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FROM THE EDITOR'S DESK

The *Journal of Research Administration* (JRA) is the premier scholarly publication in the field of research administration and management. We publish timely critical work that adds to the knowledge base for research administration and contributes to enhancing the work of research administrators across the globe. Through these contributions, JRA serves as an essential educational and career development resource for our field. Our contributors share best practices and innovative approaches to address the challenges and opportunities that research administrators confront in our fast-paced, ever-changing contexts while advancing their careers by publishing peer-reviewed scholarly journal articles that enhance our field.

As the current Editor-in-Chief of JRA, I am always mindful that the success of JRA is built on the hard work and dedication of our current and prior incredible staff, editors, reviewers, and the SRAI communication committee members. I want to thank our authors, editorial board members, and staff for all their efforts that have enabled us to put together what is another exceptional issue of JRA. The current issue is again characterized by high-quality, important manuscripts that will contribute to the knowledge base and work of those in research administration and those who depend on that work. The continuing excellence of the contributions we receive for inclusion in JRA reflects the ongoing growth of the field that so many in SRAI and our field, more broadly, have nurtured over the more than 50-year history of JRA and SRAI.

The articles in the current issue of JRA reflect the broad range of issues and challenges research administrators deal with on a daily basis and the innovative and important solutions they bring to bear as they conduct their work. The manuscripts range from a consideration of elements of the administrative burdens that accompany federal funding to considerations of aspects of who we are as professionals and how we can contribute to enhancing the infrastructure and the efficacy of the work of the investigators we support. As always, we hope that researchers and research administrators across the international membership comprising SRAI will continue to view JRA as a preferred outlet for their work and a source of critical conceptual and practical scholarship to guide that work.

Our first article focuses on one of the more pressing issues that research administrators and the investigators they support must answer as they seek to address the needs of those we work to support. Dr. Schiller of Notre Dame University and Dr. LeMire of the University of North Dakota, building on and extending the work of the Federal Demonstration Partnership (FDP) and other groups, provide us with the results of a survey of post-award administrators regarding administrative burden in their article entitled “A Survey of Research Administrators: Identifying Administrative Burden in Post-Award Federal Research Grant Management”. The authors go on to offer important suggestions regarding practices and policies that may help to alleviate post-award burdens at both the institutional and federal levels.

Our next manuscript comes from a multi-national collaboration of investigators from Portugal and the United Kingdom. This team includes José M.R.C.A. Santos of the Centro de Investigação de Montanha (CIMO), Instituto Politécnico de Bragança, Campus de Santa Apolónia in Portugal, Carolina Varela from the School of Social Sciences and Humanities, Universidade Nova de Lisboa, Lisboa, Portugal, and Simon Kerridge from Research & Innovation Services, University of Kent, Canterbury, United Kingdom. Their manuscript asks, “Who are the Professionals at the Interface of Science (PloSs) Working at Research Funding, Science Policy-making, and Similar Organisations?” They argue that although researchers have frequently been studied, the PloS community has received far less attention. The authors suggest that areas such as the profiles and roles of those in the PloS community and those in non-research-performing organisations have not been explicitly addressed in the literature. The paper reports on the results of an ongoing project studying the profiles, roles, and functions of PloSs working at organisations such as research funders, policymakers, and think tanks. They also consider the involvement in professional associations of this professional community.

Drs. Pryor and Steinberg of Boston College, in their article, “Making Interdisciplinarity Concrete: Views from Leaders of Interdisciplinary Research Buildings in Higher Education,” offer a consideration of what they argue is “one of the costliest—and increasingly popular strategies that campus leaders and research administrators employ to spur interdisciplinary research in U.S. higher education is designated interdisciplinary research spaces and buildings.” They point out that we have little data on who leads the work in these interdisciplinary research spaces, what challenges they face, or their effectiveness and aims. To address these and related questions, the authors interviewed 26 leaders of and reviewed related documents concerning interdisciplinary research buildings at ten U.S. higher education institutions. They describe types of interdisciplinary building leaders, some of the novel challenges, lessons learned, suggested leadership practices, and how leaders evaluate the effectiveness of these efforts.

Our next manuscript continues our recent special issue focus on how research leaders can support diversity, equity, and inclusion. This paper focuses on the implementation, efficacy, and future directions of a pilot program to expand research on alcohol use disorders in two underserved populations. Jessica Hanson from the University of Minnesota and her colleagues at Washington State University offer us a consideration of the “Implementation of a Pilot Project Program to Expand Research on Alcohol Use Disorders in American Indian and Alaska Native Communities.” This manuscript describes a pilot effort of the Native Center for Alcohol Research and Education (NCARE) Pilot Project Core. Employing four calls for applications from 2018 to 2021, research investigators interested in conducting alcohol use disorder research in partnership with Tribal communities were recruited, with a focus on early-stage and American Indian and Alaska Native investigators. Eight pilot projects were awarded with two primary research areas, epidemiological studies, and intervention projects. Once funded, the Pilot Project Core assisted pilot project investigators with all aspects of their work. The authors discuss the results of these awards, including subsequent efforts to obtain external funding and produce manuscripts. They conclude that the NCARE pilot program provides a model for similar programs seeking to support early-stage investigators identifying as AI/AN or other groups underrepresented in science.

Jake Carlson of the University of Buffalo provides a case study of how data management plans can be used as a communications and information-sharing tool and the barriers to doing so. In his article “Untapped Potential: A Critical Analysis of the Utility of Data Management Plans in Facilitating Data Sharing,” he points out that university administration and campus service providers could potentially leverage the content of data management plans to facilitate compliance and reduce the burden on researchers. He goes on to apply the results of a content analysis to discuss recommendations to funding agencies, university administration, and campus service providers regarding ways to improve the utility of data management plans for supporting data sharing and compliance.

The final contribution to this issue comes from the University of the Western Cape. The team of Jo-Celene De Jongh, Ph.D., Simone Titus, Ph.D., Nicolette Roman, Ph.D., and José Frantz, Ph.D. in their manuscript “The Role of Research Units At a Higher Education Institution: Intention or Reality?” explore key stakeholders’ perspectives of the role of the research units within a faculty that is clinically driven, and how these units could contribute towards developing and strengthening interprofessional postgraduate research, collaboration and capacity development amongst staff. Employing a qualitative, exploratory, descriptive approach, data were gathered from individual face-to-face, in-depth, semi-structured interviews with each of the 15 participants. The authors discuss five themes that emerged from the thematic analysis and conclude that the study’s findings indicated that the stakeholders perceived the role of the units differently. Based on these findings, they offer a potentially helpful model for further strengthening the target constituencies’ capacity and involvement in research and related activities.

I hope you enjoy this issue as much as I do.

IMPORTANT NOTICES:

I want to draw your attention to several significant changes in how we process submissions and reviews for the JRA.

1. As I discussed in our last issue, as reflected on our webpage, there has been a significant advancement in the infrastructure of JRA to facilitate and enhance the journal's operation. After a long and complex process, JRA has recently "gone live" in its move to using ScholarOne software to aid in submitting, reviewing, and managing manuscripts. This will lead to a significant increase in efficiency, speed of review, and ease of communication. Getting through this process required considerable time and effort from many individuals and they have worked to make the ScholarOne system an essential new resource for JRA. For this, I would like to thank everyone involved in making this happen.

2. The information necessary to use this system, including the process for creating an account to sign-in, is available at <https://www.srainternational.org/resources/journal/become-a-journal-author>.

With the implementation of the Scholar One system, updated author guidelines have also taken effect. Please refer to the JRA webpage <https://www.srainternational.org/resources/journal/become-a-journal-author> to ensure you are using the guidelines in effect if you are submitting a manuscript or intending to do so in the future

4. Finally, I want to remind you once again that, in 2022, we began the process of pre-publishing articles online soon after they had been formally accepted. Once copyedited and proofed by the authors, these articles will be posted on the JRA webpage and then as part of the framework of the complete Fall or Spring JRA issue in which it will be published. We hope that this will get the important lessons that our articles offer readers to them to draw on much sooner. We also hope that it will encourage potential authors to consider JRA as an outlet for their work. It will allow their work to be available in a discoverable and citable form sooner than if it was held until the formal issues were released

As Editor-in-Chief of JRA, I am privileged to have the opportunity to work with the incredibly hard-working authors and reviewers who provide us with the gifts of their insight and inspiration to make significant contributions to moving the knowledge base of our field forward. We continue to receive submissions that provide direction for continuously improving the work that has been core to our field, responding to new challenges for implementing new technologies, addressing emerging policies and processes required by sponsors, and areas where research administrators are increasingly providing leadership. We are grateful to receive and be able to present to our readers the incredibly diverse and exciting array of manuscripts we receive that reflect the work of so many talented and committed professionals.

Please email me directly with any input, questions, or suggestions you may have. Beyond the creation and implementation of the new processes, policies, and procedures in the notices above, there is the critical hard work and many contributions of the many people who support the production of JRA on an ongoing basis. The Author Fellowship Committee and the Author Fellow Advisors, under the guidance of Holly Zink, provide essential support and advice to the Author Fellows as they develop and publish their first scholarly articles. I am grateful they will continue providing this unique and vital work for JRA. Producing the JRA, constantly reviewing and improving our policies and procedures, and developing our infrastructure for the future requires a broad and committed team. I have been fortunate to have their collaboration in continuing the tradition of excellence of this journal. It is the team behind the Editor that is essential to the success of the Journal. The Board and committees of SRAI, particularly the communications

committee, provide essential guidance and input on all phases of the JRA, both for intentional efforts and as a vital resource for addressing unique situations. Holly Zink, Deputy Editor, is a valued partner and an important source of personal and professional support in what would otherwise be an overwhelming task. The contributions of Gina Snyder are impossible to summarize – in any professional sport, as she is, for the production of JRA, the MVP – I cannot thank her enough.

Finally, if you are a non-SRAI member and wish to have the Journal delivered via email, please sign up through the online system at

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ARTICLES

A SURVEY OF RESEARCH ADMINISTRATORS: IDENTIFYING ADMINISTRATIVE BURDEN IN POST-AWARD FEDERAL RESEARCH GRANT MANAGEMENT

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ABSTRACT

Research universities and the federal government partner to foster societal, scientific, and technological advancements, but the federal research grant process is criticized for its procedural inefficiencies. Principal investigators and research administrators lament losing time to bureaucratic regulations, unwieldy processes, and burgeoning reporting standards. As the cost of higher education is increasingly scrutinized, existing procedures warrant examination to identify areas of undue administrative burden and subsequently restructuring to ameliorate cumbersome inefficiencies. The purpose of this study is to identify areas of administrative burden among post-award research administrators (PARA). Ninety-six PARA were surveyed. Several overlapping themes emerged, such as frequently changing regulations and excessive reporting requirements. The suggestions to alleviate administrative burden included standardizing federal grant management systems, regulations, forms, and cash management systems and limiting the rate of changes to federal grant management systems and regulations.

Keywords:

research administration, administrative burden, inefficiency, higher education, federal grants, grant management, post-award, research accounting, financial compliance, spuddle

INTRODUCTION

University research expenditures total nearly \$75 billion per year, approximately \$42 billion of which is funded by federal grants (Kamensky, 2020; Mosley et al., 2020). Federal research grants are bound to a cadre of federal rules and regulations which are outlined in the Office of Management and Budget (OMB) publication titled, *"Uniform Administrative Requirements, Cost Principles, and Audit Requirements for Federal Awards"* (2020), otherwise referred to as "Uniform Guidance" or "UG." To avoid audit findings or bad publicity, institutions impose their own layers of policies and procedures, further encumbering the research administration process (Mosley et al., 2020). Faculty researchers (also referred to as "principal investigators" or "PIs") describe this layered framework of administrative requirements as "excessive" and "unnecessary" (Rockwell, 2009, p. 29). While some regulatory guidelines are necessary to provide accountability

for taxpayer-funded research endeavors, the federal government and institutions must seek a balance between culpability and administrative burden (Leshner, 2008; Mosley et al., 2020; Rockwell, 2009). Failure to do so diverts PI time from research endeavors to administrative tasks (Mosley et al., 2020; Rockwell, 2009; Schneider et al., 2014), which can impair scientific progress and promotion opportunities, such as tenure.

The Federal Demonstration Partnership (FDP) is comprised of representatives from ten federal agencies and over 210 federal grant recipients (Federal Demonstration Partnership, n.d.). The mission of the FDP is to “reduce the administrative burdens associated with research grants and contracts” (Federal Demonstration Partnership, n.d., para. 1). The FDP surveyed faculty researchers about administrative burden in 2005, 2012, and 2018. Ninety-seven percent of respondents to the 2005 Faculty Burden Survey (note: the 2012 and 2018 iterations of this survey are referred to as the “Faculty Workload Survey”) asserted that project managers could manage some of the administrative tasks associated with federal grants (Rockwell, 2009). A similar study by Mullen et al. (2008) found that 95% of surveyed PIs endorsed the notion that additional administrative support would alleviate some of their administrative burden and allow them to spend more time on research. When asked about the estimated impact of being provided with adequate project management support, 65% of respondents replied that this would allow them to devote three to four more hours of time to research each week, and nearly 20% of respondents believed this would liberate an additional seven hours per week for research (Rockwell, 2009). Similarly, Cole (2007) found that nearly 94% of PIs surveyed identified a reduction in administrative tasks, such as grant-related paperwork, as their highest or second-highest priority for research administrators.

In response, universities increased spending from their own funds by \$7 billion from 2010 to 2017 (Kamensky, 2020; Mosley et al., 2020) to expand research-related support. Research universities employ specialized staff to focus on the pre-award (proposal), contractual, research compliance, and post-award stages of federal awards, but this has not eliminated the administrative burden from PIs according to the Federal Demonstration Partnership (FDP). Although most research-intensive institutions employ these dedicated teams of staff that are designed to alleviate the administrative burden from PIs, internal policies and procedures often require PI engagement in these processes. Some PIs may perceive the function of research administrators as a barrier instead of one of compliance and burden relief, which further complicates the process (Cole, 2007). The inadequacy of institutional infrastructure coupled with policies described as “cumbersome and redundant, time consuming, fragmented, and unfriendly to users” (Mullen et al., 2008, p. 25) present further barriers to efficiency.

PURPOSE OF STUDY

The purpose of this study is to identify areas of administrative burden for post-award research administrators. Although research grant funding is offered from federal, state, industry, foundation, and institutional partners, this inquiry will focus on federally sponsored research awards. Research administration staff were surveyed to provide insights into the following questions: What tasks are identified as exceptionally cumbersome? Which federal sponsors are associated with the highest levels of administrative burden? What makes the grants sponsored by these federal agencies particularly burdensome? What recommendations do research administrators advance to ameliorate burdensome processes? How can this information be used to inform best practices for the field?

DEFINITION OF POST-AWARD RESEARCH ADMINISTRATORS

Essential duties and job titles of research administrators vary across institutions. Some universities employ individuals whose duties include a narrow scope of work that is specific to financial compliance (e.g., ensuring adherence to federal regulations), non-financial fund management (e.g., assisting with Other Support documents or requesting no-cost extensions), or research accounting (e.g., financial reporting or invoicing), whereas some

institutions lump any task related to those functions into a singular role. Titles also vary across institutions and may include post-award analyst, post-award research analyst, research accountant, post-award accountant, grants manager, post-award grants manager, sponsored programs manager, and more.

The post-award phase of research administration begins once a fully executed Notice of Award (NOA) is issued by the grant sponsor to the institution that will be conducting the project. It concludes upon closeout of the project, which typically includes the submission of final scientific and financial reports. Additional tasks affiliated with the post-award phase include establishing a fund identifier to which PIs assign project-related expenses, project modifications (e.g., no-cost extensions or scope of work revision), financial compliance monitoring, invoicing, scientific and financial progress reports, fund reconciliation, and closeout (Cayuse, n.d.; National Institutes of Health, n.d.-a).

For the purposes of this study, the definition of post-award research administrators (PARA) includes any individual who endorsed a role on the survey in financial compliance, post-award, research accounting, and/or research finance and whose duties include one or more tasks associated with post-award research grant management

LITERATURE REVIEW

Per the Council on Governmental Relations (COGR), the federal government implemented 110 new regulations governing federal research grants between 1991 and 2018 (Kamensky, 2020; Mosley et al., 2020). The increasingly nuanced compliance policies are compounded by each federal sponsor imposing its own procedures and reporting requisites (see National Science Foundation, 2020a, for more detail), thus necessitating teams of increasingly specialized staff to manage them. The upsurge in guidelines do not increase research output or quality, and these cumulative burdens may ultimately reduce the competitiveness of the United States in the research and development global market (Mosley et al., 2020; Schneider et al., 2014). The Research Business Models Working Group (RMBWG) is an interagency committee formed at the behest of OMB and the Office of Science and Technology Policy (OSTP) and is charged with identifying and eliminating burden from the federal research grant process. This working group also recognized the urgency in regulatory burden relief, stating, “It is especially important to do so in cases where substantial and unproductive administrative burdens affect our Nation’s scientists, thereby impeding the rate of scientific and technological advancement—and hence our National competitiveness” (Research Business Models Working Group Committee on Science, 2018, p. 1). Unfortunately, high rates of administrative burden continue to be reported even with support from research administrators. Schneider et al. (2014) stated that respondents to their 2012 FDP Faculty Workload Survey “reported a sense that the bureaucracy is so intense that they have lost the ability to focus on their research” (p. 89). Due to these findings, the most inefficient processes at the post-award stage of the research administration lifecycle will be evaluated with the intention of offering a set of best practices to alleviate the administrative burden for PARA.

KEY INEFFICIENCIES AT THE POST-AWARD STAGE

The post-award stage begins once a fully executed contract is received from a sponsor and the experiment is approved to commence by the research compliance team. This stage ends with the submission of final financial and scientific reports. This stage includes hiring, training, and evaluating of project personnel, effort reporting, managing project-related research expenditures, submission of annual financial and scientific reports, and data management, all of which were identified in the FDP surveys as among the most burdensome tasks (Rockwell, 2009; Schneider et al., 2014). Convolutional layers of federal regulations and institutional policies result in PARA responding to PI inquiries with “It depends...”, which may appear duplicitous and suspend progress on a project-related activity until an allowable course of action is confirmed. This can foster tension between PARA and PIs. A survey of PIs by Cole (2007) found that PIs desired more efficient financial reporting and access to more efficient purchasing for their research projects. Failure to complete

annual financial and scientific progress reports in a timely fashion can delay incremental research funding, which can in turn precipitate delays in the progress of the project.

ATTEMPTS TO MITIGATE ADMINISTRATIVE BURDEN

The 2005 FDP Faculty Burden Survey found that researchers spent approximately 42% of their time that was intended for federally sponsored research on administrative activities (Rockwell, 2009). Similarly, the results of the 2012 FDP Faculty Workload Survey revealed that faculty reported spending 42.3% of their time on pre-award and post-award administrative tasks associated with federal grants instead of research (Schneider et al., 2014). Although several governmental initiatives were devised to address the undue financial costs and the administrative burden associated with cumbersome regulations, few gains have been realized to date. For example, Executive Order 13563 (2011, January 18) was issued with the intention of identifying and implementing more cost-effective procedures across federal agencies while also evaluating and deploying more streamlined regulatory guidelines to reduce administrative burden. The goal was to focus on the objectives of the funded initiatives as opposed to regulating the exact mechanisms of compliance.

In December 2014, the OMB combined eight circulars into one resource of rules and regulations that govern federal awards. The purpose of this resource, *Uniform Administrative Requirements, Cost Principles, and Audit Requirements for Federal Awards* (UG), was “to reduce administrative burden on award recipients and, at the same time, guard against the risk of waste and misuse of Federal funds” (Office of Management and Budget, 2014). Unfortunately, individual federal sponsors continue to impose their own regulations to govern their agency-specific grants, which is confusing and burdensome for grant recipients (Cole, 2007). Inconsistency across federal grant-making agencies has been an ongoing source of criticism since the precursor to UG, the OMB Circular A-110, was issued clear back in 1976 (Myers & Smith, 2008). Despite this, there has been a lack of tangible progress in standardizing processes across federal departments.

In June 2016, the Report to Congressional Requesters (GAO-16-573) issued by the United States Government Accountability Office reviewed these efforts and found, “Despite these and other federal efforts to streamline research requirements, universities and stakeholder organizations continue to cite increasing administrative workload and costs for complying with requirements” (p. 3). Likewise, the results of the 2018 Federal Demonstration Partnership Faculty Workload Survey revealed the burden reduction did not materialize, and that the amount of time PIs reported committing to these administrative tasks increased to 44.3%. Research administrators echoed these findings, indicating that they spent “a disproportionate amount of time using antiquated processes to monitor compliance. Efficiencies could be gained from modernization and grants managers could instead shift their time to analyze data to improve results” (Office of Federal Financial Management, Office of Management and Budget, 2020, p. 3766).

Though not specific to federal research grants, Executive Order 13771 (2017) was issued in an effort to reduce administrative burden and to improve the impact of federal funding. The language calls for agencies to identify and repeal a minimum of two existing regulations for every new regulation they propose. The net cost of all regulations in fiscal year 2017, which included both new and repealed regulations, was expected to be less than or equal to zero. On January 6, 2017, the American Innovation and Competitiveness Act (AICA) became law (42 USC 1861, 2017, January 6). The expectations of the AICA were congruent with Executive Order 13711. The AICA required OMB and the OSTP to launch a working group to review existing research and development policies and to develop recommendations to streamline processes and to minimize the administrative burden in federal grant management. The National Science and Technology Council (NTSC) is tasked with coordinating policies associated with science and technology across federal research agencies. As such, the NTSC convened in 2017 and assembled the Research Business Models Working Group (RBMWG). This workgroup compiled a series of recommendations in a report titled, *Reducing Federal Administrative and Regulatory Burdens on Research* (Research Business Models Working Group, 2018).

As of December 2020, two of the strategies recommended by the RBMWG were deployed: The use of Open Researcher

and Contributor Identifiers (ORCID iDs) and increased usage of the Science Experts Network Curriculum Vitae (SciENCv) program. An ORCID iD is a unique digital identifier that PIs can affiliate with publications and grants that remains stable across changes in institutions and names (Office of Extramural Research, 2019). This system can upload information into other federal systems associated with federal research grants and aims to minimize the number of times a PI has to enter professional data into grant applications and associated forms. As of October 1, 2019, the NIH Agency for Healthcare Research and Quality (AHRQ), and the Centers for Disease Control and Prevention (CDC) require the use of ORCID iDs for all PIs supported by career development, research education, research training, or fellowship awards (Office of Extramural Research, 2019). At the time of the RBMWG meeting, the SciENCv system was used by NIH and the Institute of Educational Sciences (IES) and was being tested with NSF grants (Research Business Models Working Group, 2018). As of May 1, 2020, SciENCv became an official NSF-approved format for its Current and Pending Support documents (National Science Foundation, n.d.). Since the adoption of these tactics is relatively recent, it is unclear how much impact they have had on administrative burden. It should be noted that as of March 2022, SciENCv does not yet include NIH Other Support documents (SciENCv Help Desk, Personal Communication, 2022, March 3). While the intention of this system may be to reduce administrative burden, it currently stands as another example of using a parallel system and different forms for tracking grant support for a PI instead of streamlining this process into one comprehensive system.

In January 2020, OMB posted proposed revisions to UG for public comment (OMB, 2020) as per 2 CFR §200.109. Uniform Guidance must be reviewed every five years “to reduce recipient burden, provide guidance on implementing new statutory requirements, and improve Federal financial assistance management, transparency, and oversight” (OMB, p. 3766). As noted above, the Background and Objectives section of 2019-OMB-0005 stated, “...grants managers report spending a disproportionate amount of time using antiquated processes to monitor compliance. Efficiencies could be gained from modernization...” (p. 3766). Two amendments to UG were implemented on August 13, 2020, with the remaining modifications going into effect on November 12, 2020 (Guidance for Grants and Agreements, 2020). The changes are touted as providing administrative relief by “requiring Federal agencies to adopt standard data elements for the information recipients are required to report” and “improving consistent interpretation” of the regulations (Guidance for Grants and Agreements, 2020, p. 49506). Due to the relatively recent implementation of these regulatory changes, it is too early to discern if a positive measurable impact on regulatory burden will materialize.

On February 9, 2023, OMB issued a Request for Information (RFI) to afford members of the public input on 2 CFR (OMB, 2023) prior to proposing amendments to these regulations. One of the stated aims is to “revise guidance to reduce agency and recipient burden” (OMB, 2023). As a response to this RFI, COGR submitted a letter to OMB to highlight areas of regulatory ambiguity and administrative burden (COGR, 2023, March 14). One of the recommendations suggested the augmentation of section 200.106 – Agency Implementation by adding, “*federal agencies, in coordination with OMB, are encouraged to seek harmonization across IT systems, reporting, and policy implementation*” (p.7, COGR, 2023, March 14). Another recommendation advocated for the inclusion of this text in 2 CFR 25 and 170 “so that any implantation of new data elements, identifiers, reporting requirements, or other related actions are assessed for the impact on administrative burden in comparison to the value of any benefits to be received” (COGR, 2023, March 14, p. 7). Should OMB elect to include this language and hold all federal agencies accountable for adhering to these policy revisions, it is likely that PIs and PARAs would report a reduction in administrative burden

BARRIERS TO MITIGATING ADMINISTRATIVE BURDEN

Multiple layers of bureaucracy, including OMB, federal sponsors, auditors, and universities, encumber the research administration process. Inconsistent audit methods and interpretations of federal guidelines deter universities from adopting more flexible policies. As Mosley et al. (2020) noted, “There have been many attempts to streamline requirements by governing bodies, professional organizations, and grant recipients but they have achieved limited success to improve cost efficiency and performance outcomes. Moreover, even minor improvements have often taken

years to be realized” (p. 11). The issue is not the lack of recognition of the cumbersome and inefficient processes governing federal research grants, but a lack of effective policy amendments to reduce or eliminate burden across all levels of governance as well as the commitment to doing so.

A recent example of increasing administrative burden is found with the new “Other Support” document required for NIH research performance progress reports (RPPR). Effective January 25, 2022, NIH began requiring a new format by which PIs would declare their current grant support as well as “in-kind” support, which means personnel or tangible items related to an NIH-sponsored project are financially supported by a third party (Office of Extramural Research, 2021, December). Research administrators have expressed frustration about the FAQ document associated with this new required format and the requirement that an electronic signature from the PI be included on each Other Support document. Since the Other Support document is a federally required component of annual NIH RPPRs, these changes have required additional PI and research administration time to ensure compliance with both the content and the formatting.

Similarly, as of January 30, 2023, NSF also began requiring updated formats for Biosketches and Current and Pending (Other Support) documents. Although the new formats are available in SciENcv, they vary from the revised forms that NIH instituted just one year ago. Starting in October 2023, NSF will require PIs to use SciENcv to generate Biosketch and Current and Pending (Other Support) documents, but this requirement has not been adopted by NIH or other federal agencies to date. The content required by each federal agency is similar, but the layout and minor nuances differ, causing PIs and PARA to spend time reformatting information to placate federal grant sponsors.

RELATED CONCERNS

Inequity Across Institutions

Ranking methodologies emphasize research productivity and related expenditures (Mullen et al., 2008). Kamensky (2020) and Mosley et al. (2020) noted that universities “increased spending on research by \$7 billion between 2010 and 2017” (p. 1). This represents an increase from 19% to 25% of total university research expenditures (Mosley et al., 2020). While this level of institutional funding may be feasible for universities with ample and flexible endowments, it may be prohibitive for universities with fewer fiscal resources. Junior faculty are often dependent on seed funding (alternatively referred to as “start-up funds”) to build their research programs and establish a lab that is competitive enough to receive consideration for external funding. Additionally, under-resourced universities may lack sufficient laboratory space, facilities, studios, and equipment for faculty to conduct robust or innovative research projects, which may further limit opportunities for external funding.

Fiscal and physical resources are essential for vigorous research endeavors, particularly in the science and engineering fields. Competition for federal research dollars is intense, but the 20 top-funded research institutions received over \$11.8 billion in science and engineering (S&E) support, which accounts for one-third of all federal research dollars for S&E obligations in fiscal year (FY) 2017 (Pece, 2019, May). Similar trends were seen in FY 2019 as the 20 top-funded research institutions received over \$13.7 billion in S&E funding, or approximately 36% of the funds awarded that year (Pece, 2021, July).

During FY 2017, federal grant support to all Historically Black Colleges and Universities (HBCUs) decreased by 17% to a mere \$308 million (Pece, 2019). Although federal S&E obligations to HBCUs increased by 3.8% in FY 2018 and by 7% in FY 2019, this only represents an additional \$12 million in FY 2018 and \$21 million in FY 2019 across all HBCUs (Pece, 2020, 2021). The 20 top-funded research universities received a collective increase of nearly \$1 billion in FY 2018 (Pece, 2020, May), highlighting the inequities in the distribution of research funding. For comparison, the top-funded research university, Johns Hopkins University, received over \$1.7 billion in S&E federal funding in FY 2017, over \$1.8 billion for FY 2018, and nearly \$1.9 billion in FY 2019 (Pece, 2019, 2020, 2021). This is double the amount received by the second-

highest funded S&E program, the University of Michigan, and nearly five and one-half times the amount awarded to all HBCUs during this time period.

Rockwell (2009) stated that faculty at institutions that received less than \$10 million per year in federal research funding reported higher levels of administrative burden, which may be symptomatic of a lack of comprehensive research administration support at those institutions. Rockwell also found that faculty at public institutions endorsed higher levels of administrative burden related to financial tasks, whereas faculty at private institutions experienced more administrative burden related to IRB and IACUC protocols, COI, laboratory safety, HIPAA, and chemical inventories. Since the indirect costs received from federal grants help finance PARA at many institutions, this creates a cycle of having limited administrative support for grants, which may, in turn, diminish the likelihood of being awarded a federal grant due to the stringent application guidelines imposed by each federal research grant sponsor. It may be difficult for under-resourced programs to break this cycle.

The frequent imposition of unfunded federal mandates not only create additional administrative burden for PARA and PIs, but also financial burden. In August 2022, the Office of Science and Technology Policy (OSTP) issued a memorandum to instruct the federal agencies to require “free and public release” (Nelson, 2022, p. 1) of publications that were developed using federally funded research by December 31, 2025. Although the spirit of this memorandum is to allow everyone free and immediate access to research findings, little guidance has been provided to PIs on managing these new directives. Presumably, institutional personnel and resources will assist with meeting this new requirement, but the scope of the costs are unknown. While NIH began allowing Data Management and Sharing costs in grant proposals as of January 25, 2023 (NIH, n.d.-b), the results from a recent COGR survey suggest that the financial burden is projected to exceed \$1 million per year (COGR, 2023, p. 4). Without additional resources, these mandates will likely strain further the limited finances of under-resourced programs.

Impact on Tenure Process

Expectations for faculty have surged in recent decades. Faculty are expected to be responsive to students, adapt to new classroom technologies, provide educational opportunities for their local communities, and to identify collaborative opportunities with peers within and external to their institutions. Since many universities are hiring fewer tenure-track faculty, those who are hired into tenure-track roles are tasked with additional service and committee demands (Cole, 2007; Kouritzin, 2019; Sorgen et al., 2020; Wimsatt et al., 2009). In addition, tenure-track faculty are expected to contribute to the scholarly body of work in their respective fields (Cole, 2007; Hu & Gill, 2000), which is casually referred to as the “publish or perish syndrome” (Cole, 2007, p. 14). This often means obtaining externally funded research grants to support the experimental and data collection processes.

Researchers cited a lack of institutional support, including an overload of teaching responsibilities and insufficient assistance available to submit grant proposals, as prohibitive to conducting research (Mullen et al., 2008; Walden & Bryan, 2010). Hu and Gill (2000) identified a teaching load of more than 11 hours and numerous service responsibilities as inhibiting research productivity. Non-tenured faculty reported more administrative burden related to federal grants than senior faculty (Rockwell, 2009). Faculty are pressured to acquire externally sponsored funds for research to offset institutional costs, particularly at institutions that are subject to reductions in governmental funding (Lintz, 2008; Wimsatt et al., 2009). Schneider et al. (2014) asserted that some respondents to the FDP survey “noted that the funding climate is so dismal that they are highly discouraged from continuing research, or are altering the direction of their research to an area that has greater funding opportunities” (p. 89). Individuals from underrepresented groups, particularly racial and ethnic minorities and women, report higher levels of stress than their academic peers (Kouritzin, 2019; Wimsatt et al., 2009), and Rosser (2004) found that reports of increased stress levels were correlated with the likelihood of leaving their institutions or academia entirely. Most universities evaluate research and publications as part of the tenure process, so barriers to these processes may result in denial of tenure and loss of otherwise talented and diverse faculty.

SUGGESTIONS FOR REDUCING ADMINISTRATIVE BURDEN

Although literature pertaining to administrative burden in research administration is limited, a few publications have identified potential resolutions for procedural inefficiencies in the post-award grant management phase of the research lifecycle. Mosley et al. (2020) recommend that federal sponsors and auditors apply “...consistent implementation and interpretation of the Uniform Guidance” and to “focus on accountability of performance over accounting (paperwork) compliance” (p. 8). Research administrators, PIs, and the audit community should collaborate to focus on the efficiency and effectiveness of research performance, including standardization of administrative requirements and audit policies across federal agencies (Mosley et al., 2020; COGR, 2023). Auditors should demarcate more clearly the differences between fraud and administrative noncompliance. Similarly, federal sponsors should implement a streamlined resolution process to investigate and resolve allegations of administrative noncompliance. This would preserve the integrity of the audit process while tolerating immaterial levels of administrative noncompliance (Mosley et al., 2020). One initiative that federal sponsors can implement that minimizes the risk of substantial fraud or fiscal waste includes issuing fixed-price grants of up to \$250,000, similar to the process used in the Simplified Acquisition Threshold process for federal programs. Reporting requirements would be limited by sponsors, thus freeing PI time to focus on the research (Kamensky, 2020; Mosley et al., 2020).

With the implementation of a congruous framework of federal policies and expectations, universities would have the confidence to reevaluate their institutional policies to determine if each practice is “necessary, effective, and efficient” (Mosley et al., 2020, p. 9). Universities should evaluate each of their policies from a cost/benefit perspective to determine which areas warrant revision, such as the financial thresholds for purchases on federal grants or internal effort reporting mechanisms, to encourage efficient grant management.

METHODOLOGY

Instrument

A Qualtrics survey was developed to ascertain perceived levels of administrative burden among research administrators. The survey included quantitative and qualitative segments. Quantitative measures included length of time in the profession, role within research administration, and which sponsors were perceived to present the highest levels of burden. Qualitative measures included questions that allowed for open-ended input from participants to explain why the policies of specific sponsors were perceived as particularly burdensome and what recommendations they wished to advance to ameliorate administrative burden within the profession.

PARTICIPANTS

Research administrators and research accountants were recruited to complete a Qualtrics survey about the administrative burden they encounter while managing federal research grants. Of the 160 participants who started the Qualtrics survey, 122 completed the survey. Three participants did not answer any survey questions beyond the consent page, so they were removed from the data pool. The original dataset included respondents from all research administration roles, so the dataset for this publication was narrowed to include individuals who endorsed financial compliance, research accounting/research finance, and/or post-award grant administration roles for a total of 96 respondents. Of these 96 participants, the average completion percentage of the survey was 89.1% and the average duration of the survey was 29.71 minutes.

A total of 75 PARA respondents reported their total length of employment in research administration. The aggregated total of service in this field was 1,089 years for an average length of service of 14.52 years per respondent. Of the 72 who reported their gender, 90.3% identified as female, 9.7% as men, and 0.0% as non-binary.

The same 72 respondents who reported gender responded to the question regarding ethnic/racial identification. The total number exceeds 72 since respondents could endorse all descriptors that applied, and four individuals endorsed two categories each.

Table 1: Number of Respondents by Ethnic/Racial Identification

Ethnic/Racial Identification	Number	Percent
Asian American or Pacific Islander	1	1.4
Black or African American	5	6.9
Hispanic or Latina/o/x	8	11.1
Native American or Alaskan Native	2	2.8
White or Caucasian	57	79.2
Other	1	1.4
Prefer not to say	2	2.8

The majority of participants reported current employment at four-year institutions of higher education. Since respondents were able to select all attributes that described their respective institutions, the total of endorsed attributes exceeds the number of unique respondents (n=86) to this question. There was one response each for Two-Year Public, Two-Year Private, Historically Black College or University, and Women's College, so those responses were collapsed into the "Other" category for this table. None of the PARA respondents endorsed current employment at a Tribal College or University.

Table 2: Number of Respondents by Institution Type

Type of Institution	Number	Percent
Four-Year Public	55	64.0
Four-Year Private	29	33.7
For-Profit	2	2.3
Hispanic Serving Institution	10	11.6
Other	4	4.6
Did Not Respond	10	11.6

A total of 96 participants endorsed one or more current roles within the parameters of post-award research administration. Since it is common for research administrators to occupy more than one role in research administration, the total of endorsed roles (n=167) exceeds the number of respondents. In fact, 23 participants endorsed current responsibilities across all three categories of PARA. In small research programs, one individual may be responsible for nearly all of the roles across the research administration spectrum.

Table 3: Number of Respondents by Research Administration Role

Role in Research Administration	Number	Percent
Financial Compliance	38	39.6
Post-Award	86	89.6
Research Accounting / Research Finance	43	44.8

PROCEDURE

Institutional Review Board (IRB) approval was obtained from the University of North Dakota (Protocol ID IRB0002660) and the University of Notre Dame (Protocol ID 21-05-6635) prior to the recruitment of participants. Participants were solicited via email, the National Council of University Research Administrators (NCURA) professional group on LinkedIn, institutional listservs, and the Research Administration Discussion List (RESADM-L) listserv. A reminder message was submitted to the RESADM-L listserv two weeks prior to the closing date of the survey. Participants were encouraged to share the survey link with other research administrators and research accountants at their respective institutions. The survey link was available from Wednesday, May 26, 2021, through Friday, July 16, 2021.

