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2022 Journal Editorial Board

The Society of Research Administrators International Board of Directors

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From the Editor's Desk

Jennifer E. Taylor

Tennesee Tech University

The *Journal of Research Administration* (JRA) is the premier scholarly publication for the field of research administration and management. We publish timely work that covers all facets of our discipline. The Journal is an important education and career development platform. Our authors share best practices and innovative means of performing research administration and management work in our fast-paced, ever-changing environments while also enhancing their own careers through the process of publishing peer-reviewed scholarly journal articles.

As the current editor of JRA I am keenly aware that the current 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. Among that group, few have made greater contributions to JRA and our field overall than Tim Linker. Earlier this Fall, along with the rest of our SRAI community, his friends, and family, I was deeply saddened to learn of Tim's passing. Tim put in countless hours helping to build the field of research administration. Tim was a certified research administrator, served as a leader in the SRAI North Carolina chapter for many years, was an active member of the SRA Chapter Council, and first as Deputy Editor and then Editor-in-Chief of *JRA* in addition to leading research administration efforts at High Point University and as Assistant Vice Chancellor for Research Administration at North Carolina Agricultural and Technological State University. Long after he stepped down as editor, he continued to review for JRA and provide useful and always kind council to subsequent editors. Indeed, although those who knew Tim professionally were always struck by his intelligence and commitment to excellence, those characteristics were often overshadowed by his kindness and caring for others. The research administration community, as well as the larger communities in which he lived, are poorer for his loss. He will be missed greatly.

The excellence of the contributions of the current issue of *JRA* reflects the growth of the field that Tim and others have nurtured over the more than 50-year history of *JRA and SRAI* more broadly. As we move into our 53rd year, and the return to some semblance of the new, post-initial COVID era, we have been fortunate to receive a set of important contributions from our authors' that address issues that are central to the concerns of research administrators and that provide critical input for them to draw on as they carry-out their work. I want to thank our authors, editorial board members, and staff, for all their efforts that have enabled us to put together what, collectively, we think is another exceptional issue of JRA. As in the work of those we have built upon, it is again characterized by high-quality, important manuscripts that will enable another step forward in the knowledge-base and work of those in Research Administration and those who depend on that work.

The manuscripts we are pleased to share with you address a broad cross-section of critical issues that research administrators grapple with as they seek to serve their constancies. They range from those whose focus is on the recent challenges and complications that a sudden pandemic

brought to our work and the work of those we support, to others that are more closely focused on some of the most important issues that research administrators continue to address as we seek to enhance the efficacy and success of our own work, as well as that of collaborators in other units as well as investigators. As always, we hope that researchers and research administrators, across the international membership that comprises SRAI, will continue to view JRA as a preferred outlet for their work as well as a source of important conceptual and practical scholarship to guide that work.

Our first article focuses on one of the more pressing questions that are core to the decisions research administrators must answer as they seek to address the needs of those we work to support. Dr. Goff-Albritton and her colleagues both at Case Western and Florida State seek to provide important insights about "Faculty Views on the Barriers and Facilitators to Grant Activities in the USA." Those who read this article will find it has broad applicability, not just to work in the USA but across most nations. The authors argue that research development in higher education is a service-delivery system and that research development professionals need evidence-based information on which to make critical decisions regarding strategic utilization of resources and in choosing client-centered grant-related services to provide for faculty.

Continuing with the theme of how research administrators can best support investigators, centers, and units in ways that have a positive impact on research productivity, a team of authors from across the University of the Western Cape, the University of Namibia, and Stellenbosch consider how institutional policies, practices, and initiatives can encourage research productivity. They survey a select set Higher Education Institutions (HEIs) regarding these questions. Respondents identified several key factors they saw as significant contributors to productivity as well as participants and processes that contributed to increasing those factors in research institutions. Critically, the findings of the study highlight the instrumental roles of university staff and students in creating essential conditions for research productivity.

Yet another manuscript in this issue that focuses on the central theme of enhancing research productivity comes from Dr. Santos, Ms. Carolina Varela and Dr. Martinez-Galen who were all working in Portugal at the time of their initial submission. They propose a management framework for more efficient approaches to research and innovation projects built on multiple pillars derived from a careful consideration of the literature.

Our next two papers focus their attention on issues relating to enhancing the success of clinical research. The first of these discusses the work of a national joint task force in Canada to delineate the core competencies for clinical research professions. The manuscript focuses on the case of the unique scientific and ethical considerations that are important to the work of professionals engaged in child health research. The authors, Dr. Ibrahim, Ms. Guerrero, and Dr. M. Goos, expand on that discussion to apply it to what they see as the overall aims of such efforts at professionalization including increased participant safety, enhanced research quality and greater regulatory compliance as well as improve job satisfaction and institutional engagement among the clinical research workforce. The second article focused on the enhancement of clinical research comes to us from a large and diverse team at the University of Minnesota who examined efforts there by their Clinical Research Support Center to develop a structured feasibility review process

to address common clinical research study challenges. They discussed the impact of applying this process to 116 different feasibility reviews. They found the process to be highly effective in addressing a number of frequently occurring study design and resource problems, resulting in unfeasible studies being turned into well-designed protocols that are IRB-approved with few protocol-related stipulations and well prepared for execution. Among a number of other important findings discussed, the process was also found to help study teams write better quality and more robust protocols for subsequent studies.

The final two manuscripts in this issue turn their attention to issues that have required significant amounts of attention from research administrations in the daily operations of an office of research. Holly Zink, Dorothy Hughes, and Nathan Vanderford, employed semi-structured interviews to capture research administrators' experiences within four research questions: 1) how is a traditional research administration professional role defined today; 2) how does the chain of command respond to new professional roles; 3) how has the standardization of professional knowledge through education and certifications impacted the workforce; and 4) how does the distribution of tasks become fluid to get work done between the different research administration professionals? Based in their findings the authors discuss several ways in which roles in traditional research offices may be improved, including career growth opportunities for research administrators, and they offer insights into the social and administrative processes that drive the development of these extended roles. A final paper offers insight from a survey of NIH and NSF researchers regarding lessons that research institution administrators learn from researcher experiences of the COVID-19 pandemic. Insights from a survey of NIH and NSF researchers, Dr. Cargill and her colleagues across multiple institutions, note that the COVID-19 pandemic required research institution administrators and researchers to make rapid and unprecedented decisions about whether research should continue and in what form. In the fall of 2020, they conducted a national survey of 930 federally-funded principal investigators (PIs) who continued in-person research during the early months of the COVID-19 pandemic. They investigated researcher perceptions of what shaped their choices about conducting in-person essential research and managing personnel during this time. By jointly interpreting the quantitative and qualitative data, they identified 10 concrete lessons that can inform administrator decision-making and best practices in preparation and response to crisis shutdowns of research if they happen in the future.

IMPORTANT NOTICES: I want to draw your attention to two process issues regarding the operation of JRA.

1. There are new author guidelines that will be taking effect around January 2023. Please refer to the journal webpage below to see make sure you are using the guidelines that are in effect if you are submitting a manuscript at this time or if you are intending to do so in the future.

https://www.srainternational.org/resources/journal

2. I want to remind you that, in 2022, we began the process of pre-publishing articles online soon after they have been formally accepted. These articles, once copyedited and proofed by the authors will be both posted on the JRA's webpage and then as part of the framework of the full Fall or Spring JRA issue in which it will be published. We hope that this will get the important

lessons that our articles may 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 as will allow their work to be available in discoverable and citable form much sooner than if it was held until the formal issues were released.

This is my second year as Editor-in-Chief of JRA. I continue to be excited about being given the charge to continue to help move our field forward. Having the opportunity to receive and read the incredibly diverse and exciting array of submission we receive is one that I feel incredibly honored by as they reflect the work of so many talented and committed professionals. I invite you to email me directly with any input, questions, or suggestions you may have. Once again, I would be remiss if I did not mention how critical the hard work and contributions of the many people who support this work and their help as I have been honored 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 administration of SRAI and the communications committee of JRA provide essential guidance and input on all phases of the Journal including being an essential resource in addressing unique situations. Holly Zink, who serves as Deputy Editor, is an invaluable professional partner, and an important personal support, in what might otherwise be an overwhelming task. I want to be sure to recognize her hard work and intellectual contributions – she is often called on for input with short notice and always comes through. The Editorial Board members are essential partners in ensuring that the manuscripts that appear in the Journal are exceptional and that they make valuable contributions to the work of our readers and the field of research administration more broadly. As the submissions to the journal have increased, they have gone far beyond what is reasonably expected in responding quickly and with great expertise. Without the countless hours, they contribute to the review process, the Journal and its continued growth would not be possible. The Author Fellowship Committee and the Author Fellow Advisors provide essential guidance to the Author Fellows as they develop and publish their first scholarly articles, and I am grateful that they will continue to provide this unique and vital work for JRA. Many behind-the-scenes SRAI staff have shared their knowledge, guidance, and expertise to my work as Editor-in-Chief. Gina Cuevas is not behind the scenes but is very much visible as on ongoing participant in working with reviewers and authors, always quickly, thoughtfully, and with kindness. As always, she merits special recognition and thanks. She is, as I have noted previously, the day-to-day beating heart of JRA – who ensures the production of the Journal meets the highest professional standards.

