CNI Executive Roundtable Report
What Happens to the Continuity and Future of the Research Enterprise
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What Happens to the Continuity and Future of the Research Enterprise?

**Report of a CNI Executive Roundtable Series
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Introduction

The CNI Spring 2020 in-person membership meeting scheduled for the end of March in San Diego, CA was canceled due to the COVID-19 global pandemic. In response, we shifted quickly to plan and launch an online version of the event, running from late March through the end of May 2020. The extended virtual event format afforded us the opportunity to host an extraordinary additional Executive Roundtable on very short notice drawing members of our community together to discuss an issue in need of urgent attention: **What Happens to the Continuity and Future of the Research Enterprise?** Demand for participation was unprecedented, ultimately leading to four separate Roundtable sessions on the topic, made up collectively of about 60 participants representing around 30 organizations. The discussions took place in mid to late April 2020.

Participating organizations included various types of higher education institutions, including universities with high research activity (R1 and R2), mid-size universities and small liberal arts colleges. Both public and private institutions from across the United States located in urban, rural and suburban settings. Representatives from funding organizations, government agencies, association and research entities, and information providers also participated. This report is our attempt at a synthesis of those conversations, reflecting a snapshot of the situation at the time, as well as some of our thinking on the topic as of early May 2020.

Background

Clifford Lynch, CNI executive director, opened each Roundtable by noting that, as a result of the COVID-19 crisis, most higher education campuses have shut down for all practical purposes and it is unclear when they will reopen. Instruction has shifted to remote, network-based delivery. Some parts of the research enterprise have also been largely shut down, particularly campus labs, though every campus seems to have done something slightly different in areas such as identifying "critical" research that needs to continue despite the overall physical facility shutdown. There also seems to be limited thinking about when or how we can restart the research enterprise at scale, or the ways in which this interacts with various scenarios for possible later stages and endgame for the pandemic. Of note is that some leading institutions have had critically important initiatives in place for some time trying to advance "instructional resilience." These initiatives served them very well in the current emergency, even though the focus of those efforts had mainly been disruptions of shorter duration than the current emergency. The experience that many institutions had

gained with entirely online course offerings, and even online degree programs also served them well in the current crisis. To what extent does (or should) something similar exist for research, and what have been, or should be, the objectives of such initiatives? There is at least anecdotal evidence that the thinking in the research sphere has focused more on relatively short-term disaster management, and that these strategies do not scale well to much longer-term crises. We also note experience with recent government shutdowns gave federal institutions in particular some basis for addressing the current crisis.

We do not understand the shape, extent, or impact of the shutdown of the research enterprise. It's obvious that the impact of these developments is extremely uneven across different sectors of the research enterprise, with experimental disciplines most likely more severely affected. It's easy, and totally wrong, to equate the shutdown of on-campus lab work (other than COVID-19 related research) with the shutdown of the research enterprise. It's also easy, and totally wrong, to equate the research enterprise with the experimental sciences. Even in the experimental sciences, fieldwork (in the broadest sense) is as important as lab operations for many purposes, and the continuity of fieldwork is frequently overlooked in discussions of research continuity.

There has been some limited work trying to analyze this impact: for a valuable synthesis focused on science agencies like the National Science Foundation (NSF), the National Institutes of Health (NIH), and the National Aeronautics and Space Administration (NASA), see Congressional Research Service, *Report on the Effects of COVID-19 on the Federal Research and Development Enterprise*, April 10, 2020, crsreports.congress.gov/product/pdf/R/R46309. For another useful analysis, see Danielle Cooper, *Technologies at Hand: On Researcher Practices During a Pandemic*, April 14, 2020, sr.ithaka.org/blog/technologies-at-hand.

Only a very few institutions in the Roundtables described (relatively informal) efforts to reach out to faculty to try to obtain information about the extent to which faculty research was being impacted in various disciplines, as well as the primary sources of that impact. It's clear we need much more of this kind of investigation and more ways for institutions to share what they learn from such surveys and outreach. CNI stands ready to serve as a vehicle for sharing such information and can do so on a high-priority basis.

