is sometimes framed as a “mutual fund”-inspired approach, such as a Vanguard fund.

For Portfolio-based collective funds, we heard both praise for the collective, pooled nature of the approach to support a diverse portfolio of work which may be more resilient to market volatility, reduced risk for investors, and minimal management for the institution or funder investing the collective fund. On the downside, participants noted the multi-year, longer-term timeline for distributing funds, and raised concerns about having less direct management of their funds.

Concerns included a fear of a lack of transparency and return on investment. Participants also noted the need for clear criteria and performance metrics, which while a possible benefit of this model, could also be a deterrent given the complexity and time needed to design that work with the input of key stakeholders.

There was also a concern raised about whether public institutions could participate, and whether an institution investing in this model would preclude or affect other existing investments in open infrastructure. A pressing need for this model highlighted in our workshops was sufficient scoping to ensure those investing felt that their infrastructure needs were being addressed, and that this model was providing efficiency and reducing administrative overhead, not creating additional confusion regarding funding mechanisms.

IOI

As one participant stated, this approach felt “contrived, complex, and with a lot of overhead” to fund technologies and services that were “already difficult to explain” .

Rapid Response Fund. We explored Rapid Response Fund models in our workshop with participants following concerns raised in interviews about funds for ongoing project maintenance as well as the need for bridge funding in 2020 given shifts in university budgets, philanthropy, and the economy. Examples such as FastGrants and FOSSResponders, two funding mechanisms designed for quick application, approval, and allocation of funds in the pandemic served as models for discussion.

Participants raised the benefit in having a lower barrier-to-entry means to support immediate needs like bug-fixing, upgrades, prototyping, and rapid development via sprints. They also noted that this was a model well suited to the responsiveness needed in moments of crisis, as illustrated last year.

Downsides included longer-term, ongoing support for large projects, as well as the need for safeguards and clearly defined strategy to ensure support was being directed in ways that were not further exacerbating instability in the space.

Other models that were suggested over the course of this project included endowment funds, national/international subsidies (such as Internet2 and the European Open Science Cloud), and approaches similar to Red Hat’s open community-to-enterprise model for developing and supporting open source solutions.

In addition to funding and capital investment, we heard from participants about distinct needs for staffing and resourcing support to aid in infrastructure implementation, maintenance, development, hosting, and migration. Participants in institutional leadership positions referenced a reliance on vendors to ensure product success and stability — noting that the efficiencies gained from working with third-party (often commercial) vendors was higher than the cost of having that function be handled in-house.

We believe further exploration is needed to better understand incubator and other vended service needs to help relieve existing friction points in usability, hosting and implementation, and shortages in development and maintenance resourcing. This may address the cost and time concerns raised that can affect decisions over which software, tool, or system to invest in. Urgency and stability can often sway decisions about software and IT systems towards the better resourced and easier to use, often putting open solutions at a disadvantage. Collective action to ensure that tiers of services are available to support the open infrastructure ecosystem at a technical and business level is in the best interest of the scholarly community.

In summary, the impact of the pandemic on participants involved in the development of open infrastructure is perhaps too early to tell but will most likely be shaped by individual funding models, and the willingness of the community to act together towards shared aims.

5. Recommendations

To advance the collective aim of ensuring the future of open scholarship and its infrastructure is more resilient and durable, we recommend the following interventions. We use the word “interventions”

IOI

intentionally to signal recommendations and tangible pieces of work that IOI is committed to scoping, and working to move forward with the community.

A high-level distillation of key interventions and recommendations in December 2020 with project participants can be found [here](#). Below, we detail our recommendations and our work to date in operationalizing those suggestions. We've worked to map future areas of work onto a time horizon that reflects the complexity of enacting change in the system, and a time horizon for achieving outcomes.

5.1. Near-term interventions (<1 year)

These recommendations speak to opportunities to work with existing systems and investments. This intervention phase focuses on issues surrounding the interconnectedness and interoperability of shared infrastructure, exploring open metadata solutions and standards to facilitate exchange of information and resilience should a service quickly shift status or availability (consolidation, sunsetting a service, etc).