Lastly, and as always, if you are a non-SRAI member and wish to have the journal delivered to you via email, please sign up through the online system at http://www.journalra.org.
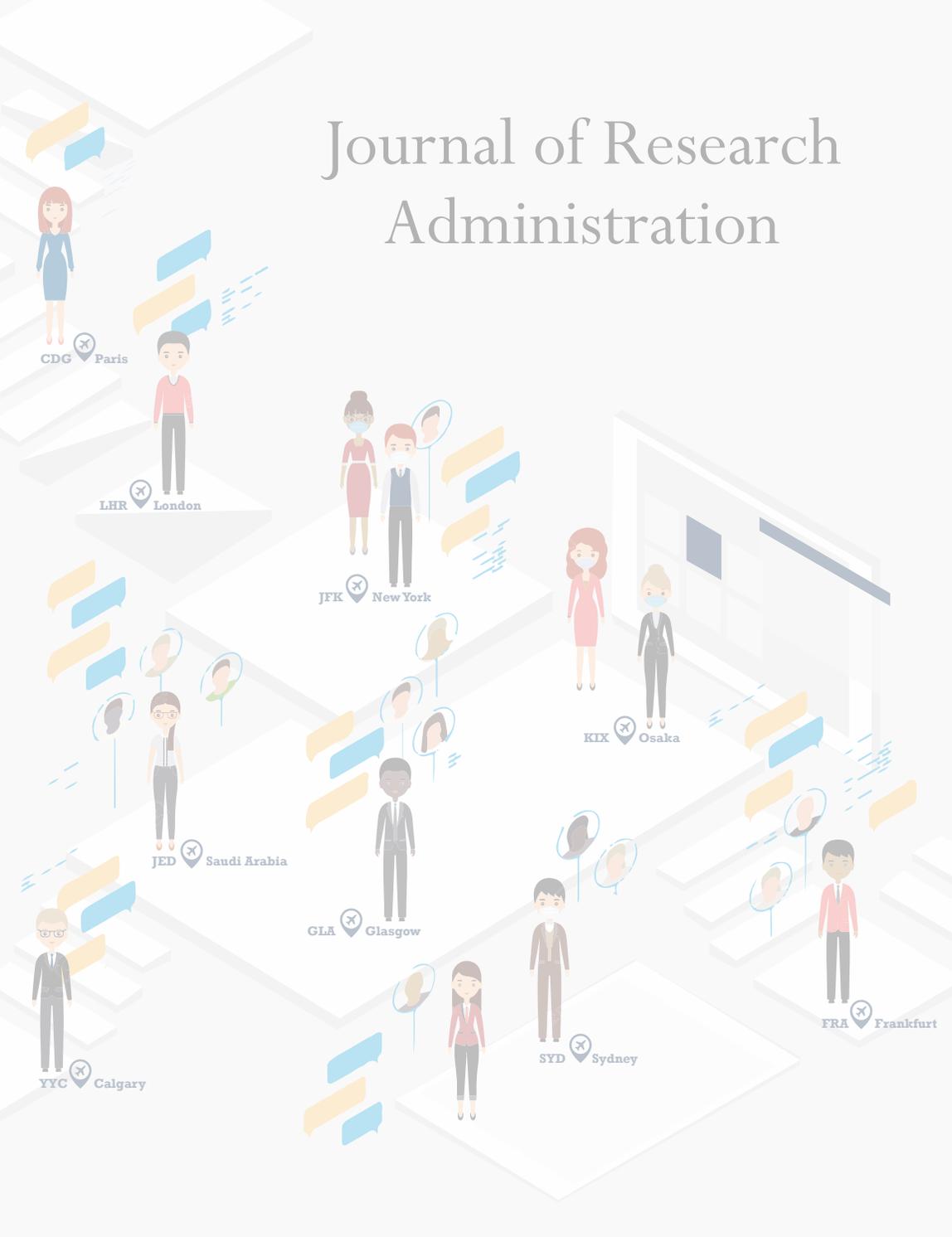
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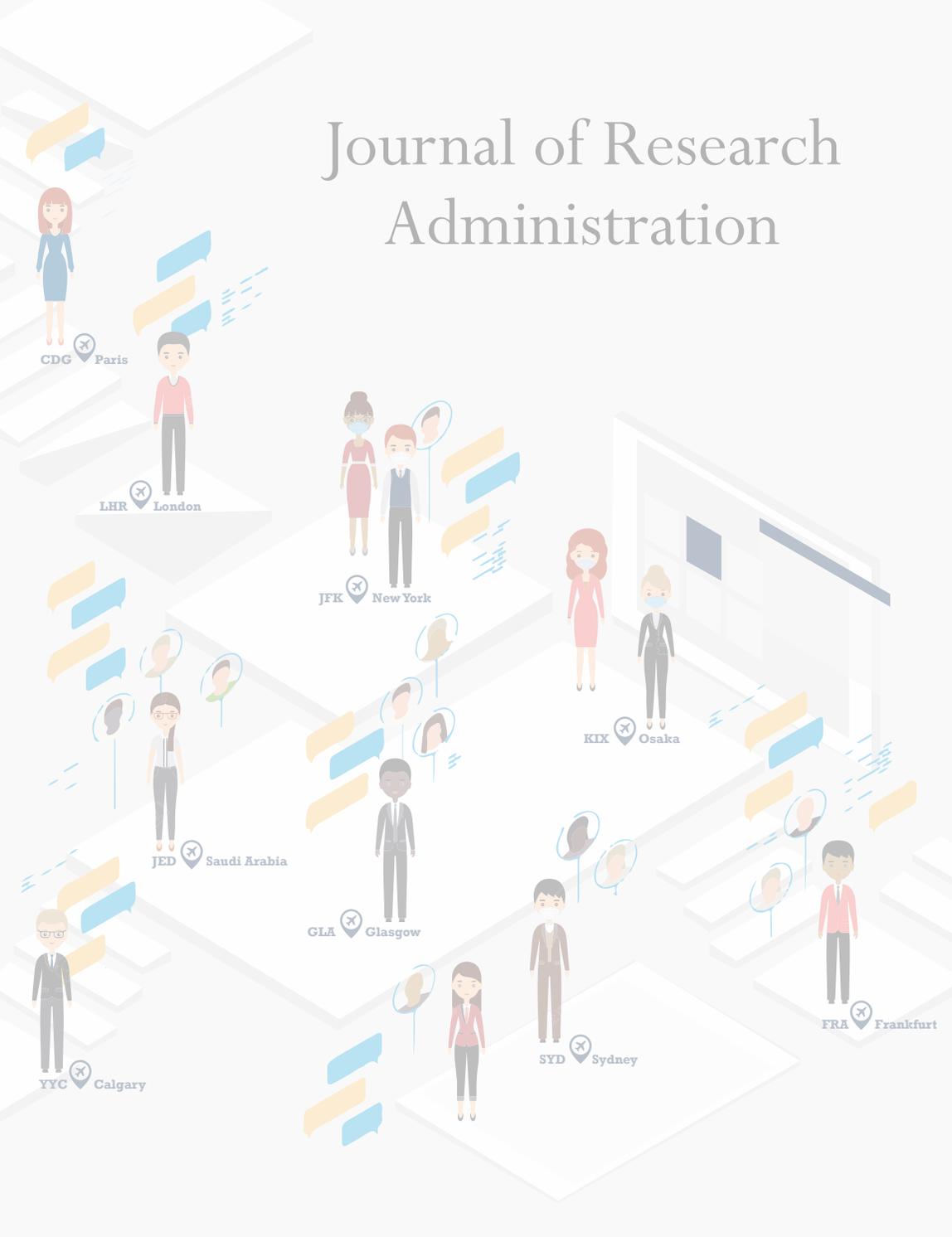
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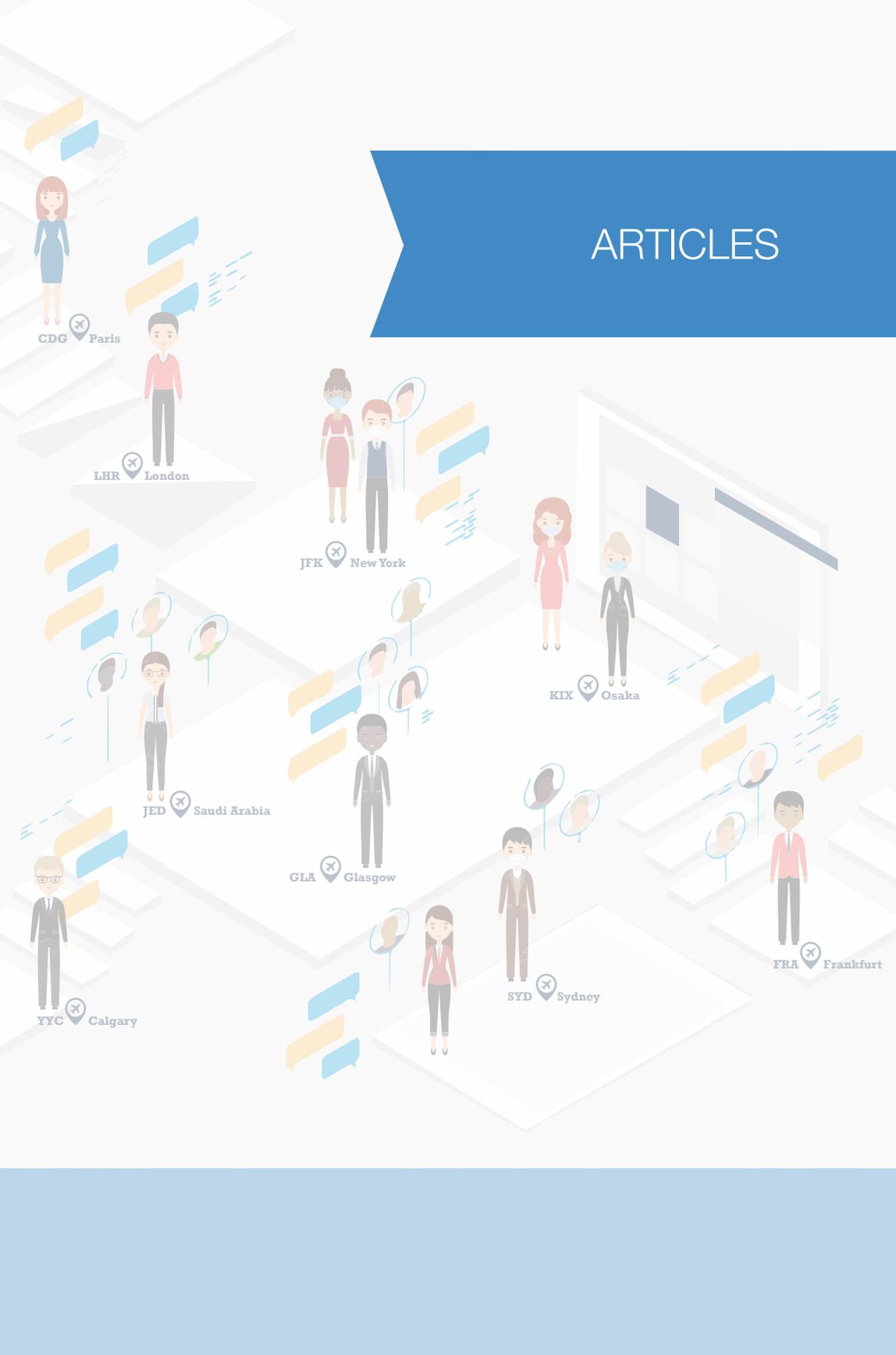
Faculty Views on the Barriers and Facilitators to Grant Activities in the USA: A Systematic Literature Review

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Abstract: *Research development in higher education is a service-delivery system. In any service field, when choosing appropriate services, practitioners should reach for 'evidence-based practices.' Limited empirical research has addressed the preferences of research faculty regarding research support services. In this project, we sought to provide research development professionals with critical knowledge related to decision making and strategic utilization of resources and in choosing client-centered grant-related services for faculty. The specific research question or objective of this study was to answer, "What factors are perceived by faculty to be barriers or facilitators to grants activity based on extant literature?" This systematic literature review on faculty perceptions of barriers and facilitators to grant activity used an eight-step systematic literature review methodology. The findings describe the characteristics, methodological attributes, and the methodological quality of the articles. Additionally, the integration of the findings revealed eight main factors that faculty perceived to be important for facilitating or hindering grant activity. Three main emerging factors or core categories appeared to be most important across all barriers or facilitators to faculty grant activity. Research development professionals need to be able to provide evidence-based and client-centered research support services. This review provides the factors that faculty view as being most important to grant activity and recommendations for management. Implementing effective client-centered research support services is critical for the success of faculty grant activity.*

Introduction

Grants and contracts are critical sources of university income. Public universities in the U.S. received 22% of university operating revenues from grants and contracts in 2016-2017 (U.S. Department of Education, 2018), which is an increase from 13% in the 1980s (Daniel & Gallaher, 1990). Many universities, colleges, and departments now require faculty to write grant proposals especially if faculty are on a tenure track. The majority of advertisements for faculty positions list "grant proposal writing" as a position requirement (Kleinfelder et al., 2003). The current workload expectations and requirements of research faculty have increased, and they must effectively balance service or clinical practice, teaching, and research, including, in many cases, grant proposal writing (Cola & Wang, 2017; Whicker et al., 1993). In fact, many universities, colleges, and departments require that faculty not only submit grants, but faculty must also be awarded grants at various levels to be realistically considered for promotion and tenure (Boardman & Ponomariov, 2009).

Faculty have varying levels of experience with *grant activities* (i.e., grant seeking, grant writing, grant submission, and grant management). Some faculty have never written a grant in the past, others may have had only one grant-writing course or seminar in graduate school. Other faculty have received grants to support their graduate studies or worked on a funded project while matriculating towards their degrees (Etzkowitz, 1990). Some faculty must have funding in order to complete their research. In contrast, others may be able to conduct research without funding and instead use grants to promote the validity of their work, enhance their reputation, or provide additional resources (Oakleaf, 2010). Some faculty enjoy the scholarly act of writing grants or prioritize grant seeking within their career goals, while others do not (Dooley, 1995; Easterly & Pemberton, 2008; Monahan, 1993; Pinto & Huizinga, 2018). Regardless of the faculty member's level of experience with grants, reliance on grants, or general interest in grant seeking, a critical role of research development professionals in higher education is to assist faculty with all facets of research and grant activities, which is a critical aspect to conducting more research and gaining tenure (Decker et al., 2007; Wimsatt et al., 2009).

Research development (RD) in higher education is a service-delivery system (Cole, 2010). RD includes strategic advancement of institutional research, communication of research and opportunities, enhancement of collaborations, and research proposal development (National Organization for Research Development Professionals [NORDP], 2019). In this service-delivery system, research development professionals, which going forward we will refer to as RDPs, serve as 'practitioners' with faculty as their 'clients.' RDPs can include any research administrators, research-related staff, research managers, research deans, department chairs, or other upper administrators, and for this paper's purposes, when we use the title 'faculty' we are referring to those required to conduct research as part of their job position or role.

In any service field, when choosing appropriate services, practitioners should reach for *evidence-based practices* (Rousseau, 2006). The term *evidence-based practice* refers to an approach in which current, high-quality research evidence is integrated with practitioner expertise and client preferences and values to aid in decision-making for provided services (American Speech-Language-Hearing Association [ASHA], 2005). The three key components of an evidence-based RD service-delivery system include: 1) the knowledge and abilities of RDPs (practitioner expertise); 2) the academic literature on effective research support services (current best evidence); and 3) faculty preferences for provided research-support services and organizational support systems (client-centered).

Limited empirical research has addressed the preferences of research faculty concerning research support services. It is critical to understand faculty preferences of support services offered, because the initial reaction is often that they are losing autonomy or that there is an attempt to increase their regulatory burden (Rockwell, 2009). The client-centered practice of providing research support services in higher education is an attempt to reduce the administrative and regulatory burden on investigators seeking sponsored research, while helping them navigate numerous indirect research activities and requirements (e.g., complying with institutional rules or navigating institutional resources), that often fall outside the scope of their research (Decker et al., 2007; Wimsatt et al., 2009).