CNI's Roundtable discussions took place within the context of Lynch's framing. Participants included individuals from university offices of research, campus IT departments, senior library administration, and research computing directors, among others. The focus of the discussions was principally on information sharing by participants, who were invited to describe their particular interests in and activities related to the topic. Issues, concerns, and observations that surfaced during the conversations are summarized below.

Key Campus Players: Offices of Research, Libraries, IT/Research Computing

Most Roundtable participants represented the perspectives of the primary drivers behind research support on college and university campuses: offices of research, libraries, and campus IT and/or research computing divisions. We also had some important contributions from organizations supporting and coordinating research activities across multiple campuses.

There is more variability than we initially expected in the extent to which institutions and/or research operations have shut down: some campuses have managed to keep research

activities somewhat open while the rest of the campus has closed and instruction has moved online; other campuses are experiencing only partial shutdowns. While probably the majority of institutions participating in CNI's Roundtables have been subject to a full campus shutdown (with varying levels of rigor and severity), there were reported exceptions with the same being true for some of the libraries represented. It is important to understand, and we will have more to say about this later in the report, that libraries (along with museums and archives) can reasonably be considered to be the laboratories of many humanists and a substantial number of social scientists. Continuity of access to physical library collections (primary monograph and periodical collections, as well as special collections) is vital to supporting research continuity in these disciplines.

In general, the **offices of research** have managed the campus research shutdown process, established the policies that determine exemptions, and drawn up the guidelines under which research may continue. These offices are also beginning to plan for the gradual restart of research. Most organizations that have shut down much of their research operations deemed similar types of projects critical and remained in operational status in some form; they include:

- COVID-19-related research
- animal care and/or maintaining living organisms
- longitudinal studies or projects involving irreplaceable samples (many field studies also fall in this category, and some are related to natural resource management or ecological studies that have impacts beyond pure research, such as management of water resources in partnership with regional governments)
- research in direct support of national security (this issue was significant but somewhat overlooked; there are some very complex specifics here that are easy to ignore, such as the inability to conduct classified research from home rather than in a Sensitive Compartmented Information Facility, or SCIF)
- human research that provides direct benefit to participants, such as clinical trials in biomedicine

Having said this, there's a surprising amount of variation in the details, particularly about who can come to campus, when to access which facilities, how frequently, and who needs to approve these activities. Intersections with campus research IT policies and practices (discussed below) illuminate interesting tensions here.

Regarding fieldwork, policies vary. Some institutions have shut down fieldwork entirely, while others are making some allowances. As peak fieldwork season draws nearer, some projects have been allowed to continue depending upon needs and timing (e.g. losing the snow pack). Research in forestry, for example, is dependent upon a seasonal clock, and missing a measurement period can have significant ramifications for the viability of a project. In these cases, human safety is prioritized, but some institutions are granting waivers if there are ways to aid researchers without jeopardizing the health of people. Fieldwork goes beyond the sciences, and in particular long-planned and now compromised fieldwork in the humanities and social sciences represents a serious dilemma for faculty. A few facets of this dilemma are discussed below.

One very important and largely unrecognized issue that emerged in the Roundtables was that there is what might be described as multi-institutional, community-wide fieldwork, such as focused campaigns across the research community to monitor certain atmospheric phenomena. Some of these efforts are long-range, longitudinal studies. There does not seem

to be much effort to coordinate thinking about these initiatives across institutions in the current environment, and this failure could have important long-term impacts.

Whether or not a campus includes a medical school, and the extent to which the medical facilities are conterminous with and jointly managed with the main campus, greatly impacts response (more buildings remain open, including spaces for respite care for healthcare workers) and can have a bearing on planning for reopening. One institution reported a phased plan to reopen research that will be in close coordination with its medical school for both guidance and also for its support in getting widespread testing to look for silent outbreaks and hotspots in order to move back to earlier phases, or to shut down anew if necessary. Several campuses have repurposed student dorms for medical workers and/or to quarantine patients, and this will also have to be unwound as part of any full campus re-opening.