RESULTS

Survey respondents were asked to endorse specific tasks that they perceived to be exceptionally burdensome. A score of three indicates the highest level of administrative burden, and a score of one indicates a low level of administrative burden. The most administratively burdensome tasks per PARA are delineated in Table 4. The number of PARA who endorsed any level of administrative burden associated with that duty is listed next to each task. Respondents were able to enter text responses to describe "Other duties not listed." The responses included: "cost share tracking," "monthly portfolio reporting," "invoicing/cash collections," "rethink participant support in a year of pandemic has been burdensome," "tracking grant progress and correlating milestones to project expenses and effort," "serving as a de facto personal grant accountant for my individual PIs although not in my grant description," and "PI transfers." Although the "Other" category was correlated with the highest levels of administrative burden, there was no consensus on a specific task or set of these tasks being the most burdensome.

Table 4: Ranking of Most Administratively Burdensome Tasks

Most Burdensome Tasks	Score	Number
Other duties not listed	2.43	7
Effort reporting	2.28	72
Updating internal policies to reflect federal regulations	2.25	65
Staying current with federal regulations	2.21	82
Current and Pending / Other Support	2.16	68
Single audit responses	2.16	43
Subrecipient monitoring	2.01	67
Research Performance Progress Reporting (RPPR)	2.00	62

Participants were asked to identify for which federal sponsors they managed grants, and of those federal sponsors, which they associated with the highest levels of administrative burden. A total of 93 participants responded to both sets of questions. The federal sponsors branded with the highest levels of administrative burden were DOD, DOJ, DOE, USAID, and HUD.

Table 5: Administrative Burden by Federal Sponsor

Federal Grant Sponsor	Acronym	Manage Grants	Endorsed Burden	Percent
Environmental Protection Agency	EPA	41	6	14.6
Institute of Museum and Library Services	IMLS	26	0	0.0
National Aeronautics and Space Administration	NASA	61	8	13.1
National Archives and Records Administration	NARA	8	0	0.0
National Endowment for the Arts	NEA	40	3	7.5
National Endowment for the Humanities	NEH	52	2	3.8
National Institutes of Health	NIH	89	28	31.5
National Science Foundation	NSF	85	15	17.6
U.S. Agency for International Development	USAID	49	18	36.7
U.S. Department of Agriculture	USDA	54	14	25.9
U.S. Department of Commerce	DOC	38	9	23.7
U.S. Department of Defense	DOD	75	40	53.3
U.S. Department of Education	ED	62	21	33.9
U.S. Department of Energy	DOE	58	23	39.7
U.S. Department of Health and Human Services (Excluding NIH)	HHS	67	17	25.4
U.S. Department of Homeland Security	DHS	34	4	11.8
U.S. Department of Housing and Urban Development	HUD	20	7	35.0
U.S. Department of the Interior	DOI	32	4	12.5
U.S. Department of Justice	DOJ	54	23	42.6
U.S. Department of Labor	DOL	17	0	0.0
U.S. Department of State	DOS	33	3	9.1
U.S. Department of Transportation	DOT	29	4	13.8
U.S. Department of the Treasury	TREAS	19	1	5.3
U.S. Department of Veterans Affairs	VA	26	5	19.2

If a participant selected a federal grant sponsor as being administratively burdensome, they were asked to specify what made that sponsor particularly burdensome. Reasons for the perceived burden included inconsistencies across intradepartmental agencies, such as between the Army Reserve Office and the Office of Naval Research,

the level of detail required in proposal documents and annual technical and financial reports, and sponsor-specific systems that were not intuitive or were difficult to access. While some of the responses were too general to draw any meaningful conclusions (e.g., “Administration”), narrative responses are summarized for each sponsor.

SUMMARIES OF ADMINISTRATIVE BURDEN BY SPONSOR

EPA. Specific responses included “Supporting documentation (i.e. copies of invoices, expense reports, etc.) required for every invoice” and “Lack of knowledge on the part of the agency representatives requires additional time on my part to make them aware of federal regulations.”

IMLS. None. It should be noted that in fiscal year 2018, only 115 new research grants were issued by IMLS and accounted for a mere 0.48% of research grants and contracts awarded to colleges and universities (USAspending, n.d.). Due to the limited availability of these awards, it is possible that the amount of administrative burden associated with these projects is underreported.

NASA. The rationales regarding why NASA research grants were burdensome included a reference to their portal as being “hard to navigate.” Another wrote, “The NSPIRES system is a PI system so we have to obtain approvals internally in a separate system, then the PI can submit. Having to provide redacted salary information is additionally burdensome.”

NARA. No respondents identified NARA as using particularly cumbersome processes related to research grants. However, in fiscal year 2018, only 42 new research grants were awarded to colleges and universities in the United States, accounting for just 0.18% of the total research grants during that fiscal year (USAspending, n.d.). It is possible that the limited scope of respondents prevented the identification of administratively burdensome federal grant procedures affiliated with this agency.

NEA and NEH. Only one respondent provided a rationale for why they correlate grants from NEA and NEH with burden. The same rationale was entered for both agencies and read, “Complex post-award requirements and challenges associated with accessing the systems.”

NIH. Although NIH is an operating division of the Department of Health and Human Services (DHHS), due to the quantity of grants sponsored by NIH, it was broken out as a unique category for the purposes of this survey. During fiscal year 2018, 13.4% of new research grants and contracts issued to institutions of higher education were funded by NIH (USAspending, n.d.).

A total of 24 participants offered details on why they perceived NIH grants to be administratively burdensome. One-third of these participants (n=8) referenced the ever-changing and increasing number of regulations, guidelines, and forms as particularly burdensome. Several respondents singled out specific forms or processes as being cumbersome, such as the Research Progress Performance Report (RPPR) and its associated processes, the new Other Support form and resolving noncompliant publications in the National Center for Biotechnology Information NCBI. Additional responses included the lack of timely replies to policy and procedural questions and encountering conflicting advice provided by grants management specialists versus program officers (PO) within the agency and across institutes. Individuals identified a broad array of complicated procedures, such as managing the NIH salary cap, calculating PI effort, receiving reduced annual increments of awards to later be awarded the remaining portion a few days to weeks later, managing foreign influence reporting requirements, research compliance, and grant transfers between institutions.

NSF. Although 10 individuals reported reasons why NSF grants were so burdensome at the post-award stage, there was no consensus among respondents. Some cited the ever-evolving regulations and lack of sponsor

guidance as problematic. Other individuals cited the requirement of submitting post-award postdoctoral fellow mentor plans, rebudgeting requests, navigating parallel systems (Fastlane.gov and research.gov) throughout the grant lifecycle for the same grants, and the level of audit burden as being challenging.

USAID. Although USAID accounted for just 0.32% of new grants and contracts awarded to institutions of higher learning in fiscal year 2018 (USAspending, n.d.), 36.7% of survey respondents who reported managing grants from this sponsor associated the agency with high levels of bureaucratic inefficiencies. A total of 15 respondents offered details about the high level of burden. Due to the international research collaborations that are financed by USAID, respondents cited challenges with enforcing sponsor requirements on foreign institutions. Several PARA cited the prior approval process for budget expenditures that deviate from the proposed budgets, excessive regulations on top of Uniform Guidance, the audit process, and the excessively detailed financial reporting required by the sponsor. One respondent explained, “Lots of rules in addition to the CFR200 (sic)... they are very hands on and you have to ask permission to do pretty much everything. Most of this is due to a lot of their work being international so it’s already extra burden but they make it a lot harder than it has to be.” Others described a “large body of regulations on top of Uniform Guidance” and “very granular reporting requirements” as commanding excessive amounts of PARA attention. Another respondent identified the rebudgeting process as particularly cumbersome, writing, “The detail in which one must budget, justify, and heaven forbid, rebudget...the budget section was a nightmare, then rebudgeting turned out to be total PTSD.”

USDA. Participants described a “not user friendly” financial reporting system that requires the use of different forms for the same data and to collect funding. Others noted the lack of consistency across programs within USDA, and compared to other federal sponsors, as requiring substantial effort to keep abreast of the changes in guidelines. One wrote, “All branches do things differently.”

DOC. Of the explanations for what makes DOC administratively burdensome, a few themes emerged: the inflexible terms and conditions of the grants, overly detailed financial reporting requirements, and lack of consistency within the same agency. Criticisms included, “Having to draw by line item within one award,” “Always wants purchase documentation. Never timely. Takes forever to get a response,” and “Grant Administrators apply rules as interpreted and there is no consistency even within the same agency.”

DOD. Identified as the most burdensome of federal grant sponsors by respondents in this survey, several central themes arose. The most-cited issues included the specialized contractual requirements, substandard online portals for submitting prior approval requests and drawing down funds, and the excessive financial monitoring of the burn rate, with some sponsors requesting monthly spend plans. Also noted were inconsistencies across agencies within the DOD (e.g., Office of Naval Research requirements versus Army Research Office), the Federal Acquisition Regulation (FAR) and Defense Federal Acquisition Regulation (DFAR) clauses in contracts that complicate contract negotiation and can delay the start of a project, and the inconsistent interpretation of sponsor-issued guidelines by sponsor personnel.

ED. Of the PARA who described burdensome procedures they encountered with ED grants, the most frequent concerns centered around communication—or lack thereof—with agency officials. Respondents noted a lack of response from program officials, and when a response is received, the lack of consistent application of sponsor policies. Comments included, “As (sic) a question and got three different answers. Took forever to get responses. Absolutely frustrating,” “Poor communication from sponsor,” and “Lack of knowledge of the part of the agency representatives requires additional time on my part to make them aware of the federal regulations.” Others singled out Section 117 reporting (foreign funding to the institution) and the 524B financial report as particularly burdensome.

DOE. Multiple grant mechanisms are offered by the DOE, but some consistent concerns were noted in regard to the inefficiency of policies and procedures. Two respondents mentioned the Foreign National personnel restrictions as problematic, and two others cited the lack of sponsor responses as complicating the grant management process. For awards that require cost share contributions, respondents noted that the required financial reports were bogged down due to the way that the budgets are managed. The frequency and level of detail required for financial reporting, including detailed estimated carryover amounts, were cited as burdensome. One respondent explained, “The budget format they use also causes confusion and should be revised. Additionally, the cost share requirement is both a financial and administrative burden on universities. The financial reporting requirements are also inordinately burdensome. Particularly the requirement for cost share to be maintained at the overall percentage on each quarterly invoice, and for ARPA-E the requirement for backup documentation for cost incurred to be provided with each invoice. DOE-EERE and DOE-ARPA-E are the most burdensome agencies to work with, from proposal stage to award close out. They should consider easing these requirements for universities conducting research and development.”

HHS (excluding NIH). The overarching theme involving HHS awards was the lack of consistency between its agencies and convoluted post-award terms and conditions. Respondents noted that some sponsors use some NIH forms, and the consistency is appreciated, but others do not. A respondent noted, “They always seem to be slower to adapt the standard practices that NIH is quick to absorb...I’m thinking of you, HRSA.” Despite being subject to expanded authority, agencies within HHS require justification for relatively minor rebudgets or carryover. The strongest statement among those provided read, “SAMHSA is from the ninth circle of hell.” No additional context was provided, but delving into this issue further may provide additional insights into the administrative burden associated with those grants.

DHS. Invoices and financial reports were cited as major areas of burden by two of the respondents, with one reporting, “They tend to look for reasons to reject items claimed for reimbursement and typically give nonsensical reasons for their rejects.” Another respondent targeted the grants portal for FEMA, referring to it as “completely unusable” and noting that the requirements are “out of line with other major federal funders.” Since only four participants shared insights on the burdens associated with DHS, it is unclear how pervasive the administrative burden is within the research grant lifecycle of DHS awards.

HUD. The chief complaint surrounding HUD awards centers around burdensome reporting practices. Per one respondent, the sponsor requires the submission of hourly timesheets for projects despite faculty not being hourly employees. Two others noted that the invoicing and financial drawdown system is complex because of the lack of guidelines and unintuitive website design. In fiscal year 2018, HUD issued just 0.15% of new research grants and contracts to colleges and universities (USAspending.gov, n.d.). Just six respondents provided explanations regarding their experiences with this sponsor, so the sample set is too small to draw definitive conclusions.

DOI. Although four respondents identified administratively burdensome practices within DOI grant management, no singular theme emerged. Each highlighted a different issue, ranging from lack of budget flexibility to inconsistent communication to the level of detail required for invoicing to a generally convoluted award process.

DOJ. The DOJ was identified as the second most burdensome sponsor in this survey. Two major themes emerged: the required but lengthy Grants Financial Management training, which is required to access the DOJ grants portal, and the JustGrants system is perceived as buggy and difficult to navigate. Respondents described the JustGrants system as “terrible,” “not easy to maneuver,” and “doesn’t work.” Respondents noted how much more inefficient this system made grant-related processes for all points of the research administration lifecycle. Others took exception to the lengthy award management training that is required to access their systems. One reported that the mandated training took approximately 15 hours to complete and that a “large percentage of the material was not applicable to my current job responsibilities and therefore I considered it a waste of my time.”

DOL, DOS, DOT, TREAS, VA. Due to the limited number of agency-specific responses (n=0, 2, 3, 1, 4 respectively), coupled with the lack of specificity among most of the comments, no general trends were identified related to administrative burden in research grant management.

SUGGESTIONS TO AMELIORATE ADMINISTRATIVE BURDEN

A total of 53 respondents suggested methods to reduce administrative burden across research administration. Three predominant themes emerged: sponsors should standardize federal grant management systems, forms, regulations and cash management systems, reduce the frequency of changes to these same systems, forms, and regulations, and provide timely and consistent responses to inquiries submitted by PARA.

A substantial number of the suggestions centered around developing a singular electronic research administration (eRA) platform through which proposals, just-in-time, annual scientific reports, and financial reports may be submitted. In addition, recommendations called for a master version of Other Support, and for all publication references to be warehoused in this system that could be referenced as needed for proposals and annual reports. While the advent of SciENCv moves the needle in this direction, it does not yet encompass all these forms. Parallel processes across numerous platforms still exist. Calls for a standardization of effort reporting were notable, including some suggestions that this be tied into the singular eRA platform to save time for both PIs and research administrators. Respondents also noted the addition of eRA systems and regulations instead of streamlining them into a singular system. Some participants cited the development of agency-specific eRA systems (e.g., JustGrants.gov) instead of adhering to grants.gov as the primary proposal submission source.

Similarly, respondents cited the need for consistent terms and conditions across federal research grant sponsors. Although UG was supposed to provide regulatory guidance across all federal research grants, each federal sponsor has augmented the standard set of regulations with its own layer of regulations, creating contradictions in regulatory expectations between agencies. In an attempt to facilitate understanding of the regulatory differences across agencies, NSF developed a “Research Terms and Conditions Appendix A: Prior Approval Matrix” (National Science Foundation, 2020b). Although UG is updated approximately every five years, individual sponsors may implement additional terms and conditions on top of UG, causing the so-called “uniform” regulations to vary by federal sponsor with more frequency than the overarching parent regulations.

DISCUSSION

Since there is a limited body of literature pertaining to research administration, this study was developed with basic research questions in mind: According to PARAs, which tasks are the most burdensome? Which federal sponsors are correlated with the most intensive procedural inefficiencies, and why? What recommendations do research administrators have to mitigate administrative burden? How can these findings be employed to develop best practices for the field and to advocate for changes to federal research grant policies?

Respondents identified effort reporting, updating policies to reflect changes in federal regulations, keeping abreast of current federal regulations, Current and Pending / Other Support documents, and single audit responses as the most burdensome tasks associated with federal research grant management. Rockwell (2009) and Schneider et al. (2014) noted that PIs identified effort reporting as particularly cumbersome in the FDP surveys, which signals that this process is cumbersome for PIs and PARAs alike.

The federal research grant sponsors that were most frequently cited for administrative burden among PARA were DOD, DOJ, DOE, USAID, HUD, ED, and NIH. Some sponsor-specific issues were identified, such as the specialized contractual parameters associated with DOD, the mandatory financial management training affiliated with DOJ,

additional regulatory layers on top of UG for USAID awards, and the annual RPPR and associated forms for NIH. Several overlapping themes across sponsors emerged, such as frequently changing regulations or excessive reporting requirements. This is also consistent with identified areas of burden in previous publications (Cole, 2007; Kamensky, 2020; Mosley et al., 2020; Rockwell, 2009; Schneider et al., 2014).

Survey respondents submitted numerous ideas to reduce or eliminate substantial sources of administrative burden. However, the suggestions trended around a few central themes. Providing a singular eRA system for proposal submissions, scientific and financial reporting, and warehousing required related documents (e.g., Biosketches, Current and Pending) would ameliorate a substantial amount of this burden. Consistent with the recommendations offered by Mosley et al. (2020), the Federal Government should coordinate terms and conditions across all federal research grant sponsors and limit or eliminate agency-specific regulations that further complicate research administration processes. Ideally, more grant recipients should advocate for these changes at FDP meetings with the ultimate goal of precipitating regulatory changes across federal research grant sponsors.

LIMITATIONS

The existing body of literature related to administrative burden in research administration is limited. Due to this, the survey was developed to capture a broad sampling of areas of administrative burden related to federal research grants. Although grants and contracts are distinctive funding mechanisms, the survey did not explicitly define or differentiate between the two and respondents may have included perceptions of research contracts in their responses. Results may not be generalized to both funding mechanisms equally, so caution should be exercised when interpreting the findings.

The invitation to complete the survey was deployed to research administrators who subscribed to the Research Administration Discussion List (RESADM-L) listserv, those who were members of the LinkedIn NCURA professional group, and other colleagues via email and internal research administration listservs. The majority of respondents were from four-year public and private institutions, with very few respondents from two-year institutions, HBCUs, TCUs, and Women's Colleges, so the identified areas of burden may be specific to larger, predominantly white research institutions and skewed toward those who were aware of and/or had the time to engage with these resources. Although general trends were identified, providing a role-specific survey to a broader group of research administrators or to PARAs employed at institutions with the same Carnegie Classifications may yield different results. As with all survey designs, self-reported data is subject to biases and omissions, so repeated deployment of a similar survey would need to be performed and analyzed to establish the reliability of the findings.

SUGGESTIONS FOR FUTURE RESEARCH

Specific subsets of research administrators and institutions of higher learning should be studied to identify unique sources of administrative burden. Do PARA at colleges with low research activity experience the same types and levels of administrative burden as those at R1 or R2 institutions? What differences are observed at HBCUs, TCUs, HSIs, or Women's Colleges that differ from Predominantly White Institutions (PWI)? If disparities are noted, what systematic changes are needed to provide a more equitable administrative experience for PARA across all institutions?

Additional topics for future research should focus on the funding mechanisms themselves. Do PARA perceive different levels or types of administrative burden related to research grants versus research contracts, and if so, in what ways? How is administrative burden reduced when managing modular grants?

Finally, opportunities for studying administrative burden abound due to recent changes in federal policy. How do recent changes to access to publications impact PIs and institutions? How cumbersome are the new NIH data management requirements and what are best practices for mitigating risk? How can PARA and PIs better leverage the collective knowledge and advocacy of COGR, FDP, the Association of American Universities (AAU), and other related groups to reduce administrative burden in federal research grant management?

SUMMARY

The research administration process, particularly in relation to federal grants, presents a virtual cornucopia of opportunities for reducing administrative burden. From the proposal to the grant closeout phase, several areas require analysis to develop more contemporary, streamlined, and efficient procedures. As PIs are increasingly pressured to obtain externally funded grants to support research, it is reasonable to anticipate that PIs will expect an increasingly robust team of research administrators to facilitate the applications for and management of research grants. Since universities have already increased their own spending for research-related support by \$7 billion to augment specialized units of research administration from 2010 to 2017 (Kamensky, 2020; Mosley et al., 2020), this figure will likely continue to expand unless the existing body of regulatory and procedural demands that dictate the research administration process are streamlined. Institutions that lack the resources to employ full complements of skilled research administrators are in jeopardy of losing out on research funding, which runs the risk of slowing new developments in science and technology. While faculty are capable of handling the administrative tasks, every minute they spend completing paperwork is a minute less spent on actual research. If the greater public was aware that some faculty report spending nearly half of their federal research time on paperwork instead of actively researching cures for cancer, infectious diseases, safety mechanisms, or societal concerns, how would they respond? The intention is to shine a light on these inadequacies and to advance solutions to mitigate administrative burden and procedural inefficiencies in the federal research grant process.

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WHO ARE THE PROFESSIONALS AT THE INTERFACE OF SCIENCE WORKING AT RESEARCH FUNDING, SCIENCE POLICY MAKING, AND SIMILAR ORGANISATIONS?

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ABSTRACT

The scientific endeavour involves not only those working in research performing organisations—but also those in science funding, policy making, and think tank organisations, among others. The workforce in all these entities is composed of researchers, policy decision makers, managers, administrators, technicians, and other supporting staff. Within this community, professionals working at the interface of science (PloSs) can be defined as those working in the research management and administration (RMA) domain, including varied areas such as science strategy and policy support, research funding procurement, project management, facilities management, communication and dissemination, knowledge and technology transfer, valorisation and impact, and related areas. Researchers have been often studied, namely regarding their job satisfaction, entrepreneurial spirit, and migration patterns. However, the PloS community has seldom been studied, with only a few reports existing, for example on their profile and roles. Specifically, the PloS community working at non-research performing organisations has not been explicitly addressed in the literature. This paper reports on the results of an ongoing project aimed at studying the profiles, roles, and functions of PloSs working at organisations such as research funders, policy makers, and think tanks. The corresponding specificities of these professionals are highlighted and their involvement in professional associations is addressed. It is argued that they are intrinsically part of the wider PloS (often called RMA) profession and that their full engagement in this community would benefit these individuals and the research and innovation ecosystem at large.

Keywords:

Professionals at the Interface of Science (PloSs); Research Management and Administration (RMA); Research Funding Agencies; Science Policy Making Agencies

INTRODUCTION

Research and innovation (R&I) ecosystems can be seen as a complex network of stakeholders that cooperate towards the production of scientific and technological knowledge and its incorporation in the society at large, from productive firms to socially-driven enterprises and, ultimately, to citizens. Core institutions in the ecosystems

include policymaking, funding, research and innovation performing and interface organizations (e.g., science and technology parks), companies, and user associations, among others.

R&I ecosystems rely on the creation of knowledge, and this is centred on communities of specialised professionals that acquire the required skills and competences through formal education (e.g., PhD) and/or through experiential learning or professional qualifications. Focusing only on the research production subset of entities, these include policymakers, staff at policy implementation agencies (e.g., funders), researchers, and all the staff that does not perform research but interfaces with researchers at some point.

Research funding agencies take the role of science funding, and some employ their own scientists directly (e.g., the Centre National de la Recherche Scientifique, in France). Their activity is financed from budgets distributed by central government, according to programs and high-level science policies (Braun, 2003; Gulbrandsen, 2005). Therefore, they play an important part in the design and implementation of science and technology policies by translating political orientations into effective activities. They constitute operational pillars for policy makers and the research community.

Research funding agencies generally allocate funds on a competitive basis. Traditional academic research funders, such as research councils, often give precedence to fundamental, disciplinary-based research issues. Thus, they put emphasis on research topics from a bottom-up perspective (Benner & Sandstrom, 2000). Mission-oriented programmes, and agencies, are increasingly designed to deal with problem-oriented research. In this case, research funding is directed to certain communities of practice (e.g., cancer research), interest groups (e.g., space), and the society at large (e.g., sustainable development). Therefore, they encourage researchers to focus on socially relevant topics.

Generally speaking, in the public sector research policy covers the design, funding, assistance, and deployment of scientific and technological resources, in the context of the “knowledge economy”. Typically, science policies emanate from governmental structures such as ministries. Some research funding agencies do however contribute to science policymaking e.g., by developing prospective reports. The intermediary role of research funding agencies and the intricacy of their mandates brings about frictions in their interactions with the state and the scientists (Veletanlić & Sá, 2020). These conflicts derive partially from safeguarding that policy objectives determined by governments are tackled while preserving scientific standards and complying with institutionalised practices.

Science policymaking is often supported by science and technology “observatories”. These may take the form of science indicators units, research units on policy, or statistical offices. Moreover, “regulatory” agencies, defining and managing standards, norms and regulations for specific areas (e.g., the Food and Drug Administration agency in the United States) directly influence science policymaking and the research endeavour process itself.

The professionals that work in the above-described organisations are the main interface with the researchers’ community. Researchers have been regularly studied, and issues such as their satisfaction at the job (Sabharwal, 2011), professional mobility (Scellato et al., 2015) and entrepreneurial spirit (Kabel & Mueller, 2009) have been addressed. However, the groups of professionals that “orbit” around researchers have seldom been studied and addressed in the literature. This is particularly evident for those professionals working at the interface of science, defined as those “working on the broader areas of the so-called research management domain, including communication and dissemination, knowledge and technology transfer, valorisation and impact, science strategy and policy support, research funding, project management, laboratory management, and other areas of research affairs” (Agostinho et al., 2020, p. 19). This definition somewhat extends the traditional concept of research managers and administrators (RMAs) to those professionals that typically are not always associated with this specific community such as science communicators and scientific facilities managers. Thus, the term ‘professionals

at the interface of science' (PloSs) is related to the roles these professionals fulfil within every institution that performs scientific research. This definition has been recently extended (Santos et al., 2021a) to include those professionals working at organisations that do not perform scientific research but that are an intrinsic part of R&I ecosystems, that is, PloSs working at e.g., science policymaking, research funding, observation, think tanks, and the like. To the best of our knowledge this community of professionals has never been characterised in terms of their profile, roles, and functions.

Professional associations perform a key role in the development of communities of professionals that share a scope of action and intervention. This includes contribution to the formal/legal recognition of specific professions, professional accreditation, initial and continuous competencies development, information dissemination, job market promotion, among other activities. RMA associations have existed since the mid-20th century. The first professional association, the National Council of University Research Administrators was formed in the USA in 1959. Since then, many other national and regional associations have been created around the world and there is even an umbrella organisation—the International Network of Research Management Societies—that was established in 2001 seeking to share good practices around the world. These professional associations perform some or all the above-mentioned activities and have been fundamental for the formal recognition of RMA, for the definition of competences frameworks, and accreditation schemes.

PloSs involved in these associations are mainly based in research-performing organizations (RPOs). Nevertheless, a few professionals from non-research-performing organizations (non-RPOs) do engage with RMA professional associations (Kerridge & Scott, 2018a; 2018b). This supports the idea that this subset of PloSs are indeed part of the wider RMA community and instigated the initiation of a research project focused on the characterisation of these professionals, their identity, profile, roles, functions, and RMA community engagement.

In face of the above, the research questions addressed in this study are the following:

1. What are the similarities and differences in terms of profile, functions, and roles between non-RPO PloSs working at science funding, policy organisations, and the like, and those RPO PloSs working at higher education institutions, research centres, and other research-performing organisations?
2. Are these professionals actively integrated in existing formal and informal, national and international RMAs associations? If not, why? Should they?

To this end, an emergent, inductive qualitative approach was used as an exploratory study. The specific stages followed in addressing the research questions comprised an online survey and semi-structured interviews.

We will provide an overview of research funding, policymaking, think tanks, and related organisations, including existing research on these organisations. This is followed by an outline of existing studies on PloSs. Next follow a description of the inquiry methods used, and the presentation and discussion of major findings. Finally, relevant conclusions are drawn and future research directions are indicated

RESEARCH FUNDING, SCIENCE POLICYMAKING, THINK TANKS, AND RELATED ORGANISATIONS

Research on funding agencies has been focused on varied topics. Cordero et al. (2008) discussed their role in encouraging knowledge translation and exchange through the research community. According to those authors, this includes the function of scientific information disseminators and, potentially, knowledge brokers, and promoters of end-users' involvement in prioritizing research areas. According to Kamenetzky & Hinrichs-Krapels

(2020), there is an increasing drive for these organizations to be responsible not only for research governance and administrative functions but also for the longer-term impacts of the supported research activities. This has been addressed by several other authors' research, e.g., Luukkonen & Thomas (2016), and Witty (2013). Veletanlić & Sá (2020) have discussed their role as occupying regions of contention between research and political actors. Additionally, research funding agencies have been described as key in the internationalisation of research, as a way to access complementary expertise, to discuss ideas, and to cooperatively resolve complex and inherently global issues in ways that go beyond what would be possible for individual researchers or national institutions (Lasthiotakis et al., 2013; Sergi et al., 2014). The contribution of these organisations in framing key societal issues such as sustainable development has also been addressed (Mobjörk et al., 2006). That author concluded that the focus has been on the environmental dimension, neglecting economic and social aspects. The impact on research funding of the increasing emphasis on commercial applications has also been addressed, for example by Ylijoki (2003), and Sá & Litwin (2011). However, to the best of our knowledge, no study on PloSs at research funding, science policymaking agencies, and related organisations has yet been carried out.

PROFESSIONALS AT THE INTERFACE OF SCIENCE

Existing literature on studies focused on PloSs is limited essentially to those working at RPOs. Nevertheless, it does provide useful general information on the profession and hints to the recognition of PloSs working at non-RPOs. As an example Virág et al. (2020) conducted a survey and interviews to understand the training and education needs of RMAs specifically working with fundraising and implementation of EU-funded projects. The study concluded that the majority of the respondents were highly qualified, with 91.6% with at least a master's degree and 29.7% with a doctoral degree. In addition, the gender representation showed the same picture reported by others (Kerridge & Scott, 2018a; Shambrook, 2012) with a majority of female respondents (72.3%). The respondents also acknowledge the importance of networks for professional development and as a community of practice for daily jobs. The authors assert that certified training in Research Management and Administration contributes to the recognition of knowledge and competences which provides more visibility and better career development. In the interviews, RMAs testified that the lack of professional identity impacted on their recognition and career perspectives.

The professional frameworks, identity, functions and impact of PloSs have been the subject of a relatively small but growing number of research projects. For example, Shelley (2010) conducted a survey to assess the changes of roles and functions of university RMAs in the United Kingdom, concluding that these professionals have a diversity of roles and a broad range of responsibilities. Schützenmeister (2010) conducted a literature review to understand the skills that researchers and RMAs may have in common, namely those brought from higher education management and from academia. It was noted that professionals with a scientific background are contracted as specialists in research management, making decisions with reference to scientific knowledge and the societal environment of research, in contrast with "pure" administrators. The author also points to the existence of a second form of research management, by referring to program managers at research funders that act as "mediators who observe scientific development closely and try to relate new research areas to political agendas" (p. 3). Poli (2018) delivered an extensive review of roles, professional development, and advancement of the research management profession, although reference to PloSs at non-RPOs is absent.

References to PloSs at non-RPOs are in fact rare. Authors such as Braun (1998), Wenneberg (2001), Schützenmeister (2010), Goldstein and Kearney (2020), and Arnott et al. (2020), address the roles of research management and administration at research funding entities, but not the professionals per se. In what concerns PloSs at non-RPOs, the only published study where they could be identified is that of Kerridge and Scott (2018a). The authors developed the Research Administration as a Profession (RAAAP) survey aimed at obtaining a snapshot of the RMA profession around the world. The main objectives of the survey were to determine the perceptions of the importance of

technical skills and transferable skills of these professionals, and to collect demographic information. From the respondents, 0.7% and 0.6% could be identified as working in research funding and governmental departments, respectively. Professionals working at charities, private companies, and hospitals represented 0.3%, 0.9%, and 3.3%, respectively. Thus, a potential total of 5.7% of the 2,673 respondents worked at non-RPOs. However, this is an upper estimate as some of these latter categories could include RPOs, for example companies that perform research, charities that perform as well as fund research. Due to the nature of the survey methodology, this group is likely to be under-represented in the response set, because they may be unlikely to be members of the RMA associations that distributed the questionnaire to their members. Still, this clearly indicates that there is a possible key “hidden” community of PloSs that needs to gain visibility in the RMAs professional context.

In face of the above, while incipient studies have been conducted, more research is needed to broaden the characterization and understanding of the scope and professional frameworks of PloSs at non-RPOs.

METHODS

The methodology adopted was a mixed methods approach, consisting of quantitative and qualitative data based on an online survey and interviews. The authors selected mixed methods for a deeper understanding of qualitative and quantitative data collection and analysis (Saunders et al., 2009) of aspects such as demographic (age, gender), academic (qualifications, topics) and professional (career, tasks, roles) profiles, and involvement in professional associations (reasons, activities, interaction with colleagues, and training activities). The study was implemented in two stages. In the first stage, the authors conducted a survey targeting PloSs working at government related ministries, agencies and institutions dedicated to research funding and/or policymaking in different parts of the world. The second stage was composed of interviews to all respondents who participated in the survey and agreed to be interviewed. Both phases of the study, the survey, and the semi-structured interviews, were exploratory and inductive in nature.

Surveys are the most widespread form of empirical social research for gathering data, knowledge, ideas, attitudes, or evaluations of social structures (Gaisch et al., 2019). Given that surveys tend to measure beliefs and not necessarily actions, they are subject to various response biases. Arguably, with a purposive sampling approach addressing a pre-selected expert cohort, cognitive and systemic biases are more likely to occur. For one, non-probability sampling draws on the subjective judgement of the researchers. In addition, the participants that represent the phenomena of interest may have been biased to provide predominantly positive responses. To minimize this bias, both structured and open-ended questions were asked. Also, all identified persons have experience in the investigated topic and draw on a variety of knowledge sources (academic, semi-formal, informal, tacit) that allow them to provide knowledgeable answers to all relevant questions and to make informed decisions about who to address in case of doubt. Arguably, the small sample size ($n = 72$) does not allow for a full breadth of views and limits the robustness of our analysis. It needs to be stated here that this investigation represents a preliminary, purely descriptive data analysis, which may form the basis for further analysis with a richer data set and a larger sample.

The survey was administered online, using the Qualtrics platform, and responses were collected between June 2020 and March 2021. Content validity of the questionnaire was ensured by means of careful definition of the research constructs through a literature review (Santos et al., 2021a) as well as using expert judgment (Saunders et al., 2009). The questionnaire was reviewed by a pilot group of respondents (PloSs). Their feedback informed the final questionnaire instrument (Santos et al., 2023a).

The questionnaire was composed of six sections: profile, career, training and continuous professional development,

identity and role in R&I ecosystems, membership of professional networks, and interaction with other stakeholders in R&I ecosystems. Likert-type scales were employed when relevant. Open-ended responses were also utilised in order to collect additional information whenever the respondents considered it necessary to support their responses.

The questionnaire was disseminated among the authors’ professional contacts at non-RPOs (e.g., research funders, innovation agencies, governmental offices) and through several existing RMA associations (ARMA, ARMS, BRAMA, CARA, EARMA, NCURA, NORDP, RMAN-J, SARIMA, and SRA-I). An invitation letter was sent via email including a link to the online survey. A series of reminders were sent to maximise the number of responses.

A total of 72 responses were obtained (Santos et al., 2021b). Data analysis was carried out using the SPSS software, version 26. Although it was made clear and stressed that the survey was aimed at PloSs working at non-RPOs, a significant number of responses originated in RPOs (e.g., Universities, R&D laboratories). In total there were 37 responses from non-research-performing organisations and 35 from research-performing institutions. This may have been due to the wider dissemination through RMA associations. It provided the opportunity to contrast the profile of these two subsets of PloSs, for the questions that were not specific for PloSs at non-RPOs.

The survey data was coded, anonymised, and analysed using descriptive statistics methods. No inferential statistical analyses were undertaken as the response level was too low for this to be meaningful. Thus, this study is exploratory in nature.

The data collected were analysed and compared and contrasted, whenever possible, with data from two Research Administration as a Profession surveys—from its 2016 (RAAAP-1) and 2019 (RAAAP-2) iterations. In RAAAP-1 (Kerridge & Scott, 2018b) and RAAAP-2 (Kerridge et al., 2022) a total of 65 [2.4% of n=2,691] and 108 [2.5% of n=4,325] responses were obtained from PloSs working at non-RPOs, respectively. The RAAAP-2 data were provided in draft status by the RAAAP task force and processed and analysed following the protocol described for the PloS study. The RAAAP surveys were aimed at members of RMA associations. The present PloS survey was disseminated directly among professionals at non-RPOs, and among RMA associations.

The framework that supported the interviews comprised four categories: “background/profile”, “professional identity”, “involvement in professional networks or associations of PloSs”, and “training and development needs”. It was generally based on the Interview Protocol Refinement Framework (Castillo-Montoya, 2016). Care was taken to not restrict the interviewees’ answers, and to allow for a free expression of opinion on the topics addressed. A total of six semi-structured interviews were conducted remotely using the Zoom platform. An informed consent form signed by the participants was collected prior to their interview. All the authors were present for each interview, and for consistency the first author led each one. An interview template (Santos et al., 2023b), which had been shared with interviewees beforehand in order that they could prepare, was used to guide the conversations. The characteristics of the interviewees can be seen in Table 1. The interviews were recorded using the Zoom platform, transcribed using Microsoft 365 Word and anonymised by the authors conducting the study. Each transcript was then checked and edited by one of the authors (the work was divided) and shared back with the interviewee for checking and correction. Text analysis was used to infer and collect information relevant to the research questions addressed in this study.