To support our pursuit of evidence-based practice in RD, we conducted a systematic literature review of faculty perceptions on grant-related research support services and organizational support systems. In this project, we sought to provide RDPs with critical knowledge related to decision making and strategic utilization of resources and in choosing client-centered grant-related services for faculty. The specific research question, or objective of this study, was to answer, "What factors are perceived by faculty to be barriers or facilitators to grant activities based on extant literature?".

Method

This systematic literature review on faculty perceptions of barriers and facilitators to grant activities was conducted using an eight-step systematic literature review approach (Dollaghan, 2007; Gough et al., 2017; see Figure 1). Articles included in this review included faculty researchers from United States (U.S.) institutions. These articles reported on barriers and facilitators to faculty grant activities (excluding articles solely focused on teaching, curriculum, or academic programs, for example). The included articles explored faculty views (i.e., attitudes, beliefs, perceptions of experiences) and used qualitative methods, such as surveys or interviews, to directly report faculty views, instead of having the investigator describe faculty views. Articles that were not peer reviewed or written in English were excluded. Articles reporting on universities outside of the U.S. or published before 1990 were excluded to better reflect current federal funding trends and institutional cultures in the United States.

1	• Establishing the review question and objective
2	• Defining inclusion/exclusion criteria
3	• Articulating the search strategy & information resources
4	• Screening articles to see if they meet the criteria
5	• Extracting relevant data from included articles
6	• Assessing the methodological quality/rigor of included articles
7	• Synthesizing, either quantitatively or qualitatively, the collective evidence
8	• Drawing conclusions & communicating them in a way that is relevant

Figure 1. Steps to the Systematic Literature Review

The systematic search, as depicted in Figure 2, used the following Boolean combinations: faculty AND grants, faculty AND perceptions, and faculty AND views. A university librarian was consulted for databases and journals most relevant to this research topic. The databases searched were ERIC (Proquest) (n=2,911), Social Sciences Premium (Proquest) in the *Journal of Faculty Development* (n=36) and *Research in Higher Education* (n=88), and Academic OneFile in the *Journal of the Society of Research Administration* (JSRA) (n=8) and the *Journal of Research Administration* (formally JSRA) (n=13). All results were imported into a citation manager (RefWorks) and filtered for duplicates (n = 104).

Figure 2. Search Flowchart: Total of 13 Included Articles in Current Review

Click here for larger image

The systematic search across select databases and journals resulted in a total of 3,059 raw hits with 2,955 remaining after removal of duplicates. In the first level of screening, three authors served as reviewers (JP, SY, and IG) to screen the title and abstract of each of these papers for the stated inclusion criteria. This first level of screening eliminated 2,793 articles. Two authors (RG & JP) independently reviewed the full text of the remaining articles (n=162) using the inclusion criteria and excluded an additional 156 articles. Nine articles remained for review.

Additionally, the table of contents, titles, and papers within the *Journal of the Grants Professionals Association* and *NCURA Research Management Review* (n=328) were hand-searched by two reviewers (RG & IG), and two additional articles were found to be relevant. These two articles were added for a total of 11. Leaders in the field, including the president of Sponsored Research Administration International, the president of the National Organization of Research Development Professionals, and the president of the National Council of University Research Administration, were consulted for relevant, potentially missing articles, however, no additional articles meeting inclusion criteria were discovered from these consultations. An additional two articles were added that were found from the extant literature (i.e., cited within included articles) that met inclusion criteria. After completion of the systematic search, a total of 13 articles were retained for the final review, data extraction, quality assessment, and synthesis..

Data Extraction and Analysis

Characteristics of each included article (i.e., the aim, faculty sample, university characteristics, sample size, response rate, sampling method, data collection, and data analysis) were extracted and compiled into data tables. The findings (barriers and facilitators) from each article were copied and pasted into individual Microsoft Word documents and exported into NVivo software for coding and data analysis. For survey data, findings reported by at least 50% of the respondents were extracted. For qualitative interview data within the included articles, any barriers or facilitators reported by participants or by the corresponding author of the article that were used to describe emerging main findings or "themes," were extracted.

The data analysis was conducted in three overlapping stages, including 'open coding,' 'axial coding,' and 'selective coding' (Charmaz, 2014; Creswell & Creswell, 2017; Saldaña, 2012). The findings from each article were examined line-by-line by one author (RG), and open (free) codes were inductively created to capture the meaning of the data ('open coding'). Free codes are non-hierarchical, not bound by the research question, and allow for emergent themes to arise organically out of the data (Creswell & Creswell, 2017). Most often, the exact wording from the survey or the participants became the open code, and these codes were recorded under headings of either a facilitator or a barrier. When all responses had been examined multiple times to ensure all results were recorded, two reviewers (RG and PC) grouped similar codes into subcategories and categories to create higher-order codes ('axial coding'). Axial coding is a way of grouping similar codes into a smaller number of concepts, which are inferential or explanatory and identify a "bigger picture" (like cluster- or factor-analysis in quantitative analysis) (Saldaña, 2012). Figure 3 provides an example of open and axial coding. With the goal of supporting open data, our codes have been made publicly available for other researchers in the Open Science Framework (https://osf.io/qp4bs/).
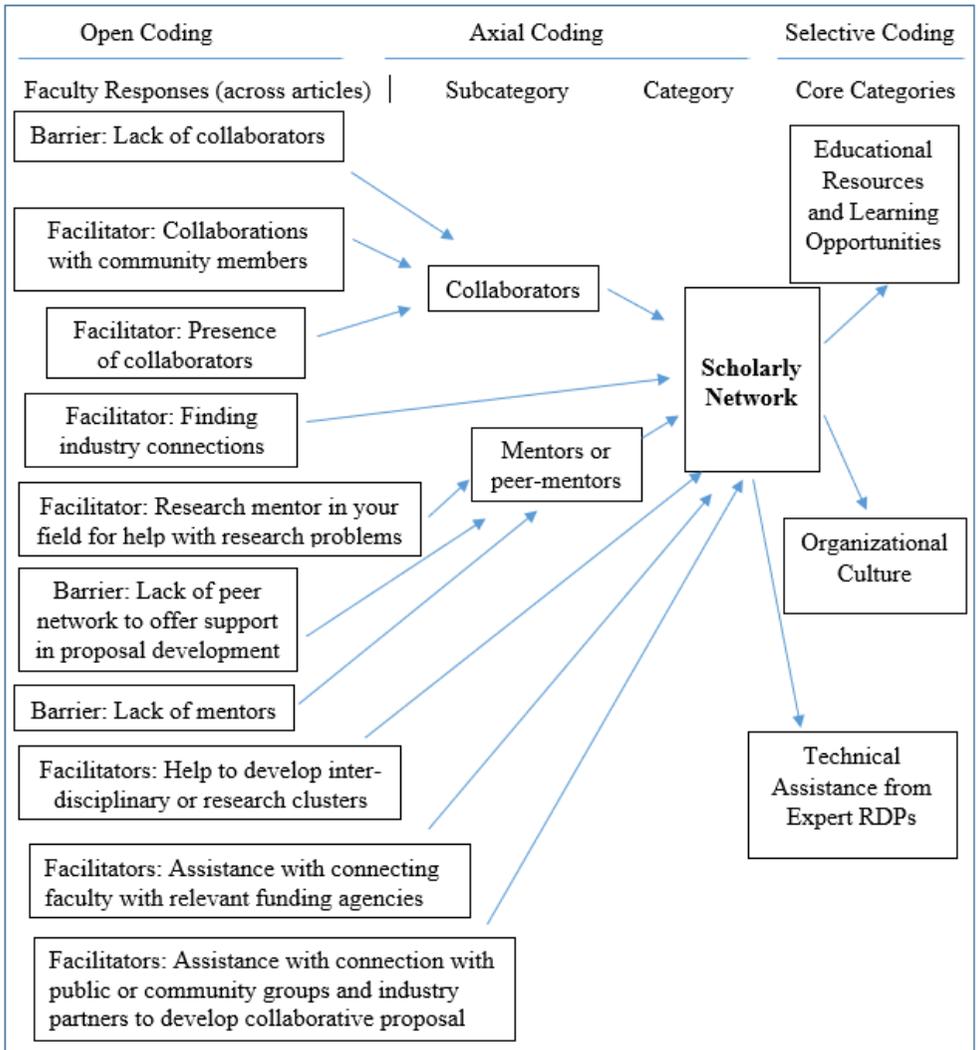
Note. The data analysis was conducted in three overlapping stages, including 'open coding,' 'axial coding,' and 'selective coding' (Charmaz, 2014; Creswell & Creswell, 2017; Saldaña, 2012)

Figure 3. Example of Open, Axial, and Selective Coding Leading To the Development of the Category of 'Scholarly Network'

Every finding was categorized within at least one axial code, with several findings categorized into more than one axial code (e.g., "poor interdepartmental communication with not enough knowledge about grant activities in other departments and within their own departments" went into both 'scholarly climate' and 'scholarly network' axial codes). Due to the small sample of relevant articles and because many of the articles included fixed-response questionnaires, the number of facilitators versus barriers (e.g., more facilitators found across studies than barriers) did not provide any indication as to whether faculty in general perceive more facilitators than barriers in grant activities. We initially planned to further refine these categories during axial coding according to our research question regarding barriers to and facilitators of grant activities, but we found that many barriers also served as facilitators (e.g., 'not having internal funding for travel' and 'having internal funding for travel'). Therefore, the findings were combined, without differentiation of barriers and facilitators, at the axial coding stage. Finally, two reviewers (RG and PC) independently further categorized the axial codes by highlighting emerging findings or categories across axial codes ('selective coding' or finding core categories that explain and summarize axial codes) and then considered the implications of the faculty views for service-delivery recommendations.

Methodological Quality Assessment

We then appraised each of the articles independently for methodological quality by two reviewers (RG and PC). Methodological quality was assessed using a modified set of criteria (Goff-Albritton & Cola, 2021) from previous reviews conducted by the UK's Department of Health and Social Care (DHSC) Policy Reviews Facility (Rees et al., 2009; Shepherd et al., 2010) and informed by principles of good practice for conducting social research with the public (Harden et al., 2004), as adapted from Lester et al. (2019). The quality of each study was rated according to:

- the rigor of sampling, data collection and data analysis;
- whether study findings were grounded in/supported by data;
- whether the breadth and depth of findings were appropriate for the review;
- whether young people's perspectives and experiences were privileged.

For example, if the sampling method was appropriate to the questions posed, attempts were made to obtain a diverse sample, and the characteristics of the sample were thoroughly described, the rigor of sampling would receive full credit or a rating of 3.

Finally, points were assigned to each of these ratings and totaled for an Overall Methodological Quality Rating (see Online Resource 1 - https://osf.io/qp4bs/). This rating provided the weight (low, medium, high) for the perceived trustworthiness of each article's findings (i.e., the extent to which the methods employed were rigorous and would minimize bias and error in the findings). Initial inter-rater agreement was 77% across rating criteria for these 13 articles and 92% for the Overall Methodological Quality Rating of the relevance of the articles (i.e., high, medium, and low). This indicates substantial and nearly perfect agreement between reviewers (RG and PC), respectively. Discrepancies were discussed between the two reviewers until agreement on the methodological quality ratings were achieved.

Results

This analysis of 13 articles resulted in findings on the views of research faculty members of what facilitates and what serves as barriers for their grant activities. The results describe the:

- **Characteristics** of the articles (e.g., the faculty members and institutions studied);
- **Methodological attributes** of the articles;
- **Methodological quality** of the articles; and
- **Synthesis of the findings** of the reported barriers and facilitators.

After analyzing the sample publications, the authors sense that faculty and RDPs will likely derive the most benefit from these findings on individual studies, the summary of findings, and the provided recommendations. Whereas researchers (i.e., those interested in furthering and studying the field of research development and research management) will likely find useful information in the provided characteristics and methodological attributes of the reviewed articles, which highlight areas in which future research seeking faculty perspectives could be better supported or improved.

Characteristics of Included Articles

Detailed characteristics of the included articles are provided in Table 1. Aims across studies were generally to study the barriers and facilitators of grant activities as perceived by faculty. A total of 1,593 faculty members were included across this sample of articles. Several articles focused on a specific population (i.e., African American faculty, female faculty, senior faculty, junior faculty, and faculty with diverse levels of experience in grant activities). College of education faculty were a focus of four articles. Health education faculty members were the focus of one article. Several articles focused on similar types of institutions. Four articles included Research 1 institutions or institutions with significant grant activity. Two articles described findings from predominately undergraduate institutions. Four articles reported responses from faculty across multiple institutions.