Other areas in which offices of research have been active include communicating with the campus community about research continuity, disseminating information about funding opportunities (including, and perhaps especially, COVID-19 research funding), providing support in award seeking/grant management processes, and managing institutional review board (IRB) and intellectual property issues. It is worth noting that, for many researchers, this is a time when they can both prepare papers for publication, analyze data they have already captured, but also prepare grant applications. In cases where the appropriate systems are not already in place, there is tremendous pressure to put smoothly functioning, entirely electronic grant proposal submission systems in place. An additional dimension that was frequently raised here was IRB approval systems. The shutdown and social distancing mandates are generating very high demand for IRB approvals of adjustments to human subject interaction protocols for research already underway, which now needs to be handled expeditiously and electronically.

Libraries have provided crucial services in ongoing support to a broad spectrum of researchers. We heard about a wide variety of partnerships and services, depending upon factors such as the kind of institution a library serves, what consortia or other partnerships it has access to, and who comprises its primary constituency. Activities also depend upon to what degree facilities are open and how many staff members are working on campus, if any. Some libraries reported being completely shut down with no access to physical collections, whereas others reported providing partial services with very limited staff, such as scanning of physical collections or paging of physical books for curbside pickup for selected users. For at least one institution, the library is considered essential and, as such, reported having about 20 staff members working in the building in shifts. In some cases libraries are closed, but some limited, co-located facilities, like computer labs, remain open for those students still on campus; libraries are also sometimes playing a part in larger campus strategies to provide wireless access for students (or others) who don't have it at home by offering coverage in parking lots and other areas, or loaning wireless hot spots or laptops.

The extent of library autonomy with regard to broader institutional policies or regulations from various governmental jurisdictions has been an important factor in determining the extent to which a facility may be open and/or able to provide services or access to resources. In some situations, libraries have a good deal of flexibility to assess risk in decisions to provide services, and more broadly, campuses have the flexibility to manage risk in allowing faculty or students access to on-campus facilities. In other cases government edicts have largely pre-empted this. This dynamic is mirrored more broadly in the university's

management of the research enterprise. In some cases various governmental orders have severely limited institutional flexibility in assessing risk and making choices and policies; in other cases, institutions have been left a great deal of flexibility to chart their own paths.

To the extent that libraries and institutions have flexibility, they have to make choices and set priorities. For example, how important is it to support about-to-graduate PhD students? Is faculty support a priority? What about the support of COVID-19 researchers? Some of these policy choices are formal, others are handled quietly at various levels of decision-making. Organizations are also suddenly having to assess risk in new ways: for example, if you can go into a basically empty library to digitize some material, or to page a few books from the stacks, and can get in and out without using public transit, the risk should be fairly minimal. Acceptable risks and associated payoffs are suddenly demanding quantification, or at least evaluation.

Not surprisingly, most libraries have focused on providing as many services as possible remotely/electronically. For more information on the reported status of US libraries during the crisis, see the work of Lisa Janicke Hinchliffe and Christine Wolff-Eisenberg, "US Academic Library Response to COVID19 Survey," tinyurl.com/covidlibrary (video about this project is available at www.cni.org/topics/assessment/academic-library-response-to-covid-19-designing-and-managing-real-time-data-collection-and-dissemination).

Some themes and comments about library support of the research enterprise:
- Many participants discussed the importance of the HathiTrust Digital Library Emergency Temporary Access Service (ETAS) for access to at least a portion of their collections that otherwise would have only been available in print form (for more information on this program see www.cni.org/topics/digital-libraries/rapidly-expanding-access-hathitrusts-covid-19-response). Some of the collection's limitations were also noted: the relative lack of newer material, the availability of only a portion of an institution's physical collections (most commonly estimated as less that 50%, though we really need better data on this), and the concern about discontinuing access once normal operations resume (and questions surrounding the definition of "normal operations"). Institutions faced tradeoffs about investing effort into integrating HathiTrust materials into discovery systems when they would only be available in the short term. HathiTrust participants noted that this was a great example of a long-term digital content investment that has offered their institution enormous payoffs in the current crisis.

- In cases where digital versions of requested materials were unavailable, some libraries reported scanning print materials; others said they were purchasing physical items and having them delivered directly to requesters' residences. Equally, many smaller institutions felt that HathiTrust participation was essentially out of reach and not an option, and they raised questions about alternatives (e.g. the Internet Archive's National Emergency Library).