Recommendations in this phase include:

5.1.1. Explore knowledge exchange models to foster cross-system interoperability and resilience

This emerged from discussions surrounding the need and opportunity for a more integrated and interoperable network of infrastructure for content and data exchange to meet the increased demand for scholarship. The global pandemic and shift to online work brought into starker relief the need for frictionless access among providers, as well as an urgency in ensuring systems are designed with interoperability in mind to facilitate such information exchange and to provide a mechanism for migration should a project unexpectedly shut down due to loss in funding.

We are currently working towards mapping a common framework to better enable the sharing of knowledge across platforms. This has taken the form of a [cross-organizational and institutional collaboration](#) on an "Open Knowledge" guideline (or "meta-standard") for the [International Federation of Library Associations and Institutions](#) (IFLA) to outline core standards and protocols recommended to facilitate that sort of knowledge transfer across repository and other library systems. This work has included conducting a survey with both IFLA members and broader members of the library and standards community. We are currently working with colleagues at [NISO](#), [Emory University](#), [University at Buffalo](#), and [Universiti Sains Malaysia](#) to draft a recommendation to share with the IFLA IT Committee in the coming months.

5.1.2. Establish an Open Infrastructure Technology Oversight Committee

In recent years, there has been increased attention paid to the commercialization and consolidation of key infrastructures and technologies relied on for research, scholarship, and civil society. Particularly in research and scholarship, there has been an increased demand for more values-aligned investments and adoption of open infrastructure, to combat the increasing commercialization of core tools and technologies, selling of user data, and misaligned motives of for-profit enterprises when it comes to open knowledge.

IOI

At the start of this project, we explored how values and principles can and should affect decision-making when it comes to the core infrastructures research and scholarship rely on, building on a body of work from Educopia Institute, the French Ministry, Principles for Open Scholarly Infrastructures, and other leaders in the field advocating for transparency, values alignment, and better business practices.

As a result of that work and its complexity, we are currently scoping an Open Infrastructure Technology Oversight group — a committee of community members from across the research landscape dedicated to furthering transparency, accountability, and advocating for investment in open infrastructure solutions to ensure equitable, affordable, and reliable access to research and knowledge.

The creation of this group provides a foundation for sharing best practices, aligning power, and calling for broader system change including negotiating with vendors on pricing, reciprocity, and values-alignment.

Core outcomes of this phase of work include:

- Modelling frictionless interoperability and interaction among open infrastructure providers;
- Build collective power through trusted peer networks to increase efficiency, accountability, and negotiating power;
- And increase awareness of costs, needs, and near term funding gaps.

5.2. Medium-term (1-2+ years)

This phase speaks to identifying levers and existing networks to drive further support for shared open infrastructures. This includes a call to examine the role of consortia, vendors, and national and international funding programs and coalitions when it comes to sustaining infrastructure to support open scholarship. It also examines power as it relates to decision-making and sharing of knowledge, where casemaking and peer support are needed, and opportunities for collective action.

Recommendations include:

5.2.1. Design collective service and support models

Further work is needed to better understand where services, shared staffing, and coordinated support are best suited for collective benefit, and where opportunities exist for consortia, national funding programs, and vendors to allocate additional resources towards shared aims. This work aims to further increase attention and drive resourcing to shared infrastructure needs, heightening the resilience of shared systems by expanding and diversifying the pool of those investing in open infrastructure.

Core outcomes of this phase include:

- The alignment of power and influence across networks and programs;
- Shifting existing consortial models towards investment and stewardship of shared open infrastructure;
- Shifting internal and external budgets towards shared needs at the institutional, consortial, and industry levels;
- Outlining values aligned shared service model for delivery, development, and maintenance

5.3 Longer-term (3 years+)

This phase speaks to the longer-term aspirations of system transformation and structural change, outlining the pieces of work needed to reimagine economic support models, shifting instead to explore collective funding strategies.

Recommendations include:

5.3.1. *Piloting a Rapid Response Fund for project maintenance*

This past December, we piloted a “rapid response” fund for open technology and infrastructure projects and their leadership and staff, following on needs that were voiced over the duration of this work for immediate relief for open infrastructure project leads and community members. Grant amounts ranged from \$5,000 - 10,000 USD, and were issued with limited restriction to support costs such as salary support for key staff, continued levels of service and development, general operations (ie., bridge funds to their next grant deadline), collaborations and integrations, and/or planning support for future growth or sustainability.