Table 1: Interviewees' Characterization

Ref.	Gender	Age range	Country	Job designation	Highest qualification	Seniority level	Tasks as PloS
1	F	35-40	UK	Head of department	PhD	Junior	Open science services
2	M	25-30	PT	Team leader	MSc	Junior	Deploying research funding instruments
3	F	55-60	AU	CEO	PhD	Senior	Deploying research funding instruments
4	M	55-60	SP	Head of department	PhD	Senior	Science policy making
5	F	35-40	HU	Research officer	PhD	Junior	Supporting research funding acquisition
6	F	25-30	PT	Project manager	MSc	Junior	Deploying research funding instruments

RESULTS

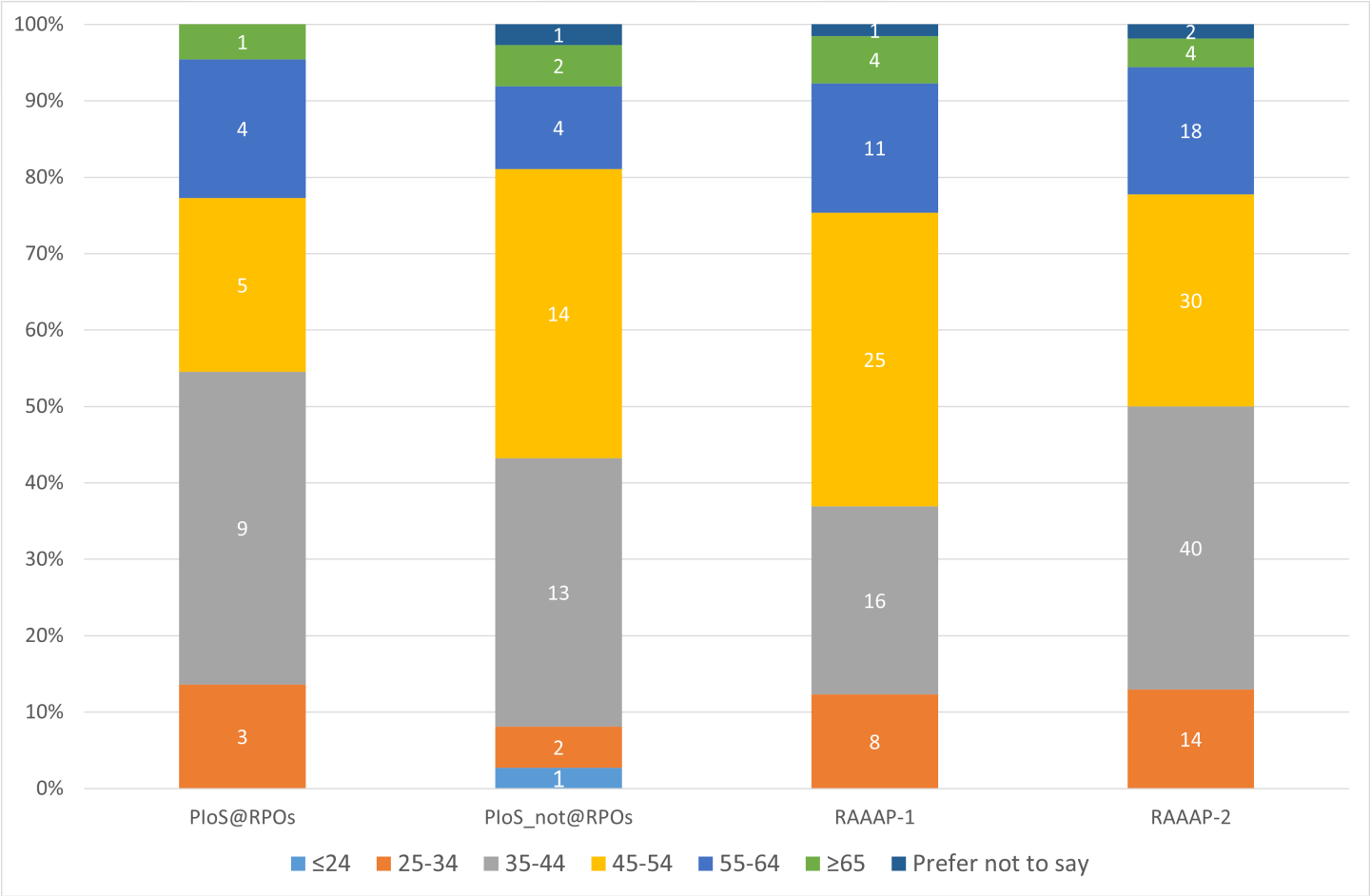
In the following sections, the demographic, institutional, academic, and professional profiles of the survey respondents are presented, analysed, and discussed. The demographic profile provides an overview of the age range, gender, and country of employment of the respondents. The institutional profile provides information on the type of institution the respondents work for, namely research funding, science policymaking, observation (collection and analysis of statistical data), think tanks, among others. The academic profile covers the highest academic qualification and corresponding thematic area. The professional profile provides an insight on the professional activity before becoming a PloS, seniority level, and tasks as a PloS. Their involvement in professional networks is characterized in terms of the reasons for being or not being enrolled, relevance of activities, participation level, the influence of the highest academic qualification subject area, and of the tasks performed on membership.

Finally, the information compiled during the interviews is analysed in relation to the survey data, to clarify and detail aspects highlighted by the respondents.

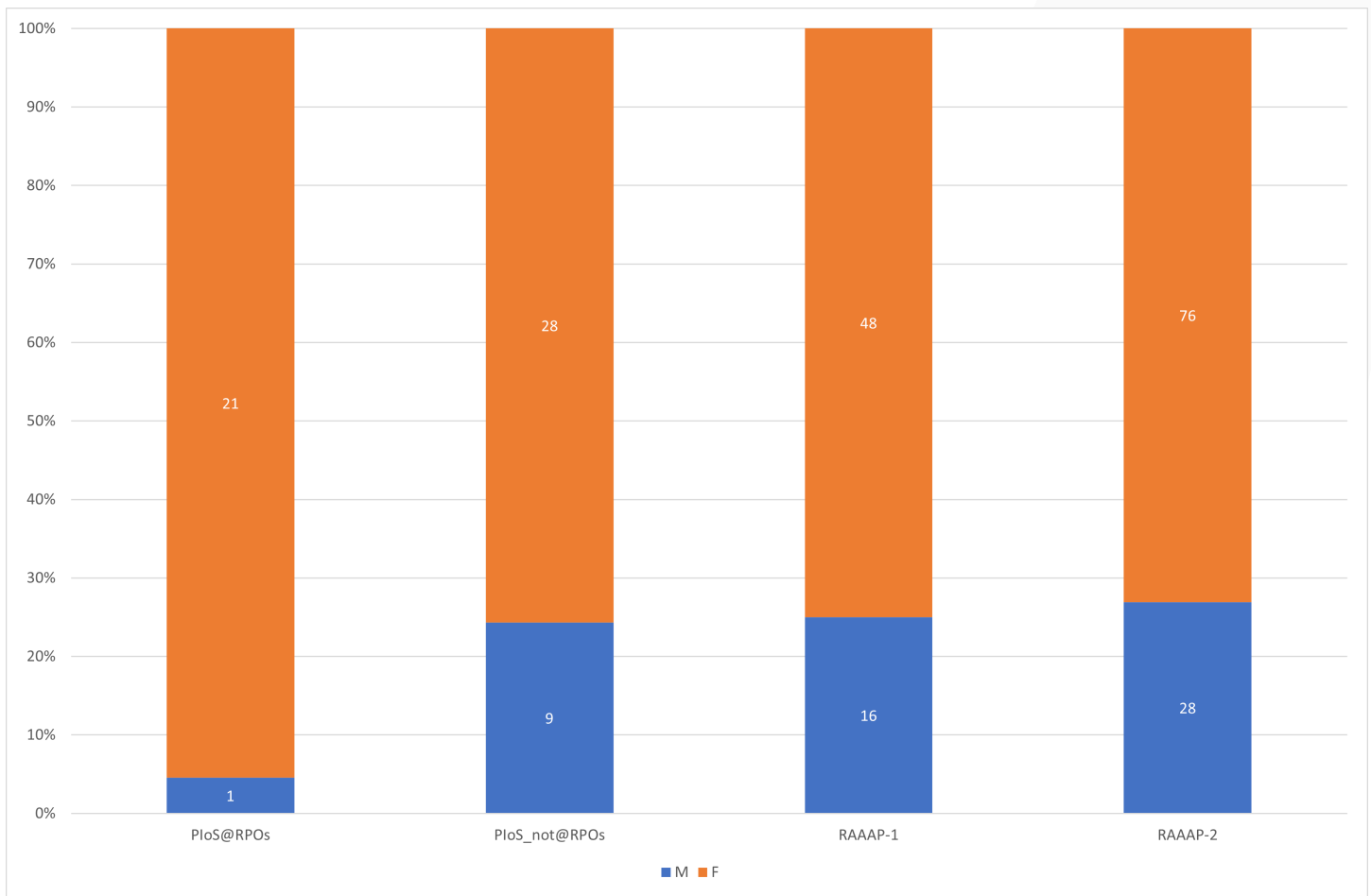
The Figures presented show the data retrieved from the survey; they include responses from both PloSs working at non-RPOs (referred to as “not@RPOs”) and PloSs working at RPOs (referred to as “@RPOs”) are shown. In addition, a comparison is made between the collected data in the PloS survey with corresponding data from the RAAAP-1 and RAAAP-2 surveys (referred to as “RAAAP-1” and “RAAAP-2”, respectively), that is to say the subset of RAAAP responding RMAs working at non-RPOs (or to be fully accurate, including those organisations that are not predominantly RPOs as the RAAAP questionnaires did not directly differentiate).

DEMOGRAPHIC PROFILE

Figure 1: Age Range of the Respondents

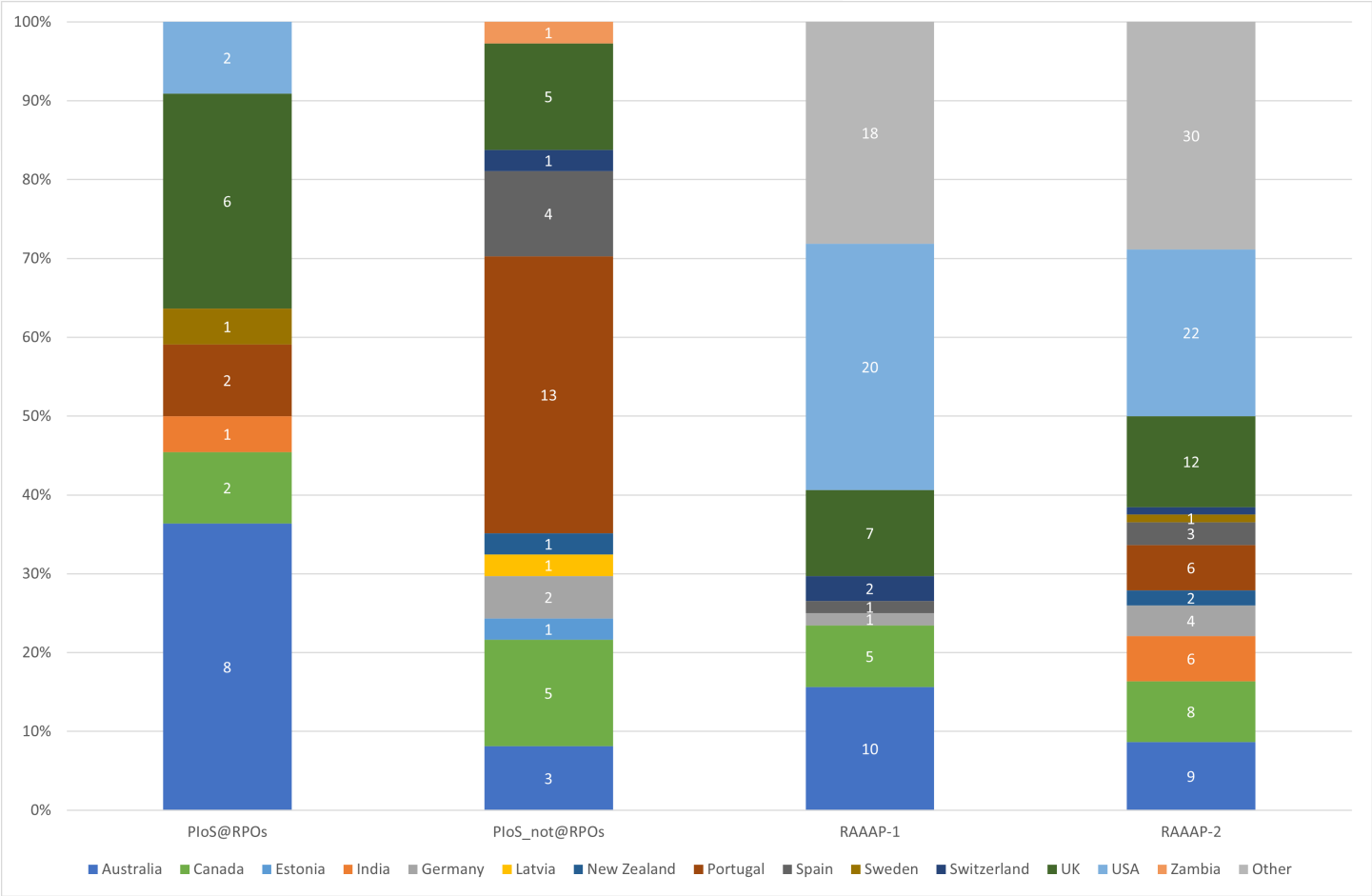


The majority of the respondents are between 35 and 54 years old, as shown in Figure 1. This applies to all the datasets analysed, indicating that professionals in this age range are predominant or more receptive to participate in these surveys. It suggests that few PloSs find their way into the profession early in their life.

Figure 2: Gender of the Respondents

Approximately 75% of the PLoSs at non-RPOs that participated in the three surveys (PLoS, RAAAP-1, and RAAAP-2) are women. This proportion increases to 95% for PLoSs at RPOs. This gender split is also reflected in the worldwide average for RMA: 75.5% of n=4,286 in RAAAP-2 (2019), and 77.0% of n=2,677 in RAAAP-1 (2016).

Figure 3: Working Country of the Respondents



The working country of the respondents varies significantly among the different studies. This relates to the nationality of each survey team and the respective reach of respondents. The PloS survey had a large presence of Portuguese and British nationals, and the RAAAP surveys had a large presence of North American and British nationals. Nevertheless, we consider that all surveys had an acceptable geographical representativeness of major regions worldwide.

INSTITUTIONAL PROFILE

Around half of the respondents (49%, 42% and 53% for PloS, RAAAP-1 and RAAAP-2, respectively) work at research-funding organisations (Figure 4). The remaining institutional categories considered vary between the PloS and the RAAAP surveys. For the PloS survey, the second most representative institution type is that of science policymaking, followed by think tanks, and other types of organisations (Figure 5).

Figure 4: Institution Type of the Respondents Working at Non-RPOs

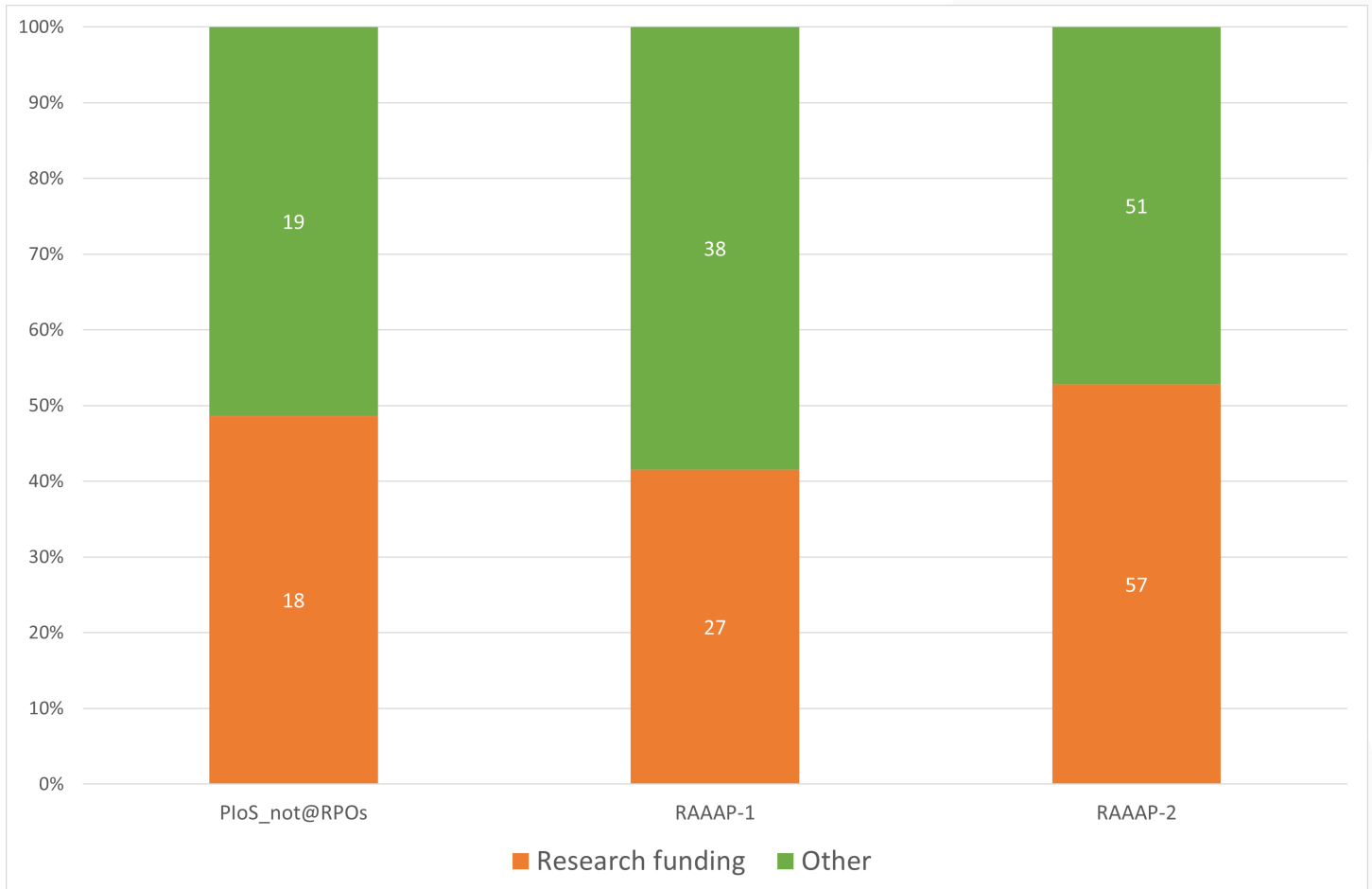


Figure 5: Detail of the Institution Type of the Respondents of the Pios Survey Working at Non-RPOss

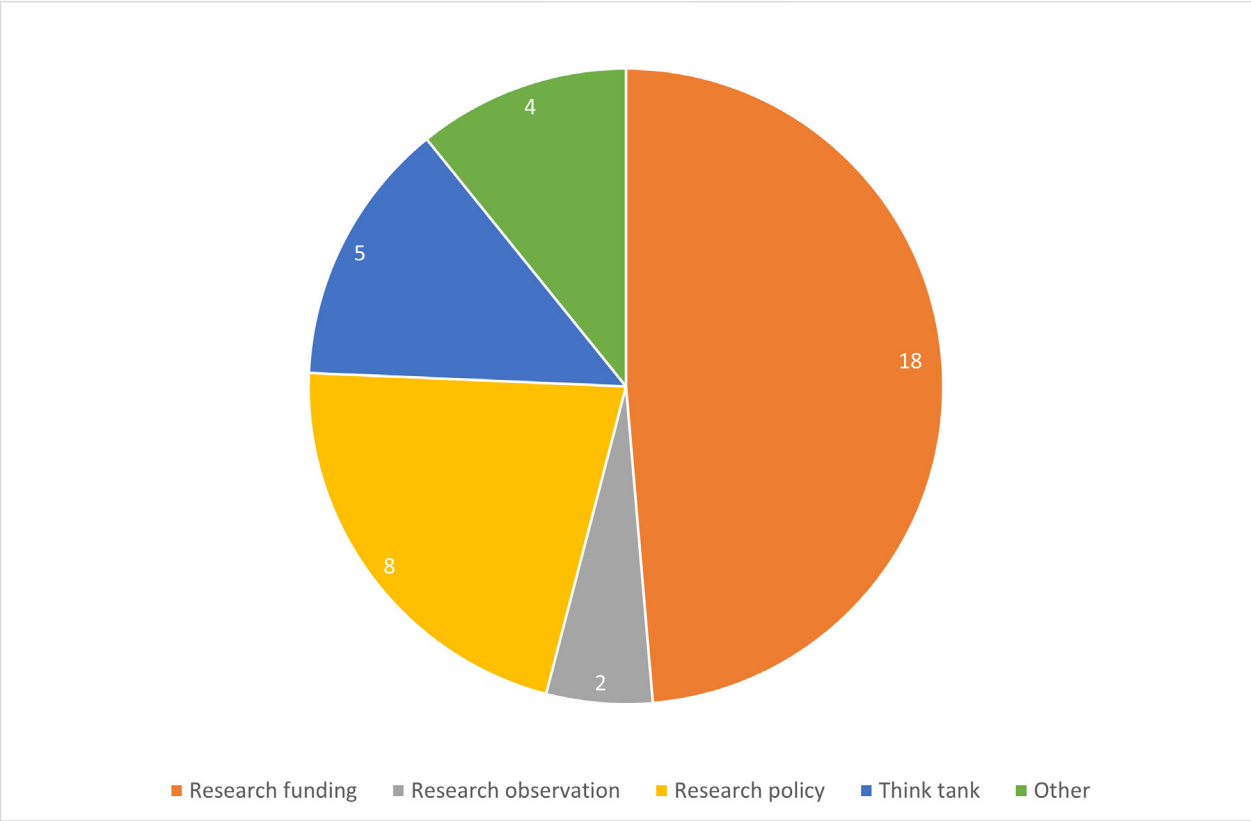
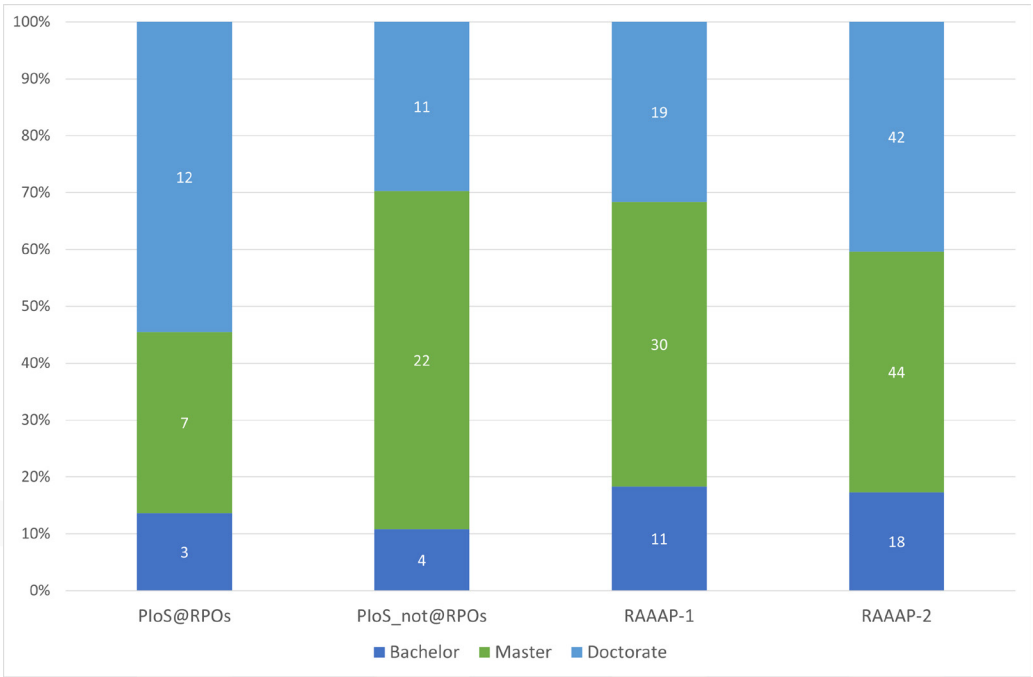


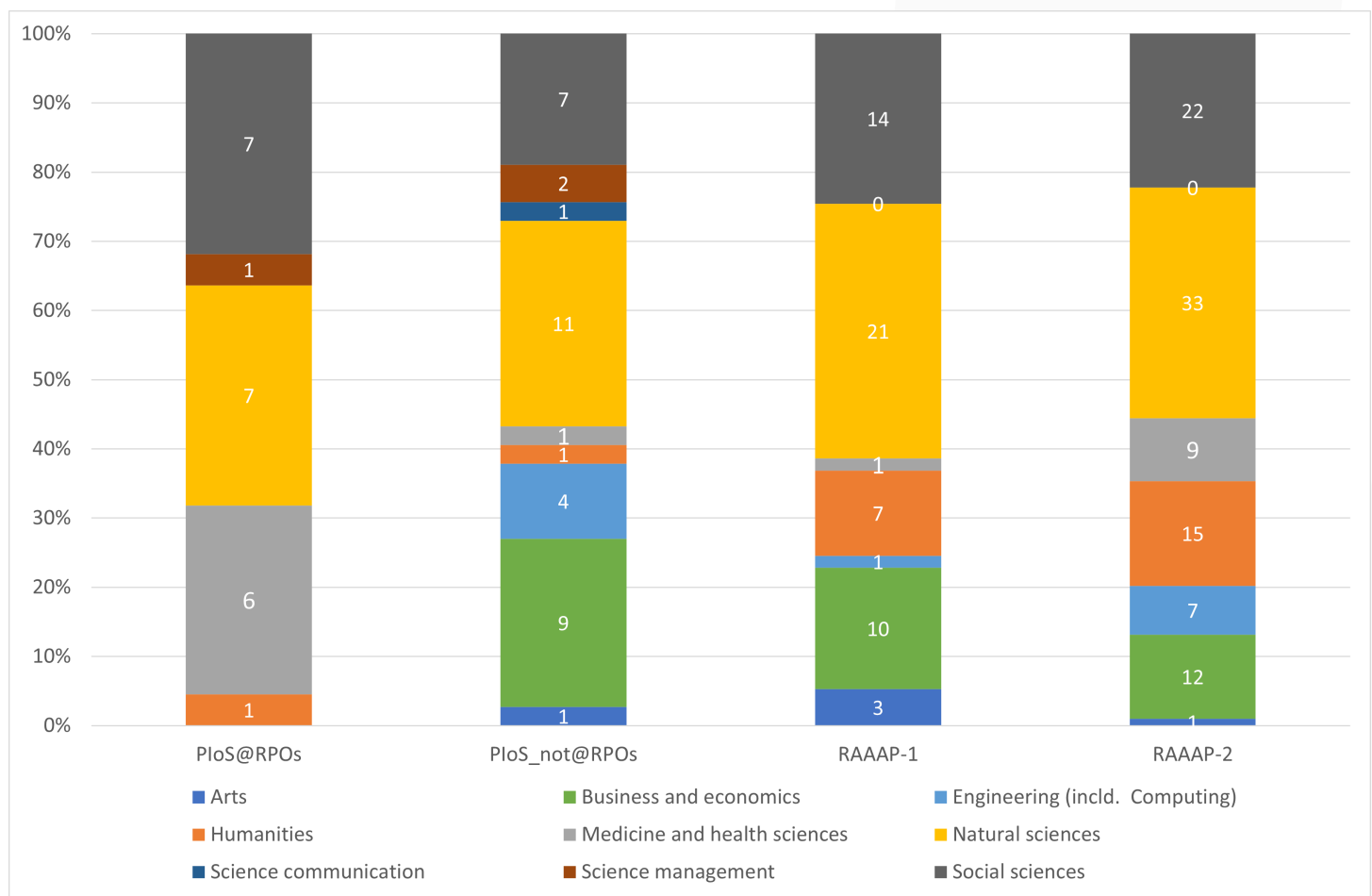
Figure 6: Academic Qualifications of the Respondents



The professionals working at non-RPOs holding a doctorate represent 30%, 32% and 40% of the respondents of the PloS, RAAAP-1, and RAAAP-2 surveys, respectively (Figure 6). This confirms that a significant share of these respondents has a research background but moved to managerial roles outside academia. The reasons why this may happen were further enquired in the interviews and are detailed in the corresponding section. In the PloS study, 55% of the respondents working at RPOs hold a doctorate degree. This may derive from the fact that PloSs working in RPOs have more employment opportunities in academic institutions than in e.g., research funders, or it could be derived from incentives to pursue doctorates due to the highly qualified environment they are integrated in.

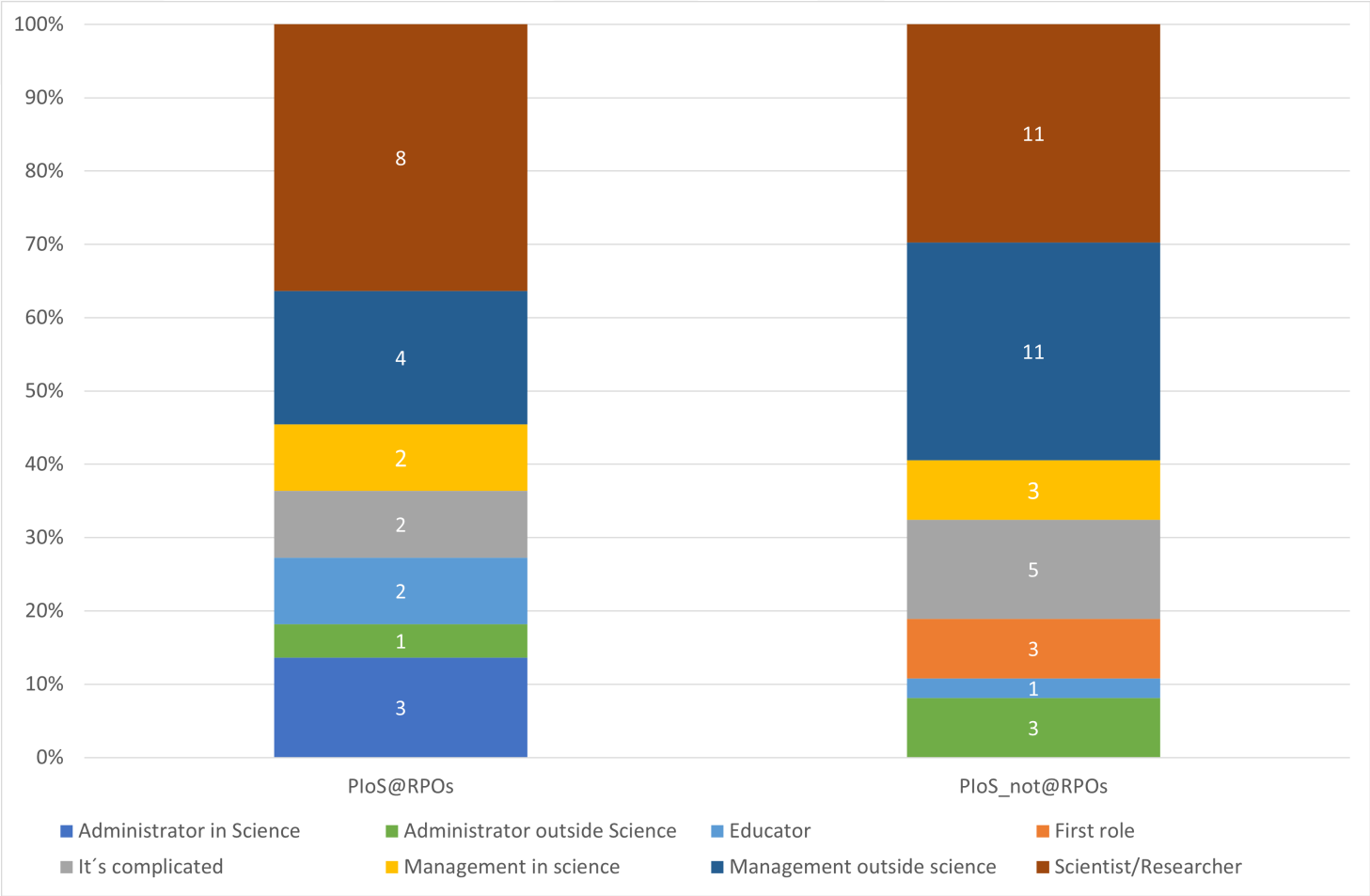
The academic background of the respondents is diverse (Figure 7). An average 33% of the respondents that work at non-RPOs have Natural Sciences as the highest qualification area followed by Social Sciences (average 22%) and Business and Economics (average 18%). This demonstrates the variety of backgrounds of the PloSs. This observation is reinforced by the variety of tasks that they execute (cf. Figure 11). The scenario does not change significantly for the respondents from RPOs: Natural Sciences and Social Sciences are still well represented (32% for each) but followed by Medicine and Health Sciences (27%).

Figure 7: Highest Qualification Area of the Respondents

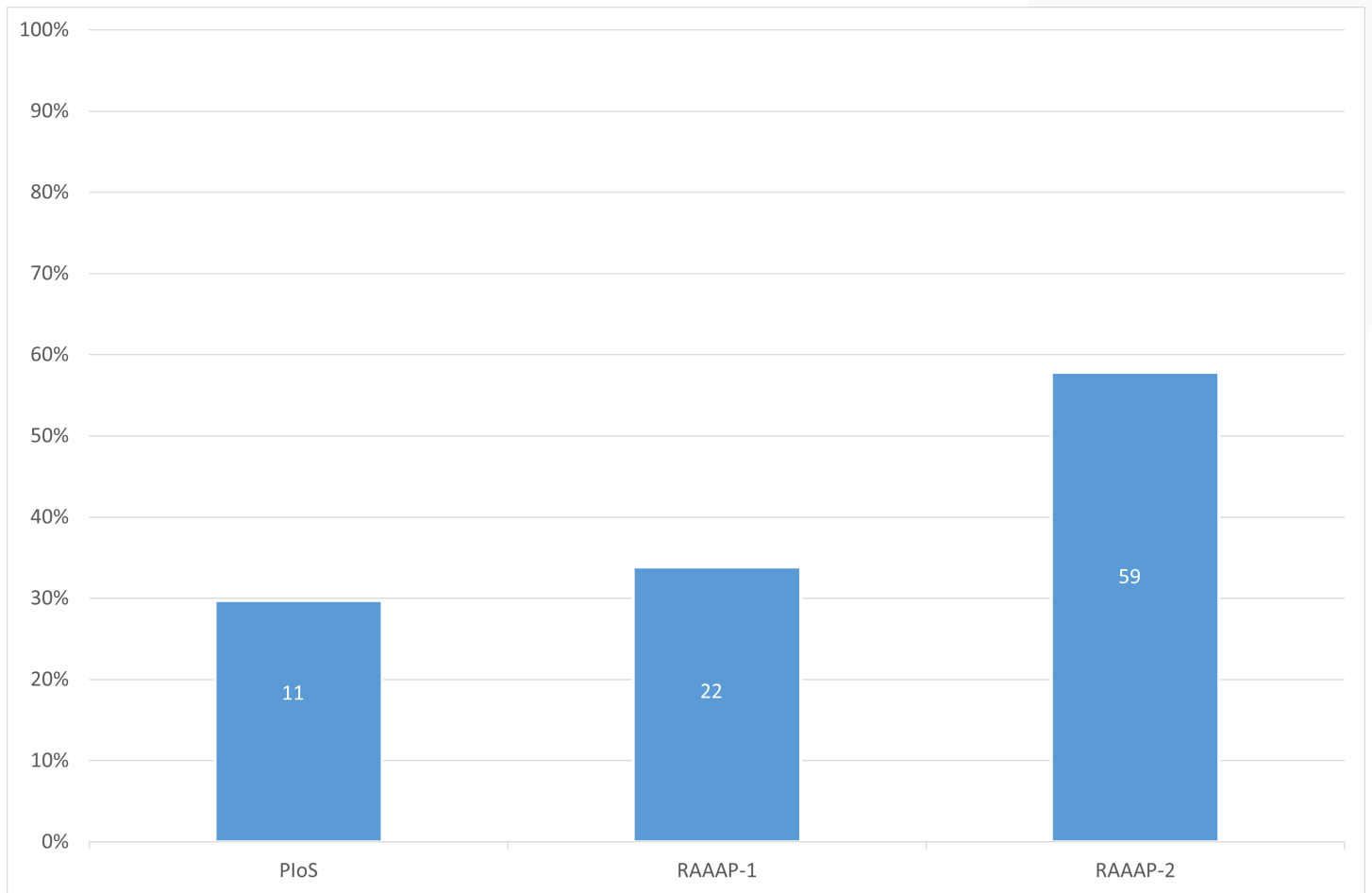


PROFESSIONAL PROFILE

Figure 8: Profession Before Becoming a PloS

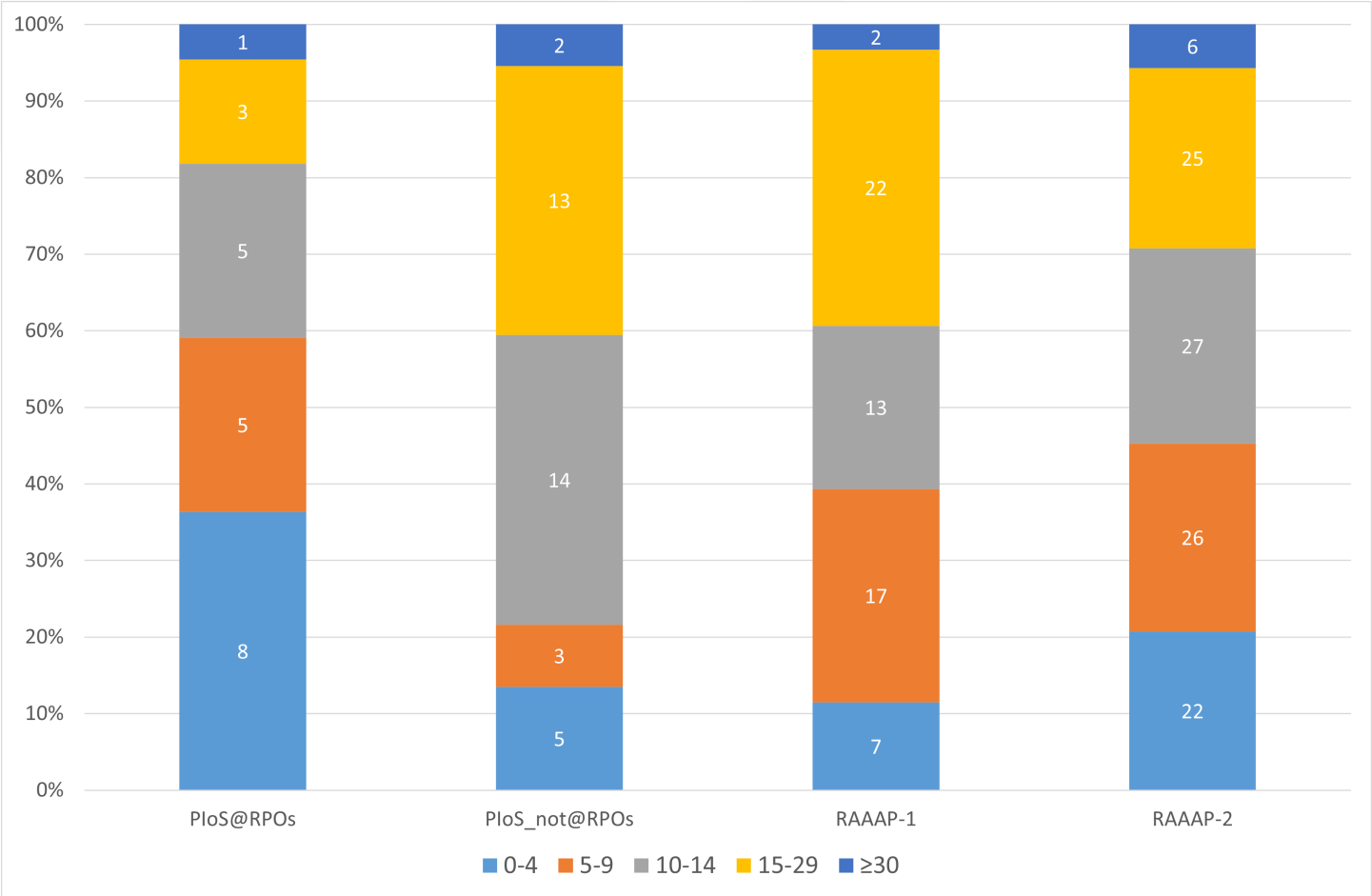


Most of the respondents of the PloS study have a scientist/researcher or “management outside science” professional background, with the former being more representative for respondents from non-RPOs. This duality of quite different professional backgrounds is notable and could be attributable to lack of career prospects in the case of former scientists/researchers, and to the still emergent professional field of PloSs in the case of professionals coming from a “management outside science” professional area. Being a researcher requires knowledge and critical thinking, comprehension ability, problem analysis, networking abilities, and, often, multidisciplinary, ability to acquire and communicate scientific and technical jargon, and awareness, or ease of identification of scientifically relevant challenges and the constant update consequence of the competitiveness of the profession. It also involves a good understanding of the academic administrative procedures and routines. Management outside science involves e.g., a culture towards administrative practices, regulations, and a good knowledge of accounting and reporting systems. It is, therefore, complementary to the profile of former scientists. Indeed, the co-existence of these two profiles is highly desirable when interfacing researchers with funders, policymakers and the like. However, it is essential that PloSs with a scientific background get training on management competencies, and that former managers outside science receive training on scientific culture and practices, in order to create bridges among these two profiles.