Although some of the included articles provided analyses of differences across groups (e.g., the difference in importance of collaborators as a facilitator for grant activities for tenured vs. non-tenured faculty), this information or these characteristics were not present or consistent across all studies; moreover, the heterogeneity of the characteristics within the included articles prevents any valid attempts to provide meaningful analysis of group differences in the current review. Also, efforts were undertaken to examine if the integrated findings could be attributed to a particular faculty or university characteristic or to the methodological quality of the primary research; however, no category appeared to contribute to a specific characteristic and no study methodological quality rating appeared to contribute more or less to the integrated findings.

Table 1. Overview: Aims, Sample Characteristics, and University Type

Article	Aim	Faculty Sample	University Type
Belgrave, Moore, & Douglas-Glenn (2019)	To identify these barriers and factors that are unique to African American faculty and to identify how these barriers might be attenuated by protective factors or assets	16 African American faculty described by career levels, academic disciplines, and gender, mostly women (purposeful sampling)	A research-intensive university in the mid-Atlantic
Boyer & Cockriel (1998)	To examine in greater detail the factors that are barriers or facilitators to pursuing grants for both tenured and non-tenured faculty	248 male and female College of Education faculty across career levels, mostly tenured	Research I institutions that were part of the Association of American Universities
Boyer & Cockriel (2001)	To examine motivating and hindering factors of junior faculty across disciplines at a research university in their pursuit of grant proposals	137 junior faculty, not yet tenured, across academic disciplines (other than College of Education due to the author's affiliation)	A Midwestern research university
Cole (2007)	To provide recommendations from a faculty perspective for how to improve the system of research administration and faculty relationships	32 senior faculty from major research universities	Major research universities (i.e., universities receiving at least 1 million in federal funding)
Daniel & Gallaher (1990)	To determine some of the barriers that impede faculty members' involvement in grant activities	15 full-time tenure track College of Education faculty across 4 departments with half having little to no experience with grants (convenience sample)	University of New Orleans College of Education
Dooley (1995)	To change its research culture to encourage more faculty grant seeking by surveying their faculty on barriers and facilitators and frequency of use of support services	58 College of Education tenure-track Faculty at Texas A & M University (also made comparisons of the sample to the population based on gender, career-level, and distribution of teaching experience and academic discipline)	Texas A&M University, which was ranked eighth among the nation's research universities by the National Science Foundation
Easterly & Pemberton (2008)	To examine the barriers and supports perceived by female associate professors to help female associate professors increase the number of proposals they write, and in turn, possibly increase their chances of achieving promotion	133 Female faculty across career levels, academic disciplines, experience with grants, and amount of support with home management	Three state universities in Idaho (i.e., Boise State University, Idaho State University, and University of Idaho)

Article	Aim	Faculty Sample	University Type
Kleinfelder, Price, & Dake (2003)	To identify barriers and incentives to grant writing, exploring the level of faculty grant activity and determine grant writing preparation in graduate health education programs	282 Health Education faculty members across career-levels	Institutions offering undergraduate and graduate degree programs in Health Education
Monahan (1993)	To compare the barriers and facilitators to grant activities for their faculty to those reported by faculty in other "views" studies in prior literature	136 faculty described by career levels, academic disciplines, and experience with grants (systematic random selection)	Eight campus-based state predominately undergraduate institutions in New Jersey
Mullen, Murthy, & Teague (2008)	To provide a vehicle for faculty input in the University's strategic planning process and assess the degree of importance faculty placed on several resources required to support research and scholarship	305 research administrators and university faculty across career-levels and academic colleges	University of South Florida, a research-extensive institution in the southeastern U.S., classified as a Carnegie research-extensive, doctoral-granting, public institution
Pinto & Huizinga, 2018	To determine how faculty maintain research productivity in external grant seeking and the impact of institutional support and leadership	15 faculty described by their different career levels, gender, racial/ethnic groups, experience with grants, academic colleges, and years at the university (purposeful sampling)	A predominantly undergraduate institution and a Hispanic-Serving and Minority-Serving Institution in California
Sterner (1999)	To study the barriers and facilitators focused on the entire faculty of a single PUI from faculty representing all colleges, departments, ranks, and years of experience	181 tenured or tenure-track faculty (for the survey) described by career levels, gender, recent grant activity, academic colleges, and years at the university; 10 tenured or tenure-track faculty (for the interviews) with two from each college	Bradley, a medium-size, predominantly undergraduate, independent institution of higher education in Peoria, Illinois
Walden & Bryan (2010)	To discover the factors that impact grant-seeking (motivators and barriers) based on the faculty members' career-level and determine if their findings (faculty perceptions) are similar to those of other universities (i.e., Boyer & Cockriel, 1998)	35 College of Education faculty (self-elected, nonrandomized sample) described by gender and career-levels	A public, four-year, doctoral-granting university in the South classified as a Research University with high research activity by the Carnegie Foundation for the Advancement of Teaching

Methodological Attributes of Included Articles

Descriptions of the methodological characteristics, including data collection methods and data analyses, across articles, are provided in Table 2. For data collection, most of the articles used a fixed-response self-completion questionnaire, using Likert scales to rate the level of importance of items related to grant activities. Fewer articles utilized other data collection methods, including fixed and open response, fixed response and interviews, or interviews and/or focus groups. For data analysis, most of the articles included both descriptive and/or inferential statistics. Fewer articles (i.e., those with qualitative data collection methods) utilized qualitative data analyses or mixed methods. Detailed structured summaries of individual articles are provided in Online Resource 2 (https://osf.io/qp4bs/).

Table 2. Methods of Data Collection and Analysis Used in Articles of Faculty Perspectives

	Number	**%**
Methods of data collection		
Fixed response self-completion questionnaire	8	62%
Fixed and open response self-completion questionnaire	2	15%
Fixed response self-completion questionnaire and interviews	1	8%
Interviews and/or focus groups	2	15%
Methods of data analysis		
Descriptive and/or inferential statistics	8	62%
Qualitative data analysis	2	15%
Mixed methods	3	23%

Methodological Quality of Included Articles

As described in the methods section, we applied six quality assessment criteria and one overall methodological quality rating to the articles of faculty perceptions (Table 3). The majority of the articles employed a series of steps to increase rigor in sampling and presented findings that were grounded in or supported by the data. However, the majority of the articles did not take the necessary steps to increase rigor in data collection and analysis, and the articles did not achieve good breadth and/or depth in the findings (i.e., breadth as the extent of description and depth as the extent to which data has been transformed/analyzed). Additionally, most of the articles did not specify whether the perspectives of faculty were privileged (e.g., no mention of assurance of

confidentiality or no involvement with participants during the design of survey questions). The Overall Methodological Quality of the articles ranged from Low (N=8) to Medium (N=5) with mostly Low overall ratings (see Online Resource 3). None of the reviewed articles received a high overall methodological quality rating

Table 3. Number of Studies Adequately Displaying the Different Criteria for the Methodological Quality of the Articles (Scoring at least a 2 or 3 rating) (N=13)

Methodological criteria	N	%
1) Were steps taken to increase rigor in sampling?	10	77%
2) Were steps taken to increase rigor in data collection?	3	23%
3) Were steps taken to increase rigor in data analysis?	6	46%
4) Were findings grounded in/supported by the data?	11	85%
5) Was there good breadth and/or depth achieved in the findings?	3	23%
6) Were the perspectives of faculty privileged?	2	15%

Key: A score of 2 or 3 was required to be considered here as adequately displaying the different methodological criteria. A rating of 2 or 3 for criteria 1-4 (i.e., rigor of sampling, data collection, and data analysis and degree that the findings grounded in/supported by the data) meant a fairly thorough attempt was made or several steps were taken. For criteria 5 (whether or not there was good breadth and/or depth achieved in the findings), a rating of 2 or 3 meant there was good/fair breadth and depth or good/fair depth but very little breadth. For criteria 6 (were the perspectives of faculty privileged), ratings of 2 or 3 meant their perspectives were privileged a lot or at least somewhat.

Synthesis of the Findings

The findings describe eight key factors reported by faculty to be barriers to and facilitators of faculty grant activities. Across these eight key issues, three main emerging factors appeared to explain these barriers or facilitators. These three emergent findings can be considered core categories, including:

1. Building an organizational culture that values and supports grant activities;

2. Developing and implementing effective educational resources and learning opportunities; and

3. Providing technical assistance from expert RDPs.

These three core categories applied to faculty grant activities appear to impact whether a research support (or lack thereof) is a barrier or a facilitator for faculty grant activities (see Figure 4).

Each of these three core categories are defined within the discussion section in relation to their practical implications and recommendations for implementation.
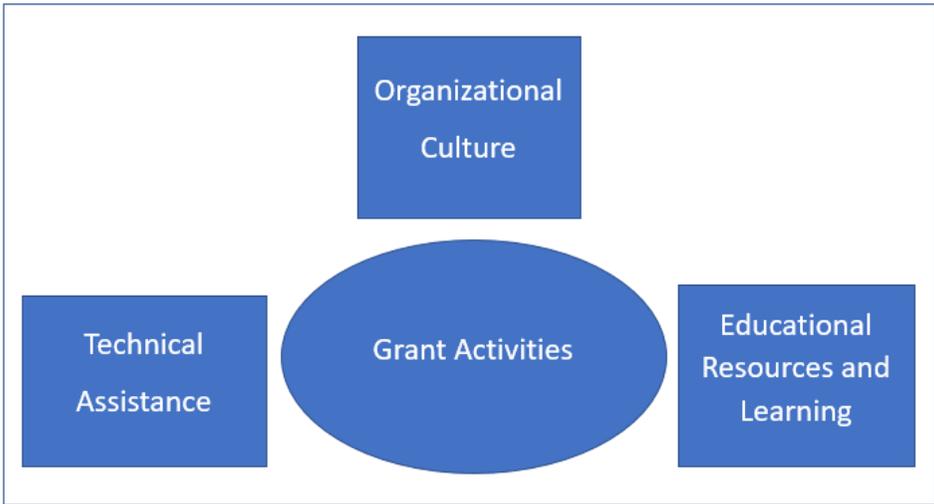
Figure 4. Emerging Factors

Barriers and Facilitators

Eight main factors emerged from the studies of faculty views. Faculty perceived the following eight main factors to be important for facilitating or hindering grant activities:

1. Grant proposal development support;
2. Time commitments, assignments, and priorities;
3. Funding or resources from the university;
4. Personal interests, knowledge, or attributes of faculty;
5. Sponsored research administration (SRA) (i.e., grant submission and management) policies, personnel, and support;
6. Evaluation, tenure, and promotion;
7. Scholarly network; and
8. Scholarly climate.

One additional factor, 'scarcity of funding,' was mentioned in only two articles; therefore, it was not considered a main or significant issue, but should still be noted as a barrier to faculty grant activities (at a national level in the USA).

Grant proposal development support. The majority of the articles (11 out of 13) described barriers or facilitators to grant activities related to the need for adequate grant proposal

development support. The main factors related to grant proposal development support included a need for assistance with finding funding, technical personnel providing individualized clerical support with proposal development, resources for connecting with funding agencies, and assistance with budget development. Specifically, a 'lack of training in grant seeking' was reported by faculty to be an important barrier to grant activities, based on responses to Likert scales rating the importance of various factors related to grant activities (Boyer & Cockriel, 1998). Faculty also reported a lack of information about funding sources by not being notified about grants in a timely manner, as another hindrance to grant activities (Daniel & Gallaher, 1990). Moreover, faculty reported to value RDPs' support in 'identifying proper funding agencies and programs beyond distribution of lists of announcements and website links,' as indicated on Likert scales (Cole, 2007).

Several articles reported that faculty perceived having graduate assistants or clerical help as a facilitator to grant activities (Dooley, 1995; Monahan, 1993; Mullen et al., 2008), and a couple of articles, also using Likert scales to rate the importance of influencing factors, specified the importance of that support 'when proposals were funded' or 'when preparing proposals' (Boyer & Cockriel, 2001; Walden & Bryan, 2010). Additionally, faculty reported the importance of having grant writers (Dooley, 1995; Pinto & Huizinga, 2018) and liaisons to work with their university's sponsored research administration office (Dooley, 1995; Monahan, 1993).