- Virtual training opportunities and workshops have increased, or new offerings launched; Data Carpentry workshops in particular were mentioned frequently. Registration and attendance for these events has been robust, often filling up very quickly. Librarians are teaching with faculty to support online instruction at some institutions. There was some speculation that interest in online training and instruction was because participants had time and were taking advantage of the

opportunity to add new skills; others speculated that there was more faculty involvement because graduate students were less available to do these things for them. Also worth noting: a number of campuses have licensed online learning materials for various kinds of data science skills to complement such workshops.

- Libraries are offering virtual consultations in various areas, including electronic theses and dissertations, research data management (RDM), geographic information services, and grant writing. Some institutions are seeing high demand for these offerings.

- Data management/support/sharing: Researchers are looking to the library for assistance in locating data sets to augment and/or expand their work. Library staff reported that researchers are increasingly tending to the state of their own data in preparation for sharing via the institutional repository (IR), and some libraries reported that IR usage rates have increased. The work being done in the area of RDM speaks to the need for partnerships across the key research support entities, with the library as one player among many, highlighting the value it brings to the research community and across campus. These developments are really important; they suggest or at least raise the possibility of a rebalancing on the economy of the value of data within the research community, and perhaps even a possibility that data collection may be outsourced to researchers that have more flexibility to do this kind of work. In addition, they raise questions about the growing importance of reusing data. The aggressive open science values surrounding much of the current epidemic research will also advance this issue.

- Libraries are purchasing more electronic resources to support campus needs when available and feasible. Some libraries reported increased adoption of relatively liberal controlled digital lending policies, signaling that this practice will likely continue after the crisis.

- Facilitating access to, or improving communications about existing remotely available tools was a common theme. One library reported setting up a virtual server to help researchers access tools. Upon discovering how poorly understood remote/off-campus access to their services was among affiliates, another library partnered with campus IT to incorporate this information into the university-wide virtual private network (VPN) messaging campaign.

- Access to archives and other special collections: Some libraries and archives units are providing scanning services for requested parts of their collections, though most recognize the gaps in what they are able to provide. This as an area that was widely recognized as being in desperate need of strategic attention and targeted resources going forward. At least a few campuses are seriously recalibrating the extent of investment in digitizing special collections; additionally, some campuses with library staff working from home but unable to do their usual jobs are re-assigning them to enhance access to digitized special collections through transcription work, for example. An additional dimension here is that some campuses hold special collections "in trust" for much broader communities than the campus – national and regional centers that normally receive a steady stream of international visitors, for example, to work with these collections, and must now consider how to address these responsibilities and prioritize the resource demands, and keep faith with the relevant communities.

Campus IT and research computing units are other key components for supporting the research enterprise. Participants from these departments, particularly campus IT, reported being focused in the near term on infrastructure capability in order to support remote teaching and learning efforts, in addition to clinical endeavors, research and administration. Maintaining and building additional internet connectivity and VPN capability has been critical to sustaining remote work. Some research computing groups have been temporarily pressed into service supporting these broader infrastructure priorities.

Seeing this moment as an opportunity, some IT departments have been offering online workshops on the use and application of central platforms and services. Information security training and education has also been an important focus of IT departments: dealing with Zoom bombing, phishing of research or administrative communities for credentials and other threats, which have been on the rise throughout the crisis. Most of this work is not specific to the research enterprise.

These units are also considering what can be done to better understand the research infrastructure service perspective in areas such as campus-wide data storage capability and provisioning high performance computing (HPC) clusters for community use. Taking an institutional view of how to get the best value out of campus resources was echoed throughout the Roundtable conversations. Discussion also surfaced about the value of (cloud-based) institutionally managed resources that have been more resilient in the current crisis, as opposed to individual lab-based computational and data resources that may be in jeopardy.

NSF and other agencies have been funding national centers such as the Texas Advanced Computing Center (TACC), not only to provide resources like HPC facilities, but also to act as centers of expertise for developing and disseminating scholarly practices related to high performance computing, big data, data science, RDM, and related practices. It is essential to consider their potential contributions in the context of institutions restarting areas of the research enterprise. These will be important layers as the research enterprise restarts, and they may play a key role in rebalancing the use of lab-based local, institutional, and national resources as researchers assess experiences and lessons from the recent shutdown. We should also recognize that some of these contributions might go beyond the sciences into the humanities and social sciences, and even into areas such as the performing arts.