Figure 9: Former Researchers/Scientists Working at Non-RPOs

The number of responses of former scientists/researchers working at non-RPOs in the RAAAP surveys almost doubled, in terms of proportion of respondents, between 2016 and 2019 (Figure 9). This could be partially attributed to the greater number of responses in the RAAAP-2 survey along with a greater presence of these professionals in RMA associations and/or increased awareness about their professional identity.

Figure 10: Profession Years as PloS



Note: the RAAAP-2 data excludes respondents from China (n=91) due to inconsistencies that inhibit a direct comparison with the majority of responses.

The respondents of the RAAAP surveys working at non-RPOs have a wider range of years in the profession than those from the PloS survey. This could be a consequence of the wider distribution (greater number of potential respondents) of the latter. It is however notable that the RAAAP-2 included a good representativeness of all seniority levels considered. In what concerns the PloS study, those at RPOs have a lower average level of seniority than those working at non-RPOs. This could indicate that in RPOs there are more professionals entering the profession than in non-RPOs.

The tasks performed by PloSs working at non-RPOs are diverse and correlate with those attributed to PloSs at RPOs (Figures 11 and 12). The main difference lies in tasks related with “definition” and “operationalisation” of research policies, strategies, and funding mechanisms, exclusive of PloSs at non-RPOs. All the other tasks are common to both subsets of professionals. This shows that these professionals share a professional space, performing similar tasks, but from their unique perspectives (research performers vs. funders and others).

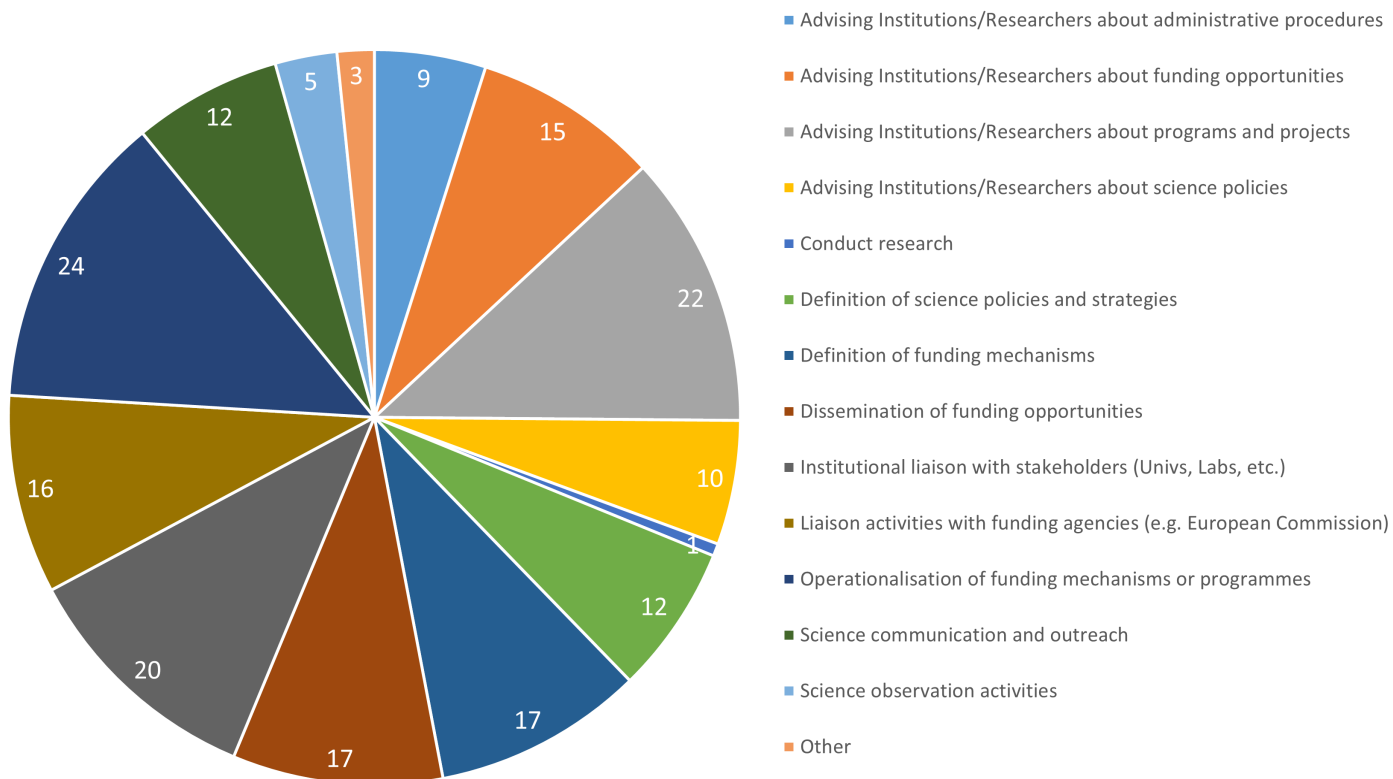
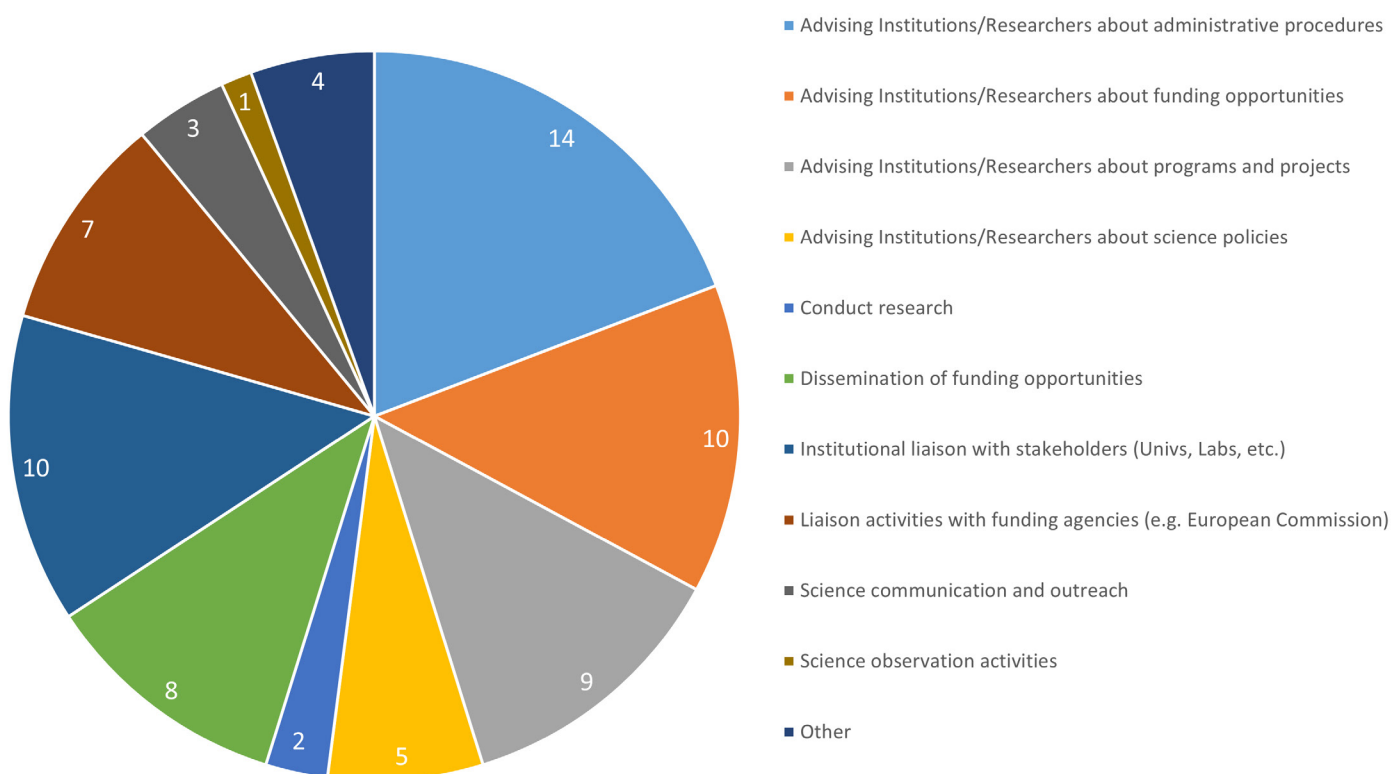
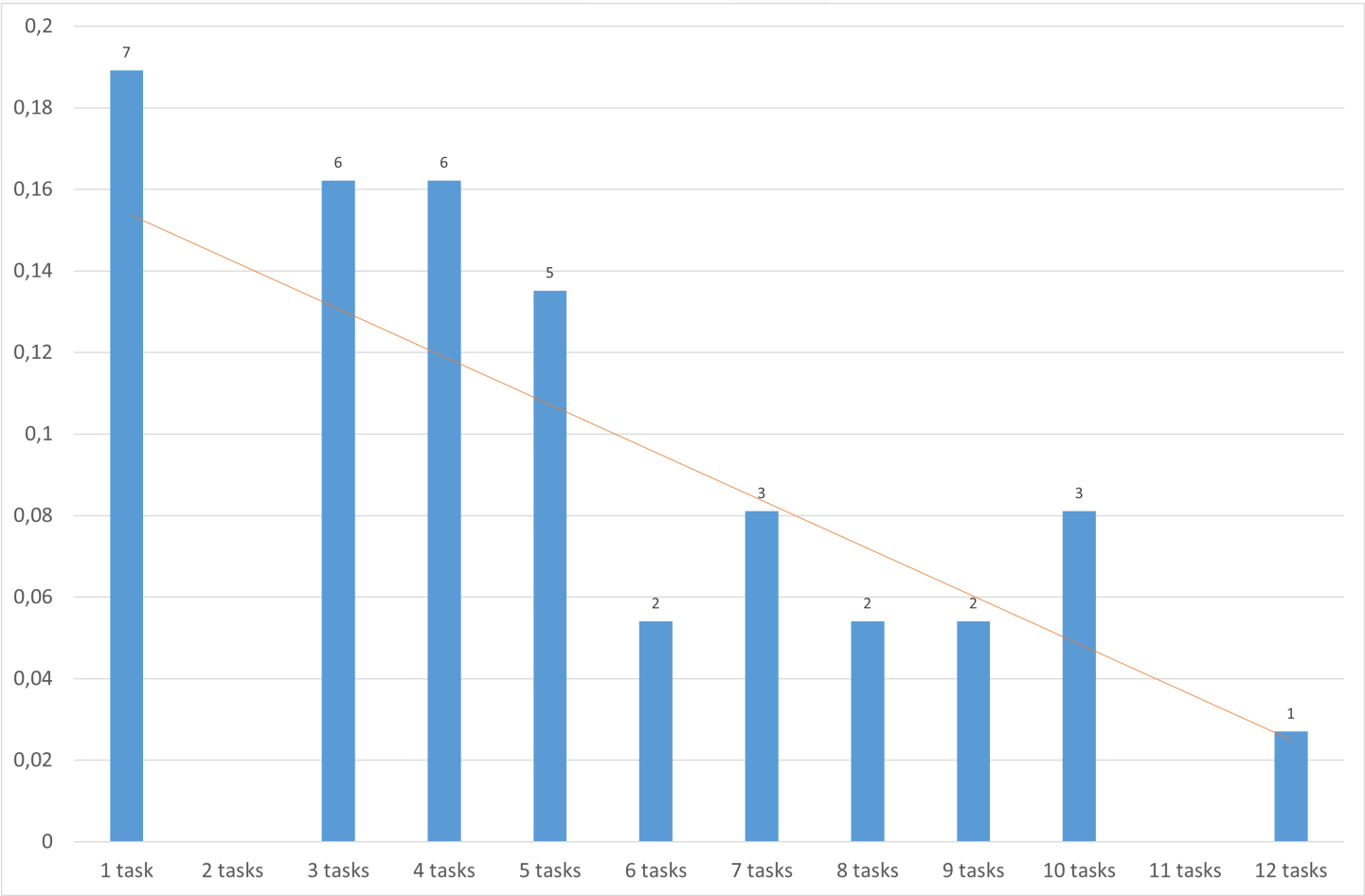
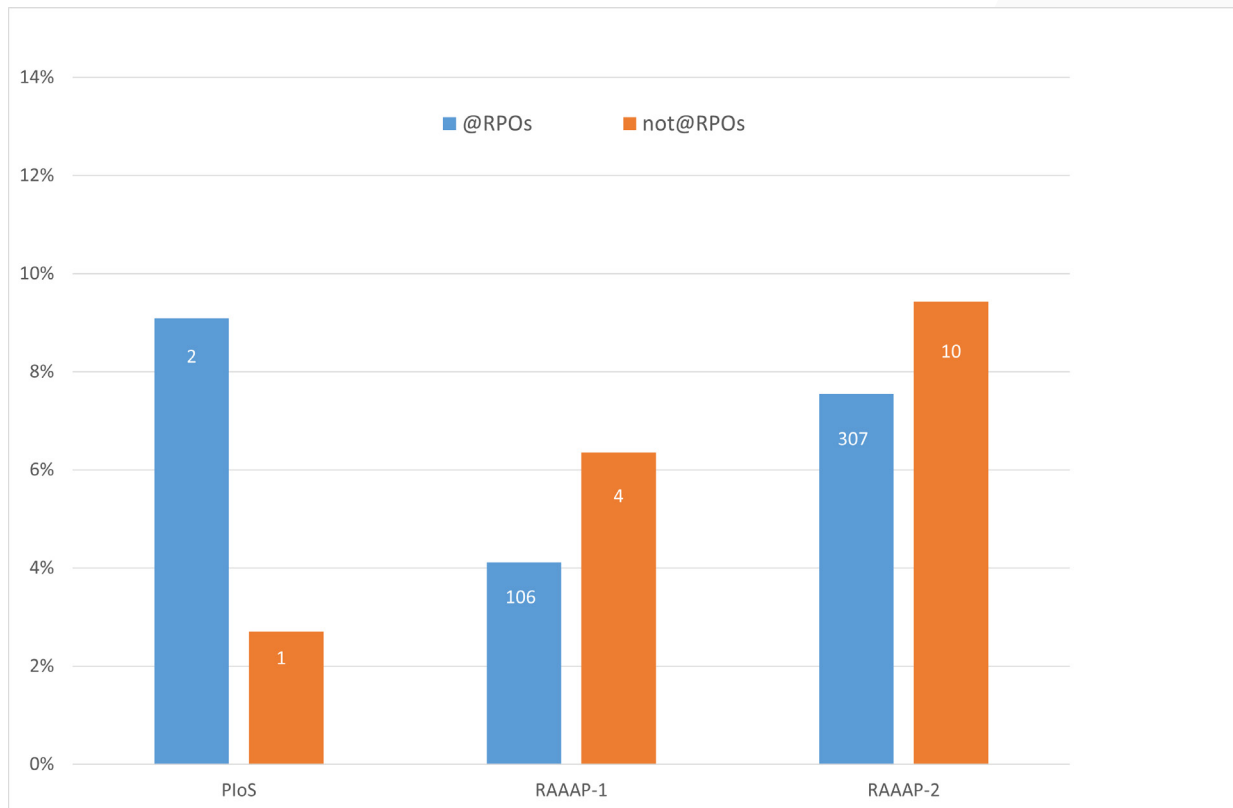
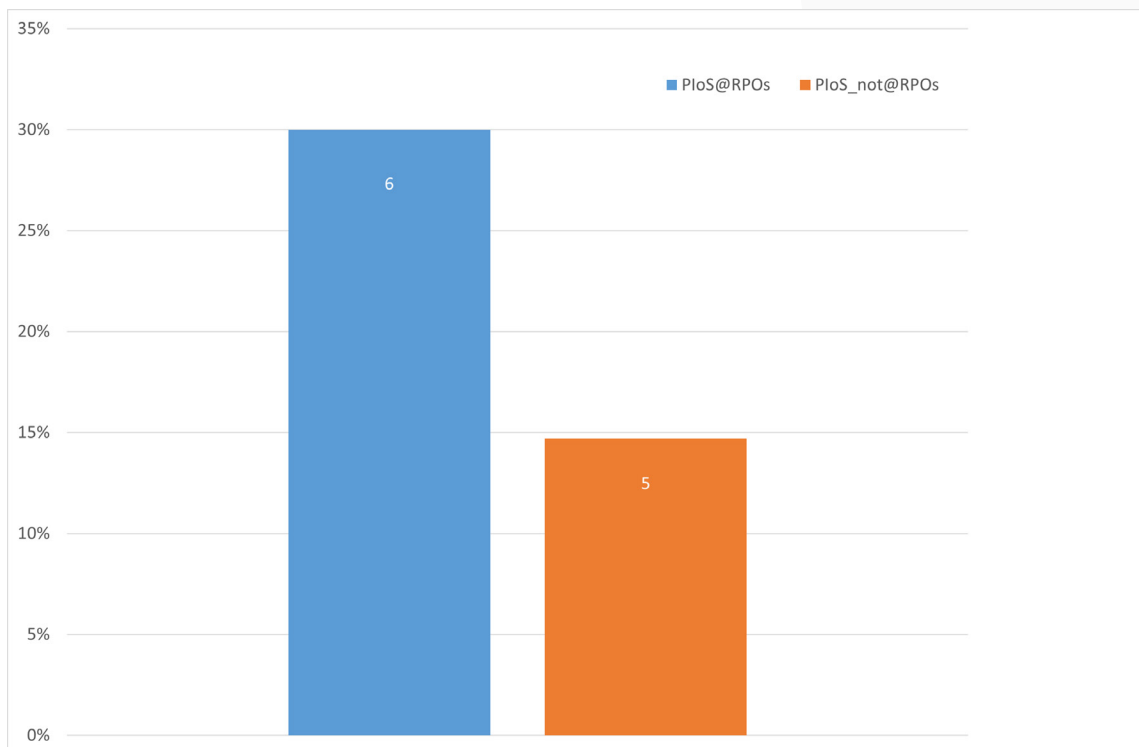
Figure 11: Tasks Performed by PloSs Working at Non-RPOs**Figure 12: Tasks Performed by PloSs Working at RPOs**

Figure 13: Frequency of Simultaneous Tasks Performed by Pioss at Non-RPOs



Most of the respondents from PloSs at non-RPOs carry out multiple tasks. This evidences the multi-tasking nature of the RMA profession, in line with what can be observed in Figure 11. The observed variety of professional and academic backgrounds among PloSs is considered an advantage in this regard as multidisciplinary teams are better equipped to perform diverse tasks than those composed of professionals from more homogenous backgrounds.

Figure 14: Respondents That Carry Out Research Activities**Figure 15: Respondents to the PLoS Survey That Carry Out Lecturing or Research Activities**

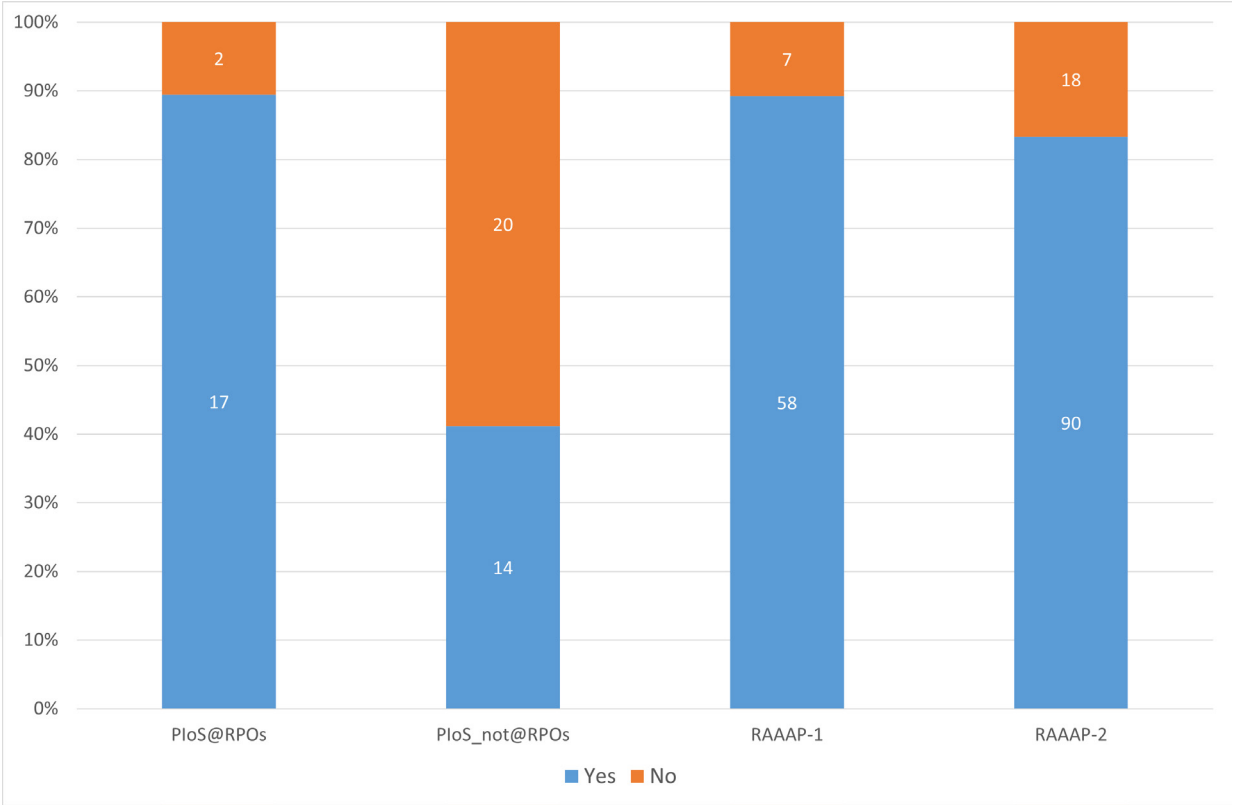
Only one respondent of the PloS study working at non-RPOs informed that they carry out research activities. This representativeness is higher, 6% and 10% in the RAAAP-1 and RAAAP-2 surveys, respectively. Despite the differences among these surveys, it is noteworthy that some RMA professionals working at non-RPOs perform research along with research management activities. In the RAAAP surveys, the representativeness of RMA professionals that carry out research is greater for non-RPOs than for RPOs. This could be influenced by the substantially lower number of respondents from non-RPOs.

With regard to academic lecturing activities, no information can be derived from the RAAAP surveys, but the PloS study (Figure 15) shows that around 30% and 15% of the professionals working at RPOs and non-RPOs, respectively, do have either lecturing or researching roles. This is thought to be related to their academic qualifications, namely at the doctorate level, and shows a significant “hybrid” profile, as advocated for these professionals by Whitchurch (2006). In fact, the majority of the respondents to the PloS survey that carry out academic or research activities hold a doctorate (60% and 67% for those at non-RPOs and RPOs, respectively).

INVOLVEMENT IN PROFESSIONAL ASSOCIATIONS

In the PloS study, almost 60% of the professionals working at non-RPOs are not involved in RMA associations (Figure 16). This decreases to 10% in the case of the professionals working at RPOs. In terms of the RAAAP surveys, it should be stressed that these were distributed through professional associations’ communication channels, so it would be expected that 100% of respondents to those surveys would have indicated that they participate in those associations. However, around 10-15% did not—this is comparable with the PloS survey respondents working at RPOs.

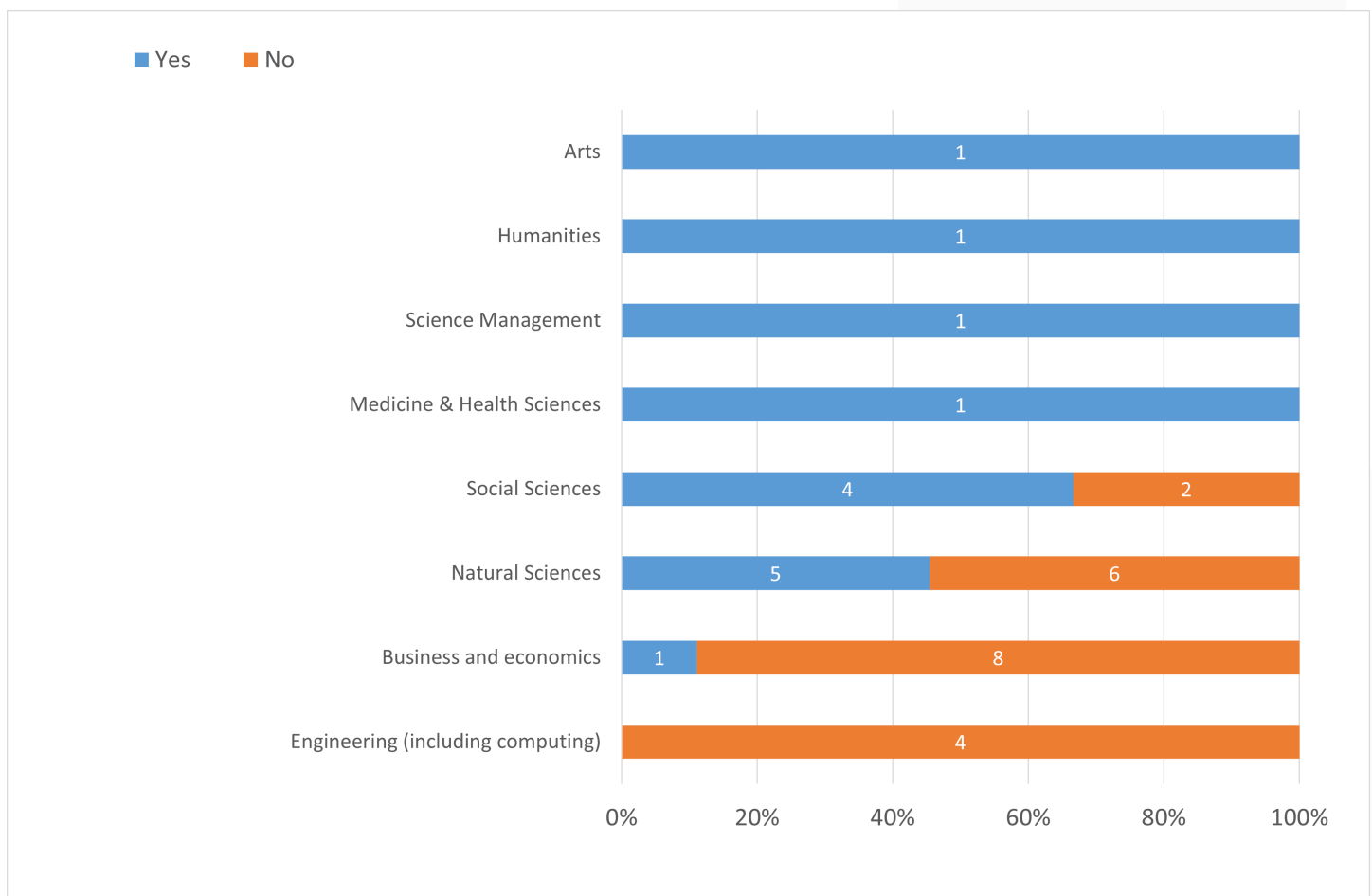
Figure 16: Involvement in RMA Associations



Bearing in mind that the PloS survey was disseminated directly to professionals at non-RPOs and through RMA associations, it can be inferred that the majority of the respondents are not involved in networks. The reasons pointed out by PloSs at non-RPOs include “not aware of existing networks” (58%), “employer provides networking activities” (21%), “existing networks not relevant” (11%), and “employer provides training activities” (11%). But 86% of those that participate do consider associations’ activities relevant. When asked about examples of relevant activities the following were commonly mentioned: training, networking, accreditation, information dissemination (e.g., updates on latest developments in the field), online platform for sharing problems/solutions, working groups, events, and conferences. The majority (71%) consider their participation level as moderate. Examples of participation in professional networks activities include drafting of factsheets, attendance at and organising events, participation and trainer in training programs, roles on committees and boards, and sharing information. One respondent mentioned hosting a virtual visit of RMA from universities to their non-RPO. This is considered a very useful activity that contributes to facilitating cooperation and collaboration among PloSs at RPOs and non-RPOs.

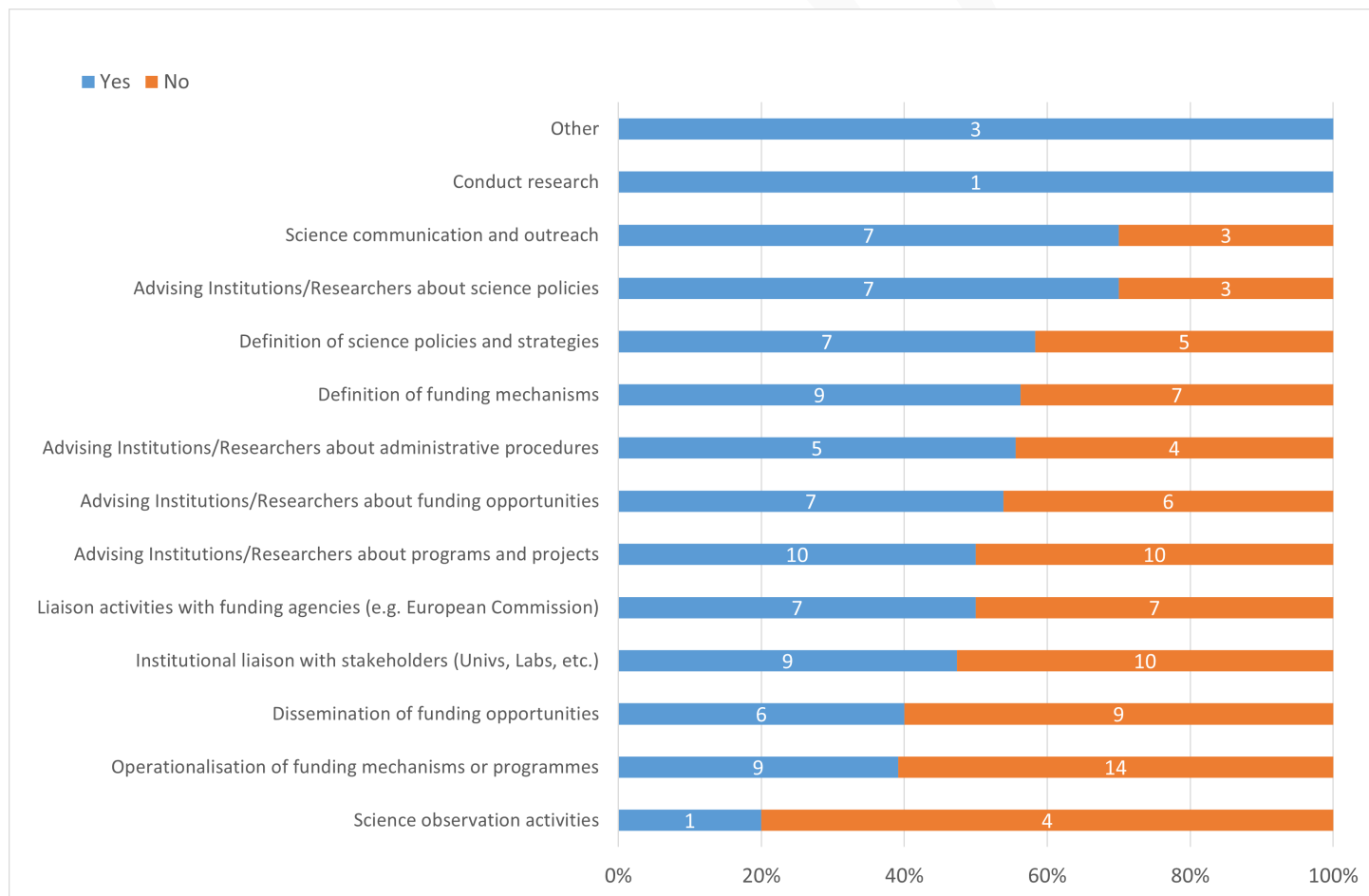
The involvement of PloSs working at non-RPO in RMA networks is analysed next in face of their highest academic qualification subject area and tasks performed.

Figure 17: Involvement in Professional Networks (yes/no) vs. Highest Academic Qualification Subject Area



Those professionals with an Engineering or a Business and Economics background are expressively not involved in RMA associations (Figure 17). The professionals with a Social Sciences background are more involved than those with a Natural Sciences one. This is interpreted as being derived from different professional dynamics associated with these scientific areas. Possibly, professionals in the Social Sciences area are more aware of existing networks, while those with an Engineering or a Business and Economics background are more acquainted with networks in their own respective educational areas.

Figure 18: Involvement in Professional Networks (yes/no) vs. Tasks Performed



Only one respondent that “conducts research” answered this question and so it is not considered in this analysis. The tasks “science communication and outreach” and “advising institutions/researchers about science policies” are more common for those that participate in associations (Figure 18). The tasks “science observation activities”, “operationalisation of funding mechanisms or programmes” and “dissemination of funding opportunities” are more common for those that do not. This is difficult to interpret but it could indicate that profiles related with more strategic and outreach roles are more aware of the relevance of participating in professional networks, while those related with more operational roles are not.

INTERVIEWS

The collected information provided further insights on their role as PloSs and that of their employers in the overall R&I ecosystem, and about the profession itself. The interviews allowed for clarification of the reasons that led the interviewees to follow a PloS career. Reasons range from first job opportunity to lack of research career in the public sector. Job positions include at research and innovation funding agencies, at science policymaking and diplomacy organisations, and other organizations at the interface of research practice and science. The text analysis was divided into three topics: background/profile, professional identity, and involvement in associations/networks following the major categories of the survey.

BACKGROUND/PROFILE

The existence of varied academic and professional profiles among PloSs at non-RPOs was mentioned by one interviewee:

“Some are previously scientists, but many of them are like let’s say, economists or...”

The scientific background was valued by several interviewees:

“... it is knowledge and experience of the research and Higher Education sector... just knowing. Is subconsciously understanding what the issues are . . . and hopefully most of the time not making unfounded assumptions about things, hopefully my assumptions are based on good knowledge and experience of the sector.”

“I think it’s important, I started my PhD exactly because I wanted to know more about science policy.”

PROFESSIONAL IDENTITY

The interviewees showed, generally, to be unaware of the existence of a research management and administration profession. But in some cases, they described their profession as research “facilitator” or “enabler”, and in other cases, mentioned the familiarity with scientific aspects as a common trait with PloSs at RPOs. The following are example quotes:

“I actually don’t believe that most of us, if even any of us, know that there is a name for what we do.”

“I feel that it’s a facilitator, mostly taking a bit of the project manager philosophy.”

“...I would consider myself as a (part of the same professional body) because if I work in the [specific area], I always deal with scientific aspects.”

The existence of cultural barriers in public administrations is mentioned to inhibit greater professional proximity between PloSs at RPOs and non-RPOs:

"...on the other hand, here they work with lawyers and administrative people. It's not funny: it's a fight, it is a war when you try to bring new ideas."

But the sense of being part of the same endeavour is clear:

"And when the project is approved, we do feel like we are part of the team, you know."

"...we don't want to be just administrative machines...we want to be able to help you. And the only way you can do that is if there's this type of professionals inside these institutions."

INVOLVEMENT IN ASSOCIATIONS/NETWORKS

Most of the interviewees were not aware of the existence of RMA professional associations or networks, but acknowledged their importance to their professional development and to that of the profession itself:

"I'm very pleased to know that these types of associations do exist, and I do hope that they are able to help share these good practices and best practices actually and experiences so that everybody can learn and develop and bring out the importance of this profession."