Another important factor for faculty grant activities was having resources for connecting with funding agencies, which could include education or technical assistance on 'how to deal with prospective sponsors' (Boyer & Cockriel, 2001; Daniel & Gallaher, 1990; Dooley, 1995; Monahan, 1993). Faculty reported a 'lack of funds to travel to meet with funding agencies in preparation for writing proposals' as a strong to moderate barrier (Easterly & Pemberton, 2008). Another commonly expressed factor related to grant proposal development support was the need for assistance with budgets, such as education or technical assistance with preparing a budget and individualized post-award support with managing the budget (Dooley, 1995; Kleinfelder et al., 2003; Monahan, 1993; Mullen et al., 2008; Pinto & Huizinga, 2018).

Additional grant proposal development supports viewed as important by faculty included the need for training or assistance with proposal writing (Boyer & Cockriel, 1998; Dooley, 1995; Kleinfelder et al., 2003; Monahan, 1993). Assistance with the 'physical preparation of proposals' (i.e., boilerplate language or templates) and basic 'grants 101 assistance' were also viewed as important (Daniel & Gallaher, 1990). Faculty reported that having someone to review proposals was a facilitator to grant activities (Pinto & Huizinga, 2018).

Time commitments, assignments, and priorities. Ten of the 13 articles expressed barriers and facilitators to grant activities in relation to time commitments, assignments, and priorities. Teaching commitment was the barrier to grant activities that was mentioned the most by faculty, across nine of the 13 articles (Belgrave et al., 2019; Boyer & Cockriel, 2001; Daniel & Gallaher, 1990; Easterly & Pemberton, 2008; Kleinfelder et al., 2003; Monahan, 1993; Pinto & Huizinga, 2018; Sterner, 1999; Walden & Bryan, 2010). Committee or administrative assignments were expressed as barriers across five articles (Daniel & Gallaher, 1990; Easterly & Pemberton, 2008;

Kleinfelder et al., 2003; Pinto & Huizinga, 2018; Sterner, 1999).

Another related factor reported to be important by faculty in several reviewed articles was release-time provided for them to have the time to prepare proposals or work on funded proposals (Dooley, 1995; Kleinfelder et al., 2003; Monahan, 1993; Sterner, 1999). Two other reported time-related factors were 'flexibility in how time was allocated' and having research priorities outside of grant-related activities (e.g., publishing manuscripts) (Boyer & Cockriel, 2001; Daniel & Gallaher, 1990; Walden & Bryan, 2010).

Funding or resources from the university. Ten of the articles suggested that faculty perceived funding or resources from the university to be important to grant activities. Nine of these ten articles suggested internal funding to be a facilitator. For example, travel funds for conferences or to meet with peers or funding agencies were considered important (Boyer & Cockriel, 2001; Dooley, 1995; Monahan, 1993; Pinto & Huizinga, 2018; Walden & Bryan, 2010). Six articles mentioned the ability to purchase equipment as an important facilitator (Boyer & Cockriel, 2001; Dooley, 1995; Monahan, 1993; Mullen et al., 2008; Sterner, 1999; Walden & Bryan, 2010).

Additional university resources found to be important in facilitating grant activities included being supplied ample lab space, bridge funds between funded projects, and funds for pilot work and manuscript submissions (Cole, 2007; Mullen et al., 2008; Pinto & Huizinga, 2018). University funds to pay student research assistants or student tuition waivers and the ability to hire or utilize university support staff (e.g., research or laboratory staff, clerical support, and statistical or other expert technical support) was also perceived as important facilitators to grant activities (Mullen et al., 2008; Sterner, 1999; Walden & Bryan, 2010). Whereas, a reported barrier by faculty in one article was the absence of a clearly defined rewards system, where sometimes graduate assistants would be provided to work on an awarded grant but not always, or promises for matching funds (e.g., cost-share) would be broken (Pinto & Huizinga, 2018). A couple of articles mentioned the need for better graduate student recruitment (Cole, 2007; Dooley, 1995), and a couple more reported the importance of having a library of grantsmanship aids (Daniel & Gallaher, 1990; Mullen et al., 2008).

Seven of the thirteen articles expressed faculty views that barriers to grant activities were the indirect cost reimbursement policy and financial compensation for awarded grants (Boyer & Cockriel, 2001; Cole, 2007; Daniel & Gallaher, 1990; Dooley, 1995; Monahan, 1993; Sterner, 1999; Walden & Bryan, 2010). In some of the articles, the issue was specified to indirect costs not being returned back to the department, to the college, or to the faculty awardee (Boyer & Cockriel, 2001; Cole, 2007; Daniel & Gallaher, 1990; Dooley, 1995; Sterner, 1999; Walden & Bryan, 2010). Faculty also viewed having 'no reward' for awarded grants as a barrier and 'personal financial compensation' as a facilitator to grant activities (Dooley, 1995; Monahan, 1993; Walden & Bryan, 2010).

Faculty personal interests, knowledge, or attributes. Ten out of the 13 articles reported faculty to view their own personal interests, knowledge, or attributes to be a facilitator or barrier to grant activities. Some faculty reported a lack of personal interest in spending time on grant activities, saying "there are less labor-intensive things people can do to further their [professional] growth

and development" (Daniel & Gallaher, 1990, p. 10). Other faculty across several articles rated 'building my professional reputation as a capable researcher' or 'gaining recognition for my institution or program' as important factors of grant activities (Boyer & Cockriel, 1998, 2001; Dooley, 1995; Monahan, 1993; Walden & Bryan, 2010). Several articles rated the 'opportunity to research new information' as an important facilitator (Boyer & Cockriel, 2001; Dooley, 1995; Monahan, 1993; Sterner, 1999). Faculty in one study reported innovation or scholarly contribution as facilitators to grant activities by appreciating the "ability to focus research work in particular areas that might have a great impact and broader dissemination of results—thus impacting the field" (Walden & Bryan, 2010, p. 92). Several articles found faculty satisfaction with obtaining a grant or their individual drive in grant activities to be a facilitator, reporting that being awarded a competitive major grant was part of their career goals (Dooley, 1995; Monahan, 1993; Pinto & Huizinga, 2018).

Faculty also reported that their level of knowledge or skills in grant activities was an important facilitator or barrier. For example, technical skills, such as project management and grant writing skills, were viewed as facilitators (Belgrave et al., 2019). Additionally, having prior experience with securing grants (e.g., learning or assisting with grants at other universities or in graduate school), and 'knowing your audience' (i.e., understanding the sponsor's expectations) were viewed by faculty to facilitate grant activities (Easterly & Pemberton, 2008; Pinto & Huizinga, 2018). Some reported barriers were a lack of training in grant seeking, lack of knowledge of budget development, and being discouraged by rejected proposals (Boyer & Cockriel, 1998; Daniel & Gallaher, 1990).

Some personal attributes suggested by faculty to be important to grant activities included having tenacity, being innovative, and being confident that ideas are worthy of external funds (Belgrave et al., 2019; Easterly & Pemberton, 2008). Only one article asked questions to probe for attributes of faculty members' personal lives or living situations (Belgrave et al., 2019). In this article, the faculty reported a facilitator to be having a life partner who shares equally home and family duties and that their partner or family were supportive of academic work.

Sponsored research administration (SRA) (i.e., grant submission and management) policies, personnel, and support. Nine of the 13 articles found faculty to perceive SRA grant submission and management policies, personnel, and support to be a key factor in the facilitation or hindrance of grant activities. This was related to pre-award/grant submission process or the post-award/grant management infrastructure, or both. For pre-award, faculty viewed a lack of administrative support and infrastructure for getting grants submitted as a key barrier (Belgrave et al., 2019). Faculty rated that having 'inadequate support to submit in a timely manner' was an important barrier to grant activities (Boyer & Cockriel, 2001; Walden & Bryan, 2010). Several articles identified the importance of being able to quickly obtain necessary administrative approvals or signatures for proposal submissions (Daniel & Gallaher, 1990; Dooley, 1995; Monahan, 1993). Additionally, faculty rated the importance of RDPs 'assisting with proposal preparation' (e.g., assisting when required items are missing), 'support for processing the submission of grants,' and 'review and negotiation of contracts' (Dooley, 1995; Mullen et al., 2008; Walden & Bryan, 2010).

Three articles commented explicitly on post-award issues, e.g., the 'financial management of grants' or 'disbursement of funds' (Mullen et al., 2008). One article reported post-award barriers to include inexperienced post-award administrators, poor follow-through to pay contractors, and reports not being submitted on time, resulting in faculty having to hire their own personal administrator for post-award management (Pinto & Huizinga, 2018). Additionally, faculty rated post-award support services as a high priority for grant activities to 'reduce bottlenecks for better financial accounting' and to provide 'follow-up notifications to faculty of progress reporting and renewal proposal deadlines' (Cole, 2007).

Some of the reported SRA-related barriers or facilitators were not specific to either pre- or post-award. One key issue reported was the need for a centralized pre- and post-award (i.e., SRA) office. Faculty with decentralized pre- and post-award offices did not know whom to go to for support (Pinto & Huizinga, 2018). To 'add more research administration staff during times of peak proposal deadlines to overcome frustration and alleviate the increased workload' was rated on Likert scales to be a high priority to grant activities (Cole, 2007). Some other barriers to grant activities rated as important by faculty included a 'lack of technical assistance' and allowed 'budgetary items not reflecting the needs of the project' (Daniel & Gallaher, 1990). Rightly, faculty also rated 'support for compliance with safety and security rules' as an important facilitator for grant activities (Mullen et al., 2008).

Evaluation, tenure, and promotion. Nine of the thirteen articles reported barriers or facilitators related to the value placed on grant activities. In one article, faculty rated that an important support for grant activities was that 'writing proposals for external funding is valued at my institution' (Easterly & Pemberton, 2008). Faculty in eight articles specifically rated the importance of grant activity being part of the 'consideration in tenure and promotion' or consideration in 'evaluation/ merit increases' (Boyer & Cockriel, 1998, 2001; Daniel & Gallaher, 1990; Dooley, 1995; Monahan, 1993; Pinto & Huizinga, 2018; Sterner, 1999; Walden & Bryan, 2010). Conversely, a revolving administration with differing expectations or inconsistent value placed on grants was reported as a barrier to grant activity (Daniel & Gallaher, 1990; Pinto & Huizinga, 2018).

Scholarly networks. In eight of the 13 articles, faculty viewed barriers and facilitators related to scholarly networks. Five of the 13 articles found faculty to view 'collaborators' to be a facilitator to grant activities. Diverse collaborators were mentioned, including collaborations with community members, collaborators at their university, peer-collaborators, industry connections, and collaborations with senior researchers (Belgrave et al., 2019; Cole, 2007; Easterly & Pemberton, 2008; Pinto & Huizinga, 2018; Sterner, 1999). 'Good collaborative research networks' was reported as a key facilitator (Belgrave et al., 2019). Additionally, several articles responded that 'having mentors' facilitated grant activities or 'a lack of mentors' was a barrier (Belgrave et al., 2019; Easterly & Pemberton, 2008; Mullen et al., 2008). One other reported facilitating factor related to scholarly networks was the development of interdisciplinary or research clusters to facilitate large-scale university proposals (Cole, 2007).

Scholarly climate. Six of the thirteen articles found that faculty viewed facilitators and barriers to grant activities to be related to the scholarly climate. Some faculty viewed 'the institution' itself or the 'general intellectual/scholarly climate' to be facilitators to grant activities (Belgrave

et al., 2019; Mullen et al., 2008). In four of the reviewed articles, faculty rated the importance of supportive upper administration or 'a strong commitment from the college president' for facilitating grant activities (Belgrave et al., 2019; Boyer & Cockriel, 1998, 2001; Daniel & Gallaher, 1990). Some faculty complained of barriers being an unscholarly culture not valuing the rigorous research necessary for grants or not valuing grants at the department level (Pinto & Huizinga, 2018; Walden & Bryan, 2010).

Additionally, transparent policies and procedures related to research was another key component of a scholarly climate that faculty reported to facilitate grant activities. For example, having poor interdepartmental communication about grant activities was thought to be a barrier to grant activities (Daniel & Gallaher, 1990). Additionally, having channels of communication and clarity of information on research policies, procedures, and guidelines and on research integrity or compliance was viewed as facilitators to grant activities (Mullen et al., 2008).

One article by Cole (2007) focused on understanding the attitudes of faculty and RDPs necessary for a scholarly climate. When referring to research administrators, using Likert scales, faculty rated high levels of importance to the need for changing attitudes to 'reduce arbitrarily implemented policies and be less rigid in their attitudes' and to 'offer services as the greater purpose and not just attending to compliance.' Faculty also rated the importance of the needed attitude changes from the faculty themselves to 'understand that administrators are trying to facilitate grant submission and administration and to treat administrators with mutual respect' and to 'be more sensitive to the time of research administration personnel and their workload.'