Other issues that were raised regarding IT and research computing:

- There is a very complicated and institutionally-specific discussion emerging that potentially will be of great importance going forward driven by the extent to which IT systems supporting research labs can be accessed and supported remotely, the extent to which physical access to facilities is possible and the extent to which it is necessary to support lab IT systems used by a remote user base as well as the opportunities for researchers to gain strategic advantage by transitioning from such lab-based IT systems to centrally supported facilities which offer greater resilience and continuity. Other important factors here are the menu of institutional service offerings, and the offerings of national centers or shared disciplinary facilities that offer services to researchers. In some cases commercial offerings may be an additional competing alternative.

- The value of the ability to monitor research equipment and facilities with much less human intervention as extensions of "smart building" technologies, e.g. smart labs, or network connected facilities such as freezers.

- The current emergency has underscored the value of cloud-based electronic lab notebooks.

Research in the Humanities and Social Sciences

We wanted to learn about what has been happening in the humanities and social sciences. So much of the research planning and focus has been on issues that impact (specific areas of) scientific research, involving labs, specimens, observational facilities, etc.; and indeed, this is where the vast majority of the research funding flows. But we did not want to lose sight of other disciplines: what kinds of challenges they are facing, what kind of support they need and are receiving, and what concerns dominate the spheres in which they conduct their research. Here is some of what we heard:

- The humanities have been hit disproportionately hard with travel restrictions; disruption in travel to archives, collections and exhibits is having a profound impact on the ability of some researchers to continue their work. Much of this (such as funded sabbaticals) is planned far in advance, and is not easily re-arranged. A virtual interface is often not useful for humanities scholars who need to be with objects, collections, etc. Humanists are relying on digital primary source collections more than they traditionally would.

- The crisis is having a crushing impact on arts and culture organizations; funders are being greatly challenged in planning and prioritizing. This is connected to the research enterprise but somewhat indirectly and in complex ways and the implications need to be carefully considered.

- Performing arts represent a space that is relatively small but unique and really important for some institutions and for the future of the arts. It sits somewhere between instruction and research, and is critically endangered. This is an area that urgently calls for a focused examination; CNI will try to do some preliminary work on this in the coming months if nobody else steps up.

- The grants being made available for arts and humanities by the National Endowment for the Humanities (NEH) and the Institute of Museum and Library Services (IMLS) are very important opportunities. Campuses should track these, and we should follow up with a look at what has been funded at the appropriate time. The recent announcement of the NEH collaboration with the UK Arts and Humanities Research Council is also welcome and worth tracking.

- The humanities and social science research office of one institution surveyed its humanists, artists and social scientists and found that working at home when children are present and have to be homeschooled or watched has been disastrous for their productivity. It's unclear how these problems distribute across the broad range of disciplines, and also how they vary based on attributes like gender; we need to get a

better understanding of this.

- There are reports of scholars who have lost access to personal collections in their offices that they cannot physically visit. It's unclear how widespread this is, and to what extent it's a consequence of overly aggressive and overly risk-adverse campus lockdowns, as opposed to (for example) materials scholars were unable to take home for various reasons. Note that this is not just faculty offices; library carrels for PhD students offered another example of this kind of problem. Hopefully many of these situations will be resolved as time goes on, but currently there is no data other than anecdote on the scale or severity of this problem.

- Moving image libraries as research data are problematic and, due to the asymmetric bandwidth of most consumer broadband facilities, most scholars working at home do not have the bandwidth to deal with these materials effectively, particularly in scenarios where they not only need to view, but also to download, manipulate, and then upload very large media files.

- More broadly, the resilience and quality of (consumer) broadband networks that provide last-mile to residences has become a critical issue for research as well as instruction.