The inaugural Fund was supported by the [Chan Zuckerberg Initiative](#), [Crossref](#), [ITHAKA](#), [Hypothesis](#), and [Invest in Open Infrastructure](#), with \$50,000 USD awarded to (8) projects in total. They include [La Referencia](#), [Openscapes](#), [PreReview](#), [2i2c](#), [sktime](#), [AfricArXiv](#), [Humanities Commons](#), and [Knowledge Equity Lab](#). You can [read more about the awardees here](#).

5.3.2. *Test feasibility of a collective funding model to meet community needs*

Our work in assessing blockers to the implementation of existing funding models at scale surfaced a few key findings that warrant additional exploration and community engagement. We suggest a framework of funding models to address the complexity and range of funding needs and timelines. Additional scoping is needed to ensure that a collective fund has clearly defined aims and objectives, explicit performance metrics, as well as clarity around how decisions are made and what aims should be advanced. A number of participants mentioned efforts to explore some of these issues, and we’d recommend coordination and knowledge sharing to reduce duplication of efforts and maximize support. We also recommend this work to explore values-aligned service provider relationships to bolster effectiveness, levels of service, and increase the durability, reliability, and viability of open infrastructure solutions.

Core outcomes of this phase include:

- Institutional, consortial and funding stakeholders taking a more active role in directing pricing and terms for vendors and service providers;
- Funding is directed more effectively to sustaining infrastructure for open scholarship in measurable and scalable ways;
- Open infrastructure is a competitive, durable, trusted, and cost-effective choice for institutions

We will continue to [update our project page](#) with further developments as they arise, and review the recommendations of this report annually.

6. Next steps

We believe that a change in strategy is needed to address the complexity in making open technology and infrastructure a competitive, durable, trusted, and cost-effective investment for the research enterprise.

The work above represents a snapshot of the core needs of institutional decision makers, infrastructure providers, philanthropic funders, and other supporting organizations in a time of crisis as it relates to the future of open scholarship.

The findings and recommendations for this work exist in an environment and context that is, at the time of writing this report, still rapidly evolving.

To address the dynamic nature of this work, we commit to continually revisiting the findings and recommended interventions detailed above to ensure strategies suggested are responsive, additive, and still appropriate in the future. Reflection and evolution of this work will be conducted in an open, iterative fashion alongside and with the community via consultations, community calls, and open comment periods.

If anything, the work of this report has shown not simply that open technology and infrastructure for scholarship is essential, but is truly possible. Together we've started to create the roadmap and together we can take the action to make that vision real.

7. Appendix

Appendix I: Full list of participants

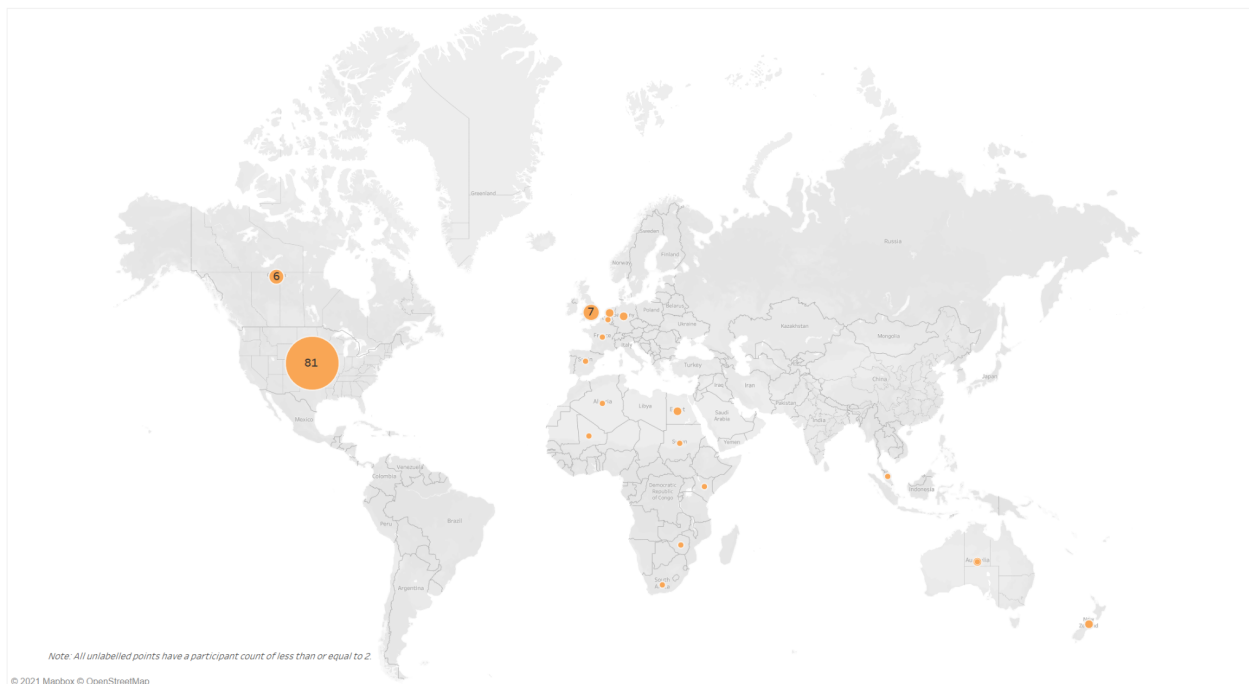
The full list of participants for the Future of Open Scholarship Project can be found [here](#).