The discussion section describes how each of the eight issues relates to the three core categories and may support the service-delivery of RDPs, and recommendations for RDPs have been suggested. Additionally, practical implications, study limitations, and suggested future research are provided.

Discussion

We sought to answer the research question: "What factors are perceived to be barriers or facilitators to grant activities by research faculty based on extant literature?" There were eight important issues reported by faculty, and across those issues, the three main takeaways (or core categories) for RDPs were the importance of: 1) organizational culture; 2) educational resources and learning opportunities; and 3) technical assistance from expert RDPs.

Practical Implications

RD in higher education is a service delivery system with RDPs serving the role of practitioners and faculty as clients. The results of this systematic literature review are important because RDPs need to be able to provide evidence-based practice and this review informs RDPs of the factors that faculty (their 'clients') view as being most important to grant activities. Implementing effective client-centered research support services is critical for the success of faculty grant activities, especially since grant activities are most often a required job task for faculty and often necessary for promotion. Additionally, it is important that the organizational culture supports grant activity

and helpful educational opportunities, and technical support are offered to faculty to ensure autonomy and decrease regulatory burden. This has been studied in many ways from a research management perspective with meaningful changes in processes becoming normalized for future activities (Cola et al., 2022). It is from such examples that we can learn how to improve grant activity processes and better support investigators in meaningful ways. We define 'organizational culture' as the collection of values, expectations, and practices that guide the action of all involved, including faculty, research staff, upper administration, entire university research support offices, and academic departments or colleges. All the involved individuals and groups will also need to support effective educational opportunities and technical clerical support for faculty in order to facilitate grant activities. There is much literature that supports these ideas of organizational culture or climate as being important to ongoing research support services (Hackett, 1990).

Recommendations

The findings support several recommendations in response to the perceptions by faculty on factors of importance to grant activities. The three core categories can help to support the eight issues that were viewed by faculty as important to grant activities.

Organizational culture. A supportive organizational culture is key to facilitating all eight of the main issues related to grant activities. Based on faculty responses it is recommended to promote a scholarly organizational culture that supports grant activities. This culture includes supportive attitudes of RDPs that value grants and grant support, over arbitrary policies, and attitudes of faculty that express mutual respect for RDPs. It is recommended that internal funding opportunities are available (and promoted/announced) for scholarly pursuits, such as travel, funding for research student assistants, and matching (cost-share) funds. It is also recommended that faculty are rewarded for their grant activities, especially in their evaluation process, and awarded grants are recognized and announced within departments and colleges and university wide. Supportive policies for release-time from teaching and other assignments to work on grants are recommended. This may impact the individual drive of faculty for grant seeking and shows that grants are valued over or equally with other scholarly activities.

Based on faculty views, it is also recommended that mentor programs are created for faculty within departments, colleges, and university-wide and that faculty are supported in their effort to find collaborators. RDPs must encourage relational capacity in research, i.e., the ability to build deep and meaningful relationships with other researchers, such as mentors and collaborators (Cola & Wang, 2017). RDPs could host networking events based on a research topic and invite community members, possible industry partners, and researchers across disciplines. Positive collaboration and relationship building has been shown to improve performance, self-awareness, and many other measurable competencies across many cultures and work disciplines (Boyatzis et al., 2015). Additionally, RDPs can help faculty find collaborators with a specific skillset or research interest by providing them with a list of possible collaborators from faculty at the institution (or at others) with that same interest or skillset.

Additionally, clear channels of information about policies and procedures should be provided to faculty. Based on the views of faculty in the literature, it is recommended to have a central

office for SRA (grant submission and management), which reduces confusion on where to go for grant submission and management support and helps to facilitate streamlined policies and procedures. It is key that RDPs greatly value SRA employees (in the central office and across the university), and it is recommended that only technical experts in grants management be hired for these positions.

Educational resources and learning opportunities. Our findings suggested the utmost importance of educational resources and learning opportunities to facilitate faculty grant activities. It is recommended that faculty are provided with timely educational and training workshops on topics such as "how to recover from a rejected proposal," "how to know your audience [reviewers]," "Grants 101," and "steps within the proposal development process." Additionally, based on the responses of faculty we recommend faculty seminars (department-specific) on time management for tenure, how to connect with potential sponsors, and understand the indirect cost rate on grants and related disbursements of funds. Finally, it is recommended that faculty be provided with a library of grant activity aids (continuous support and resources), e.g., agency-specific grant writing workbooks. Based on faculty views, it may also be helpful to allow faculty to have time to hear from their peers or senior faculty within these workshops. It would likely be important to hold these learning activities in collaboration with multiple RD-related offices or groups.

Expert technical and clerical assistance. Based on the responses of faculty, it is recommended that faculty can receive technical assistance from expert RDPs in relation to their grant activities. Faculty need individualized help with finding funding opportunities, grant writing (or editing), working with compliance offices for submission or grant management, and connecting with funding agencies, potential community partners, or industry contacts. This level of individual or expert support may be especially valuable for junior faculty as well as for those faculty with less support at home. Additionally, it is recommended that faculty have expert support to assist with pre- and post-award management, such as making the signature/approval process for grant submissions as streamlined as possible, assisting faculty in dealing with sponsors (in the review and negotiation), and reducing bottlenecks for better financial accounting and reporting of grant funds and more timely purchasing practices. These process improvements are important and generalizable across research-related management practices (Strasser et al., 2013).

Limitations

The synthesis of qualitative research utilizes the findings of individual studies that are de-contextualized, and it could be possible that issues identified in one context may not be applicable to others (Thomas & Harden, 2008). An attempt was made to preserve context by providing detailed summaries of each study, including the study aims, faculty and university characteristics, methodological characteristics, and methodological quality detailed for each study. Therefore, it may also be beneficial for RD professionals to target one of the reported factors at a time, assess the perceptions of faculty specific to their university, and then strategize possible infrastructure, services, and resources within their university (while consulting the views reported in this systematic literature review). It should be noted that the results presented herein represent results obtained from the articles included in the systematic literature review, but they are not necessarily considered completely representative of all USA faculty that engage in grant activities.

Additionally, it may be the case that other barriers and facilitators to grant activities would be identified if this review was conducted on different countries or regions. Therefore, a potential future research area would be to conduct a similar review with an international focus.

The findings were described based on the number of articles per code. However, not all articles utilized interview or survey questions (e.g., fixed-response questions) that would lead the faculty participants to provide responses related to every code. Thus, it is important to note that the number of articles per response does not necessarily indicate that the barrier or facilitator is more or less important than others. The faculty responses are biased or based on the questions posed by the authors of each individual study. Other unknown barriers or facilitators to faculty grant activities that were not mentioned during interviews or surveys may be important to faculty grant activities, therefore, continued research in this area is necessary.

Future Research Directions

Further qualitative studies are needed with continued methodological rigor, across various faculty and university characteristics, to shed additional light on the perceptions of more faculty members within U.S. institutions and internationally. Additionally, further integration comparing the results of this and similar reviews (i.e., on faculty perceptions of barriers and facilitators to grant activities) to effectiveness studies of interventions (i.e., research-support services for grant activities) could provide further well-informed recommendations for evidence-based practices and continue to inform the development of chosen service-delivery strategies for practitioners in this field.

Conclusion

Faculty within U.S. institutions face many barriers and facilitators to grant activities, including: 1) grant proposal development; 2) time commitments, assignments, and priorities; 3) funding or resources from the university; 4) faculty personal interests, knowledge, or attributes; 5) sponsored research administration (i.e., grant submission and management) policies, personnel, and support; 6) evaluation, tenure, and promotion; 7) scholarly network; and 8) scholarly climate. Faculty, staff, administration (management), and university units require an effective 'organizational culture,' 'educational resources and learning opportunities,' and 'expert technical and clerical assistance' to address these issues.

In order to provide evidence-based practice supporting faculty grant activities, research development professionals are tasked with: 1) capitalizing on their professional expertise; 2) finding and utilizing the best evidence (i.e., empirical research on the effectiveness of research-support services/interventions); and 3) identifying the needs of their clients (i.e., faculty). This review offers the latter part of the triad of evidence-based practice by providing RD professionals with a review of faculty views on barriers and facilitators in grant activities to support pursuit of evidence-based and client-centered research support services by RDPs.

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Institutional Policies, Practices and Initiatives Impacting Research Productivity: The Strengthening of Collaboration, Leadership and Professionalism in Research Management in the Southern African Development Community (SADC) and European Union (EU) Higher Education Institutions (StoRM)

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Abstract: *Research productivity and research excellence are elements essential to the creation of a conducive research environment, in which research publications, research dissemination, and research utilization, are key in fostering the sustainability of higher education institutions. In this study, the current institutional policies, practices, and initiatives that encourage research productivity were explored. A mixed-method methodology, embodying a sequential exploratory approach, was adopted for the study. Non-probability, convenient sampling was used to select Higher Education Institutions (HEIs). A survey questionnaire comprising closed and open-ended questions was used for data collection. The data collection tool was piloted and refined. An integrative analysis consisting of descriptive statistical analysis and thematic analysis was used to analyze the collected data. The findings of this study highlight the instrumental role of university staff and students for research productivity. Building an institutional research culture was seen to boost research productivity. Increasing research capacity and visibility, the implementation of appropriate management infrastructure and the adoption of research policies were found to be effective strategies to support research productivity within Higher Education settings. Support for research publication and publication performance management was similarly identified to improve research productivity. It is recommended that the policies, practices, and initiatives set by HEIs should focus on research productivity, creating an institutional research culture,*

supporting research publications, and research performance management, in order to drive research productivity and contribute towards sustainability.

Keywords: *Higher Education Institutions, research productivity, research excellence, research management, research policies and practices*

Introduction

Higher Education Institutions (HEIs) have been recognized as institutions of learning and knowledge creation. By means of research and education, HEIs can create change agents for sustainability, through staff and students. However, Wright (2010) identified the sustainability of HEIs as a concern, because several issues and challenges arise regarding global sustainability, which has disproportionately affected HEIs, especially in Africa. Considering the higher education sector from the aspect of academia, administration, research, and social responsiveness, this highly complex phenomenon of sustainable development may overwhelm higher education institution administrators, academics, and leaders. A study conducted by Wright and Horst (2013) highlighted the paucity of empirical evidence that focused on the sustainability of HEIs and suggested that the concept of sustainability needed to be explored within, as well as across universities. While underexplored, education, research, and daily operations have been identified as domains that affect the sustainability of HEIs (Wright & Horst, 2013). Research is one such domain that enables sustainable development within and beyond HEIs. The findings of a review conducted by Findler et al. (2019) suggested that research played a pivotal role in the sustainability of HEIs, while promoting engaged scholarship, and impacting non-academic stakeholders. Therefore, research excellence could increase the sustainability efforts of HEIs through traditional academic impacts such as scholarly influence and non-academic impacts geared towards civil society and public policies, such as societal well-being (Aguinis et al., 2014; Thomas & Ormerod, 2017).

The best way that HEIs could create a momentum for sustainable development and research excellence is through collaboration and sharing of good practice on sustainability in education and research (Minguillo & Thelwall, 2015). This idea is twofold; firstly, in the endeavor to develop universities with research excellence, an enabling research environment must be present. Creating a conducive environment is required for growth and the effective utilization of research. For this environment to be present several factors need to be considered, including, but not limited to, adequate infrastructure, current technology, skilled and trained workforce, institutional capacity, an international standard, and adequate financial support. While HEIs may differ in their context and needs, the issues around sustainability may be addressed through the sharing of ideas, in an inter-professional, inter-university, and inter-country approach (Minguillo & Thelwall, 2015). This approach allows for the cross-population of ideas, leading to the enhancement of the sustainability of HEIs across the continent. Secondly, although this approach would allow for knowledge transfer and increased research productivity, developing best practice guidelines, considering the diversity across HEIs, remains a challenge.