The Human Toll: Implications for Graduate Students and Early Career Researchers

It is very easy to equate research to what faculty does, but in fact, graduate students perform a tremendous amount of research, both functioning in teams with faculty advisors and relatively independently. Undergraduates conduct research as well (and this varies considerably, with some institutions having a very strong commitment to undergraduate engagement with research), but certainly graduate students are an absolute engine of research, so it is important to think about the implications of this crisis for work in which students are engaged and how they are impacted. There have been some very difficult situations, with some PhD students literally just weeks away from completing dissertation research suddenly having their work put on hold. Many institutions are struggling with how to support graduate students, considering the significant financial, career, and perhaps additional pressures such as visa status. Here is some of what we heard regarding the situation for students across campuses:

- Visas for incoming fall 2020 graduate students has been an enormous challenge, but also for current students whose visa extensions, needed to complete degrees, are in limbo. Some students were in the last few weeks of experimental work when the shutdown occurred and are in dire need of visa extensions. If the shutdown continues for much longer, many students in this situation will be in need of alternative pathways to completion.

- Continued or extended funding for student researchers and post-docs whose work was interrupted by the crisis is another critical and dire challenge. This is true for both US citizens and international students.

- One institution surveyed PhD and postdoctoral supervisors and learned that, so far, the crisis has impacted their work by about two to four months. Asked how they are

mitigating impact, some respondents replied that they are engaging in computational work, including acquiring computational skills, and shifting to conducting analysis. Some said that they are beginning to write the dissertation when they might otherwise not have started yet. Here it's important to distinguish between people who are trying to accomplish a relatively near-term goal, such as filing a PhD thesis, those who have a real but very limited amount of flexibility to alter the sequencing of activities towards that goal before time and financial constraints need to be re-examined, and others, such as faculty, who typically have much more open-ended flexibility to reschedule and resequence activities like grant-writing, data analysis, and data collection/experimentation (particularly with extensions to tenure and promotion timetables currently becoming routine; see below).

- Internships, pre- and post-doctoral programs, and summer research programs have been already, or likely will be, interrupted, delayed, or canceled. Some internship programs are planning to be offered virtually. Internships are starting to emerge as a major concern. Also disrupted were outreach programs and collaborations with community colleges and high schools.

- Undergraduates are missing out on the research component to their educations. For some there have been opportunities: at one engineering school, students have been able to work on prototyping protective equipment for medical workers, for example.

- Another overlooked area is what will become of the next generation of medical students and others in related health professions. Remote instruction is not sufficient here, and unlike, say, with the performing arts, there is no question that we *must* advance the next cohort of these students, as society will need them desperately.

- For early career researchers (postdocs and junior faculty) there seems to be broad and non-controversial agreement that "clocks" for events like tenure evaluations will be extended by six months or a year upon request, although the bureaucracy of putting these provisions in place may take a few months.

- There are interesting interactions in the research restart and undergraduates remote scenario: for example, if more support is needed for large remote introductory undergraduate courses, this might provide additional employment opportunities for in-residence graduate students.

Planning for Return and Restart

Institutions reported being at varying stages in planning for reopening, and surely the process is fluid and rife with influencing factors. A fundamental strategy choice is whether to restart the research enterprise first, or to prioritize the return of undergraduate instruction in person. The epidemiology suggests that a carefully managed research restart will be more feasible; institutional financial priorities (particularly for non-R1 institutions) may stress other priorities. Some of what was reported included:

- Decisions about what and how to reopen depends in part upon state, county and municipal regulations and restrictions; one institution straddles two different counties,

each with varying policies regarding the shutdown.

- Some research-intensive institutions reported beginning to plan for reopening of research, which would be separate from a general campus reopening. The ultimate goal is to welcome students back, but the first step is researchers and staff, including selected graduate students (perhaps in a second wave). This is a fundamental strategic choice, and there is considerable reason to believe that it's going to be easier to restart research with faculty and graduate students (in conjunction perhaps with some graduate instruction, presumably with small classes and less density) than to welcome undergraduates back to campus (with high-density dorms and large introductory classes).

- Several institutions working toward returning to a residential model in the fall are exploring the use of density mapping and contact tracing. Frequent testing is also a common strategy that is being considered. All of these have substantial implications for IT systems and infrastructure.

- It is clear that, in the near term at least, lab and classroom spaces will have to be less dense. Staggered on-campus presence, in order to decrease density, is being proposed as a possible strategy, but what would this approach mean for the research process if it were applied to labs? Would organizations consider a 24-hour schedule where access is staggered? There are very substantial operational complexities to running lab facilities on a 24-hour cycle, particularly with increased cleaning frequencies. It's unclear how long low density research facilities are going to be required, but if this continues long enough to affect the specifications for new research space being planned and constructed, the financial implications are huge: much larger square footage will be needed to support new labs, for example; at the same time, because of potential crowding in elevators, high-rise buildings may be very undesirable.