Appendix II: Participant demographics

Participants represent 18 countries and 5 continents in total, with the largest concentration being from the United States, as evidenced in the mapping below. These include Egypt, Malaysia, Australia, New Zealand, Mali, Zimbabwe, Kenya, South Africa, Algeria, Sudan, Germany, the Netherlands, Belgium, France, Spain, the United Kingdom, Canada, and the United States.

As noted above, participation in this effort was entirely voluntary, and there are known gaps in representation among attendees (most notably in Latin America).

Figure 1.



We've also done a preliminary analysis of the roles and organization / institution types (*Figure 2*).

The classifications below are sorted initially into the following categories (*further refinement can be expected over the coming weeks*):

Academic library: participant works at a library at a University

IOI

University: participant works at a University but not at the library (e.g. professor)

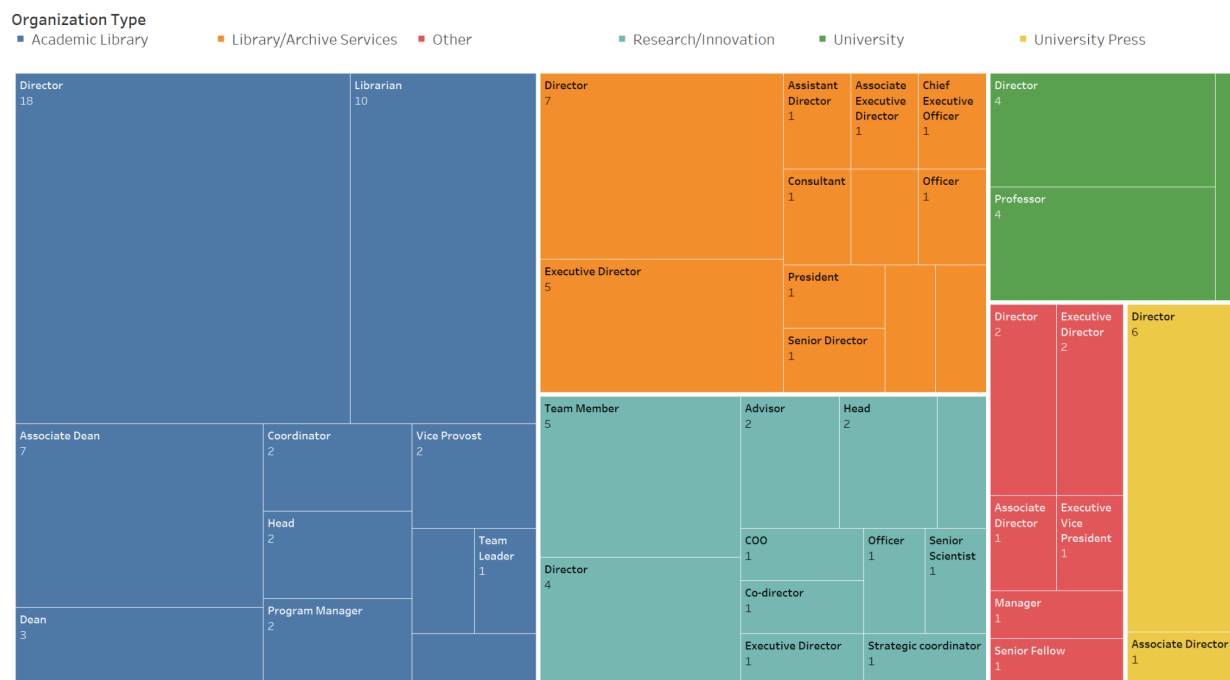
Library/archive services: organization provides consulting, consortium, networking and other related services directly aimed at libraries and archives