There has been a call for scientifically warranted best practices within HEIs to address the productivity, efficiency, and quality of higher education, as well as the manner in which academic and institutional researchers determine research excellence within their institutions (Dowd & Tong, 2007). The scholarship of best practice should focus on professional development and learning among higher education practitioners, while the view of academic researchers as facilitators of learning, should be maintained (Dowd & Tong, 2007). Consequently, a continuous search is being conducted for best practices to be identified across HEIs to increase productivity and excellence. Aithal (2016) suggested that best practices for research productivity should include organizational objectives and policies, administrative support for research, faculty motivation for researchers and student participation in research, as well as supporting structures from the central university. Pratt et al. (1999) identified some factors related to high performance research environments, which include, but are not limited to, leadership commitment to research, programs on research management, integrating research into teaching and learning, as well as investments in research capacity. Quimbo and Sulabo (2014) highlighted that, while attempting to understand research productivity and research excellence, research capability, research outputs, research dissemination, and research utilization need to be considered to create a conducive research culture. Evidently, best practices surrounding research excellence and productivity are essential in fostering the sustainability of HEIs; therefore, this current study was aimed at exploring and describing the current institutional policies, practices, and initiatives that encourage research productivity.

Methodology

Study Design

A mixed-method methodology embodying a sequential exploratory approach was adopted to evaluate the current institutional policies, practices, and initiatives that encourage research productivity at HEIs. A mixed-method design uses both quantitative and qualitative methods, combined to satisfy the main objective of the study, and allows for a more comprehensive exploration of a problem than could be achieved with any singular method (Morse & Niehaus, 2016). In this current study, a sequential explanatory approach (QUAN-qual) was used, where the qualitative data assisted in clarifying some of the quantitative data.

Research Setting

Within an increasingly complex and competitive global research environment, effective and strategic research management is critical in ensuring the success and sustainability of HEIs. The Strengthening of Collaboration, Leadership and Professionalism in Research Management in the Southern African Development Community (SADC) and European Union (EU) Higher Education Institutions (StoRM) is a three-year project, funded by the European Union (EU)'s Erasmus+ Program, directed at supporting effective research management (StoRM Project, 2015/6). The overall goal of the project is to promote research outcomes, innovation, and impacts, through capacity building and professionalization of a skilled group of research

managers and administrators within HEIs in Africa, as well as Europe. Additionally, the aim is to promote collaboration and foster a mutual understanding between HEIs within the EU and SADC regions.

To reach these goals, the architects of the StoRM project have set out to, (1) establish a research management certificate course for early career research management professionals; (2) develop an executive Master's degree curriculum for mid-career research management professionals; (3) develop a Recognition Mechanism for research management professionals who have already produced a portfolio of work; and (4) implement a staff exchange program, aimed at sharing good practice and developing research management capacities across the various regions. As part of these outlined deliverables of the StoRM project, the strategy was to benchmark and develop best practice guidelines for institutional research policies, practices, and initiatives, which may impact research productivity at HEI's. In line with this deliverable, this study was conducted to evaluate current institutional policies, practices, and initiatives that encourage research productivity with a specific focus on research publications across the EU and SADC region.

Population and Sampling

Non-probability, convenient sampling was used to recruit Higher Education Institutions (HEIs) to participate in this current study. The HEIs targeted were partners in a European consortium and some of their networks. A total of 36 HEIs were invited to participate in this current study, of which twelve (12) HEIs agreed to participate, indicating a 33 percent participation rate.

Data Collection

Data were collected from participating institutions using a survey questionnaire, as suggested by Jones et al. (2013). All partnering institutions were invited to participate in the study via electronic communication. Through such communication, the purpose and aim of the current study was conveyed to the respondents in the form of an information sheet. Informed consent was gathered from the participating institutions prior to the commencement of the study. The respondents were instructed to complete the questionnaire electronically, to the best of their ability. An instruction guide was provided to respondents on the first page of the questionnaire, explicitly outlining the format, the preferred method of completion, a brief overview of the questionnaire, and contact details for response. Ethical clearance to conduct the study was received from Stellenbosch University Research Ethics Committee: Humanities under project no. 1714.

Data Collection Tool

An initial questionnaire survey was developed based on literature and circulated among StoRM partner institutions for content validity. The survey questionnaire consisted of closed as well as open-ended questions, to allow for the collection of quantitative and qualitative data simultaneously. The preliminary survey questionnaire was developed and distributed to the developing partners for feedback. The feedback was delivered during a consortium meeting and integrated into the questionnaire. These changes included reducing the length and changing the

format of the questionnaire from an e-survey to an electronic MS word version.

The final questionnaire included an information sheet, instruction questionnaire, and covered ten sections: (1) institutional background; (2) research management and infrastructure; (3) building and institutional research culture; (4) support for research publications; (5) open access; (6) research data management; (7) predatory publishing; (8) research capacity building; (9) research published performance management; (10) and research information management.

Data Analysis

An integrative analysis approach, consisting of descriptive quantitative analysis, as well as a thematic qualitative analysis was used (Caracelli & Greene, 1993). Descriptive statistics were calculated for the quantitative data, which included the frequency, range, mean, mode, and medium. The data set was captured, coded and cleaned then entered into the Statistical Package of the Social Sciences (SPSS) version 1.0.0.1406. A thematic analysis (Clarke & Braun, 2014) was conducted for the analysis of the qualitative data. The qualitative data were entered into Atlas.ti, a data analysis program, and coded. Initial codes were generated based on interesting elements present in the raw data regarding the phenomenon. Extracts supporting initial codes were inclusively selected including surrounding data. Initial codes were reviewed for similarity and merged to form themes and sub-themes representing the overarching ideas within the dataset. Themes were reviewed for accuracy by reviewing the entire dataset and coded data extracts supporting each theme thus ensuring that each theme displayed a coherent pattern and had sufficient supporting evidence.

Results

The results are presented below in five overarching themes, as emerging from the findings of this evaluative study. These include: (1) demographic details, (2) research productivity, (3) building an intuitional research culture, (4) supporting research publications, and (5) research publication performance.

Theme 1: Demographic Details

Twelve universities from the SADC and European regions participated in this current evaluative study. The majority of these universities were located in South Africa (n=7), followed by Namibia (n=2), Botswana (n=1), and Zimbabwe (n=1). The remaining university is in Lithuania, part of Eastern Europe.

Theme 2: Research Productivity

Several key components have been identified as pertinent for the support of research productivity within participating universities. These components included university staff and postgraduate students, who had either enrolled or graduated at participating universities. The findings supporting these two key components are discussed below.

University Staff Component

The participating universities provided the staff components within their institutions for the period 2017-2020. The university staff, including academic and non-academic staff members, have been observed to support research productivity at the participating institutions. The majority of the participating universities (n=7) employed a larger proportion of permanent non-academic staff (n=15 665), with a mean of 1305, followed by permanent academic staff (n=6269), with a mean of 522. The number of permanent non-academic and academic staff ranged from 0 to 6131, and 0 to 2122, respectively. However, the majority of the participating universities (n=7) reported employing non-permanent staff to support research productivity within their institutions. The findings indicated that the majority of non-permanent staff were employed as non-permanent/atypical academic staff (n=14078), ranging from 0 to 9855, with a mean score of 1173.

From these findings, most participating universities (n=7) disclosed the percentage of permanent staff members who had attained a doctoral degree, which varied across institutions, ranging from 20% to 72%. Of the staff components across universities within the SADC region, one South African university maintained the highest component of staff members who have obtained a PhD (n=64).

Postgraduate Students' Component

The majority of the participating universities (n=8) reported on the postgraduate students' enrolment and completion of masters and doctoral programs, as presented in Table 1.

Table 1. Master's and Doctoral Students (2017-2020)

Variable	Frequency (n)	Range	Mean
Postgraduate master's students			
Enrolled master's students	15757	194-5336	1969
Graduated master's students	4520	40-1668	565
Postgraduate doctoral students			
Enrolled doctoral students	5458	23-2287	682
Graduated doctoral students	132	0-311	16.5

Postgraduate students are identified as the key contributors towards research productivity at participating institutions. From this current study's findings, master's enrolments (n=15757) ranged from 194 to 5336 across participating institutions. The postgraduate students (n=4520), who had obtained a master's degree from participating institutions, ranged from 40 to 1668. In addition, the findings revealed that doctoral enrolments (n=5458) ranged from 23 to 2287. The postgraduate students, who had obtained a doctoral degree (n=132), ranged from 0 to 311. Interestingly, one participating university reported no doctoral graduates for the reporting period.

The findings revealed that postgraduate students supported research productivity at participating institutions, as depicted in Table 2.

Table 2. Electronic Repository and Encouragement to Publish

Variable	Frequency (n=12)	Percentage (%)
A dedicated electronic repository for archiving Master's theses and doctoral dissertations	9	75%
Encouragement of postgraduate students to publish from theses and dissertations	7	58.3%

Most participating institutions (9, 75%) indicated that an electronic data repository was dedicated to the archiving of theses and dissertations produced by postgraduate students. Unanimously, the participating universities (12, 100%) reported that their institutional libraries were responsible for the management of these repositories. Most of the participating universities (7, 58.3%) reported the encouragement of postgraduate students to publish from their theses and dissertations. Additionally, various methods were utilized to encourage publications among postgraduate students, including (1) financial incentives, (2) publications as a requirement for enrolment in doctoral programs, (3) as a requirement for dissertation submission, and (4) outcomes for staff development programs. These methods are further clarified in the excerpts presented below:

> *"In some faculties, it is compulsory/part of the completion requirements. We have a program which encourages publication from PhD." (University 1)*

> *"Modest financial incentive in some faculties." (University 4)*

> *"Many of the PhD students are staff members and it is part of their staff development program to publish." (University 6)*

> *"Indirectly by giving points to student's supervisor for publishing articles together, as well if master's student wants to gain PhD he/she needs publications for enrolment completion." (University 11)*

Theme 3: Building an Institutional Research Culture

The majority of participating universities (11, 91.6%) indicated that several initiatives geared towards promoting a culture of research have been implemented within their institutions. By building an institutional research culture, several initiatives have been implemented to enhance research capacity, increase research visibility, and support research productivity, as depicted in Table 3.

Table 3. Promoting an Institutional Research Culture

Variable	Frequency (n=12)	Percentage (%)
Presence of specific initiatives to build a research culture	11	91.6%
Strategies in place to create visibility of research-related activities	9	75%

Building Research Capacity

Most of the participating institutions (11, 91.6%) indicated that several programs aimed at building the capacity of researchers were being offered at their institutions, as depicted in Table 3. Various departments and offices were responsible for the implementation of such programs, namely, (1) institutional divisions for research development; (2) research office/directorate; (3) directors of research capacity development; (4) Deans of faculties and Heads of Departments; and (5) centers for research and publication.

Research Management Infrastructure

The majority of participating universities (11, 91.6%) had implemented research management infrastructure to oversee and govern research strategies, activities, and outputs, as depicted in Table 4.

Table 4. Research Management Infrastructure

Variable	Frequency (n=12)	Percentage (%)
Presence of research infrastructure	11	91.6%
A dedicated Vice Chancellor or deputy vice chancellor for research	9	75%
A dedicated research director	11	91.6%
A dedicated research office	10	83.3%

Research management and infrastructure focuses on the research management managers and directors within HEIs. The participating HEIs reported that research at their institutions was managed by either a deputy vice chancellor (9, 75%) or a research director (11, 91.6%), while most (10, 83.3%) had a research office. The remaining participating institution (n=1) disclosed the absence of such research management infrastructure. The institutions reported that the number of staff members in their current research offices ranged from 2 to 50 members.

Research Visibility

The majority of the participating universities (n=9) indicated that strategies had been implemented at their respective institutions to increase research visibility. These strategies

included: (1) research reports; (2) media; (3) institutional websites; (4) newsletters; (5) social media handles; (6) national and international conferences; (7) research weeks; and (8) strategic research areas. The following excerpts elaborate on these specific strategies, aimed at increasing the institutional research visibility:

> *"Division for Research Development has an annual Research Report that creates visibility for research activities; we nominate our researchers for awards and prizes, etc." (University 1)*

> *"Faculty research days, research week." (University 6)*

> *"The university website has a dedicated page for the Research Office where all research activities are posted... [s]ending academic members of staff to international conferences where they share their research activities." (University 9)*

Open Access Publishing

The strategy to support open access publishing is closely linked to increasing the research visibility of an institution, as depicted in Table 5.

Table 5. Open Access Publishing

Variable	Frequency (n=12)	Percentage (%)
My institution has an institutional policy and/or guidelines on open access	7	58.3%
My institution is in the process of developing an open access policy	3	25%
My institution is not planning to develop an open access policy	-	-
I am not sure	2	16.7%
Specific strategies are set in place to support open access publishing	5	41.7%

Seven of the participating institutions disclosed an existing open access policy (58.3%), while three other institutions (25%) were expected to implement an open access policy within months of this current study. The majority of the participating institutions indicated that the libraries and designated research offices of institutions were responsible for the promotion of the open access policy on campus. At five of the institutions (41.7%), specific strategies had been implemented to encourage open access publishing, namely, funding, training, advocacy, and engagement. The remaining seven participating universities (58.3%) failed to identify specific strategies that were implemented for the support of open access publishing. Two participating universities (16.7%) indicated that they were unsure about any institutional policies or specific strategies geared towards open access publishing. In addition, several barriers to open access publishing had been identified by the participating universities, as displayed in Table 6.