- For some institutions, particularly those focused on highly interactive undergraduate instruction emphasizing small classes, bringing undergraduate students back to campus is the priority/first step.

- Rollout of any reopening plan will be limited by public health concerns, and also by supply chain limitations (getting access to necessary personal protective equipment, or PPE, for example, or the ability to do frequent fast-turnaround testing).

- As libraries move toward phased reopening, they are considering issues such as how to do targeted digitization, especially with regard to special collections, and how to individually assist researchers. Like others, they are grappling with the need to prioritize limited resources and how to manage risk.

- Human resources issues (aging staff, child care, pre-existing conditions, employee safety and vulnerability, the Americans with Disabilities Act) and liability issues came up repeatedly as additional sets of factors that need to be considered in restarting the research enterprise.

Beyond Return: The New Research Environment

International travel and access to foreign resources are likely to be difficult for some time to come. Dilemmas involving long-planned faculty sabbaticals or fieldwork, often grant-supported, involving international travel (visiting foreign archives for example, or on-site archeology investigations) abound. International conferences and collaborations have relied on relatively frictionless international travel. Current network-based collaboration tools are a highly imperfect substitute, and are most effective when there's already a significant amount of social capital in place among the collaborators that has been built up through in-person encounters. We are struck by how little thinking is being done about how the international research enterprise will differ three years from now, as opposed to how it was in 2019. We believe that "routine" (and we use the term advisedly) international travel will take much longer to come back than domestic travel, or travel within specific clusters of nations (such as the European Union, or the Schengen Area); it will also be very inconsistent for different nations, with particular complexities involving so-called "developing nations." Perhaps immediate concerns are overwhelming our attention.

Based on what we heard at our Roundtables, there has been surprisingly little consideration about how lasting restrictions on international travel may reshape research. This is going to create huge problems for researchers pursuing work ranging from field ecological investigations that have taken place annually for many years, to archaeological investigations, to long-planned and negotiated sabbatical visits for work with foreign archival collections. In-person scholarly collaborations will also face major difficulties. There are possibilities here as well as crisis: one can imagine reciprocal proxy digitization networks that libraries and archives might take the lead in establishing to help scholars, for example. But one can also imagine a very grim world for scholars who wish to examine archaeological sites or conduct ethnographic studies in remote and isolated societies, but also interesting scenarios involving remote drones, robotic explorers, telepresence, and similar data collection proxies. And we should remember that people could be proxies, as well as robots: reciprocal arrangements may make this possible.

We also heard from institutions with campuses or major research centers outside the US. These face a host of challenges over and above the challenges of international travel, which we did not explore in depth in our Roundtables but should not be overlooked; many of these are country and institution specific.

Not exactly part of the discussion of research continuity but closely related were various observations about the ways in which COVID-19 has accelerated the transition to open scholarship, to changes in scholarly communication, and expedited data sharing; the use of preprints in biomedicine (and the challenges of finding the right balance between speedy availability of unvetted results and the importance of peer review in the context of an epidemic); the creation of literature collections for text mining as well as searching, with the cooperation of commercial publishers.

There is certainly some recalibration about copyright, fair use, and new ideas like controlled digital lending that are taking place in light of the current emergency and public priorities. Several participants suggested that we might also see recalibrations in other policy areas, such as the barriers between patient records and research in major academic medical centers embedded within research universities.

There were many questions we were not able to answer well in these Roundtables, but that are important and demand ongoing attention. For example, how practical is virtual and

remote-controlled experimental apparatus, and in what disciplines, and what units should take the lead in working with researchers on these possibilities—research computing perhaps? Do research-support or research groups include people with the right expertise (robotics, for example) to succeed here? Currently, most of the work in this area seems to be taking place at a small number of technology-intensive institutions. Interesting and suggestive developments that one might look at here include the Jisc Research 4.0 work (demos.co.uk/wp-content/uploads/2019/10/Jisc-OCT-2019-2.pdf), or the work of Emerald Cloud Lab (www.emeraldcloudlab.com). There was some very limited exploration of this topic during our conversations, but not much, and it remains unclear how seriously researchers will take this as a strategic direction, much harder to predict than shifts to centralized research computing support. Another element of this is the possible increased outsourcing of some bench science from universities.