From the information provided by the survey respondents that were interviewed it can be concluded that i) reasons for joining the profession are varied and mostly not related with vocational calls; ii) prior scientific research experience is found to be valuable; and iii) the RMA associations should reach out to professionals working at non-RPOs. An increase of PloSs from non-RPOs in RMA networks would improve their professional identity awareness, inter-institutional communication, competencies development, exchange of best practices, and would contribute to lower existing cultural barriers between this subset of PloSs and those working at RPOs.

LIMITATIONS OF THE RESEARCH

A main limitation of the PloS survey is the low number of responses obtained. This was due to the fact that the study was disseminated essentially through professional contacts and RMA associations. However, in what concerns the general demographic, institutional, academic and professional profiles, the results are broadly consistent with those of the RAAAP survey. This suggests that the sample was indeed representative of the community under study. It is foreseen that the publication of this first survey aimed specifically at PloSs at non-RPOs will form the basis of follow-up surveys with a larger sample size and a more representative sampling strategy.

CONCLUSIONS AND IMPLICATIONS FOR FUTURE STUDIES

PloSs working in science policymaking, funding and observation organizations (i.e. other than research-performing entities) have demographic, academic, and professional profiles similar to those working in research-performing

organizations. The most common respondent to the survey on PloSs at non-RPOs was female, between 35 and 54 years old, holding a master's degree and working at a research funding agency. The academic background varies from natural and social sciences to business and economics. Previous professional experience includes management outside science and research activities. The majority of those PloSs at non-RPOs holding a doctorate have academic teaching or research duties. The majority of female respondents and a high representation of female respondents and respondents with a PhD mirror the demographics from other studies such as Kerridge & Scott (2018b) and Virágh et al. (2020) that focused on RMAs working in RPOs.

PloSs at non-RPOs perform a variety of roles/functions that can be classified as research management and administration. The tasks performed are multi-faceted and comparable to those performed by PloSs at RPOs, but from a complementary perspective. This indicates that these PloSs share a common professional space. The majority of PloSs at non-RPOs are not involved in RMA associations, mostly due to not being aware of these existing networks. However, the fact that some of these professionals do participate in professional RMA networks does reinforce the perception of a shared professional space. The majority of those that are involved in networks do consider activities to be relevant. Differences in academic qualification subject areas seem to influence their positioning towards involvement in networks. Those with an Engineering or a Business and Economics background seem not to be involved in RMA associations. Also, professionals in strategic and outreach roles seem to be more involved than those involved in more "operational" tasks.

The interviews validated the survey findings, namely the existence of varied academic and professional profiles, with relevance to experience in the scientific research area. Although being mostly unaware of the existence of a research management and administration profession, most interviewees do express that there is at least a partial shared identity, even though from different perspectives. Institutional cultural barriers in public administration are mentioned as hindering communication and professional exchanges between PloSs at RPOs and non-RPOs. The activities of RMA professional associations are considered crucial for their professional development and to that of the profession itself. Thus, it is argued that the involvement of these professionals in networks should be promoted as this would lead to improved fluidity of the research funders-research performers nexus, and ultimately to more agile, efficient, and effective research and innovation ecosystems. Existing studies in literature in Research Management and Administration (Shelley, 2010; Virágh et al., 2020) point to the lack of recognition in Research Management and Administration as a common problem in the profession, and formal training would contribute to increasing recognition. Virágh et al. (2020) refer to the low awareness of the profession as a result of the lack of recognition and professional identity. Shelley (2010) provides an example of the typical titles of RMAs in RPOs such as 'non-academic' or 'administrators' as contributing to the lack of the recognition of these professionals. The authors of the current study suggest that the inexistence of a role title and clear role as well as unawareness and/or connection with a professional network contribute to the lack of professional self-awareness and recognition to the RMA profession. Professional networks and/or associations contribute to professional empowerment, inter-institutional communication, competencies development, exchange of best practices, and would contribute to lower existing cultural barriers between this subset of PloSs and those working at RPOs.

Final conclusions from the information provided by the survey respondents that were interviewed point at the reasons for joining the profession being varied and mostly not related with vocational calls. Evidence provided by Virágh et al. (2020) also points out that becoming a RMA is often non-intentional. Future work could include a thorough study on the sense of belonging of these professionals to the global PloS community. This includes the differences between the career frameworks of PloSs at RPOs and PloSs at non-RPOs and the existing training for these professionals. The contributions of this study for the PloS community are diverse. The most significant is the evidence that professionals at RPOs do share the same "professional space" as those working at non-RPOs. This opens the way to the promotion of an effective integration of these professionals, namely in networks and associations, ultimately leading to enhanced competencies, skills, and sharing of best practices. This may contribute

to the mitigation of the current divide between PloSs at non-RPOs and RPOs, to improved communication and to more efficient and effective R&I ecosystems.

Authors' Note

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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MAKING INTERDISCIPLINARITY CONCRETE: VIEWS FROM LEADERS OF INTERDISCIPLINARY RESEARCH BUILDINGS IN HIGHER EDUCATION

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ABSTRACT

Among strategies that campus leaders and research administrators employ to spur interdisciplinary research in U.S. higher education, one of the costliest—and increasingly popular—is designated interdisciplinary research spaces and buildings. Yet while interdisciplinary research buildings, often focused on the sciences, stand as significant investments and concrete manifestations of institutional interdisciplinary commitment, empirical research thus far has shed little light on who leads them, the challenges these leaders face, and buildings' broader aims and effectiveness. Using interviews with 26 leaders of and documents related to interdisciplinary research buildings at ten U.S. higher education R1 institutions, this qualitative multi-site case study begins to fill this gap. In probing key issues attending interdisciplinary buildings as a growing tool for research administration and development, this study describes various types of interdisciplinary building leaders; details novel challenges, lessons learned and suggested leadership practices; and explores how leaders already do (and future scholarship might) conceptualize and gauge building effectiveness. In doing so, this work provides novel and timely contributions to the current practice of leading interdisciplinary research efforts and grounds future directions for research

Keywords:

Interdisciplinary, higher education, research administration, infrastructure, leadership, organizational priorities

MAKING INTERDISCIPLINARITY CONCRETE: UNDERSTANDING HIGHER EDUCATION INTERDISCIPLINARY RESEARCH BUILDINGS AND THEIR LEADERSHIP

In U.S. higher education today, institutions of higher education (IHEs) and research administrators make many attempts to spur interdisciplinary research (IDR). They modify strategic plans to enable academic flexibility and transcend disciplinary and structural barriers (Harris, 2010; Harris & Holley, 2008). They create and institutionalize interdisciplinary academic fields and programs (e.g., Brint, Turk-Bicakci, et al., 2009; Camic, 1995; Olzak & Kangas, 2008; Rojas, 2006; Small, 1999). They hire faculty strategically via cluster initiatives, joint appointments, and affiliations across academic units (e.g., Bloom et al., 2020; Hart & Mars, 2009; Sá, 2008b; Samuels, 2020). They create novel academic structures including research clusters, centers, and institutes (e.g., Boardman & Corley, 2008; Geiger, 1990; Geiger & Sá, 2008; Sá & Oleksiyenko, 2011). And they organize physical spaces—within, across and in addition to existing campus infrastructure—in which IDR and other types of interdisciplinary work can take place (e.g., Harris & Holley, 2008; Kabo et al., 2014; Sá, 2008a).

Within the growing landscape of IHEs' IDR strategies, scholars have more recently begun to consider the influence of strategies including hiring and research centers on outcomes like faculty IDR productivity, collaboration and scholarly impact (e.g., Biancani et al., 2018; Bloom et al., 2020; Curran et al., 2020; Leahey et al., 2017; Samuels, 2020). Though some work has explored the intentions and outcomes of spaces for IDR, specifically (e.g., Harris & Holley, 2008; Kabo et al., 2014), empirical inquiry is scant relative to the recent proliferation of these spaces across IHEs. A basic internet search reveals entire buildings devoted to IDR ("IDR buildings")—a particularly costly subtype of interdisciplinary space—cropping up at IHEs across the U.S.; many have been erected in the past decade (e.g., Michigan State University Office of Research and Innovation, 2019; Shaw, 2021). Often costing hundreds of millions of dollars, such buildings in sum represent billions of dollars of investment.

As IDR buildings claim greater proportions of campus real estate and university funds, lacking empirical knowledge of their stewardship—including their design, use, management, and effects—presents a challenge for research administrators seeking to realize the promise of such buildings, as well as scholarship seeking to understand how they function. Yet the cost, proliferation, and high hopes associated with these IDR spaces necessitates a better understanding of the phenomenon of IDR buildings, where IHEs seek to make interdisciplinarity "concrete."

PURPOSE

This qualitative multi-site case study seeks to meet this need by illuminating the leadership of IDR in the U.S. Using interviews with leaders of and documents from IDR-focused buildings on ten R1 IHE campuses, this work poses three research questions. First, what are the roles and responsibilities of IDR building leaders? Addressing this question synthesizes information on role level and domain as well as primary responsibilities to typologize a diverse set of IDR leaders, including research administrators as well as space planners, building managers and others. Second, what challenges do these leaders encounter, and what lessons do they learn from this experience? Addressing this question delineates key leadership needs in the management of IDR buildings. Last, how do IDR building leaders perceive building goals and effectiveness? Addressing this question considers the purported impact(s) of these buildings on fostering IDR and other aims and suggests how current practitioners are, and future research might, more systematically gauge success.

In sum, answers to these questions are expected to provide a baseline of knowledge about the rapidly expanding interdisciplinary research building landscape; detail emerging and potential best practices in their design, construction and ongoing management; and probe how scholars, research administrators and other campus leaders may evaluate these buildings' success at achieving myriad purposes. This work thus provides foundational insight into a costly and highly visible interdisciplinary strategy in U.S. higher education that is increasingly common yet understudied.

LITERATURE

Two strands of literature ground this study. The first explores interdisciplinarity in U.S. higher education, mapping and evaluating the various strategies institutions and research administrators implement to spur IDR and other interdisciplinary activities (e.g., Harris, 2010; Holley, 2009a; Sá, 2008a) and the changing academic and organizational landscapes that result (e.g., Brint, Turk-Bicakci, et al., 2009; Jacobs, 2014; Leahey et al., 2019; Pryor, 2020; Pryor & Barringer, 2021). The second strand of literature investigates the role in higher education and research of physical space, generally (e.g., Fugazzotto, 2009; Kabo et al., 2014; Owen-Smith, 2018; Strange & Banning, 2001; Temple, 2014), and IDR space, specifically (e.g., Barringer et al., 2020; Harris & Holley, 2008). Together, these literatures illuminate the historical and currently evolving landscape, as well as the myriad goals

and impacts, of interdisciplinarity. This work also considers the potential role of space as a means by which campus leaders and research administrators can foster interdisciplinarity effectively.

INTERDISCIPLINARITY IN U.S. HIGHER EDUCATION

Higher education's current and expanding interdisciplinary landscape has mid-20th-century roots, as academic disciplines have proliferated and diversified to meet demands of scientific advancement and research (Geiger, 1990); vocational curricula (Brint, 2002); and student preference (e.g., Brint et al., 2011; Brint, Turk-Bicakci, et al., 2009; Pryor, 2020; Rojas, 2010; Turk-Bicakci, 2007; Zupanelli, 2017). This process has resulted in curricular churn (e.g., Allardyce, 1982; Brint et al., 2011; Brint et al., 2012; Brint, Proctor, et al., 2009; Slaughter, 2002) and other types of dynamism, including novel disciplinary fragmentations and/or alliances (e.g., Camic, 1995; Gumport & Snyderman, 2002; Pryor & Barringer, 2021). New areas of study and scholarly interest have arisen at the intersections of disciplinary splintering, alignment, and reconstitution (e.g., Brint, Turk-Bicakci, et al., 2009; Holley, 2009b).

In the 21st century, a primary vector of interdisciplinarity has turned more tightly toward scientific advancement and generative, impactful research (e.g., Abbott, 2001; Abbott, 2002; Jacobs, 2014; Jacobs & Frickel, 2009). Seeking scientific generativity to solve complex social problems such as climate change, public health, etc., IHEs have turned to novel scientific fields of study, boundary-spanning organizational structures and processes and, increasingly, physical infrastructure to support collaborative and innovative science and research (e.g., Bloom et al., 2020; Geiger & Sá, 2008; Harris & Holley, 2008). These highly visible efforts have positioned IDR as a "cornerstone of science and research policy in the United States" (Barringer et al., 2020, p. 680) and the nexus of many of academia's "hot topics" (National Academy of Sciences & Medicine, 2005, p. 17). Scholars have recently begun to assess whether IHE efforts to spur IDR and interdisciplinary collaboration are paying off.

These assessments show mixed results. Recent work on interdisciplinary cluster hiring, for example, suggests that it does not always lead to intra-cluster collaboration and generativity (Bloom et al., 2020); when positive effects are seen, they are limited by faculty, IHE and academic field characteristics (Curran et al., 2020). Work on faculty affiliations with research centers finds similarly mixed outcomes: More citations but less work volume (Leahey et al., 2017). Still other scholarship focused on IHEs' "structural commitments" to IDR suggests that interdisciplinary departments and centers result in increased scholarly and grant activity (Leahey & Barringer, 2020). Implicit in this work is a central question: Are IDR strategies worth it? Are they worth research administrators' time and effort, worth "the size of expenditures that accompany these ambitious programs," and worth the "potential to shift some share of control over the direction of university research from faculty members to university administrators" (Bloom et al., 2020, p. 757, in their discussion of cluster hiring)? A second strand of literature explores space and IDR space in higher education.

PLACE, SPACE AND IDR SPACE IN HIGHER EDUCATION

Despite the increasing prevalence of online learning, place and space remain highly salient across U.S. higher education. From the symbolic, bucolic geography of the Colonial-era "hilltop colleges" (Thelin, 2011); to the collective nostalgia of the "American college town" (Gumprecht, 2003); to the enduring centrality of college location in shaping enrollment (Hillman & Weichman, 2016), physical place foundationally shapes IHEs' identity, culture and function. Intra-campus geography and architecture are important, too, such that "some universities are almost defined, at least in the public mind, by their physical presence" (Temple, 2014, p. 5). Institutional space planning and use shapes all facets of campus life including student, faculty and staff recruitment and experience (e.g., Kaiser, 1975). As such, campus space bears significant practical and symbolic weight, shaping day-to-day experience and telegraphing

institutional culture, values, and logics. Within campus place and space, the designation of spaces for innovative and collaborative IDR represents a highly visible though “difficult and costly” endeavor (Harris & Holley, 2008, p. 40).

Demand for collaborative IDR spaces has expanded as interdisciplinarity has gained traction and attracted funding (e.g., Brint, 2005; Council, 2014; Harris & Holley, 2008; National Academy of Sciences & Medicine, 2005). This infrastructure boom has particularly aimed at broadening access to STEM fields for more student learners (e.g., Wu & BEST, 2004; Narum, 2013; Narum, 1992) as well as higher research productivity. Rapid construction of interdisciplinary R&D spaces, often comprising “science and clinical facilities, which are among the most expensive per square foot to build,” has “changed the face of American higher education” (Trani, 2014, p. 159). Laboratories, core facilities, vivaria, and other high-tech spaces can present novel and complex safety, security and management issues for campus research administrators and myriad other leaders including facilities personnel (Carter et al., 2019; Dorhout, 2016; Haley, 2009, 2011; Hockberger et al., 2018; Trani, 2014; Zwick, 2021). Within IHEs, these technological issues as well as use by stakeholders across campus thus often necessitate space oversight that begins at the university level. In this way, IDR spaces can mark a distinct “culture shift” from traditional departmental- and faculty-governed space (Dorhout, 2016, p. 111). And these high-risk and culturally divergent management processes are often combined with lofty goals, as such spaces aim to break down disciplinary siloes (e.g., Harris & Holley, 2008) and serve as “force multipliers” in support of myriad IHE aims (Zwick, 2021). Though an emerging literature on higher education’s IDR spaces has begun to detail their parameters, there is much we do not know about the management, functioning and outcomes of these high-cost, high-complexity and high-hope-laden spaces.

DATA AND METHODS

To provide a foundational understanding of the leadership and management of IDR research spaces, this multisite case study draws on qualitative interviews with leaders of and institutional documents from IDR buildings at ten U.S. R1 IHEs.

INSTITUTIONAL SITE AND LEADER PARTICIPANT SELECTION

Site and participant selection followed a three-step process. First, the research team and others convened a virtual workshop on IDR building leadership, identifying prospective invitees via an Internet search of buildings at U.S.-based IHEs that had an explicitly interdisciplinary focus (e.g., interdisciplinarity mentioned in building name, website, press release) and incorporated research in the natural science disciplines. Second, a member of the research team reached out to publicly listed leaders at prospective buildings (e.g., Building Manager, VP of Research) and secured workshop participation from leaders at 10 institutions (plus the 11th coordinating institution). Third, after the workshop the research team invited workshop attendees, all of whom were university leaders, research administrators, and other staff and faculty involved in leadership of one or more IDR buildings, to participate in this study. The study was approved by the home institution’s IRB (protocol #22.081.01E). Leaders from ten of eleven workshop participant-institutions agreed to participate. Snowball sampling via these initial contacts resulted in 26 total leader participants.

Institutions represented in this study comprise a diverse set of high-status, R1 IHEs housing between one only (4 institutions) and 2 or more (6 institutions) IDR buildings related to the sciences. Select institutional site attributes are summarized in Table 1.

Table 1: Participating Institutions, Select Attributes

Institution	Size	Region	Control	Land-Grant?	AAU Member?	# Participants
City University East (CityU)	20,000+	East Coast	Private	No	Yes	1
College University (CollegeU)	10,000-19,999	East Coast	Private	No	No	4
Eastern City University (Eastern)	20,000+	East Coast	Private	No	No	2
Elite University (EliteU)	10,000-19,999	Mid-Atlantic	Private	No	Yes	4
Middle Coast University (MiddleU)	20,000+	Mid-Atlantic	Public	Yes	No	2
Midwest University (Midwest)	20,000+	Midwest	Public	Yes	Yes	4
Northeast University (NortheastU)	10,000-19,999	East Coast	Private	No	Yes	1
Southern City Tech (SouthernTech)	20,000+	Southeast	Public	No	Yes	3
West State University (WestU)	20,000+	West Coast	Public	Yes	No	3
Western City University (WestCity)	20,000 +	West Coast	Public	Yes	Yes	2

DATA COLLECTION AND ANALYSIS

Data in this study results primarily from in-depth qualitative interviews with 26 leader participants during Fall 2021. After answering a brief demographic and professional survey, participants engaged in roughly hour-long, one-on-one, semi-structured virtual interviews covering four broad topic areas: (1) leaders' IDR buildings and roles, (2) challenges and practices in IDR building leadership, (3) assessing building effectiveness, and (4) general interdisciplinarity. Interviews were held virtually to mitigate travel constraints; the use of Zoom-based video interviewing also aligns with the increasing adoption of virtual qualitative methods in the wake of the COVID-19 pandemic (e.g., Roberts et al., 2021).

In addition to interviews, institutional documents including IDR building plans and strategic visions, web copy and institutional research statements were solicited and obtained from participants directly or archived from IHE websites. Descriptive and qualitative analysis of survey and interview data address RQ1, on the roles and responsibilities of IDR building leaders. Qualitative analysis of interview data and institutional documents address RQ2, on challenges and lessons, and RQ3, on IDR building goals and effectiveness.

For interview and document data, the lead researcher undertook qualitative analysis by first completing two rounds of open coding. The first round constituted descriptive or topic coding to create “bread and butter” categories for further analytic work (Saldaña, 2015, p. 88). These categories, based loosely on research questions, included broad topics such as leadership roles (RQ1), challenges in IDR building leadership (RQ2) and assessing success (RQ3). A second round of open coding worked within and across these categories to address new ideas emerging from the data (Holley & Harris, 2019). Within leadership roles (RQ1), second-round coding generated subcodes such as *allocating, managing and re-allocating space; getting faculty buy-in and assessing success*. Within challenges in building leadership (RQ2), second-round coding generated sub-codes such as *determining building access, unclear building purpose and determining administrative and financial support*. Of particular note, COVID-19 challenges received a unique sub-code, as the pandemic was cited by multiple leaders as a factor shaping all sorts of challenges—building-related and other. And within assessing success (RQ3), sub-codes included building goals such as *beacon of campus innovation and use ID to address societal issues* as well as methods of assessment including *foot traffic, word of mouth and institutional prestige*.

As coding proceeded, the lead researcher iteratively revised and expanded open codes to ensure sensitivity to data,

exhaustiveness, mutual exclusivity and conceptual congruence (Merriam, 2009). Last, she undertook axial coding, grouping codes together within larger themes and using the constant comparative method in allocating them to themes, collapsing multiple codes or modifying code categories (Glaser & Strauss, 1967; Lincoln & Guba, 1985) until reaching analytic saturation (Creswell, 2007).

LIMITATIONS

This work evinces three primary limitations. First, we determined our sites and participant sample purposively and in an ad hoc rather than systematic fashion; while each building and IHE represented in the study met our eligibility criteria, we did not systematically review the population of IDR buildings at U.S. R1 IHEs. Our sample is thus limited and not explicitly representative of the broader population. Relatedly, and connected to our efforts to uncover the broad array of actors involved in IDR building leadership, we included one participant whose campus did not yet have any IDR buildings up and running. We also interviewed a handful of participants who had been in their building-related roles for less than a year, as well as those who had not been employed at their institutions during various stages of the building's life (e.g., the planning and construction phase). This hindered our ability, in multiple cases, to ask in-depth questions about the initial stage of building design, resourcing and planning. We instead posed broad, atemporal questions including, "Describe your role," "Describe some challenges you've faced," and "What are some things you've found to be most effective in your building leadership?" Despite anecdotal knowledge that decision-making during this earliest phase of building planning—including foundational allocations of funds—represents a central inflection point and challenge in the lives of these buildings, our sample renders us unable to fully explore such issues in the current study.

Despite these limitations, we contend that our sample's diversity and breadth—by individual background and role, AAU status, region, number of IDR buildings, timing of their planning, etc.—strengthens the foundational nature of our findings. The broad base of knowledge we provide here also points toward future opportunities to further explore individual and institutional differences in IDR building leadership, as well as home in on key phases (e.g., the project initiation phase) of building development and leadership practice.

Second, the broader context of the COVID-19 pandemic, in its 2nd year during our data collection, foundationally shaped the challenges faced by leaders across higher education (e.g., Marinoni et al., 2020) particularly those related to space and its use (e.g., Jens & Gregg, 2021). It is therefore impossible to extricate the space-based leadership challenges we outline in this paper from the pandemic context. However, the fact that our findings align with much common wisdom about academic building challenges in general (Temple, 2014) suggests that this analysis still provides useful information to the field. Third, this study is exploratory in nature, and our findings are not generalizable to other institutions or buildings beyond those included. Yet foundational work to map the landscape of IDR buildings is needed to conduct more systemwide future research, potentially via expanded case selection or population-wide survey work. Despite these limitations, we believe this work provides novel, timely and critical insight into an important higher education trend.

FINDINGS

Our findings suggest that IDR buildings are led by individuals who hold a diverse array of roles and responsibilities at varying levels of institutional hierarchy; that building leadership gives rise to many challenges and related opportunities for lessons learned; and that building leaders rely on a variety of objective and subjective indicators to gauge building effectiveness in achieving myriad and sometimes conflicting goals. Our initial analysis paints a rich and diverse portrait of IDR building leaders at R1 IHEs. All IHE and participant names are pseudonyms.

ROLES AND RESPONSIBILITIES

Addressing the question, “Who is involved in IDR building leadership?” resulted in a highly variable list of roles and responsibilities held by individuals arrayed hierarchically—at the institution-, building-, and unit-level—within university organizations. At each level, we uncovered distinct role domains and professional profiles, leading us to allocate IDR building leaders to one of four unique types.

UNIVERSITY-LEVEL LEADERS

At the university level, IDR building leaders led research administration, guided strategic and large-scale architectural planning and oversaw building governance and space customization and use. Two distinct types of university-level leaders emerged in the domains of research and innovation and space planning.

Leader Type #1. University-Level Research and Innovation

University-level research leaders and administrators, many of whom were Vice Presidents, Provosts or Chancellors within Offices of Innovation or Research, were among the best represented leader type in our sample (N=8) and reflected the unique university-level needs of IDR buildings. All senior research administrators and tenured faculty leaders’ primary building-related responsibilities included strategically overseeing building plans and occupants, creating multi-level and complex building governance structures (and overseeing other types of building leaders), and in some cases contributing to ongoing strategic efforts aimed at fostering intra-building community. Preoccupied with what Elite University (EliteU) research leader Marcus called “the whole gamut” of broad strategic planning and day-to-building life and processes, research and innovation leaders described their roles with positive phrases like *exciting*, *challenging* and *brainstorming*; innovation-oriented phrases like *cutting edge* and *brand enhancement*; and phrases focused on consensus-building and mediating like *advocacy*, *influence*, *liminal*, *intermediary* and *collaboration*.

Leader Type #2. University-Level Space Planning

University-level space planners, many within Offices of University Planning, were also well-represented (N=5). As design and architecture professionals (one also held a faculty role), they primarily worked alongside external architecture and construction firms, as well as individual building occupants, to implement building design, project-manage construction and, as College University (CollegeU) space planner Lillian described it, “align spaces with people.” Highly attuned to ways in which the concrete process of construction clashed with manifold, murky and shifting stakeholder priorities, space planning leaders described their roles with words like *interactive*, *negotiator*, *balance*, *communicator*, *political*, and *diplomat*.

Leader Type #3: Building-Level Leaders

Typified by leadership within a building boundary, building-level leaders (N=8) contributed to “boots on the ground,” day-to-day management of buildings by facilitating intra-building communication; resolving disputes and fostering community; and tracking metrics like square-foot use and research expenditures. Day-to-day work included receiving, sorting, and delivering mail (or overseeing personnel who did); responding to requests to repair broken equipment, to address malfunctioning tech, to grant key-card access and to reserve rooms; and communicating with occupants about potentially disruptive building activities. West State University (WestU)’s Amy likened her role to “the building’s personal assistant;” others used parenting analogies. Midwest University (Midwest) leader Pamela described mediating disagreements between building occupants as “hav[ing] to bring the kids to the table and say, ‘Now, why are you hitting Johnny?’” At SouthernTech, Mary described faculty as “the kids in [my house], my rules.” Constantly in motion to respond to many and competing priorities, building-level leaders referred to their work as

tactile and *essential*, used conflict-laden words like *compromise*, *juggling*, *squeezed*, *problem-solving*, and emphasized their roles in *enabling*, *influencing*, and *facilitating* intra-building work. EliteU building-level leader Erin summarized: "I'm an advocate, and I'm a smoother-over of volatile issues. [...] We won't say babysitter, but sometimes..."

Though building-level leaders shared many common responsibilities, they varied by professional profile: five were facilities professionals who did not hold a PhD or come from a high-level research background; three were active faculty researchers. Views varied as to which type of professional background was ideal. City University East (CityU)'s Lucas felt his lack of disciplinary affiliation enabled him to remain neutral and resist "affinity to a certain discipline in this building because I know it really well." Conversely, Eastern City University (Eastern)'s Farrah was an experienced researcher who considered her faculty experience crucial: "In this position, the person needs to have done the research himself, needs to have written the grant himself, needs to have all this experience because [then he] understands it."

Leader Type #4: Unit-Level Leaders

As leaders at various academic units that resided in (e.g., research centers) or affiliated with faculty (e.g., departments, colleges) in ID buildings, unit-level leaders (N=5) contributed to or voluntarily spearheaded building governance and community building efforts beyond their unit-level purview. These leaders coordinated formal networking events and speaker series as well as informal building-wide get-togethers, as in the case of the weekly "faculty soup lunch" facilitated by Middle Coast University (MiddleU)'s Jack, whose institute had governed a prior building but was "just another tenant" in his current building. Unit-level leaders' work was often more self- than building-interested; College University (CollegeU)'s James stated, "I'm less concerned about the goals of the building being a success as I am the institute being a success." Because of this, unit-level leaders sometimes encountered "some suspicion," MiddleU's Jack noted, in their leadership efforts. Southern City Tech (SouthernTech) research leader Richard had witnessed this firsthand, when a building had "gone off the rails—where all the occupants claim that the entity who manages it is always favoring their thing versus all the other things." Continually balancing their own unit's needs versus those of the broader building, unit-level leaders described their roles using phrases like *politics*, *diplomatic*, *turf wars*, *negotiation*, *fulfilling* and *educational*.

Table 2 summarizes select professional attributes and responsibilities of IDR building leaders.

Table 2: IDR Building Leaders, Select Attributes

Leader Level	Role Domain	N	Professional Profile	Yrs. in Role	Est. % FTE on Buildings	Example Job Title	Key Responsibilities
University	Research and innovation	8	Tenured faculty	7.4 (<1-23)	27.2% (1-80%)	Vice President, Institutional Research & Planning	Strategic/research planning and administration, governance structuring and oversight, community building
	Space planning	5	Design professional	4.1 (2-7.5)	8.4% (1-15%)	Director, University Planning	Design, project management, “tenant improvements” oversight
Building	Building and facilities	5	Facilities professional	6.3 (1.5-12)	89% (40-100%)	Facilities Manager	Day-to-day management, ongoing communication, community building, metrics tracking
	Faculty researcher	3	Research-active, tenured faculty	3.3. (3-4)	45% (20-100%)	Operations Director	
Unit	Faculty/administrator	5	Research-active, tenured faculty	6 (3-10)	22.5% (20-25)	Director, Institute; Associate Dean, College of Science	Governance participation, volunteer advocacy

Leaders brought their unique roles to bear on many challenges that arose uniquely within IDR buildings; navigating these challenges led to emergent lessons and suggested practices.

CHALLENGES FACED AND LESSONS LEARNED IN IDR BUILDING MANAGEMENT

Across all types of building leaders, challenges arose in four primary domains—*planning, programming and construction; space allocation; occupant needs; and resources and administrative personnel*. In navigating these challenges, leaders generated insights and both enacted and suggested responsive leadership practices. Challenge domains, takeaways and practices are summarized in Table 3.

Table 3: IDR Buildings: Leadership Challenges, Emergent Lessons and Suggested Practices

Domain	Challenge Detail	Emergent Lessons	Suggested Practices
Planning, programming, and construction	Determining cohesive and interdisciplinary building purpose	<i>Interdisciplinary buildings should have a clear and commonly understood vision and purpose.</i>	Tie building purpose to university mission; give building a clear academic focus (e.g., data science); devise and telegraph clear vision, purpose, and brand for “general” interdisciplinary buildings
	Tailoring building to initial and future long-term occupants	<i>Significant and potentially unanticipated space modifications should be planned for; enhanced occupant management will be necessary.</i>	Secure occupant commitments prior to space retrofits; hold timely, one-on-one meetings with future occupants; provide real-life senses of shared space; encourage wait-before-change mentality; leave shell space when necessary
Space allocation	Determining initial building occupants	<i>Initial occupants should be selected via an intentional and transparent process that considers total-building cohesion.</i>	Select targeted occupants via committee; select among faculty “cluster” applications; meet frequently with college/department leaders; select interdisciplinary-minded faculty (not just research “rockstars”); clearly communicate occupant decision processes
	Maintaining or re-allocating long-term-use space	<i>An interdisciplinary building should not be “set and forget”; ongoing processes to align space use with building vision and purpose should be developed.</i>	Deploy shared governance to make space decisions; use a visible, periodic tracking and review process to inform decision-making
	Allocating short-term-use space	<i>Interdisciplinary buildings are architecturally innovative attractors; significant disruption from visitors should be anticipated and planned for.</i>	Devise guidelines for external use of building spaces; communicate potential intra-building activities and disruptions (e.g., university PR efforts, construction, power disruptions) regularly
Occupant needs	Determining safety and access across disciplines	<i>Complex safety (among multiple disciplines) and building access protocols should be devised.</i>	Telegraph highest-need safety protocols in shared lab spaces; secure broad consensus on building security clearances
	Promoting collaborative, cooperative mindsets	<i>Intentional promotion of intra-building community will be necessary.</i>	Select interdisciplinary-minded faculty; build community through formal and informal events; track common research interests
Resources and personnel	Securing building philanthropy	<i>Intentionally planned and “branded” buildings will garner more philanthropic support.</i>	Telegraph a clear building “brand” and vision
	Determining funding sources for equipment, maintenance, administrative support	<i>Questions of who pays for shared equipment, space and administrative support will arise; streamlined standards of cost-sharing should be devised.</i>	Clarify which costs fall to buildings and facilities, to faculty and colleges/departments, and to other sources
	Operating with lacking or under-developed staff	<i>Personnel typically at the departmental- or college-level may be needed at the building level instead; forecast hiring needs beyond the disciplinary unit.</i>	If possible, hire building-wide staff in areas including mail receiving, administrative support, engineering and repairs; create communities of practice for building personnel to share best practices
	Operating within unclear/biased reporting structures	<i>Traditional academic reporting structures may be inappropriate for interdisciplinary buildings; clarify building-related organizational hierarchies to level playing fields among units and researchers.</i>	Clarify/consolidate chains of command to university (not unit) level

Many foundational challenges arose as interdisciplinary buildings were planned, programmed, and constructed.

Planning, Programming and Construction Challenges

Nearly all participants had experienced leading IDR buildings in some phase of planning, programming or construction (including retrofits to previously constructed space). Challenges in this domain of IDR building management included determining whether buildings had clear and intentional aims and how these were devised; securing major building philanthropy; and tailoring under-construction or previously constructed buildings for individual occupant use. Unlike more streamlined monodisciplinary buildings, IDR buildings without a clear mission or purpose—described as having “no plan,” not being designed for “anyone in particular,” and being “programmed before there was a program”—were referenced at nearly half of institutions represented in the study. Such buildings posed serious challenges. Leaders across multiple levels derisively summed up how they functioned: “Apartment building,” “pre-K classroom where everybody is doing parallel play” and interdisciplinary in name only. Eastern space planner Gabe stated: “Some very prestigious institutions, who have a long list of interdisciplinary buildings for many years, do not have interdisciplinary buildings. [...] There’s interdisciplinary buildings, and there’s truly interdisciplinary buildings.” For buildings that were deemed interdisciplinary in name only, leaders opined the difficulty—or impossibility—of fostering interdisciplinarity when it was already “too late.”

In cases where building purposes were unclear, this challenge exacerbated others, including what Lillian at CollegeU called “tenant improvements.” Though lab space customization was also challenging in monodisciplinary buildings, lacking vision for interdisciplinary buildings resulted in greater strife, as initial lab-design assumptions were proven false and retrofit costs stacked up. Western City University (WestCity) space planner Joseph described this phenomenon as “a tiger by the tail:” “[The building] was planned as generic plug-and-play laboratories, but as they started to assign PIs, [...] generic wasn’t really going to fly. [...] So, we started effectively renovating the building before it was even done.” Recalling similarly renovating newly constructed space, Eastern space planner Gabe winced: “If you think that still hurts, it does.” Even in buildings with clearer goals, the challenge to discern, manage and meet occupant expectations was high. EliteU space planner Connor described complications caused by a “chicken and the egg” dynamic in which potential occupants and planners confusedly looked to each other to set expectations for innovative, out-of-the-box IDR building design.

In addressing these challenges, leaders stressed the need to devise and telegraph clear building goals as well as bake flexibility into design processes. To recognize clear building goals and aims, multiple leaders referred to university mission and strategic planning—sometimes in competition with unit-level decision-making. At SouthernTech, building-level leader Mary’s response to this challenge was ensuring that “you [are] very interconnected at university and unit levels.” At SouthernTech and one other institution, leaders found it most effective for buildings to have a clear and singular interdisciplinary academic focus (e.g., brain sciences). For buildings whose purposes were more generally interdisciplinary, which made up far more of those represented in this study, other leaders offered guidelines to facilitate a cohesive vision. Building-level leader Linda at West State University (WestU) stressed devising a clear, structured selection process and “setting the tone from the beginning” of building operation. To plan adaptable spaces, leaders suggested multiple practices. Most dealt with engaging directly with future occupants. Midwest research leader Edward recounted a worst-case experience: A prospective occupant declined to move after his future space received a costly retrofit. Edward therefore suggested securing advance commitments from prospective occupants. Though other leaders did not cite quite as dire experiences, they discussed how to mediate incoming occupants’ expectations. CollegeU space planners Lillian and Stefani focused on holding in-depth and timely meetings with occupants and giving them real-life indicators of space; Midwest building-level leader Pamela agreed: “I think they should use more of [...] giving people the opportunity to walk through a plan to really feel where the walls are.” WestU building-level leader, Eliza, concurred, describing “literally tap[ing] out on the floor of the space [...] where each piece of equipment would go, so that there would be no surprises.” And at

least six leaders hammered the necessity of “shell space,” in which unoccupied space was left unfinished. Related to yet distinct from issues of planning and design, challenges of how to allocate and use space also commonly arose.

Space Allocation Challenges

Challenges of allocating intra-building space spanned considerations over the long term (e.g., designating initial occupants to fill spaces, re-allocating inefficiently used space, navigating ad hoc space decisions) and short term (e.g., lending conference rooms and event space). These challenges were contextualized by differing and competing priorities between university leadership and faculty researchers, between differing research faculty and groups, and/or between academic departmental homes and interdisciplinary building-based faculty. The COVID-19 pandemic added in additional wrinkles. For at least two institutions, interdisciplinary buildings were repurposed temporarily as testing centers. Both in and outside of the critical pandemic era, selecting the “right” initial building occupants, and organizing them appropriately, was considered a very high-stakes challenge—in WestU building-level leader Linda’s mind, “the number one important decision. Everything else that happened is secondary.”