Research/innovation: works in the production of research (policy research etc.) or software (e.g. LiberateScience) or both. While the products of these organizations can be used by libraries/archives, this work is not exclusive to libraries/archives.

Other: publishers, university presses, and misc. organizations.

Further areas of exploration include examining the affiliation types and roles across geographic boundaries (e.g. comparing “head of” to “director” levels), and refining the categorization types to reflect more nuance regarding publisher entities, scholarly societies, university presses and other miscellaneous organizations.

Figure 2.



IOI

8. Briefs for the Future of Open Scholarship Ancillary Projects

Brief I: [Open Monograph Ecosystem Impact Analysis](#)

Brief II: [Costs & Benefits of Collective Investment](#)

9. References

- FEMA (Federal Emergency Management Agency). (2016). *National Mitigation Framework* (2nd Edition). <https://www.fema.gov/emergency-managers/national-preparedness/frameworks/mitigation>
- Fyffe, R. C., & Kobulnicky, P. J. (2000). Negotiating the soul of the library: Change management in information access and local collection development. *Journal of Library Administration*, 28(4), 17–35. doi: 10.1300/J111v28n04_03
- Hawkins, B.L. (1998). The unsustainability of the traditional library and the threat to higher education. In B. L. Hawkins & P. Battin (Eds.) *The Mirage of Continuity: Reconfiguring Academic Information Resources For the 21st Century*. Washington, DC: Council on Library and Information Resources.
- HHS (U.S. Department of Health and Human Services). (2015, June 9). Community resilience. *Public Health Emergency*. <https://www.phe.gov/Preparedness/planning/abc/Pages/community-resilience.aspx>
- Lassere, M. (2019, June 18). The soup’s on us: Introducing the information maintainers. *Maintainers*. <https://themaintainers.org/blog/2019/6/18/the-soups-on-us-introducing-the-information-maintainers>
- Miller, R. H. (2000). Electronic resources and academic libraries, 1980–2000: A historical perspective. *Library Trends*, 48, 645–671.
- Mukherjee, S. (2020, April 27). What the coronavirus crisis reveals about american medicine. *The New Yorker*. <https://www.newyorker.com/magazine/2020/05/04/what-the-coronavirus-crisis-reveals-about-american-medicine>
- Rossmann, D., & Arlitsch, K. (2015). From acquisitions to access: The changing nature of library budgeting. *Journal of Library Administration*, 55(5), 394–404. doi: 10.1080/01930826.2015.1047279
- Russell, A., & Vinsel, L. (2016, April 7). Hail the maintainers. *Aeon*. <https://aeon.co/essays/innovation-is-overvalued-maintenance-often-matters-more>

10. Acknowledgments

Our special thanks to those who've helped make this work possible, especially University at Buffalo, SPARC, North Carolina State University, Indiana University Bloomington, Iowa State University, the Center for Research Libraries, the Libraries of the Big Ten Alliance, the Wellcome Trust, Chan Zuckerberg Initiative, and Stanford University, in addition to IOI's operational supporters Schmidt Futures and the Alfred P. Sloan Foundation.

Additional thanks go to our research team for this effort: Saman Goudarzi from the University of Toronto, Vanessa Rhinesmith of UCLA's Center for Critical Internet Inquiry, Kate Pugh from AlignConsulting and Columbia University, and Heather Staines.

We are grateful for the time, generosity, and participation of the project participants, external perspectives from Valerie Sichi-Krygsman, Eric DeLuca, Gil Yehuda, and for the additional support from [IOI's Steering Committee](#).