We should also be thinking about how and to what extent developments and experiences are reshaping faculty and graduate student research agendas; systematic investigation of this is going to be essential. Some participants spoke of the challenges that the new environment may offer to individual identities as scholars in particular subject areas that have suddenly become effectively inaccessible, perhaps for a long time to come.

We think that libraries and memory institutions more broadly, and perhaps research support groups, are going to have to play a much larger role in coordinating international collaborations to support scholars in various nations, but right now there's little evidence of progress in this area.

Conclusion

Although we heard from a wide range of institutions on the higher education spectrum, several common threads permeated our conversations. Clearly the 20-30 years libraries have spent building and investing in digital infrastructure have served their institutions well during this time, and many participants noted that the crisis presents an opportunity for libraries to demonstrate their value as a critical nexus for research, teaching, learning, computing, publishing, and data management and manipulation strategies and methods.

Consortial/collaborative/reciprocal/sharing agreements have played a key role in the ability both to manage print collections and costs associated with them and to deliver research materials to constituencies, but the current emergency has underscored the extent to which these arrangements depend on the physical movement of material underpinned by the doctrine of first sale. Programs like HathiTrust's ETAS don't reflect these inter-institutional arrangements—they are institutional in nature. Controlled digital lending is better, but is not yet widely adopted. One must ask whether the current crisis has illuminated a very powerful problem that demands a public policy or legislative solution. This demands exploration going forward.

Similarly, centralized systems for research data and research computing are valuable infrastructures that are proving critical and attractive to those who do not currently enjoy access to those kinds of resources. Funders as well as institutions are going to need to consider these implications as they design programs going forward. Clearly advance disaster planning or the existence of emergency management groups or teams have given some organizations an advantage over others in coping with the crisis, but it was also clear that no

amount of advance planning could have fully prepared research organizations for the current conditions.

A few other themes loomed large during these discussions, including funding issues and the still uncertain impact on budgets and spending priorities, the extent to which the academy may or may not shift their focus to challenges with high social payoff and engagement (e.g. many researchers taking a perhaps opportunistic approach and shifting their work toward COVID-19 related projects), the potential shifts in scholarly culture and adoption of open scholarship practices, and the implications for multi-institutional and larger scale collaborations. There are very broad questions as well about the relationships between the academy and society at large: will science gain new respect and legitimacy, or will it come out of the crisis even more discredited? Will the humanities and social sciences be able to claim new relevance, or become even more marginalized?

We close identifying what may be a failure of imagination and is clearly a challenge, and goes beyond the goals or scope of the Roundtables recounted here. In the last few months, we've essentially realized an initial approximation of a shift to online instruction, and a much deeper understanding of its strengths, tradeoffs, compromises, shortcomings and limitations, but also its possibilities and advantages. In the research sphere, we've been much less successful: some solutions have been pauses, shutdowns, delays, reprioritization rather than adaptation. We need to collectively envision what a maximally resilient, highly distributed, low-density, and network-based research enterprise might look like. Until we develop that vision we cannot exploit it as a way to enhance resilience in our current enterprise, and we cannot begin to explore questions about what parts of this vision are desirable, and which are problematic and counterproductive.

CNI Executive Roundtables, held at CNI's semi-annual membership meetings, bring together a group of campus partners, usually senior library and information technology leaders, to discuss a key digital information issues and their strategic implications. The roundtables build on the theme of collaboration that is at the foundation of the Coalition; they serve as a forum for frank, unattributed intra and inter-institutional dialogue on digital information issues and their organizational and strategic implications. In addition, CNI uses roundtable discussions to inform our ongoing program planning process.

The Coalition for Networked Information (CNI) is a joint program of the Association of Research Libraries (ARL) and EDUCAUSE that promotes the use of information technology to advance scholarship and education. Some 250 institutions representing higher education, publishing, information technology, scholarly and professional organizations, foundations, and libraries and library organizations, make up CNI's members. Learn more at cni.org.