Yet even good early-on decisions needed revisiting. Maintenance and future re-allocation of long-term-use space represented, for a majority of interviewed leaders, a source of possibility and dread. Leaders as disparate as EliteU research leader Marcus and SouthernTech building-level leader Mary discussed unanticipated space use by building occupants: “Space is getting utilized—and nobody told us!” WestCity research leader Ishan was optimistic, hoping space turnover would ensure a building “stays fresh and new and exciting [...] at the cutting edge.” WestU building manager Linda was more cautious, concerned with future reversion to disciplinary norms: “How do we get succession plans for these research themes to evolve over the years? [...] How do you keep that [synergistic research] done without it getting 5, 10 years, balkanized?” Shorter term considerations for space use were complicated by buildings’ common role as campus focal points; in some cases, research activities were disrupted by tours, meetings, and press events. For example, WestU building-level leader Amy evinced frustration that a “gorgeous seminar room” was only used “maybe twice a month,” and that the building as “event center” meant such spaces couldn’t be used for research. At Eastern, building manager Farrah opined that “everybody likes [the building] because it’s beautiful. [...] This is really very good for the university, for everybody, but it makes my job harder.”

To address these challenges, leaders emphasized that initial occupants be selected intentionally and transparently; that ongoing and systematic review serve to maintain and re-allocate space; and that communication forestall day-to-day disruptions. To fill buildings intentionally and transparently, leaders extensively targeted and evaluated faculty in line with building and broader campus stakeholders and goals or, conversely, solicited applications from existing campus-based research clusters. Across both methods of initial space allocation, leaders emphasized selecting interdisciplinary-minded faculty occupants—not just “heavy hitters” whose large teams might stress limited space and cause “tension,” as was one case at Midwest.

To maintain and re-allocate space leaders designed, implemented or served on committees to govern space-use decision-making. At SouthernTech, research leader Richard developed a complex, three-tiered governance model to streamline space allocation decisions. Leaders also tracked key space use metrics (see more detail in “Building Goals” section) and devised review processes to determine ongoing space and potential reallocation needs. At Midwest, a “five-year rolling evaluation” helped to determine whether occupants had outlived their tenancy. And to communicate about day-to-day space use, leaders relied on “over-communication” to ensure research was not compromised by other building activities. At WestU, using a single-point-of-contact building email address and a “lab lead newsletter” facilitated timely intra-building communication. At EliteU, it was a messaging system as well as series of monthly meetings to discuss projects or meet with unit-level leaders. Many practices related to addressing

space allocation challenges also mitigated a third large category of challenges: occupant needs.

Occupant Need Challenges

Challenges arising from unique and sometimes conflicting occupant needs included basics such as determining safety and security protocols in shared labs, as well as broader, but grand, challenges of promoting interdisciplinary cooperation and collaboration in the face of occupants' tradition-, culture- and discipline-bound perspectives on academic activity. A handful of leaders raised issues with keycard building access and safety hazards in labs facilitating fundamentally different types of research. WestU building-level leader Amy relayed how an abrupt administrative decision to make a previously secure interdisciplinary research building open-access had caused uproar among occupants, while MiddleU unit-level leader Jack described safety challenges in shared lab space: "You have one lab and one PI and a large open concept lab that's working with radioactive material; everyone in that space needs to go through basic radioactive safety training." Safety considerations regarding disease transmission were also central during the COVID-19 pandemic, with significant restrictions on the number of students, staff and faculty that could gather in or access common spaces synchronously.

Traditional and disciplinary perspectives on research and space also got in the way of bringing building occupants together. At their most benign, these perspectives manifested in faculty's attempts to cover glass office windows or hole up in closed-door offices. More significantly, though, these attitudes stymied collaboration and cooperation. Often, the notion of "shared" space raised the specter of "lost" space; at Midwest, Bob noted that many faculty saw only "what is their actual desk space—and they don't take into account that they've got a lot of shared space!" His colleague, building-level leader Pamela, relayed an incident in which a faculty member had insisted she "tape off areas on the floor. [...] That's how contentious it was." The pandemic was also a factor hindering intra-building gathering and community-building. Linda, a building-level leader at WestU, was one of multiple leaders who described COVID as a "hiatus" of sorts and spoke about instituting or re-instating more interactional programming post-pandemic.

To address issues of safety and access, leaders suggested accounting for disciplinary differences and devising and communicating processes in light of these. To promote collaboration and cooperation, leaders discussed the need to break down mental as well as physical siloes, encouraging faculty occupants to, as Lillian from CollegeU put it, "think in new ways" by intentionally fostering interdisciplinary engagement. Consistency, "cross-training and coverage," as CollegeU research leader Kyle put it, was essential to mitigating safety issues, broken down equipment and "redundancies" caused by proliferating school-based protocols. Intentional interdisciplinary engagement comprised of formal and informal events, including seminar series, artist events, lunch and learns, and more. EliteU research leader Marcus articulated why such undertakings were necessary: "I think we put a lot of stock in the idea that the building drives those kinds of things, but we have a lot of buildings that get used in a way that we never anticipated. And we have these great collaborative spaces where nobody sits." His colleague, research leader Kate, concurred that spaces weren't enough: "It's very hard for an institution to [ask faculty] to do interdisciplinary research [...] when everything else about their life at that institution still exists with a very siloed structure—like tenure, promotion, all of those different pieces." Yet leaders were also hindered in efforts to respond to myriad occupant needs by resource and personnel constraints and limitations.

Resource and Administrative Personnel Challenges

Unique challenges pertaining to sourcing resources and administrative personnel significantly impacted day-to-day life within IDR buildings. These challenges included determining who, among the many PIs and academic units involved, paid for and provided what (e.g., occupant renovations, building and equipment repair and maintenance, administrative support services); inadequate staffing for proper building functioning; and held-over departmental

or college-level reporting structures for building personnel that were inappropriate for multi-unit, multi-disciplinary team use. Equipment repair needs loomed large in the mind of building-level leader Pamela at Midwest, who was “just waiting to see” who would pay for a recently broken \$30,000 piece of equipment.

Inadequate, under-developed or inappropriately reporting staff was also a common issue, arising within at least 12 participants’ perspectives, across levels of leadership. Of IDR building leadership in general, EliteU research leader Marcus chuckled, “There should be people that specialize in this!” while MiddleU research leader Dale leveled: “We’re great at building buildings, I’ll be honest with you. We’re not great at staffing buildings once we build them.” Other and more quotidian building needs were also unmet due to staffing crunches, as at Eastern when time- and temperature-sensitive mail languished, with no one to deliver it, on an outdoor loading dock. And even staff who did perform critical functions at the building level were sometimes holdovers from departments or colleges whose faculty had become occupants.

To address challenges of determining the source(s) of funding and administrative support, leaders recommended foreseeing issues and preparing streamlined processes for future scenarios. For lacking staff and personnel development, they looked to departmental and collegiate buildings to forecast building staffing needs. And to clarify reporting structures and mitigate bias, they suggested new building-level hierarchies. Midwest building-level leader Pamela looked to one criterion to determine building versus faculty costs: Whether a resource would outlast the faculty occupant’s stay in the building. Across interviews, leaders discussed key personnel in areas including shipping and receiving; general administrative support; and equipment facilitation, management, and repair. In other cases, enhanced professional development or reconfigured reporting structures rather than new personnel was viewed as a solution to foster best practices and mitigate potential disciplinary bias. At SouthernTech, Richard discussed the recent creation of a university-wide “community of practice” for interdisciplinary building managers; Mary, his building-level colleague who facilitated the group, described it as “about consistency. It’s about networks, standard career progression, finding community and sharing information.” And while they had not yet implemented it, EliteU space planner Connor called for a needed “central command location” for EliteU’s multiple IDR buildings.

CHALLENGES SUMMARY

Across these four domains of challenges, building leaders worked within and across a strikingly broad group of stakeholders, competing priorities, personalities and resource limitations to serve as what Ishan, WestCity research leader, called “stewards” of IDR buildings. Whether addressing grand or day-to-day challenges in building management, leaders foregrounded building goals and effectiveness in determining their practice.

ASSESSING BROAD GOALS AND EFFECTIVENESS OF IDR BUILDINGS

While they sought to successfully shepherd buildings through many challenges, leaders of all types considered the broader goals of IDR buildings and offered varying indicators of buildings’ effectiveness at meeting them.

Goals for IDR Buildings

Leaders at multiple levels and institutional documents relayed multiple and sometimes competing goals for IDR buildings; these included proximate goals to *foster cooperation, collaboration and community* and *enhance broader institutional priorities* as well as broader goals to *represent and spur interdisciplinary innovation to solve complex societal problems*.

Whether tightly focused on an interdisciplinary academic area or more broadly aimed at interdisciplinary inquiry and knowledge generation at the intersection of many fields and topics, the utmost stated goal for IDR buildings was to *foster cooperation, collaboration and community* among faculty and student scholars and, in a few instances, industry partners. Traditional avowals of the power of interdisciplinarity to “break [disciplinary] silos down,” as CollegeU space planner Lillian described it, arose across interviews and institutional documents. Midwest research leader Bob described how placing faculty from different disciplines together aimed at integration and interaction: “They’re different departments. They’re different colleges. But together, they’re stronger than they are apart.” The key for Eastern space planner Gabe was that the building instigated “interactions that wouldn’t happen otherwise.” WestCity space planner Joseph described an ideal interaction, spurred by “collaboration space,” that led to innovation: “That’s sort of the dream come true, right?”

Many leaders connected buildings directly to grander aims to *enhance broader institutional priorities* that included IDR and other interdisciplinary activities in a fundamental way or, conversely, considered how buildings sometimes fulfilled unrelated or even competing aims. At Eastern, space planner Gabe easily connected his campus’ IDR buildings to a university mission for interdisciplinarity to be “complete, all pervasive, and everywhere.” WestCity research leader Ishan similarly described institutional goals to not “build our university in its old traditional discipline-based model” and stated proudly, “This building in many ways exemplifies and physically impersonates that vision.” Buildings contributed to other institutional goals including enhanced faculty and student recruitment, increased sustainable and innovative architecture, attainment of university-wide distinction in particular disciplinary areas and the enhancement of overall institutional reputation. At Northeast University (NortheastU), university-level leader Paul described a planned IDR building as “brand enhancement. [...] Keeping up with the Joneses, a little bit.”

IDR buildings also provided in-demand space. “The university’s out of space,” intoned space planner Stefani at CollegeU. “Every time you hire someone, I’m going to ask you: ‘Where are they sitting?’” WestCity space planner Joseph concurred, describing “just a desperate need” on his campus for wet lab and research space. Yet this general need for more research space on campus, cited by multiple leaders, sometimes clashed with IDR goals. As MiddleU research leader Dale stated, “Occasionally deans or department chairs will come to me and say, ‘I need lab space.’ Right? And these buildings are not designed to solve the problem of, ‘I need lab space.’ They are designed to build an intellectual community of scholars to allow them to do things.” This issue arose at Midwest, too, where unit-level leader Jennifer’s “apartment building” was just giving “space to people who don’t have space, or whose space is obsolete”—the opposite, she opined, of a “coherent building that has a theme and has floors integrated vertically.”

Multiple leaders and documents described IDR buildings’ goals to *represent and spur interdisciplinary innovation to solve complex societal problems*, suggesting the symbolic role of IDR buildings as a “beacon,” “focal point” and “showcase” of interdisciplinary innovation. At CollegeU, unit-level leader James stated that “many of society’s most critical issues need an interdisciplinary approach,” and that a building goal was to enable such. Midwest unit-level leader Ted acknowledged that many “problems are beyond the scope of” any one discipline; at NortheastU, building-targeted problems were “the world’s hardest: [...] health, food, and energy.” Joseph, the WestCity space planner, was starry-eyed about the potential for life-changing research to stem from his campus’ IDR building: “What if, by chance, when we bring [experts from different disciplines] together, a grand problem in the world is solved?” In the face of these many and varied goals for interdisciplinary buildings, leaders looked to many indicators to gauge their effectiveness.

Gauging Effectiveness of IDR Buildings

The methods leaders used to gauge building effectiveness included objective measures as well as fuzzy and subjective measures of success. Additionally, a critical mass of leaders discussed the difficulty in gauging the success of IDR buildings. These various measures and factors in difficulty are summarized and quantified in Table 4.

Table 4: Interdisciplinary Building Goals and Effectiveness: Leader-Derived Measures and Measurement Challenges

Type	Measure/Factor	# Unique Mentions ¹
Objective measures	Increased research productivity	10
	Dollars of funding per square foot	5
	Enhanced institutional status	3
	Increased donor activity	3
	Growth in building-related programs and units	2
	Increased donor activity	3
Subjective measures	Student and faculty recruitment, retention, and satisfaction	10
	Building reputation ("word of mouth")	9
	Foot traffic ("buzz")	3
Measurement difficulty factors	Lack of clear building goals	6
	Buildings' limited lifespans	1
	Building effects versus effects of other interdisciplinary initiatives	1

1. How many unique participants mentioned the measure/detail at least once.

Concrete, quantifiable and *objective measures* for assessing building success included many not unique to interdisciplinarity: dollars of funding generated per square foot of space used, increased donor activity, enhanced institutional status, growth in building-related programs and units, and increasing research output, both specifically IDR and more generally. Multiple leaders mentioned dollars per square foot as a useful measure—both in assessing overall building success and in determining which occupants were allowed to maintain residency. Others focused on academic productivity and grant attainment, whether interdisciplinary or not. At WestU, building-level leader Eliza looked to “bigger types of grants than perhaps we’ve landed” in the past to gauge building success; at MiddleU, research leader Dale cited already-attained “pretty significant large-scale research awards [...] from NIH, NSF, Department of Energy.” CollegeU space planner Stefani noted how building success should “roll up [...] to better rankings for CollegeU, more fundraising, more philanthropy.” At Midwest, unit-level leader Ted noted, “Research stature means a lot to our position in the AAU.” MiddleU’s Dale acknowledged that objective measures were requested by the likes of governing boards, who considered buildings “more of an ROI, return on investment.” Yet many leaders also, or even more greatly, valued less-concrete measures of building success.

Qualitative *fuzzy* and *subjective measures* of success included observations of building foot traffic; informal interdisciplinary engagement and “buzz”; broader building reputation and word of mouth; and student and faculty recruitment, retention and happiness. At SouthernTech, research leader Richard gauged success “by the traffic in the lobby or atrium,” tying on-the-ground “buzz” to the notion that “collaboration is very physical.” At Eastern, building-leader Farrah described her sense, walking around every day, that she could see “the student[s] working day and night, [...] different subject, different college, different people.” She concluded that the building was successful: “It’s moving, moving, moving all the time.” The broader campus buzz about buildings, too, was a means of gauging effectiveness. CollegeU space planner Lillian discussed wanting to “hear that chatter and that discourse between people. If there’s a lot of complaining, then I know it’s not working.” At NortheastU, research leader Paul hoped for “a jealousy of those that get to be in the space.” And WestCity research leader Ishan concurred: “If the building turns out to be a success like I expect it will be, more people will want to be in it.”

A focus on recruitment, retention and occupant happiness was also evident, though often unrelated to specific interdisciplinary aims. At Midwest, unit-level leader Bob straightforwardly referred to this as “faculty acceptance” of life in the building: “Were faculty happy? Recruiting of new faculty, retention of faculty.” EliteU research leader Marcus also focused on faculty recruitment and happiness: “We watch if we have retention challenges or competing recruitments and the sense that the facility is not up to speed.” Above all, he wanted faculty to not “view [the building] as a hurdle, an obstacle to recruiting graduate students to their group or to advancing their science.”

Difficulty in Gauging Success

Factors that rendered gauging the success of IDR buildings difficult included lacking clarity of building goals; the complexity of disentangling building effects from related IDR programming, faculty initiatives, etc. and, in multiple cases, buildings’ limited lifespan to see clear and sustained progress toward goals. CollegeU space planner Stefani wondered, “Is the goal research? Is the goal academic programs and departments? [...] I don’t know.” NortheastU research leader Paul mused, “It’s not like we have a controlled study, where we have one building that’s boring and old, versus one new one, and how does it work out?” And Midwest research leader Bob guessed that many buildings “haven’t been around long enough for us to see if they’re successful yet.”

DISCUSSION

This work sought to illuminate increasingly prevalent and resource-intensive IDR buildings in higher education. In richly mapping these buildings and describing related leadership issues, our findings suggest that a broad and variable range of higher education leaders, research administrators, faculty and support professionals contribute to building leadership via dynamic roles, responsibilities and lessons learned in the face of myriad challenges. And while leaders at multiple levels cited different lived experiences, significant alignment on many topics, including how they framed building goals and effectiveness, suggests an emerging consensus on what IDR building leadership is and is for. Our analysis also suggests that IDR buildings serve multiple and sometimes conflicting purposes, and that gauging their effectiveness is a highly complex process frequently tied to indicators that are not overtly interdisciplinary, such as revenue generation and overall increases in research output. Overall, our findings suggest that IDR buildings utilize and demand multifaceted, multi-level leadership teams; result in robust and unique challenges that provide opportunities for enhanced knowledge and practice; and represent a high-need, high-reward context for further scholarship and best practices development.

In documenting IDR spaces’ many strategic goals, Harris and Holley (2008) 15 years ago avowed that, while “difficult and costly [...] a well-designed physical space holds powerful potential for fostering active engagement among community members and encouraging the collaborations necessary for interdisciplinary work” (pp. 40-41). Our findings suggest that both the problems and potential of IDR buildings are being realized today. As with core facilities, IDR buildings are framed as potential “force multipliers” (Zwick, 2021), serving a range of university priorities including fostering cross-campus collaboration; spurring innovative research; and supporting recruitment, retention and faculty and student success. In supporting this conclusion, our work joins a growing body of research exploring the multifaceted and resource-intensive IDR strategies that typify the modern research university.

Our findings also join a critical, yet limited, literature evaluating IDR strategy effectiveness. Though we make no causal claims about IDR building effects, our findings suggest reasons for optimism—and caution—regarding buildings’ ability to spur productive and impactful interdisciplinary collaboration. Optimistically, multiple participants echoed prior findings that physical proximity can spur collaboration (Kabo et al., 2014) and institutional commitments to interdisciplinarity can work (e.g., Leahey & Barringer, 2020; Leahey et al., 2017). Still, other leaders acknowledged buildings’ limitations. In addition to addressing many challenges unique to these buildings (see

again Table 3), many leaders stressed that IDR buildings alone cannot promote collaboration. Like recent research suggesting that ill-maintained cluster hiring can result in limited collaboration (Bloom et al., 2020), the many and varied strategies leaders undertook to foster intra-building collaboration—social events, seminars, speaker series, grant-tracking, shared core facilities—suggests that effective IDR strategies require operational attention and care. And careful assessment, too: This work suggests that efforts to gauge buildings’ unique “value-add” are complicated by the potential overlapping effects of other IDR factors and strategies (e.g., hiring, funding, faculty characteristics).

To the practice of careful IDR building leadership, our work brings novel insight into the types of challenges building leaders across the field may face, and what lessons they may learn from facing them. Summarized in Table 3, emergent lessons and practices arising from leaders’ experiences paint a foundational portrait of what scholars of interdisciplinary buildings, as well as building leaders themselves, might take away from our findings. An overall lesson is that interdisciplinary buildings should have clear vision and purpose. In a very basic way, this central lesson distinguishes interdisciplinary buildings from their mono-disciplinary counterparts; after all, the vision and purpose of a “biology building” is rarely questioned. This central lesson thus shapes suggested practices within the building planning, programming, and construction phase (e.g., give building a clear academic focus); it also orients lessons and practices for selecting building occupants (i.e., to align with the building vision), making ongoing space-use decisions, seeking philanthropic support and other domains of challenge. Many building leadership practices, suggested by leaders themselves and arising through the research process, comprise intentional planning (around building vision, occupant selection, building processes) and also purposeful communication of planning processes and decisions. Certainly, a “best practice” of purposeful communication, for example, is common across many academic initiatives. Yet the more nuanced suggestions we provide here, for how to select building occupants and arrange interdisciplinary spaces, are largely unique to IDR buildings. Through the contribution of these lessons and suggested practices, then, our work aims to provide a tangible and targeted benefit for research administrators and other leaders of current and future IDR buildings.

In identifying the significant expense, break-neck proliferation and transformative field-wide undertaking represented by IDR buildings, this work thus suggests an urgent need for further research and best practices development in IDR building leadership. Future scholarship should continue mapping these buildings field-wide, creating a robust, longitudinal dataset to assess building outcomes (see again Table 4). Surveys of and continued interviews with building leaders as well as occupants can further illuminate life inside IDR buildings and explore the extent to which the lessons learned and suggested practices (see again Table 3) generated by this work hold across a broader sample. Work that disentangles buildings from or maps intersections with other IDR strategies can clarify whether buildings represent merely one of many or, conversely, a uniquely impactful interdisciplinary strategy. For practice, this work provides university, research, and faculty leaders, at any stage of building planning or leadership, with foundational knowledge to guide decision-making in building planning, programming, and construction; creating and/or enhancing multi-level building leadership teams; foreseeing potential challenges and emergent best practices in building management; and tracking and assessing building goals and effectiveness.

Overall, this work brings the concrete realities of higher education interdisciplinary research spaces to light and establishes a foundational set of guideposts for future inquiry. In doing so, it signals multiple directions for future research and efforts to ground administrators’ practices in the management of IDR buildings. As such, we aim to answer the imperative to better understand these costly, time-intensive, and potentially transformative higher education spaces.

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IMPLEMENTATION OF A PILOT PROJECT PROGRAM TO EXPAND RESEARCH ON ALCOHOL USE DISORDERS IN AMERICAN INDIAN AND ALASKA NATIVE COMMUNITIES

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ABSTRACT

Pilot project programs offer early-stage and other investigators support to pursue emerging research areas, explore new methodologies, gain experience as principal investigators, and collect pilot data needed to pursue larger extramural research funding, such as from the National Institutes of Health. Pilot project programs may be particularly important to early-stage investigators from underrepresented backgrounds, who must overcome unique challenges to launching careers in community-based participatory research. This paper describes the structure, function, and impact of the Native Center for Alcohol Research and Education (NCARE) Pilot Project Core. **Methods:** During four calls for applications from 2018 to 2021, research investigators interested in conducting alcohol use disorder research in partnership with Tribal communities were recruited, with a focus on early-stage and American Indian and Alaska Native investigators. Eligible investigators were required to submit letters of intent prior to preparing full applications, which underwent a rigorous review process. **Results:** Eight pilot projects were awarded. Of the eight pilot project investigators, seven were early-stage scholars, seven were female, and four identified as American Indian or Alaska Native. The funded projects included two primary areas of research, epidemiological studies and intervention projects. Once funded, the Pilot Project Core assisted pilot project investigators with securing approvals for their research studies, responding to methodological and analysis questions, and mentoring and monitoring their progress. At the time of writing this paper, three pilot project investigators have completed their pilot projects, three investigators are currently collecting data, and one is in the

analysis phase. One pilot project investigator did not complete their project due to COVID-19 restrictions early in the pandemic. The pilot project investigators submitted 36 grant proposals for independent external funding and received 25 grants after funding of their pilot project; four were directly related to pilot project grants. Additionally, four peer-reviewed manuscripts resulting from Pilot Project Core support were published. **Conclusions:** Despite challenges related to the COVID-19 pandemic the pilot project funding through NCARE provided eight pilot grants, half of which identified as AI/AN and most of which led directly to multiple grants and papers. The NCARE pilot program provides a model for other similar programs seeking to support early-stage investigators who identify as AI/AN or other groups underrepresented in science.

Keywords:

Pilot projects; training programs; substance use disorders; American Indian and Alaska Native communities

BACKGROUND

Recently, the National Institutes of Health (NIH) has introduced a variety of initiatives focused on increasing the diversity of the scientific workforce (National Institutes of Health, 2022). These efforts include the funding of research investigators through programs such as diversity supplements and other training awards designed to attract scholars from groups underrepresented in science. NIH has also prioritized research that seeks to improve health equity and addresses the complexities of social determinants of health, which in turn mandates a range of opinions and perspectives (S. A. Blanchard et al., 2019; Daley et al., 2009; Hemming et al., 2019; Polite et al., 2017). Investigators from groups underrepresented in science are often highly motivated to address health outcomes that directly impact their communities and may actively engage them in integrating cultural practices into public health prevention programs and interventions (Gibbs & Griffin, 2013; Mahoney et al., 2008; Pedersen et al., 2016). However, compared to their white peers, investigators from groups underrepresented in science are less likely to be awarded federal funding (Ginther et al., 2011) and, if not funded, less likely to reapply (Tabak & Collins, 2011).

Early-stage investigators often face a catch-22: funding bodies want to see the results of preliminary studies before providing financial support; yet, such support is needed to conduct preliminary studies (Crist et al., 2004). Although some institutions offer a modest level of funding for early-stage research, the scope of current programs is limited by significant constraints and by insufficient funds in relation to need. Shortcomings include: restrictions on funding to members of specific departments, schools, centers, or programs; inadequate funding for high-risk but potentially high-impact projects; meager support for training; an absence of frameworks for sharing core resources essential to developing innovative research; and limited incentives for cross-disciplinary collaborations or networks (Buchwald & Dick, 2011; Hall et al., 2018; Morozumi et al., 2020; Nearing et al., 2015; Vizueta et al., 2020).

Pilot projects provide valuable opportunities for early-stage investigators to advance their research objectives and can serve as the impetus for future funding. Pilot projects can seed emerging research areas, explore new methodologies, and pursue new regional and national collaborations that might evolve and produce independently-funded research or demonstration projects. Pilot project data are also crucial for obtaining funding from the NIH, industry partners, and private foundations. Therefore, institutional support for pilot projects is vital, particularly for diverse faculty, such as American Indian and Alaska Native (AI/AN) investigators, engaged in health equity research (Ginther et al., 2011). Additionally, prior pilot project programs supporting research on the topic of social determinants of health in AI/AN populations have shown preliminary success in addressing health disparities (Becker et al., 2018).

The overall objective of the Washington State University Native Center for Alcohol Research and Education (NCARE),

a Comprehensive Alcohol Research Center (P60) funded by the National Institute on Alcohol Use and Alcoholism (NIAAA), is to develop and implement innovative community-engaged alcohol use disorder (AUD) prevention and treatment research that positively impacts AI/AN people across the lifespan. The NCARE Pilot Project Core was designed to support pilot projects that rigorously examine practices, treatments, educational efforts, and policies that can affect sustained, widespread reductions in AUD-related health disparities experienced by AI/AN populations and offer logistical and scientific resources to investigators. In this paper, we describe the NCARE Pilot Project Core, its initial outcomes, and lessons learned. The Core offers a model that might be replicated to increase the diversity of the scientific workforce and facilitate new research efforts to improve AUD prevention and treatment in AI/AN and other underserved communities. We hope that this approach will foster an ecosystem of innovative and rigorous research to reduce AUD and related health disparities in AI/AN communities.

METHODS

We conducted four calls for applications during the five years of NCARE funding. Each call involved the recruitment of pilot project investigators, the submission of applications, peer review and scoring of applications, funding decisions, and evaluation of other support needs and professional development. Information on the process for pilot project investigator recruitment, application review, and outcomes was gathered to evaluate the NCARE Pilot Project Core (see Figure 1 for a step-by-step illustration of the application submission and review process).

Description of Funding and Eligibility

Pilot project applicants could request up to \$40,000 for 12 to 24 months of funding; indirect costs were not provided and funding for the investigator's effort in excess of 15% required approval from Pilot Core leadership. While pilot project proposals were being developed, the applicants were able to request ethical, statistical, and data management support, including from the Pilot Project Core Leader, who is an investigator with expertise in AUD treatment and experience partnering with AI/AN communities. Support could include discussing pilot project proposal concepts and community partnerships, reviewing draft Specific Aims, and consulting with the Research Methods Core on methods and statistical design.

The proposed pilot project research was required to address AUDs and related health inequities in AI/AN communities; both community-based and secondary analysis studies were permitted. Other eligibility criteria included holding a doctoral degree in social, behavioral, or health sciences or a similar field. Pilot project principal investigators either could not have received an NIH R01 level grant, or if they had received an R01 or similar grant, they could not have conducted research focused on AUDs in AI/AN communities. These eligibility criteria favored early-stage investigators. AI/AN investigators who met eligibility criteria were strongly encouraged to apply. During the COVID-19 pandemic, potential applicants were asked to consider telemedicine/telehealth interventions, virtual data collection methods, and/or secondary data analyses.

Recruitment

NCARE solicited pilot grant applications four times total and advertised funding opportunities to all NCARE-affiliated investigators and partners, as well as through presentations and webinar announcements, email listservs, and social media posts. The call for applications was sent out three times over three months to allow for wide distribution and time for applicants to formulate an idea and submit their letter of intent (LOI). The announcement promoted innovative research projects to reduce the burden of AUDs and related health inequities in AI/AN communities that were likely to lead to future external funding. After the start of the COVID pandemic, recruitment materials included updated relevant considerations (e.g., telemedicine, virtual collection, and secondary analysis). Recipients were asked to widely distribute the call for applications to their networks. All information was also posted on the NCARE website.

Review Process for NCARE Pilot Project Core Proposals

The review process consisted of two levels. First, interested investigators were required to submit an LOI that included a list of potential co-investigators and community partners who would assist in the completion of the project; the intended community, Tribe, or setting of the proposed project; and a 500-word abstract that included a background, specific aims, and data analysis plan. The NCARE Pilot Project Core lead, an investigator with expertise in AUDs, and an AI/AN research organization leader reviewed the submitted LOIs for scientific merit and programmatic priorities. Applicants were contacted to clarify questions brought up during the initial review; applicants whose LOI was accepted were invited to submit a full pilot project grant application and sent detailed instructions describing grant formatting, content requirements, and the submission process. Full applications followed an NIH-style format consisting of a detailed budget; a budget justification, including personnel, travel, and equipment requests; a one-page specific aims; and a six-page research strategy comprised of significance, innovation, and approach. A full application also included a statement of future directions and career plans, biosketches from the pilot project principal investigator and key personnel, letters of support and collaboration, and Tribal resolutions or similar documents of support from Tribal partners.

Full pilot project grant applications were reviewed by the NCARE Pilot Project Core Review Committee, which functioned like an NIH grant review panel. The Committee was composed of multidisciplinary investigators who were experts in AUDs, AI/AN health, and/or research methods with experience in NIH-style grant reviews. Reviewers included NCARE faculty, as well as external faculty with relevant experience. The chair was a senior investigator with expertise in AUD research who headed a large pilot project program at a partnering university, followed by a senior investigator with expertise in AUD research with extensive NIH grant reviewing experience. After the first grant cycle, we also invited funded pilot project investigators to serve as reviewers. Three individuals reviewed each application. The review team included a Research Methods Core member, an expert in the field, and a funded pilot project principal investigator (following the first call for applications). Also, the Pilot Project Core Review Committee included a member from each of the NCARE cores, who gave extensive feedback during the review process, particularly members of the Research Methods Core.

Evaluation, Scoring, and Funding of Pilot Project Applications

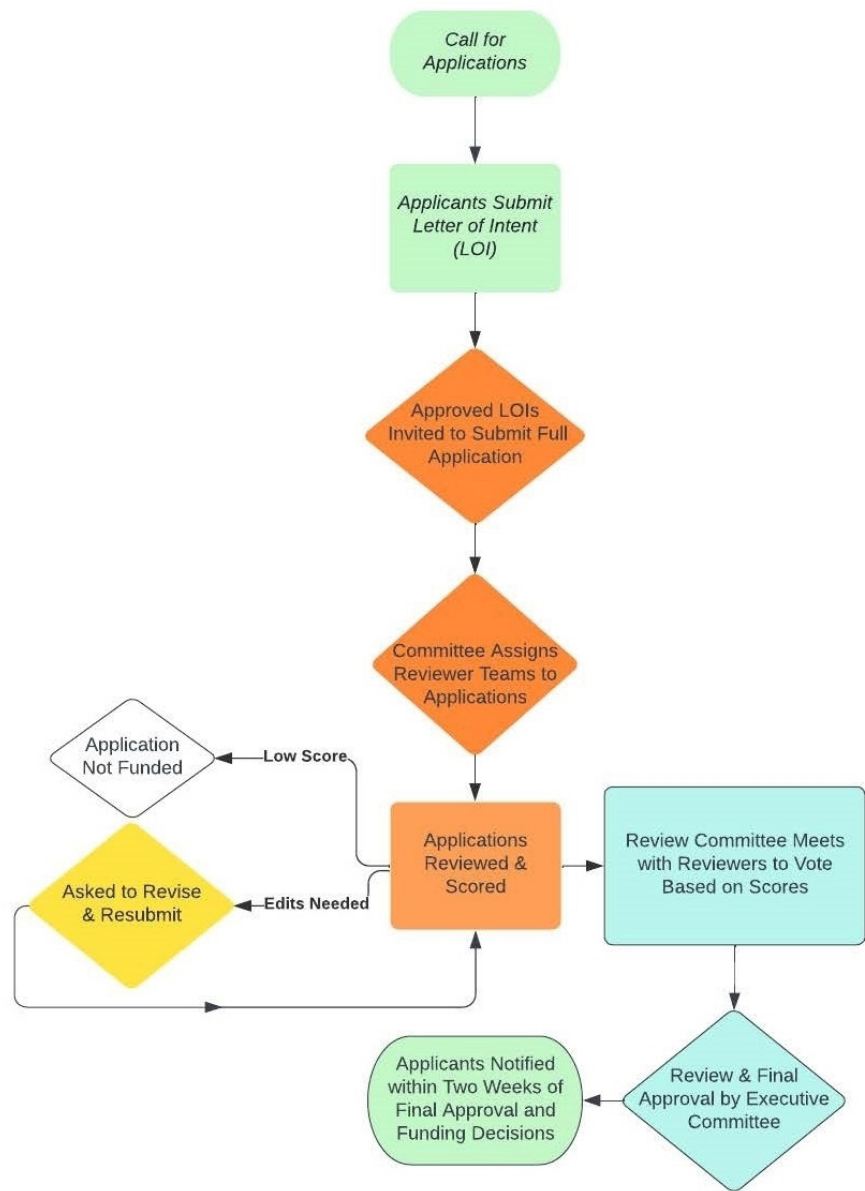
Reviewers evaluated grant applications based on relevance to AUD research and implications for AI/AN health equity, as well as typical NIH review criteria of significance, innovation, approach, environment, and the qualifications of the research team. They also evaluated the likelihood that the grant proposal would result in useful outcomes and that the results could be disseminated and eventually used to obtain additional research funding. Each reviewer provided written feedback and suggestions to the applicant based on the above criteria and then assigned scores for each criterion with an overall score based on the standard NIH scoring system (from a high of one to a low of nine). Additional considerations included: assurance of the project's feasibility for completion with available resources within the grant's maximum period of 24 months; that it complied with NIH and U.S. Food and Drug Administration guidelines; and its compatibility with the priorities, goals, and interests of NCARE.

Summaries were compiled from each review team and initial scores were tallied. The Pilot Project Core Review Committee discussed and scored applications in a follow-up meeting with all reviewers present. Reviewers could change their scores during their respective team's discussion of the application. Final scores were averaged and multiplied by 10 per NIH scoring standards. Like the NIH council review process, each application was then presented to the NCARE leadership team for final decisions, and recommendations were sent to NIAAA for funding the most meritorious applications.

Eligible applicants could resubmit in subsequent calls for applications, and those whose applications had

weaknesses that could be improved upon were strongly encouraged to reapply for funding and offered the full range of NCARE services. Those encouraged to reapply were provided with detailed reviewer comments, offered an opportunity to review comments with the Pilot Project Core Co-Leader, and offered the opportunity to receive feedback on their revised application from the Pilot Project Core Co-Lead. Relevant IRB and Tribal approvals were required.

Figure 1: NCARE Pilot Project Application and Review Process



RESULTS

Table 1 below details the total number of LOIs that were submitted, the number of full proposals submitted, and the number of pilot projects funded each year. There were three LOIs rejected prior to review because of ineligibility (in one, the PI did not have a terminal degree; in the second, the proposed project was not focused on an AI/AN

population; and in the third, the applicant was from an institution that was not eligible to receive an NIH grant). After review of full applications, some investigators were asked to revise their full application and resubmit. Of those investigators who were selected to submit a full application, six did not do so, resulting in the discrepancy between the number of LOIs invited to submit full applications and the number of full applications subsequently received. Funded projects that involved clinical trials or 'greater than minimal risk to human subjects' designations required prior approval by NIAAA before initiation, as stipulated by the RFA.

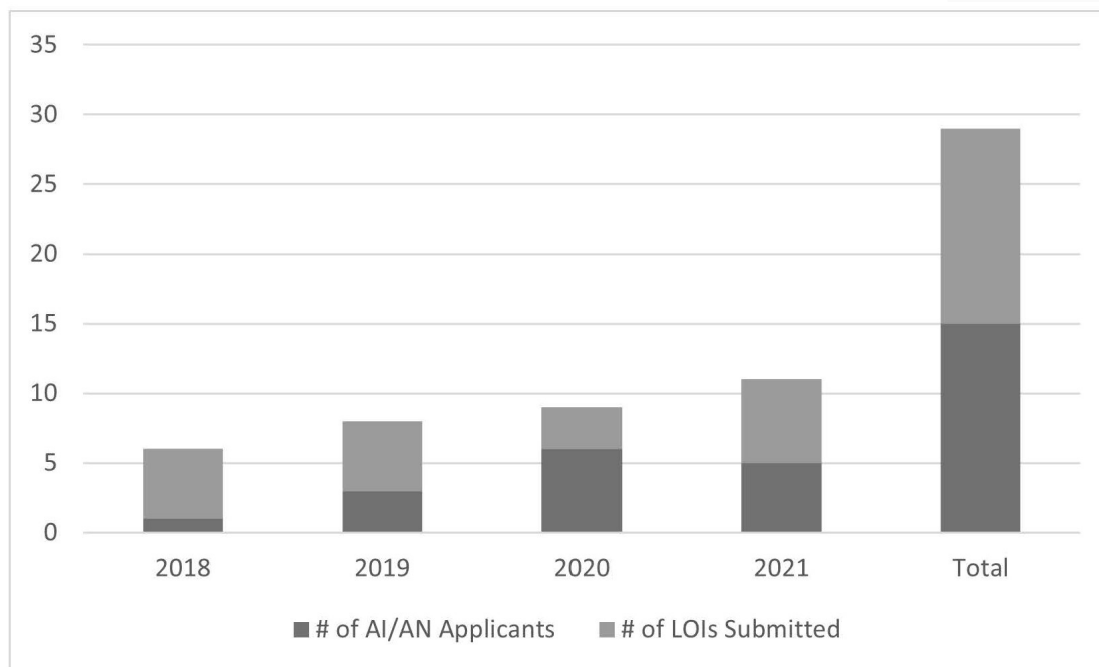
Table 1: Data on Pilot Grants Submissions*

Grant Submission Year	LOIs Submitted	LOIs Invited for Application	Applications Submitted	Awarded Projects
2018	6 (1)	6 (1)	5 (1)	3 (1)
2019	8 (3)	7 (3)	3 (2)	1 (0)
2020	9 (6)	8 (5)	7 (5)	3 (2)
2021	6 (5)	5 (4)	4 (3)	1 (1)
TOTAL	29 (15)	26 (13)	20 (11)	8 (4)

*Data in parenthesis indicates self-identified AI/AN investigators out of the total number provided

Figure 2 visually describes the number of AI/AN investigators who submitted LOIs out of the total number of LOIs. Of the eight pilot project grants awarded, seven came from early-stage investigators (e.g., Assistant Professor or Research Fellow) and seven were from female investigators. Four funded pilot project investigators (50%) identified as AI/AN.

Figure 2: Data on AI/AN Applicants and Total Number of Applicants



The topics of the funded pilot projects encompassed primarily epidemiological studies (i.e., secondary data analyses and/or data collection related to AUD) and intervention projects (i.e., development of intervention or prevention programs on AUD). As shown in Table 2, pilot project topics represented the spectrum of AUD-focused research, from alcohol abstinence to reduction of risky drinking to developing and validating culturally relevant measures. Pilot projects included men and women, a range of ages, including children and adolescents, and featured sites across the country. Some data in this table are incomplete (e.g., number of grants and publications) because projects are not yet completed.

Table 2: Funded Pilot Project Titles

Epidemiological Studies
Exploring Alcohol Use and Pregnancy Among American Indian and Alaska Native Women
Re-Centering Measures for Alcohol Misuse Among American Indian and Alaska Native Communities
Assessment Of Alcohol Use, Mental Health Risks, And COVID-19 Experiences Among Native Americans Living Along the Eastern and Southern Seaboard of The U.S.
Relationship Of Food Security and Alcohol Use Among American Indian and Alaska Native Parents of Young Children
Exploring The Impact of the COVID-19 Pandemic on AUD Among Native American Young Adults
Intervention Projects
Real-Time Breathalyzer Monitoring and Contingency Management for Alcohol Use in American Indian Women
Pathways To Recovery Among Urban Alaska Native and American Indian People with Long-Term Abstinence from Alcohol
Feasibility And Impact of Distance American Indian Peer Recovery Coaches

At the time of writing this paper, three pilot project investigators have completed their pilot projects, three are currently collecting data, and one pilot project is in the analysis phase. Project timelines were frequently delayed due to the cascading effects of the COVID-19 pandemic on partner Tribal communities, site staffing issues, disparities in technological access/usability, and changes to virtual intervention formats. One pilot project investigator did not complete their project due to restrictions early in the COVID-19 pandemic. The pilot project investigators submitted 36 grant proposals for independent external funding and received 25 grants after funding of their pilot project; four were directly related to pilot project grants using the data and skills acquired from the NCARE Pilot Project Core experience. Four peer-reviewed publications have resulted from pilot project data, and six of the eight pilot project investigators have served as a reviewer for another NCARE pilot project applicant.

In the submission process, few direct requests were received from pilot project investigators for specific NCARE core support. Once funded, informal contacts with Pilot Project Core staff and pilot project investigators occurred frequently, including correspondence and questions via email unless phone was requested. Existing mentoring relationships appeared important to the pilot project investigators, as they indicated they were collaborating closely with a current mentor at their own institution on questions such as data analysis. During the COVID-19 pandemic, the pilot project investigators worked closely with the NCARE Pilot Grant administrative team to adjust timetables and additionally with the Research Methods Core to discuss potential changes in sample size or data collection procedures.

DISCUSSION

Our preliminary data from the NCARE Pilot Project Core shows initial and promising successes from our pilot project investigators. As noted in previous papers, pilot projects are an important first step in providing support for diverse faculty, as well as for understanding different health disparities that are under-researched (Becker et al., 2018; S. A. Blanchard et al., 2019; Cruz et al., 2020; Daley et al., 2009; Harawa et al., 2017). The NCARE Pilot Project Core was able to provide substantial pilot project funding to often underserved early-stage investigators, specifically AI/AN scientists who are consistently among the most underrepresented minority groups in health research (Buchwald & Dick, 2011) and of NIH-funded awardees (Ginther et al., 2011). While the long-term impact of the present study is yet to be explored, we know from other analyses of pilot project programs that an increase in small grant funding shows great promise in providing future opportunities for external grant funding and other training for culturally diverse investigators (R. D. Blanchard et al., 2019; S. A. Blanchard et al., 2019; Buchwald & Dick, 2011). For example, a pilot project funding program for early-stage investigators, similar to NCARE where many of the investigators were racial or ethnic minorities, led to five of the seven funded faculty later obtaining independent extramural funding totaling \$4.7 million (Daley et al., 2009). In addition to providing funding for early-stage investigators, these pilot projects provide early-stage investigators the resources to develop collaborative community partnerships, which is often a resource-heavy undertaking (Cruz et al., 2020).

While the NCARE Pilot Project Core showed preliminary accomplishments, some lessons learned can be considered for future programs. First, the number of applications to the NCARE Pilot Project Core were fewer than anticipated. The reasons remain unclear but might include competing programs and diminished demand; the COVID pandemic and its role in hindering recruitment; or a need for other recruiting techniques to reach audiences that we did not use. Future pilot project programs should collect more specific data on the recruitment and application process, including more data from people interested in the opportunity who do not subsequently apply to identify barriers to applying, as well as collecting more data on interactions with different cores to see how these could be better promoted and used. In our NCARE Pilot Project Core, it is unclear if the requirements for applying, modeled after the NIH application and review process, were too stringent for the funding offered.

There are additional challenges in these types of pilot projects that should be considered. We found this in the NCARE Pilot Project Core, where some early-stage investigators needed assistance from the Research Methods Core, but others seemed to get most of their help from their own internal and existing mentors. Having a clear understanding of the number of mentors available to early-stage investigators, and coordinating their activities as they apply for pilot project funding is critical for their long-term success (Cruz et al., 2020). Other pilot project programs have explored the promise of group mentoring, where a cohort of scholars receives mentoring in different topics in a group setting (Buchwald & Dick, 2011; Harawa et al., 2017; Manson et al., 2006). However, researchers also recognize the vital importance of individual mentoring (Manson et al., 2006). Harawa et al. (2017) conclude that an individualized mentoring approach may be warranted, as "...important predictors of success...likely vary across scholars' backgrounds," meaning that pilot project and mentoring programs can better and more precisely focus training strategies.

Of additional note is how the success of these pilot project programs is evaluated. Traditionally, metrics for success evaluate research productivity, such as peer-reviewed publications and receipt of research funding (Harawa et al., 2017). Indeed, we provide the results of some of these metrics in our Results section. However, success can and should be measured in additional ways when focusing on community-engaged research. For example, other programs have also included the development of pilot project ideas that directly engage community partners; increased opportunities to develop strong professional networks; and encouraging alternative ways of disseminating materials, such as lay publications, presentations, and social media dissemination efforts that are designed for community audiences within their evaluation measurements (Buchwald & Dick, 2011; Harawa et al., 2017; Manson et al., 2006). Outside of traditional

academia, community organizing activities and the development of curricula or trainings that influence health-related behaviors and healthcare practices are also important measures. Additionally, Harawa et al. (2017) describe informal or “invisible skills” that are critical to career success, such as work-life balance, which could be included in training programs and eventually evaluated. Finally, subsequent to receipt of their NCARE funding our early stage investigators submitted and were awarded 36 and 25 grants, respectively, suggesting they may have gained valuable skills in moving through the Pilot Project Core process.

Therefore, how we view the “success” of pilot project grantees should be adapted to the wants and needs of the community when tracking the long-term impact of these programs. While pilot project grant programs may not fully address the unique needs of minority investigators (Buchwald & Dick, 2011), they are important first steps in both training and addressing health equity and promoting community-engaged research projects (Harawa et al., 2017; Manson & Buchwald, 2007; Manson et al., 2006). Our NCARE Pilot Project Core has shown preliminary success both in supporting diverse early-stage investigators and developing a greater understanding of the epidemiology of and potential for culturally informed interventions to address AUDs and related health inequities with Tribal communities.

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UNTAPPED POTENTIAL: A CRITICAL ANALYSIS OF THE UTILITY OF DATA MANAGEMENT PLANS IN FACILITATING DATA SHARING

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ABSTRACT

Many funding agencies require researchers to include a data management plan with their grant applications explaining how they intend to make the data generated from the research publicly accessible. University administration and campus service providers could potentially leverage the content of data management plans to facilitate compliance and reduce the burden on researchers. A case study at the University of Michigan demonstrates the promise of using data management plans as a communications and information sharing tool and the barriers in doing so. I apply the results of a content analysis to develop a series of recommendations to funding agencies, university administration, and campus service providers to improve the utility of data management plans in supporting data sharing and compliance.

Keywords:

Data Management Plans, Data Sharing, Funding Agency Requirements, Data Curation, Institutional Data Policy and Practices

INTRODUCTION

Over the past decade, federal and private funding agencies have instituted a requirement that grant applications include a data management plan (DMP). The details of the requirement differ between agencies but the primary objective behind the DMP requirement is to make data from funded research available to others outside of project personnel.

Ideally, DMPs provide a description of the research team's approaches and practices they will use in developing and sharing the data from their project. Given their content, DMPs could be quite useful as a shared, centralized reference document between the researchers developing the data and the data curators who will eventually take on the responsibility of making the data accessible to others once the data are submitted to a repository (Chodocki et al., 2020). Having access to the DMP would also help local data service providers, such as libraries or IT, reach out to researchers who may benefit from having support as they develop their data. In addition, as data sharing requirements take root, research administrators will need to document the steps taken by researchers to ensure that they successfully made their data publicly available. Given the function of the DMP, it could be used by research administrators as the means to track the progress of researchers in meeting their obligations in complying with agency mandates.

In practice however, DMPs are rarely used in these ways. In part, this is due to DMPs being largely inaccessible beyond the researchers who submitted the proposal and the grant agency reviewing them (Miksa et al., 2019). Although awarded grants are considered public documents, universities do not make them readily available to

anyone outside of those personnel who are responsible for administering them. In addition, funding agencies often require all grant documents to be pasted together and submitted as a single document, making it quite difficult to extract and route specific pieces of a proposal, like a DMP, to a particular stakeholder. Furthermore, DMPs exist as static documents. The information they contain is representative of the researchers' thinking and intent at the start of their project. Although researchers can update their DMPs locally, these updates are not usually attached or associated with the grant itself.

Beyond considerations of their accessibility, it is important to consider the purpose of the DMP as structured by the funding agencies that require them. Funding agencies currently use DMPs to aid review panels in evaluating the proposal, not to communicate information to data repositories or local service providers who offer support for sharing data. Review panels are generally comprised of experts in relevant fields of study, who may not have knowledge or skills in curating or sharing data themselves. Moreover, it does not appear that reviewers consider the quality of DMPs in their determination of whether or not to award funding (Hudson-Vitale & Moulaison-Sandy, 2019; Mischo et al., 2014). Nor does it appear that having a DMP attached to a data set has an impact on whether or not researchers will share their data in ways that are accessible to the public (Van Tuyl & Whitmire, 2016). The overall lack of consideration on how DMPs could be shared and used outside of a grant review has created a situation in which a tool that was ostensibly developed to encourage researchers to share their data may in fact be a barrier.

When DMPs are studied, the focus of the analysis tends to be more on the perceived quality of a DMP (whether it meets the stated guidelines of the funding agency), than on the utility of the DMP itself (i.e., does it provide useful, actionable information that could be used to provide services and support). In this article, I analyze the content of DMPs written as a component of grants awarded to the University of Michigan as the lead institution over a period of twelve months to explore the potential utility of this content to data curators and local service providers. I then use this analysis to make recommendations for how DMPs could be modified to make them more useful as a means of communicating important information to data service providers, research administrators and data repositories. This in turn would help DMPs to serve their intended function of enabling public access to high quality data sets produced with federal tax money.

LITERATURE REVIEW

The idea for a data management plan requirement grew out of a desire to support the emergence of data-intensive research in the early 2000s. Several terms were coined to try to define this phenomenon and its potential: cyberinfrastructure, eScience, the Fourth Paradigm, Data Science, etc. Scholarly societies, federal agencies, and other research organizations formed working groups to articulate what investments in human and technical infrastructure would be needed to realize the potential of data intensive research. A key component in many of these reports was the recognition that data intensive research requires ready access to high quality, well described data sets and that processes would need to be developed to ensure that data would be widely available. For example, the 2009 report from the Interagency Working Group on Digital Data (IWGDD) stated: *"We envision a digital scientific data universe in which data creation, collection, documentation, analysis, preservation, and dissemination can be appropriately, reliably, and readily managed... To pursue this strategy, we recommend that... agencies promote a data management planning process for projects that generate preservation data"* (IWGDD, 2009, p. 1-2).

The National Science Foundation (NSF) was the first agency in the United States to require all applications for funding include a data management plan (DMP). The DMP, as defined by the NSF, is *"a document of no more than two pages and should include information about the types of data to be generated in the project, the standards to be used in formatting and contextualizing the data (metadata), the policies for accessing the data, the policies for reusing the data, and the plans for archiving the data"* (2020). As they are a part of the submitted grant application, DMPs are

evaluated as “an integral part of the proposal” (NSF, 2020). The NSF’s announcement, and the subsequent policy memorandum from the Office of Science and Technology Policy in 2013 (also known as the Holdern Memo), led to many other federal agencies and private funding agencies in the US adopting data sharing policies and DMP requirements of their own.

The DMP is still evolving as a tool and funding agencies continue to make changes to their data sharing requirements. The NIH recently unveiled a new Data Management and Sharing Plan that went into effect in January 2023 for any proposal that will generate research data (NIH, 2020). Although their new DMP requirement is similar to the NSF’s in some ways, including the two page limit and focus on community standards, several new elements are introduced. The NIH requirement asks researchers to include information about any tools or code used to generate the data, an explanation on how compliance with the plan will be monitored and managed, and a description of any considerations for access, distribution, or reuse of potentially sensitive data. The NIH also encourages researchers to update their DMP over the course of the award to reflect any changes in the management or plans for sharing the data.

However, the DMP requirements of funding agencies do not appear to have had the desired effect of increasing access to research data thus far. Several studies completed soon after funding agencies instituted their DMP requirements demonstrated the difficulties that researchers were having in trying to respond. Many researchers, even those with experience in sharing data informally with colleagues, were not accustomed to making their data publicly accessible to anyone at that time and so the new DMP requirement was out of step with their practices (Imker, 2017). The DMP requirement itself was confusing and raised many questions for researchers. Were they supposed to share all their data or just the data that directly supported their findings? How should they respond to the requirement to use “community standards”, if such standards did not yet exist? (Steinhart et al., 2012).

Outside of increasing access, data librarians and others have studied DMPs as a means to learn more about the strategies and activities researchers employ in managing and sharing their data. Studies of DMPs do show some utility in understanding variability between different disciplines, but overall DMPs lack consistency and often do not even contain the information that funding agencies require. Many researchers do not appear to understand fully what funding agencies are asking for, or do not see the utility of spending time and effort in developing plans to share their data (Bishoff & Johnson, 2015; Parham et al., 2016). Therefore, DMPs, as currently structured, appear to have limited value as a means to understand researcher’s approaches to sharing data as well as the corresponding practices. These types of analyses also reveal a need to push beyond the boundaries of DMPs as currently defined by funding agencies to identify and encourage approaches that would produce improved results. Despite their name, DMPs generally emphasize how post-publication data will eventually be shared rather than how the data will be collected, processed, and managed as it is being developed (Williams et al., 2017). The DMP policies as currently defined by funding agencies do not address data preservation, formats, documentation, and metadata clearly or sufficiently enough to support the data sharing vision articulated by the IWGDD (Dietrich et al., 2012).

Data curators consider what policies and practices are needed to assist researchers and their staff in developing a data set that has enduring value for themselves and others over time. For example, ICPSR, a data repository for the social sciences, recommends several additional elements including statements on the format of the data, determining who will have particular responsibilities for managing and sharing data, the intended audience for the data, and any Ethics and Privacy issues (Inter-university Consortium for Political & Social Research [ICPSR], 2012). The Digital Curation Center, an agency providing expert advice and practical help on storing, managing, sharing, and preserving data, developed their own checklist for a DMP as a means of codifying best practice. They also recommend including statements detailing who will have responsibilities for ensuring that data are well managed and shared appropriately, explicitly defining which data will be retained or shared, and addressing any ethical or

legal issues present in the data in the DMP (DCC, 2013). Studies have shown that when data curators work closely with research staff in developing a DMP, the resulting DMP is more comprehensive and more likely to be ingrained in the researcher's practices and workflows (Burnette et. al., 2016; Karimova et al., 2021).

An emerging approach to addressing the shortcomings of the DMP is to make them machine actionable. Most funding agencies with a DMP requirement require researchers to write up their DMP as a static document and then embed it with other components of the funding proposal. However, this approach makes it difficult for anyone to access the DMP once the award has been made, including its authors, and therefore unlikely that the DMP will be used as intended. In contrast, machine actionable data management plans (maDMPs) would be submitted as a digital document enabling information to be easily read and automatically extracted as needed. Given their accessibility and flexible structure, maDMPs could easily be adjusted and updated as needed to reflect current thinking and practice in managing, sharing, and curating the data as the data are being developed. They could also more easily incorporate relevant standards and best practices, such as the application of controlled vocabularies, to facilitate communication across stakeholders. Finally, maDMPs could be assigned a unique and persistent identifier, such as a DOI, to connect it definitively with the researchers associated with the data and the other outputs associated with the research (Sims et al., 2017; Stodden et al., 2019). The NSF believes that maDMPs are a promising direction in addressing the current shortcomings of DMPs and have encouraged their development and implementation (NSF, 2019).

METHODOLOGY

In my previous position, I oversaw a suite of services offered by the University of Michigan Library to support researchers in managing, sharing, and preserving their data (<https://www.lib.umich.edu/research-and-scholarship/data-services>). These services include reviewing DMPs, consulting and training sessions on preparing data for sharing, and operating Deep Blue Data, a data repository for sharing and preserving data generated at U-M (<https://deepblue.lib.umich.edu/data>). I was interested in learning more about the data management and sharing practices and needs of the U-M community, as well as obtaining advance notice of data deposits that will be submitted to Deep Blue Data. Although researchers who intend to deposit their data into Deep Blue Data are encouraged to contact the library early in the lifecycle of their data, this did not happen often. I asked U-M's Office of Research for access to U-M's grants management system, which they granted in January 2020.

For this project, I reviewed the DMPs from proposals to federal agencies that were awarded to U-M as the lead institution for twelve months, from March 2020 to February 2021. I located DMPs by opening the narrative description of the proposal and using the find command available in the Google Chrome browser to search for the terms "data management", "data sharing", or "resource sharing". If unsuccessful, I scrolled to the bottom of the proposal narrative and then slowly scrolled up the document looking for a DMP. If I was still unsuccessful, I looked at other files attached to the record of the grant to see if the DMP is included as a separate document. If none of these approaches led to the discovery of a DMP, I listed the award as not having DMP available. Although descriptions of data, as well as data management and sharing activities, are included sometimes in the body of the narrative or in other documents outside of a DMP, I did not review or capture this information. My process for identifying the DMPs for this study is presented visually in Figure 1.

Figure 1: Process for Identifying DMPs

Once acquired, I then reviewed the DMPs to identify the following key pieces of information:

1. The types and formats of the data to be generated,
2. Any indications and descriptions of the metadata and documentation to be provided,
3. Any mention of intellectual property (IP) concerns or constrictions on making the data available to others,
4. Statements on how and when the data will be shared with others outside of the project, and
5. The expected duration of preservation needed for the data.

Every federal funding agency has a different set of requirements for researchers to follow when it comes to sharing the unique resources generated from funded projects. Funding agencies even have different names for their requirements: data management plan, data sharing plan, resource sharing plan, etc. In this paper, I refer to these plans as DMPs no matter how individual funding agencies refer to them. As my intent was to study the content of these plans rather than to ascertain the level of compliance to the directives of funding agencies, I reviewed each DMP for the same set of variables. I found wide variability in the coverage and depth of the information provided, as expected. However, I also found that many DMPs did not provide required information, as well as more than a few DMPs that provided more thorough and in-depth information than was asked for by the funding agency. I collected all this information from the DMP regardless of the repository or data sharing method mentioned by the PI.

The top funding agencies awarding grants to researchers at the University of Michigan from March 2020 to February 2021 were the National Institutes of Health (NIH), the National Science Foundation (NSF), the Department of Defense (DoD), and the National Aeronautics and Space Administration (NASA). I grouped information from DMPs of grants awarded to U-M by other agencies together and present them in the category of "Other". Table 1 displays this information according to the awarding agency. In this period, there were 744 grants from federal agencies where U-M was the lead institution. Of these, I was able to locate data management plans, or the equivalent, for 476 of them in U-M's grants management system. Not being able to locate a DMP does not necessarily mean that a DMP does not exist for the award, only that I was unable to locate one within the U-M grants system. There may in fact be good reasons why a DMP would not be included in the materials, such as a DMP was not required for the particular funding program, or the award was supplementary to one already given. Nevertheless, the absence of DMPs from awards is potentially problematic. Without a DMP, the institution does not have an easy means of understanding what the research team has promised to the funding agency in making data from the project available.

Fifteen of these DMPs indicated that no data would be generated, leaving 461 DMPs for analysis.

Table 1: Awards Made to U-M with and without DMPs by Funding Agency

Agency	Total # of Awards	Awards with a DMP	% of Awards with a DMP	Awards not generating data	Total # of Awards from DMPs Generating Data
NIH	384	236	61%	3	233
NSF	199	183	92%	10	173
DoD	51	12	24%	1	11
NASA	44	23	52%	1	22
Other	66	22	33%	0	22
Grand Total	744	476	64%	15	461

RESULTS

The Types and Formats of Data

I reviewed each DMP and attempted to determine the nature of the data that research teams would be generating in the awarded project. To aid my analysis, I developed a broad categorization scheme based on the patterns that emerged. The data categories and definitions I developed are as follows:

Administrative – Data that pertain to administering or evaluating research or teaching programs.

Clinical – Data that pertain to the direct observation and treatment of patients rather than theoretical or laboratory studies.

Code – Data where the inputs and outputs were primarily or entirely comprised of instructions for computers to follow.

Experimental – Data that result from experiments conducted in labs or other controlled environments.

Genomic – Data derived from or that pertain to the DNA, RNA, proteins or other genetic elements of humans, animals, or other organisms.

Observational – Data developed through observing people or phenomena. This would include data gathered through surveys, interviews, and other interactions with people as well as data gathered using sensors and other instruments.

Physical Specimens – Data comprised of physical objects such as human or animal tissues, rocks, plants, etc.

Secondary – Data that were originally developed through prior research or for a different purpose than the project described in the DMP.

Simulation / Model – Data that were created for, or resulted from, a computer simulation or a model of a particular phenomenon.

Occasionally I found that the data described in the DMP fit into more than one of the defined data categories. When this happened, I assigned multiple categories to the DMP. Table 2 shows the breakdown of data category by funding agency.

Table 2: Data Category Assigned to the Data Described in the DMP by Awarding Agency

Data Category	NIH n=233	NSF n=173	DoD n=11	NASA n=22	Other n=22	Total N=461
Administrative	0	2	0	0	0	2
Clinical	27	2	0	0	1	30
Code	6	25	0	1	0	32
Experimental	18	51	6	1	8	84
Genomic	98	6	4	0	0	108
Observational	16	72	0	4	7	99
Physical Specimens	1	9	0	0	1	11
Secondary	16	15	0	5	2	38
Model or Simulation	9	42	3	16	12	82
Data Not Listed	63	5	1	0	0	69
No Data will be Generated	3	10	1	1	0	15

Note: Columns do not add up as a DMP may have included statements that fit into more than one of the listed categories.

In reviewing DMPs, I also identified any mention of the format of the data that would be developed over the course of the project. This information was not often included in DMPs, even in DMPs submitted to the NSF, which asks for information about data formats directly. On average only a third or so of DMPs included any mention of the format of the data:

- Eighty-four of 233 DMPs to the National Institutes of Health (NIH) included some information about the format of the data (36%).
- Fifty-six of 173 DMPs to the National Science Foundation (NSF) included some information about the format of the data (32%).
- Four of the 11 DMPs to the Department of Defense (DoD) included some information about the format of the data (36%).
- Five of the 22 DMPs to the National Aeronautics and Space Administration (NASA) included some information about the format of the data (22%).
- Seven of the 22 DMPs to Other Federal Agencies included some information about the format of the data (32%).

Metadata and Documentation

In reviewing DMPs, I sought to identify any indication that metadata and documentation would be generated (Table 3). When metadata or documentation was mentioned in the DMP, I noted if it was mentioned in passing or if some detail was provided. “Mentioned” is defined as the researcher providing a general or broad statement indicating that metadata or documentation would be generated, and “detailed” as the researcher providing a description of at least some of the content of the metadata or documentation to be gathered for the data over the course of the project.

Table 3: References to Metadata and Documentation in DMPs by Agency

	NIH n=233	NSF n=173	DoD n=11	NASA n=22	Other n=22	Total N=461
Metadata						
Mentioned	14 (6%)	23 (13%)	2 (18%)	4 (18%)	2 (9%)	45 (10%)
Detailed	3 (1%)	41 (24%)	2 (18%)	3 (14%)	4 (18%)	53 (11%)
Total	17 (7%)	64 (37%)	4 (36%)	7 (32%)	6 (27%)	98 (21%)
Documentation						
Mentioned	33 (14%)	43 (25%)	2 (18%)	5 (23%)	3 (14%)	86 (19%)
Detailed	12 (5%)	40 (23%)	2 (18%)	1 (5%)	7 (32%)	62 (13%)
Total	45 (19%)	83 (48%)	4 (36%)	6 (27%)	10 (45%)	148 (32%)

Forty-four DMPs in this study, or nine percent, included information about both the metadata and documentation to be generated for the data.

I also noted if a metadata standard or if a specific type of documentation was listed in the DMP, regardless of how much detail about content of the metadata or documentation was included. The specific type of documentation to be used was mentioned much more often in DMPs than specific metadata standards. One hundred and thirteen DMPs, or 24% listed a specific type of documentation that they would develop for the data. The most popular types of documentation were: Lab Notebooks (mentioned in 28 DMPs), Read me files (20), and Codebooks (11). Only 19 DMPs, or four percent, listed a specific metadata standard that they would employ. Of the standards listed, Dublin Core was mentioned three times and the Data Documentation Initiative (DDI) standard was mentioned twice.

How Will the Data Be Shared?

Most researchers gave some kind of indication of how they are planning to share their data. Only 38 of them made a statement that they are not planning to share (Table 4).

Table 4: Methods of Sharing Data Listed in DMP

	NIH n=233	NSF n=173	DoD n=11	NASA n=22	Other n=22	Total N=461
Repository – Domain	103 (44%)	44 (25%)	6 (55%)	4 (18%)	5 (23%)	162 (35%)
Repository – General	7 (3%)	11 (5%)	0 (0%)	2 (9%)	1 (5%)	21 (5%)
Repository – Institutional	12 (5%)	55 (32%)	4 (36%)	12 (55%)	13 (59%)	96 (21%)
Repository – Not Specified	19 (8%)	2 (1%)	1 (9%)	1 (5%)	2 (9%)	25 (5%)
Repository – Total	141 (61%)	112 (65%)	11 (100%)	19 (86%)	20 (91%)	304 (66%)
Researcher Hosted Website or GitHub	30 (13%)	68 (39%)	2 (18%)	7 (32%)	9 (41%)	116 (25%)
In Presentations or Publications	75 (32%)	41 (24%)	4 (36%)	6 (27%)	8 (36%)	134 (29%)
On Request	52 (22%)	47 (27%)	5 (45%)	2 (9%)	4 (18%)	110 (24%)
Some or All of the Data will not be shared	3 (1%)	8 (5%)	0 (0%)	0 (0%)	0 (0%)	11 (2%)

Note: Columns do not add up as some DMPs included more than one method of sharing data.

Repositories were listed as the primary means by which researchers would share their data. Roughly two thirds of DMPs from NIH and NSF grants mentioned a repository of some kind to share their data. Repositories were listed at even higher rates in DMPs from the DoD, NASA, and other agencies. I made note as to whether the repository mentioned in the DMP was a domain repository, a general repository, or an institutional repository.

Domain repositories, those that host a particular type of data or serve a specific field of research, were listed most often, particularly in DMPs to the NIH and the DoD. As the NIH supports multiple data repositories that are widely known and used by researchers in the medical and life science fields, this result is not surprising.

Generalist repositories are repositories that accept a variety of data types and formats, that were not associated or tied to a particular field or subject, and that were not associated exclusively with a single institution. Repositories that met these criteria included Figshare, Dryad and the Open Science Framework (OSF). Researchers did not list generalist repositories in their DMPs as often as domain or institutional repositories.

Institutional repositories serve as an archive for collecting, disseminating, and preserving the intellectual output (research data in this case) of a specific institution. Researchers did mention institutional data repositories frequently in their DMPs. Deep Blue Data, the University of Michigan Library's data repository, accounted for 85 of the 96 mentions of an institutional repository. Institutional data repositories were not as much of a factor for researchers applying for NIH funding, but for those submitting to the NSF, institutional repositories were selected more often than domain repositories. Institutional repositories were also a popular choice for researchers seeking funding from NASA. This may be due to the NSF and NASA serving a number of research communities that have not yet developed robust and open repositories of their own yet. It is important to note that institutions without

an institutional data repository, or without an organization like the library that provides services for research data, would likely see different results in their DMPs.

Researchers also listed means of sharing data outside of repositories in their DMPs. Roughly a third of DMPs, regardless of the funding agency, included some mention of sharing their data through presentations given at conferences or through publishing the results of their research. It was often difficult to discern what the researcher meant when stating that data sharing would take place through their presentations or publications. Some researchers appeared to believe that the tables, charts, and graphics summarizing the data in their presentations and publications would be sufficient. Others alluded to sharing the data behind their figures as separate supplemental files. Many simply did not provide enough information for me to determine what data would be shared through presentations and publications and to what extent.

Two additional methods of sharing data were regularly mentioned in DMPs: the researcher hosting and disseminating their data themselves or sharing the data when requested to do so by a person outside of the original research team. Each of these methods appeared in roughly a quarter of all DMPs. These methods allow the researcher a greater degree of control over what data are shared, when, and to whom. However, studies have shown that researchers do not always follow up on the promises made in the DMP to deliver their data to individuals who request it (Krawczyk & Reuben, 2021; Tedersoo, 2021). In addition, researchers who reported hosting the data themselves generally did not describe the steps they would take to ensure ongoing access to the data or the duration of access to the data they would ensure in their DMPs.

Many DMPs listed more than a single method of making their data available to others. For example, some made a distinction as to how they would share their data before and after publication of the results, such as including statements that the PI would share the data on request prior to publishing the results and then deposit the data into a repository as a part of the publication process. Other researchers referred to using more than one type of repository as a means to share their data.

Some researchers listed just a single method for sharing their data in their DMP. The number of times a particular method of sharing data was listed in the DMP as the only method to be used is presented in Table 5.

Table 5: DMPs Listing a Single Method of Data Sharing

	Total # of Mentions in DMPs N=461	Mentioned as Only Method N=461
Repository – Domain	162	68 (15%)
Repository – General	21	3 (1%)
Repository – Institutional	96	35 (8%)
Repository – Not Specified	25	8 (2%)
Researcher Hosted Website or GitHub	116	28 (6%)
In Presentations or Publications	134	39 (8%)
On Request	110	32 (7%)
Some or All of the Data will not be shared	11	6 (1%)

When Will the Data be Shared?

Researchers mentioned the timing of the expected release of the data in half or less than half of the DMPs, regardless of the funding agency. When included, statements on when the data would be shared clustered around two events: the lifespan of the grant or project, or the publication of the results. As shown in Table 6, the publication of the results was the primary event triggering the release of the data from the project, with most researchers stating that they would share their data upon acceptance, upon publication, or after publication of the results.

Table 6: Expected Timing of When the Data Would Be Made Publicly Available

	NIH n=233	NSF n=173	DoD n=11	NASA n=22	Other n=22	Total N=461
DMPs mentioning when data will be shared	109 (47%)	77 (45%)	4 (36%)	11 (50%)	8 (36%)	209 (45%)
Before or at Project's End	5	4	0	0	1	10
After Project Ends	19	15	0	1	2	37
Before Publication	6	4	0	1	1	12
On Acceptance or on Publication	49	18	2	6	2	77
After Publication	32	25	1	1	4	63
Other Time Frame	10	19	1	3	0	33

Note: The numbers in the column do not add up to the total listed in the top row as some of the DMPs listed more than one time frame for sharing components of their data.

Intellectual Property Concerns or Other Restrictions on Making the Data Available

In their DMPs, researchers often raised stipulations around sharing their data. These stipulations included provisions to ensure that the researcher and the University of Michigan would retain the rights necessary to file patents or otherwise retain the benefits derived from the outcomes of their research. Other considerations

centered on following federal and university policies, such as using a Material Transfer Agreement as the means to share data with others. Researchers also mentioned developing Data Sharing Agreements as a means for the researcher to weigh the merits of a request in deciding whether or not to share it with the requester and as a means of setting and enforcing terms and conditions for making the data available.

Table 7 displays the different IP or other concerns researchers had about sharing their data and in some cases, what steps they intend to take to address these concerns. Most often the steps described centered on adhering to established U-M research policies or practices, asserting their rights or the rights of the University over the data as a part of the research, or asserting more control over the sharing of their data than making it publicly accessible would normally permit.

Table 7: IP or Other Restrictions on Data Sharing Listed in DMPs

	NIH n=233	NSF n=173	DoD n=11	NASA n=22	Other n=22	Total N=461
# of DMPs that included statements on IP or conditions for sharing	151 (64%)	117 (64%)	9 (75%)	1 (5%)	13 (59%)	291 (63%)
Retaining Patents, Tech Transfer or Commercialization Rights	58 (25%)	27 (16%)	6 (67%)	0	2 (9%)	93 (20%)
U-M Policies	21 (9%)	30 (17%)	0	0	4 (18%)	55 (12%)
Policies of Other Institutions	29 (12%)	14 (8%)	1 (11%)	0	4 (18%)	48 (10%)
Limitations on Commercial Use	19 (8%)	10 (6%)	0	0	0	29 (6%)
Material Transfer Agreement or Simple Letter Required	76 (33%)	4 (2%)	2 (22%)	0	1 (5%)	83 (18%)
Data Sharing / Use Agreement, or Approval of PI	34 (15%)	21 (12%)	0	0	0	55 (12%)
PI or 3 rd parties retain ownership (including statements that part or all of the data will not be shared)	20 (9%)	21 (12%)	4 (44%)	0	3 (14%)	48 (10%)
Use of Licenses	9 (4%)	26 (15%)	1 (11%)	1 (5%)	2 (9%)	39 (8%)
Prohibits Re-distribution	8 (3%)	10 (6%)	0	0	0	18 (4%)
Prohibits Creating Derivatives	4 (2%)	8 (5%)	0	0	0	12 (3%)
Requires Attribution of PI or Funding Agency	11 (5%)	30 (17%)	1 (11%)	0	4 (18%)	46 (10%)
Copyright or Publisher Policies Limiting Sharing	1 (0%)	13 (8%)	1 (11%)	0	1 (5%)	16 (3%)
Rights of Research Participants Stated	3 (1%)	2 (1%)	0	0	0	5 (1%)
No Restrictions on Sharing or Use of the Data Stated Explicitly	11 (5%)	39 (23%)	0	0	3 (14%)	53 (11%)

Note: Columns do not add up as a DMP may have included statements that fit into more than one of the listed categories.

Preserving Access to the Data

Researchers did not regularly include information about how long they would preserve access to their data. This is particularly true for DMPs developed for NIH grants, but even when preserving access to the data is explicitly included in funding agency guidance, as it is for the NSF, many researchers did not mention it in their DMPs.

Table 8: Preservation of Access

	NIH n=233	NSF n=173	DoD n=11	NASA n=22	Other n=22	Total N=461
# of DMPs that included a preservation of access statement	10 (4%)	84 (49%)	5 (45%)	3 (14%)	12 (55%)	114 (25%)
3 years or less	2 (2%)	26 (15%)	1 (9%)	0	2 (9%)	31 (7%)
Between 4 to 9 years	5 (2%)	28 (16%)	2 (18%)	0	3 (14%)	35 (8%)
10 years	2 (2%)	14 (8%)	2 (18%)	2 (9%)	4 (18%)	24 (5%)
More than 10 years, defined	0	2 (1%)	0	0	0	2 (0%)
Indefinitely or Undefined	2 (2%)	23 (13%)	0	1 (5%)	4 (18%)	30 (7%)

Note: Columns do not add up as a DMP may have included statements that fit into more than one of the listed categories.

The average duration of data preservation is rather short. The majority of these DMPs stated that the data only needed to be preserved for 10 years or less. This aligns with earlier findings that few researchers think about the long-term preservation of their data (Jahnke & Asher, 2012).

DISCUSSION

This analysis suggests that DMPs, as they are currently defined and implemented by funding agencies, are not as useful a tool for communicating detailed information about the anticipated data output to future data curators and stewards of those data as they could be. The literature review suggests that this finding is not limited to the University of Michigan, but likely holds true for DMPs more broadly. Nevertheless, the need for a means to communicate information about the data across stakeholders and the potential for DMPs to serve this purpose is great enough that funding agencies should not abandon them. Instead, funding agencies should better define, clarify, and support the role of the DMP and push to make DMPs from award grants more widely available to data curators and other service providers. Revisiting the content, accessibility, and the utility of DMPs as a tool to support data curation would realign them with the vision of the Interagency Working Group on Digital Data as a means to support ready access to high-quality research data.

In order for DMPs to fulfill this role, funding agencies would need to make significant adjustments in both the structure and content of the DMP. Based on the results of my analysis, I would make the following recommendations for improving the utility of DMPs:

Data

Despite their name, researchers did not always include much information about the data they expected to generate in their data management plans. In some ways, this is understandable as the DMP is included as a part of the larger grant proposal document. If the researcher describes their data as a part of their research narrative, it may feel redundant to provide this information again later in the same document. In addition, researchers may not have a complete understanding as to what information about their data should be provided as funding agency guidelines are often vague and researchers may not be used to sharing their data.

One way to address this would be to change the format of the DMP away from being a solely narrative based document to include a list of short answer questions, or asking researchers to select the best answer from a list of options. Asking for this information directly and making it easier to respond in the data management plan would likely increase the chances that researchers would provide this needed information. There are a number of data management planning tools, such as the DMPTool and DMPOnline, which employ a structured, form-based approach in assisting researchers in developing their DMPs. It is time for the funding agencies to follow suit and adopt an approach that would increase the likelihood of generating more useful and actionable information from researchers.

This should include asking researchers to provide the following information about their data in their DMPs, at minimum:

- *Data Type* – Different types of data entail different considerations for management, sharing and preservation. By identifying what types of data will be generated, even at a high level, data curators could provide relevant guidance on best practices and connect researchers to the services they might need in developing their data.
- *Formats* – Knowing the file formats researchers intend to use would help data curators consider issues around the use of proprietary formats, the structure and organization of the data, and what connections may be needed between the different components of the data.
- *Expected Data Size and the Number of Files* – Having a sense of how much data to expect and how many files will be included can help data curators plan for the eventual deposit of the data or help the research make alternative arrangements if their repository is not able to accommodate the data set.

It may be difficult for the researcher to feel like they could provide accurate information on some of the elements of their data set given that they create their data management plans before they generate data. However, even having a broad understanding of the likely characteristics of the data can provide valuable information to the data curator and help identify issues before they become larger problems. The new NIH data management and sharing plan and guidance that went into effect in January 2023 is a step in the right direction, asking researchers to describe their data in ways “*that address the type and amount/size of scientific data expected to be collected and used in the project*” (NIH, 2020). Ideally, researchers would treat the DMP as a living document and update information about the data set as it comes more into focus.

Metadata and Documentation

A critical element for ensuring that the data generated in a project will be findable, understandable, trusted and used by other is the amount and quality of metadata and documentation that accompany the data set. Many DMPs, however, did not include any information about metadata or documentation at all. Others simply mentioned that they would generate metadata or documentation without providing much, if any, detail about the nature of what they would provide.

A better approach for DMPs would be to frame the requirement around two questions. First, what information about your data would someone else need to understand it, trust it, and make use of it? Second, how will you document this information and provide it with your data set? The first question could be asked as an open-ended narrative and the second question could provide a list of preset options for the researcher to select from (lab notebook, readme file, codebook, etc.) with a write-in option. Questions about metadata and documentation standards would still be included as a part of the DMP. Reframing how documentation and metadata are presented to the researcher in DMP guidance could help prompt researchers to think more critically in their responses. Sharing more detailed information about the researchers' ideas and plans for communicating information about their data with data curators could help jump start discussions about how to capture and present contextual information about the data effectively.

Methods of Sharing Data

Although they varied in detail, the vast majority of the U-M DMPs included a statement on how researchers intend to share their data with others. Data repositories were listed by more than half of the DMPs, which may indicate that repositories are becoming more integrated into the research process. What remains unclear is researchers' actual understanding of the services and support provided by data repositories. In the follow up discussions that I have had with researchers who listed Deep Blue Data as their designated repository for their data, it was evident that some researchers had listed Deep Blue Data without really knowing what it was, how to use it, or how to prepare their data for deposit. The follow up conversations with researchers about Deep Blue Data and what services we offer have been invaluable.

Currently, DMPs are not readily available as they are incorporated into a larger grant proposal when they are submitted to a funding agency. This makes it very difficult for data curators and repository managers to access useful information or to communicate our services to researchers who need them. Machine actionable data management plans (maDMPs) are a promising development towards making the content of DMPs more accessible and actionable and there is some indication that funding agencies are considering their adoption (NSF, 2019). However, simply endorsing a maDMP protocol would not address the communication barriers between researcher and curators. In order to work effectively at scale, maDMP systems will have to consider how to connect to existing institutional systems and practices as seamlessly as possible. More importantly, for an institution to adopt a maDMP, it must demonstrate that it will add value to an institution's research program sufficient to justify the costs that the institution will incur in its adoption. Applying for grant funding, in addition to tracking the work and ensuring that researcher and institutional commitments are met over the course of the award, is time and labor intensive for an Office of Research. Personnel in the Office of Research are understandably wary of introducing new steps or systems that may slow down or add "extra work" to their processes. In addition, institutional grants management systems are generally closed to all but those who are actively engaged in carrying out the research and the grants manager assigned to manage the award. A maDMP system could potentially make more information available to data curators and local service providers, but without a culture change to allow institutional service providers and potentially non-institutional actors (such as data repositories) access to this information, the impact of the maDMP would be sharply curtailed.

Although it is not always included in the DMP, an indication of who will be responsible for managing the data and preparing it to be shared who be invaluable for data curators and should be listed. Inevitably, data curators will have questions about the data set and the needs of researchers who are submitting the data to the repository. Being able to ask these questions to the people who are directly responsible for developing the data set would save a lot of time and be more efficient. Having contact information would also enable the data curator to connect with the research team to share needed information about the repository, communicate the services offered, and initiate a relationship so that preparation and curation work can start early in the data life cycle.

Intellectual Property

The variety and depth of intellectual property concerns of researchers, as revealed in the analysis of U-M DMPs, is an area for further exploration. Some researchers face potentially competing interests between having to share their data and protecting their ability to commercialize the results of their research. These researchers often invoked university policies (U-M or other universities) in their DMPs as a means to assert some degree of authority and control over sharing the data, while still adhering to the requirements made by funding agencies. Statements such as “...any Intellectual Property Developed Within This Proposal Will Be Administered By The University Of Michigan”, were common in the DMPs. The outputs of grant-funded projects have long been important revenue generators for universities and researchers, and university policies are the foundation for the systems and practices developed to ensure that this revenue comes to fruition. Referring to university policies may provide researchers with some justification for delaying or denying sharing some or all of the data they generate. It is not clear how federal agencies or researchers’ home institutions interpret these statements, or what the role of the university should be in enforcing data sharing requirements.

It is also apparent from studying U-M’s DMP that some researchers may not be completely comfortable with the loss of control over the interpretation and use of the data that comes with making it publicly available. Researchers included a variety of statements that indicated a desire to retain some degree of control over the data or to place conditions on what others can do with it. Many of these assertions were fairly modest, such as requiring individuals who make use of the data to cite project personnel or the funding agency who supported the research. Some researchers included explicit statements prohibiting specific uses or actions with their data, such as creating derivatives, redistributing the data, or using it for commercial purposes. Other researchers went further and stated that they would require a data sharing agreement or the review and approval of the principal investigator before making their data available to others. A smaller minority of researchers included statements in their DMPs that they or third parties retained ownership over the data and would limit access to part or all of the data to be used or generated in the project. There are undoubtedly situations in which limitations on the access and use of the data are necessary and I did not have sufficient information to determine what constituted justifiable reasons for limiting or denying others access to the data. However, from the results of the analysis, it does appear that acceptable norms and expectations on how much and which elements of the data being generated must be shared have not yet been fully developed by funding agencies or universities, particularly in situations where there is a likelihood that the outputs of research will be patentable or commercialized.

Researchers take their cues on sharing their data from their scholarly communities and peers, but they are not the only influences on the cultures and norms of research. University policy plays a large role in determining acceptable research practice and influencing behavior in sharing their data. Many U-M researchers referred to university policy in their DMPs. However, their statements often did not go beyond making a generic observation that the university has authority over how data sharing will (or will not) take place. Researchers provided few, if any, details on what they expected the university’s role to be in supporting data sharing. This may be because the researchers themselves may not be aware of or fully understand their university’s policy as it pertains to data, assuming their university has a data sharing policy at all. The University of Michigan did have an Institutional Data Resource Management Policy (U-M, 2008) when I conducted my analysis of DMPs, but it did not address managing, sharing, or preserving research data specifically. Instead, the policy listed research data together with administrative, clinical, and educational data, despite the different purposes, contexts, and uses of each. The lack of a policy on research data is not unusual. As of 2015, out of 206 universities, only 90 had some kind of policy specifically addressing research data at the university level (Briney et al., 2015). As a part of its Research Data Stewardship Initiative launched in 2022, U-M did develop a new policy that directly addresses research data which will go into effect in 2024 (U-M, 2023).

Institutions provide the resources and support needed to carry out research and they too have an impact on research practice through policies and provisioning. In addition to the library, researchers mentioned a variety of other institutional offices and service providers in their DMPs, such as Information Technology Services, the Office of Research, and the University's Tech Transfer Office. Although these offices are likely aware of each other and the services that they provide, at least at a high level, their relationships are likely to be informal and personality based. Furthermore, interviews with Research Integrity Officers indicated some uncertainties and confusion around who at the university is responsible for overseeing DMPs and ensuring that the data are shared as required by the funding agency (Bishop, et al., 2021). The lack of clarity around roles and responsibilities in supporting data sharing work makes it harder for researchers to get the support they need and complicates the process of demonstrating institutional compliance with federal mandates. Data curators, research administrators, and researchers themselves would benefit from stronger, more defined relationships with more visible connections between departments.

One way to develop and communicate norms and expectations around data sharing would be for university administration and other institutional stakeholders to create a shared institutional strategic plan for research data. Such a plan would clearly and concisely describe the university's policies for making research data publicly accessible and list the units on campus providing services and support for doing so. A well-defined and publicized strategic plan, if stakeholders developed, agreed to, and maintained it collectively, could have a real impact in reducing the burden on researchers from having to figure out how to share their data on their own.

Preserving Access to the Data

Guidance from funding agencies does not always require statements from researchers on how they intend to archive or preserve their data to ensure long-term access, but such information is critical for data curators to have in working with data. Specifically, the intended duration of preservation needed for the data is important for curators to understand so that they know when to weed out data in their collection, as data may lose their value over time. The costs of data preservation are such that it is unrealistic to expect that all data would be preserved indefinitely. The researchers generating the data will likely have a better sense of when the data no longer merit the effort and resources it will take to preserve them than the data curator and so ideally researchers would communicate this information in their DMP. The DMP could serve as a starting point for the researcher and data curators to determine what actions and expenditures would be reasonable to undertake to ensure that the data are accessible and usable over time.

Unfortunately, only 25% of the reviewed DMPs included a statement about the length of time the researcher expected the data to be preserved. The majority of those who listed a timeframe for the preservation of their data stated that their data only needed preservation for 10 years or less. It is not entirely clear why researchers listed relatively short timeframes for preserving their data, but researchers may be equating data preservation with data retention. Data retention is more focused on record keeping for regulatory obligations than data preservation, which is centered on ensuring the long-term access and usability of the data. In addition, researchers may not be considering the full ramifications of what not having access to their data would mean for their research impact. Without considering how long their data may have value to others and themselves, researchers may incorrectly assume that their data will be preserved "indefinitely". Asking researchers to consider the value of their data over time directly in their DMPs, and asking them some specific short answer questions in addition to open-ended narratives, would help identify where discussions may need to happen to set reasonable expectations.

Table 9: Summary of Key Findings

Element of the DMP	Finding	Recommendations
Types and Format of the Data	Limited or no information about the data to be generated making it difficult to know if data sharing requirements were addressed adequately	Replace the free text narrative with a more structured approach, such as a checklist or short answer questionnaire Explicitly ask for information about the data type, format and expected size of the data
Metadata and Documentation	Insufficient detail about the metadata or documentation to be provided which limits the utility of the data	Reframe DMP guidelines to center on the information needed to understand, trust and make use of the data
Methods of Sharing Data	Lack of understanding of the services provided by repositories and how to use them making the deposit process more difficult	Reframe the DMP as a vehicle for communications between researchers and repositories
Intellectual Property	Uncertainty about loss of control over the data and the potential consequences of making it publicly accessible	Clarify questions of ownership and responsibilities with research data in University policies Develop a strategic plan for supporting data sharing with appropriate boundaries at the institutional level
Duration of Preservation	Frequently left out of DMPs and likely equated with data retention requirements	More discussion and guidance in determining the likely value of the data over time given the costs of its preservation

CONCLUSION

The current iterations of data management and sharing plan requirements by funding agencies are not adequate in communicating information from researchers to data curators, local service providers or administrators about making data publicly accessible to others. Many of the DMPs analyzed in this study provided insufficient information about the types of data to be produced, the metadata and documentation to make it discoverable and useable by others, how and when the data would be shared, intellectual property concerns and the expected preservation duration, to be useful. This was true even when the funding agency asked for this information directly.

This study was limited to DMPs from a single institution for a period of twelve months. As reported in the literature review, earlier studies performed at other institutions produced similar results. A larger study conducted across multiple institutions, or one conducted over a longer period may produce a more nuanced understanding of how researchers understand and respond to data sharing requirements. Furthermore, expectations around data sharing continue to evolve, as evidenced by the NIH's recent expansion of their data sharing policy and the release of the 2021 Nelson memo from the Office of Science and Technology Policy recommending federal agencies update their public access policies on research data. At the University of Michigan, these and other developments have led to the creation of a university wide Research Data Stewardship Initiative (RDSI) to raise awareness of data sharing requirements and to connect researchers with services to support them in making their data publicly accessible. The RDSI is led by U-M's Office of the Vice President for Research and membership includes representatives from the Library, Information and Technology Services, Regulatory Affairs, Research Integrity and Innovation Partnerships, among others. RDSI's efforts have included workshops and other educational programming for

researchers on how to navigate the data sharing requirements of funding agencies and develop actionable DMPs. The RDSI also led a successful effort to develop an institutional policy to articulate the university's expectations and guidance for the stewardship of research data more clearly. Given the attention that data sharing has received at U-M recently, a content analysis study on DMPs might yield different findings if it were done today.

If data sharing mandates are to succeed, then current practices and structures to facilitate the data sharing process need to be reconsidered. Although they are flawed as currently designed, DMPs have tremendous potential to serve as a powerful communications tool between stakeholders in support of sharing data. Within an institution, DMPs could be used as a centralized source of information to create a shared understanding of the data sharing commitments made to the funding agency and to connect researchers to the support they would need to fulfill them. Applying the DMP in this manner would help clarify administrative roles and responsibilities and promote solid working relationships across campus. With the DMP as the centerpiece of a documentation and tracking process, institutions could collect and analyze data from institutional stakeholders regarding the effectiveness of the strategies and approaches taken to support data sharing mandates. Reframing the structure of DMPs and making them into more accessible, extensible, and actionable documents would better enable them to fulfill their original intended function of facilitating widespread public access to high-quality data sets.

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THE ROLE OF RESEARCH UNITS AT HIGHER EDUCATION INSTITUTIONS: INTENTION OR REALITY?

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ABSTRACT

Higher education institutions are moving towards highlighting the importance of research. According to the Department of Higher Education and Training in South Africa, the status of higher education institutions will be determined by the extent to which they are engaged in research and research-related activities. Higher education institutions have a role to play in generating new knowledge as well as producing appropriately skilled professionals. The current study explored key stakeholders' perspectives of the role of the research units within a faculty of health sciences that is clinically driven, and how these units could contribute towards developing and strengthening interprofessional postgraduate research, collaboration and capacity development amongst staff. The study adopted a qualitative, exploratory descriptive approach. Data were gathered from individual face-to-face, in-depth semi-structured interviews with 15 participants. Five themes emerged from the thematic analysis, namely: i) "There's been intentions and there is the reality"; ii) "Driving the research agenda and pulling it together"; iii) "The stronger your base, the stronger your output, the stronger your future: Creating a succession pipeline"; iv) "It takes a specific kind of personality to run a Unit" and v) "The climate has changed, views have changed". The findings of the study clearly indicated that the stakeholders perceived the role of the Units differently. The establishment of a 'Faculty Research Centre' with a contextually relevant framework or model could contribute towards developing a clear understanding and consistent description of a research centre. It may also facilitate the strengthening interprofessional, postgraduate research, collaboration, and capacity development amongst staff

Keywords:

Research units, research centre, stakeholders, capacity building, post-graduate research, interprofessional, collaboration, contextual framework

INTRODUCTION

The role of research in higher education institutions in South Africa has been recognised by the Department of Higher Education and Training (DHET) to make a significant contribution within the local context of institutions as well as positioning them globally. According to the Department of Higher Education and Training (DHET, 2019) the status of higher education institutions is determined by the extent to which they are engaged in research and

in the development of research activities. Universities are significant mediators for research, innovation, growth, and development (Bonander et al., 2016). Thus, higher education institutions have a role to play in generating new knowledge as well as producing appropriately skilled professionals (Bonander et al., 2016). Research has therefore become the basis for ensuring that teaching programs are contextually relevant and up to date. If universities and government want to achieve ambitious research goals, they must create an enabling environment through institutional structures (Youtie et al., 2018).

However, it has been recognised that there are challenges influencing the growth of research, especially in historically disadvantaged institutions. These challenges may include limited research experience amongst academics, disciplines without research tradition and an environment that is not sensitive to enhancing research capacity building (Singh, 2015). The Human Sciences Research Council (2022) indicates that despite the interventions by government to redress the shortcomings in research and development, historically disadvantaged institutions still continue to lag behind in this area. Various strategies to build research capacity have been introduced and these include the introduction of postgraduate programmes, faculty development initiatives as well as the establishment of a research unit (Department of Science and Technology, 2021; Singh, 2015). However, the success of any of these initiatives is dependent on external and internal support.

Within the context of research intense universities, a conducive environment needs to be created. One aspect of such an environment is the creation of research units. At the University of the Western Cape in South Africa, a 'Unit' is defined as a research structure that has the characteristics of demonstrating consistent research productivity to support a clear research hub or niche in a field of intellectual and/or applied study and is coordinated by a member of the academic staff who is an established researcher. The main purpose of such a research unit is moving towards developing a critical mass of researchers and has sustainability plans that will support the development of a research hub. Furthermore, such a research unit is linked to a department, and therefore does not have its own independent undergraduate or postgraduate programmes.

In the Faculty of Community and Health Sciences at the University of the Western Cape (UWC), which has been classified as a research intense university, there are several research initiatives which were established some years ago, as part of the faculty's research niche areas. The intention of these research initiatives were to offer a service component for interprofessional collaboration and research. With regards to the research units, the focus of research units may be limited and very narrow. Interdisciplinary research facilitates multidisciplinary research and collaboration by allowing the integration of ideas across various disciplines (Resnick, 2011). Thus, interdisciplinary research facilitates communication and research activities amongst researchers, which may foster an enabling environment to address the complex problems that researchers aim to address.

However, understanding whether these units can meet the research needs of the higher education institutions is essential in driving the process forward. Therefore, the need to understand the views of stakeholders in implementing or driving these units towards supporting the research intense process is important. These research units have great potential to contribute towards developing and strengthening interprofessional, postgraduate research, collaboration, as well as capacity building amongst staff. Therefore, the aim of this study was to explore key stakeholders' perspectives of the roles of the units within the faculty that is clinically driven, and how the units could contribute towards developing and strengthening interprofessional, postgraduate research, collaboration and capacity development amongst staff. The findings of this study may offer insights into how research units could drive the research agenda of an institution.

METHODOLOGY

A qualitative, exploratory descriptive design was used to conduct the study within a Health Sciences Faculty at a University in South Africa. As the study was exploratory in nature, purposive sampling was employed where specific individuals with specific experiences were identified.

At the institution where this study took place, there are three models utilized in the Health Sciences Faculty where the focus is to develop research niche areas. These models comprise of a research unit, a research centre and a research focus area within a department. The sampling strategy was purposive so that a more diverse sample of participants could participate in the study. The criteria for the selection of participants included: the most research active units in the faculty, namely (n=3): a unit with a research focus on studies related to children and families, a centre with a niche area on sport for development and lastly, a unit with a core focus on Interprofessional Education (IPE). All staff and students were invited to participate in the study. The participants were recruited via an email invitation to participate in the study. The final sample consisted of 15 participants, including three faculty leadership staff members, three directors, two academic staff members, an administrator and six postgraduate students from different levels of study, for example, postgraduate diploma, masters, or PhD, in order to ensure a representative sample.

Data were collected through individual face-to-face, in-depth, semi-structured interviews with each of the 15 participants. The interviews were conducted by one researcher supported by a research assistant. Key questions were asked to define the areas which were explored, but also to allow the interviewer or interviewee to diverge in order to pursue an idea or response in more detail (Babbie & Mouton, 2010). The following questions were asked with each participant: i) How is the development of a research culture or a culture of scholarship central to the unit?; ii) Describe your experiences regarding research in the unit?; iii) What types of scholarship activities are you engaged in?; iv) Describe your role in the research unit?; v) What are the opportunities for developing the scholarship of research in the unit?; vi) What are the challenges for developing the scholarship of research in the unit?; and vii) What would you consider the critical success factors to be for establishing a strong research culture or scholarship of research within the unit?

Participation was voluntary and all participants were assured that they could leave the study at any time without any adverse effect. The study protocol received ethics approval. All transcribed data was coded using open coding and analysed using thematic analysis, following the five steps of analysis as suggested by Terre Blanche, Durrheim and Kelly (2006). The analysis of the data has been interpreted through the lens of the Appreciative Inquiry framework (Priest et al., 2013).

ANALYSIS AND RESULTS

From the thematic analysis, the following five themes emerged (Table 1).

Table 1: Themes and Categories

THEMES	CATEGORIES
1. "There's been intentions and there is the reality."	1.1 Role of the Units 1.2 Stakeholders' perceptions of the Units
2. "Driving the research agenda and pulling it together."	2.1 Interprofessional supervision 2.2 Collaboration
3. "The stronger your base, the stronger your output, the stronger your future: Creating a succession pipeline."	3.1 Capacity development 3.2 Sustainability
4. "It takes a specific kind of personality to run a Unit."	4.1 Challenges 4.2 Strengths 4.3 Way forward
5. "The climate has changed, views have changed."	5.1 Faculty driven 5.2 Advantages 5.3 Selling the concept

Theme 1: "There's been intentions and there is the reality"

This theme captured the participants' perceptions of the roles within the faculty and their perceptions regarding the culture of scholarship. Participants perceived the departments they previously registered with had a research culture, but it is not as active or intensive as the research culture in a research unit. One participant said:

"There is many things in the unit that kind of promotes a culture of scholarship and in my experience I would say that, that is what draw me towards the unit. Knowing that is the culture of scholarships."

There is also an indication from most of the participants that the academic staff who work in the units drive the culture of scholarship. The findings revealed that a research unit allows for the appreciation of multiple views in order to meet the needs of a society as one participant quoted:

"...Looking for this interdisciplinary approach and if we are to meet the needs of society we cannot look at it from one view anymore, we need to look at it as a collective."

The majority of the participants were of the opinion that the agenda of the different units was to drive interprofessional education and research, with some having a service learning component linked to their department. Whereas, some of the participants perceived the units as taking a life of their own due to the changing requirements from institutional facilities and in doing so they try and make sense of their own reality. However, despite a clear focus for a research unit, at times there is a lack of control in driving the research agenda. As one participant stated:

"...spirals this way and then faculty wants us to do something else and then it spirals a bit the other way."

Whereas, another participant said:

"It mushroomed too much out of control."

The findings also indicated that despite challenges, the majority of the participants found having research units motivating and encouraging because their access to resources within the research unit was centralised. The unit also encouraged and allowed for self-directed learning activities to occur, which promotes a 'supportive environment' as quoted by a participant:

"...so it started off with that experience so that, it gave me a kind of at home feeling where I knew if I got stuck, even if it's not to my own supervisor or to some of the students that were in my group there will always be someone that you can ask because I find that the people that work in the unit they really want to help the students... I think it's a very supportive environment they create."

Theme 2: "Driving the research agenda and pulling it together"

This theme highlighted the participants' perceptions and experiences of how they have tried to facilitate interprofessional postgraduate research and collaboration by offering different types of scholarship activities. All the participants agreed that they have received supervision and postgraduate teaching from various disciplines within the faculty and that an interprofessional approach to different research topics was applied. In addition, some participants mentioned that they have accessed departments across faculties to assist with supervision as they have experience with individuals coming from multidisciplinary backgrounds. This theme also highlighted the different activities that were conducted within the different units with regard to the research process.

"... my role is to engage with faculty, whoever that is to try to collaborate so while we grow we also allow others to grow from a research perspective."

"...We believe that for us research is central so research must cover teaching and learning and then research must cover community engagement, we starting to build those aspects, so our scholarship would be in teaching and learning and our scholarship would also be community engagement but for the students, we believe that we must arm students in order for them to successfully do what they are required to do."

Theme 3: 'The stronger your base, the stronger your output, the stronger your future: Creating a succession pipeline'

All the participants were in agreement that there are opportunities for development within a research unit. The majority of the participants were in agreement that as staff members, they were able to contribute in some ways towards capacity building and development of staff and students. It was evident from the findings that some units were contributing more towards interprofessional capacity development. The units who collaborated interprofessionally had a variety of opportunities available for individuals to participate in, which contributed towards capacity development. There were many opportunities for staff and students to participate in various activities, which enhanced their research skills and abilities. Some of these opportunities included: seminars,

discussions, workshops, writing retreats, block weeks, publishing of articles as well as supervision, as one participant quoted:

"...the biggest opportunity that I became aware of was where we were reminded that once you were done with your thesis, it will not just be the thesis that will get published and placed wherever; you will actually write an article for publication, so that is one of the main opportunities."

Another participant said:

"If you take the co-supervision of a post graduate student as a capacity building [exercise], and you take the thesis that comes out and take it to a publication, you do capacity building right through."

Theme 4: "It takes a specific kind of personality to run a unit"

This theme emphasised the challenges and the strengths experienced within each research unit. Challenges such as finding time and funding appeared to be a commonality across all participants' perceptions. The majority of participants were of the opinion that conducting research is a time consuming and lengthy process. Therefore, adhering to a time frame is of utmost importance. Another challenge to consider is the bureaucratic process of obtaining funding for research. One participant indicated the following:

"...so you may have many students that don't have funding within the unit but you see the potential [in the student]...but the criteria does not always match the scholarship, so I think that could be one of barriers which the unit may experience."

As always, the list of challenges experienced dominated everything else. Most of the participants (11 of 15) agreed that the biggest challenge was to get everybody together at the same time, on the same page and to agree and commit themselves. Another challenge experienced by some of the participants was that they had difficulty in recruiting interprofessional researchers to their projects. Those researchers who participated in these projects, which were outside their departments, were concerned that they could not add it to their departmental workloads. Retaining students was another challenge as some students never completed their postgraduate studies as some failed to meet the deadlines for submission of their thesis. Research funding, especially for community projects, did not always cover administrative responsibilities or the running of workshops. A concern raised by one of the participants was that in order to monitor progress within the community, you have to go back to the community which normally happens outside of the funding period. Resource allocation has been experienced by some of the participants as another challenge as quoted below:

"This unit doesn't have an assigned administrator but there are other units that actually have a permanent full time administrator yet, they cannot compare with the outputs that we have, so for me there is a sense of unfairness around this whole process of resource allocation."

According to one participant, it takes a particular personality to be able to run a multidisciplinary interprofessional unit and the challenge is that there are only a few people that have the necessary skills. At times, they have leadership skills, but they don't always have the research skills as one participant quoted:

"You have to be, I almost want to say, be a very strong visionary but, a stronger advocate and a stronger lobbyist to convince people so that they get onto the same page as where you are. And that's not easy; you have to do a lot of communication, a lot of selling, a lot of talking to others so that eventually you see the thing through the same lens."

A strength identified by most of the participants was that everybody was clear about the research niches of the units. All the participants were in agreement that a lot of opportunities were available for individuals to get involved in research and projects of their choice. Despite these activities being voluntary, staff and students took on opportunities to be involved in research projects as it may contribute to capacity development of self and others. One participant said:

"There is a kick back eventually, when you publish with students it all counts to when you want to do promotion and also if you publish you get the researchers' authors fund."

Another strength identified was the structure and procedures implemented by some of the units that worked well. The three units who participated in this study could all fund an administrator, which was beneficial as all the administrative work was done on time and reports submitted by the deadlines. International partnerships were identified as another strength of the units towards facilitating internationalisation of research.

Theme 5: "The climate has changed, views have changed"

This theme captured participants' views about the establishment of a Centralised Postgraduate Interdisciplinary Research Centre comprising the different research units in the faculty, as a critical success factor. The majority of the participants were in favour of such a Centre. They believed that if it was a faculty initiative and driven by the faculty, then everyone would buy into it. All the participants were in agreement that they did contribute in some ways towards capacity building and development. It was evident from the findings that some units contributed more towards interprofessional capacity development.

One participant quoted:

"Our collaborative interprofessional research, our postgraduate drive to increase the postgraduate numbers and supervision in the Faculty could stem from this."

Another advantage of the establishment of a Faculty Research Centre was the allocation of research funding which could be centralised. All the participants supported having administrative support centralised. Having a Centre with a proper infrastructure and expertise centralised could contribute towards capacity development of staff. Often within decentralised spaces there may be duplication of research projects or administrative processes. Should there be a centralized research centre, these forms of duplication would no longer take place and more time would be available for the implementation of other creative research initiatives. In addition, the establishment of a faculty research centre would facilitate collaborative grant writing for funding proposals.

According to one participant:

"I think the other critical thing that can add to the success would also be: just having more and more engagement with students, not just in supervision but maybe have workshops, seminars things to kind of stimulate students."

"So maybe that is one of the things how they can help. How they can offer a strong research foundation."

Participants who were not very supportive of the establishment of a Faculty Research Centre needed more clarity about the concept of such a Centre. They were concerned about how it would work, who would report to who and what would be the benefits? Some of the participants who had difficulty in recruiting interprofessional researchers to their units, the reasons given being that they were busy with their own research agendas, could not visualise the conceptualisation of such a Centre, and question why it would suddenly work now. One critical success factor could be determined by the make-up of such a Centre. The importance of 'buy-in' of a vision within such a Centre is key to the ongoing sustainability and success of such a Centre.

One participant stated:

"Motivated students, capacitated supervisors...working towards one vision to create communities of engagement."

DISCUSSION

This discussion of the findings follows the four stages of the Appreciative Inquiry framework.

The Appreciative Inquiry (AI) is an intervention theory and methodological framework that focusses on the positive aspects of a system to incite change (Cooperrider & Whitney, 2005). Furthermore, AI is a thorough investigation of what works in an organisation and uses the strengths of the organisation as the impetus for continued growth. According to Priest et al. (2013), AI has been found to be a useful tool for leadership educators, as its foundation in constructionist theory aligns with contemporary leadership and learning theories. The authors go further by stating that leadership educators are uniquely positioned to serve academic communities as facilitators of change by bridging theory and practice in pursuit of new ways of knowing and working together. Appreciative Inquiries are conducted in a series of phases known as the 4-Ds, or Discovery (What is); Dream (What could be); Design (What should be); and Destiny (What will be) (Clarke & Thornton, 2014).

Discovery (What is?)

The intention of the establishment of different research units should be to facilitate collaboration, interprofessional education (IPE) and research. Over the past three decades, universities have become decentralised to allow units, research centres and other entities to practice autonomy in their academic projects (Martin, 2016). The findings in the current study demonstrate the reality that the stakeholders interpreted the roles within the units differently. They perceived that the intention to collaborate, to work interprofessionally, and to conduct research did not always reflect the practical realities. On the other hand, the findings also revealed that the culture of research was stronger and more focused within a research unit than within individual departments. This provided clear motivation of the

value played by research units within higher education intuitions. This is supported by Franco and Pinho (2019) who indicated that the intention of university research centres is to facilitate and promote research collaboration in a way that allows for the development and transmission of knowledge.

Whilst there may be some challenges related to defining how a unit is run, who runs it, and what the research agenda may be, it is also found to be a space that fosters an encouraging and motivating environment that allows the research to thrive. Furthermore, it was clear that interprofessional education played a role in the advancement of a research unit. Similarly, Soini et al. (2018) indicated that research centres aim to engage in participatory and interdisciplinary approaches. This allows for the facilitation of deeper understanding of connections between human and natural systems. Interprofessional collaboration fosters a conducive environment for capacity development amongst staff and students (Singh, 2015). A clear and focused research agenda of the unit should be driven by all stakeholders in the unit in order to avoid lack of control and conflict.

Dream (What could be?)

The dream is visualised by the current higher education climate that is located in a changing environment. Amid a changing environment, universities still play a key role in knowledge acquisition, by conducting research and building capacity in the form of human capital (Bonander et al., 2016). The findings in the study indicated that a shared vision and mission for the units, that should be driven by faculties, are of utmost importance. All the challenges, for example where academics perceive these units as “belonging” to the school or department where the unit is situated, would therefore be mitigated and collaboratively addressed by all stakeholders due to shared vision with a collaborative buy-in. If a research unit is driven from a central point, and all stakeholders understand the intention based on the everyday realities, then sustainability can be assured and brought into fruition. To achieve such sustainability, literature shows that administrative support is of utmost importance in the day-to-day operations in order to uphold the standards of the institution (Youtie et al., 2018). Therefore, if a unit should be centralised, a strong administrative infrastructure and smooth functioning should also be considered.

Design (What should be?)

One of the leveraging points for research units lies in the acquisition of supervisors from various disciplines, which further strengthens the knowledge economy within research units. Franco and Pinho (2019) indicate that within research centres, knowledge transfer allows for faster access to knowledge held by researchers. This approach leads to collaborative participation, problem solving as well as a deeper understanding of market needs. The advantage of having different supervisors and academics with different expertise from different disciplines is that it contributes a broader worldview of research perspectives. In addition, to disseminate scientific knowledge, centres of research are often orientated towards transdisciplinary systems, which involve stakeholders from various disciplines by using various participatory methods (Soini et al., 2018). Furthermore, the findings in the study highlighted that the success of a research unit is mediated by the availability of resources that could contribute towards the facilitation of approaches such as self-directed and experiential learning. This is similar to findings by Amanjee and Carmichael (2015) who found that the collaboration between students facilitate group processes to achieve their learning goals.

Students who function within the research units may develop a sense of agency as they are able to autonomously direct and take responsibility for their own learning. Therefore, one of the benefits of a centralised, well-resourced Faculty Research Centre could contribute to increased scholarly outputs, especially in interprofessional postgraduate research, collaboration, capacity development and education. To this end, it is important to ensure that resources are allocated to a research centre. Franco and Pinho (2019) indicate that universities in developing countries, like South Africa, should implement cooperative strategies with other centres in developing countries

in order to negate some of the resource challenges. They further suggest that this strategy may also reinforce research capacity amongst staff and students. Creating opportunities for engagement, outreach, scholarship, and professional staff development will empower, capacitate individuals, and develop an understanding of engaged scholarship across disciplines (Fitzgerald et al., 2016).

Destiny (What will be?)

The importance of sustainability and capacity development as a growth opportunity in research units are crucial to the maintenance and sustainability of research units, especially from an interprofessional perspective. Units who collaborate interprofessionally have a greater capability to contribute more deeply and meaningfully to capacity development of staff and students through the various research opportunities and activities. Disterheft et al. (2015) found that the relevance of capacity building was an important component of transformative participation and critical thinking as it allowed a space for relevant stakeholders to have a voice and offer their input. To this end, the cyclical approach informed by this study shows that sustainability is achieved by continuous offering of workshops, block teaching, writing retreats, research capacity development activities and seminars to develop research capacity in faculty, staff, and students. Thus, the importance of providing workshops and seminars to staff and students within the units are fundamental.

Sustainability is informed by a strength-based approach in the design of a research unit. According to literature, capacity development facilitates sustainability. Sustainability of an autonomous and independent unit is dependent on having support from the university for funding, infrastructure, and affiliations (Soini et al., 2018). Each unit is then seen as having a unique set of strengths and challenges. One challenge identified in the current study was the issue of academics' time, as in many academic settings, lack of time is created by high workloads (Miller, 2019). Thus, institutions should be cognisant when establishing a research centre in a health science environment as the stakeholders are from across various health professional disciplines. The success of such a research centre is compounded by complexities in the availability of participants, as well as structural conditions. Ideally, conditions and the universities should allow participants to allocate enough time and availability to a centre. This is important in order to integrate sustainability into the institutional structure (Disterheft et al., 2015).

From the discussion, the development and implementation of a contextually relevant and responsive framework has been identified as a need to address the complexities as unpacked in the various phases of the AI methodological framework as applied to the study results.

RECOMMENDATIONS

This study recommends that in order to develop a sustainable Faculty Research Centre, higher education institutions should consider the implementation of continuous academic support for staff and students—for example, regular supervisory meetings, access to centralised resources, and training programmes that may mediate capacity development. The implementation of bi-annual writing retreats are successful ways to engage all parties and to increase research outputs. The establishment of projects which offer emerging researchers opportunities to participate in research processes through a subtle self-directed learning approach are recommended, as well as a mentoring system whereby experienced researchers are paired with novice researchers for capacity development and to facilitate collaborative publications. Finally, an annual Faculty Research Day could be offered as an opportunity for post-graduate students to showcase their research.

CONCLUSION AND IMPLICATIONS FOR PRACTICE

In conclusion, the aim of this study was to explore key stakeholders' perspectives of the roles of the units within the faculty that is clinically driven, and how the units could contribute towards developing and strengthening interprofessional, postgraduate research, collaboration and capacity development amongst staff. The findings in the current study propose the establishment of a Faculty Research Centre with a clear vision and mission supported by all stakeholders. The adoption and implementation of a contextually relevant framework or model in the Centre could contribute towards strengthening interprofessional, postgraduate research, collaboration and capacity development amongst staff. A Research Centre with a clear framework, underpinned by sound procedures and governance could allow for opportunities such as internationalisation, digitisation and transformation.

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