Table 6. Barriers to Open Access Publishing

Variable	Frequency (n=12)	Percentage (%)
Lack of awareness of the value and benefits of open access	7	58.3%
Lack of precise definitions, technical standards and procedures in the area of open access	4	33.3%
Different practices and types of data across different scientific areas	4	33.3%
Uncertainty about national regulations	3	25%
Fragmented copyright regulations	3	25%
Lack of funders` regulations	3	25%
Concerns with higher costs incurred with open access	6	50%
Concerns with privacy and confidentiality of data	6	50%
Lack of specialized staff for teaching and promoting open access	2	16.7%
Lack of support at institutional level to assist researchers	2	16.7%

Seven participating universities identified the lack of awareness of benefits of open access publishing (58.3%); six identified the higher cost (50%); six expressed concerns for privacy and confidentiality (50%); and four identified the lack of definitions, technical standards and procedures (33.3%), as barriers to open access publishing. In addition, the following barriers were identified by the participating universities: differential practices and data management across scientific areas (4, 33.3%); uncertainty of national regulations (3, 25%); fragmented copyright regulations (3, 25%); lack of funder regulations (3, 25%); lack of specialized staff for teaching and promoting open access (2, 16.7%); and lack of institutional support for researchers (2, 16.7%).

Research Policies to Address Research Productivity

Besides the contribution of human capital components towards research productivity and outputs, all the participating universities (12, 100%) reported the implementation of a research policy, or strategy document, within their institutions. These policies/documents were aimed at increasing research productivity by addressing the culture of publishing within the institutions. It was anticipated that these policies and strategies would promote research outputs, increase research productivity, enhance the quality of publications, provide incentives for publications, and encourage publication in reputable journals (high-impact and non-predatory journals). Overarching strategies utilized across universities included the following aspects: open access, publication fees, research ethics, research integrity, plagiarism, data management, confidentiality of data, as well as citation and authorship.

Support for Research Productivity

The majority of participating universities (11, 91.6%) indicated that initiatives had been implemented to support research productivity within their institutions. The most commonly reported initiatives included: (1) funding; (2) conference support; (3) project support; (4) publication fee support; (5) incentives for publication; (6) recognition of research achievements; (7) fellowships; (8) workshops and training; (9) writing retreats; and (10) a designated research repository.

The respondents elaborated on the specific initiatives that were implemented at their respective universities to build a research culture, as depicted in the excerpts presented below:

> *"Internal funding is available to researchers to attend local and international conferences and to pay for research-related expenses related to a specific project." (University 6)*

> *"Institutional researcher of the year awards, Institution Research." (University 5)*

> *"Internal small grants for interdisciplinary teams to undertake joint applied research projects and we have conference attendance guidelines to support staff to attend conferences where they present academic research." (University 12)*

Data Repository to Increase Research Productivity

The majority of participating institutions (n=8) reported that a dedicated repository had been established for the archiving of staff publications, which was primarily managed by: (1) library information services; (2) research office; and (3) the ICT directorate. Additionally, the institutions indicated that the database/repository distinguished between local and international publications, as well as the different types of publications. As part of a data management strategy, the majority of institutions (n=9) reported the use of an electronic data repository for the archiving of masters and doctoral dissertations.

Theme 4: Supporting Research Publications

The participating universities also described effective strategies used to increase research outputs within their HEIs. These strategies included: (1) publications as a requirement for promotion; (2) workshops to address publishing; (3) incentives for publications; and (4) the provision of mentors to researchers, academic staff, and postgraduate students. These strategies are discussed further in the excerpts below:

> *"Recruitment of academics makes it mandatory for academics to undertake research and is a national regulatory requirement by the Botswana Qualifications Authority and internally our statutes require academics to research and publish for teaching and promotion purposes and criteria for promotion is available to guide the kind of research and publication that earns more points than others." (University 12)*

> *"Taking academic members to writing retreats with the condition that they submit a draft manuscript they will work on during the retreat and submit the manuscript for publication*

towards the end of the retreat." (University 9)

"The University provides incentive funding for Department of Higher Education and Training (DHET) subsidy-earning publications, with the intention of increasing research output. However, the impact of this is not clear. While this does encourage publication, producing publications also forms part of the academic endeavour of our academic staff, and so, it cannot be ascertained whether publication output is a result of this or the incentives."(University 6)

"Recently we established the mentorship programme for research publications development. The aim of this programme is to develop researchers' competencies and produce high-quality research publications." (University 11)

Barriers to Publishing

Despite these strategies, the participating institutions identified four core barriers to publishing within their institutions, namely: (1) time constraints; (2) workload; (3) lack of experience in publishing; and (4) insufficient resources. These barriers are well identified in the excerpt provided by a participating university below:

"Lack of resources to conduct cross-cutting research which is publishable. Inexperience in publishing attributable to lack of mentorship. Workload too much for academic staff with the university being a teaching intensive university. Time to conduct research is restricted by huge teaching loads." (University 9)

Predatory Publishing

Predatory publishing has been identified as a practice that undermined the integrity of published works and served as a barrier to increased research outputs. Of the participating institutions, 83% reported that they were aware of predatory publishing. Evidently, eight institutions had implemented policies and procedures to address predatory practices; however, two institutions admitted that zero policies or procedures had been implemented by them for this purpose. These strategies included: (1) workshops; (2) communications to the research community; (3) published works; (4) research policy; (5) board meetings; and (6) the provision of an accredited journal list. These strategies are outlined in the excerpts presented below:

"The division has facilitated a workshop last year where experts have shared their knowledge with researchers of the dangers involved in predatory publishing and the pitfalls to look out for. Links to this workshop and others in this regard are available on the division's webpage. A general information document on predatory publishing drawn up by the division will also shortly be circulated to academics." (University 1)

"Communique regarding predatory practices are regularly sent out and the Library plays an integral role in creating awareness thereof. Academics are informed about these practices during Institutional Repository training sessions and when inquiring when they are approached by certain publishers to publish their dissertations with them." (University 10)

"It is addressed on the library website and a database with white-listed and blacklisted journals are available to research to verify publications." (University 5)

Theme 5: Research Publication Performance Management

The participating universities identified several licensed bibliometric databases, or products to which they had access, as presented in Table 7.

Table 7. Licensed Bibliometric Databases

Variable	Frequency (n=12)	Percentage (%)
Access to bibliometric databases or products	7	58.3%
CA Web of Science citation database (previously ISI)	7	58.3%
Elsevier Scopus database	7	58.3%
Journal Citation Reports	6	50%
Elsevier`s SciVal	4	33.3%
CA`s InCites	2	16.7%

The majority of participating universities (7, 58.3%) indicated that bibliometric analysis services were accessible to individual researchers within their institutions, while the remaining universities reported having no access to bibliometric databases. Bibliometric databases that were most accessible to the participating universities included CA Web of Science (7, 58.3%) and Elsevier Scopus (7, 58.3%). Only two universities (16.7%) with access to bibliometric databases were able to access CA's InCites. However, the participating universities specified other bibliometric databases to which they had access including Emerald, EBSCO-host, African Digital Library and Proquest Central. They indicated that the library and information services, data analysts, and research and innovation departments were responsible for the rendering of these services within the institutions.

Discussion, Conclusion, and Recommendations

The findings of this current study highlighted four key elements that foster sustainability in HEIs, namely, research productivity, an institutional research culture, support for research publications, and research performance management. These findings are consistent with the findings of a review conducted by Findler et al. (2019), suggesting that research, which promotes engaged scholarship, plays an influential role in the sustainability of HEIs. Research productivity, as outlined in the findings of this current study, focused on individual and institutional attributes in relation to the size of an organizational workforce, the enrollment of postgraduate students, and the qualification level of faculty members. Nygaard (2017),

similarly, identifies that sufficient size and capacity of a faculty is a key contributor to research productivity. The findings of this current study revealed a mean of 522 and 78.25 for permanent and non-permanent academic staff, respectively, within the participating universities.

However, increased research productivity requires more than mere faculty size; instead, the focus is placed on the individual characteristics of faculty members, such as age, gender, status, rank, discipline, and qualifications (Nygaard, 2017). The qualifications of academic staff were highlighted in this current study, as the participating universities varied in the number of academic staff who had obtained a doctoral degree (ranging from 20% to 72%). A study conducted by Smeltzer et al. (2014) highlighted the shortage of capacitated scholars to assume academic roles as senior faculty members begin to retire, and indicated the importance of doctoral programs to build the capacity of scholars, particularly its effect on promoting scholarly productivity in the faculty. Consequently, the capacity and experience of faculty members impact the research productivity of postgraduate students within HEIs.

Postgraduate students have been recognized as contributors to the research productivity in HEIs, as they are often encouraged to disseminate the results of their thesis to the scientific community in the form of peer-reviewed journal articles or conference abstracts (Obuku et al., 2018). While most participating universities in this current study indicated the establishment of an electronic database for the archiving of completed theses and dissertations produced by postgraduate students, seven institutions actively encouraged research productivity among students. A study conducted by Morales et al. (2017) suggests that faculty-student productivity, while understudied, is likely to contribute to research productivity, enhance collaborative research, produce more productive scholars, and increase the capacity of students. The review conducted by Obuku et al. (2018), similarly, suggests that reviewed articles failed to report on the effects of strategies to increase research productivity or dissemination of research produced by postgraduate students. While this current study did not report on the effectiveness of strategies for research productivity among postgraduate students, the participating universities highlighted the various strategies that were implemented to increase research productivity, including financial incentives, publication as a requirement for enrolment to a doctoral program, or dissertation submissions, and outcomes for development programs.

At inception, Dundar and Lewis (1998) suggested that research productivity in HEIs assumes a multidimensional character, drawing on knowledge production, as well as knowledge dissemination, which are to be supported by an institutional research culture. Concurring with the ideologies outlined by Dundar and Lewis (1998), this current study identified an institutional research culture as an important factor that determines research productivity, as well as the performance of individual faculty members for the sustainability of HEIs. An institutional research culture relates to shared attitudes and values within an institution which create a research-orientated culture, where all members are socialized to be strong researchers (Dundar & Lewis, 1998). This is achieved through graduate training, valuing research, maintaining communication and collaboration with other researchers, and recruiting a capacitated faculty with appropriate research credentials.

The findings of this current study highlight the infrastructure, strategies, as well as policies implemented to create a research-orientated culture within participating HEIs, with key focus areas being research capacity programs, research management infrastructure, research visibility, open access publishing, research policies, support for research productivity, and dedicated research repositories. Aligned with the reasoning of Dundar and Lewis (1998), faculty members are to be capacitated and encouraged to attain skills that are associated with strong researchers. These skills and competencies are cultivated by the participation of individual faculty members in research programs, offered at the majority of participating institutions. HEIs, especially those based in Africa, are urged to provide such training programs that focus on research methodologies, statistical interpretation, and scientific writing, to adequately develop and support individual academic members (Chu et al., 2014). Additionally, the capacity development of academic members may be strengthened further through regional and international partnerships that contribute to sustainable development across HEIs (Chu et al., 2014).

Research management infrastructure, as discussed in this current study, plays an instrumental role in the development of a research culture in HEIs, as it is often responsible for the conception and implementation of policies and programs geared towards capacity development and research productivity (Aithal & Kumar, 2016). The same infrastructure, implemented to oversee policies and strategies that support research productivity, addresses an institutional research culture which has been implemented across all participating universities. These policies and strategies promote research outputs, publication quality, incentivising research outputs, and publications in reputable journals. Aithal and Kumar (2016) identified similar focus areas of institutional policies and strategies, including financial support for research expenditure, appreciation of good performers, the provision of appropriate facilities (such as libraries and internet facilities), encouragement of collaborative research, and the development of a research-based curriculum. These ideas, expressed by Aithal and Kumar (2016), concur with this current study's findings, which advocate institutional support for research productivity. The participating universities described their continuous efforts and initiatives, implemented to support research initiatives, such as funding, conference and project support, publication fee support, incentives for publication, recognition for research achievements, fellowships, writing retreats, workshops, and designated resources for research-related activities.

While it remains important to provide support for the production and dissemination of research and knowledge, the participating universities placed their focus on research visibility. One core aspect of visibility is open access publishing, which, as Niles et al. (2020) suggest, is being met with enthusiasm and has become increasingly valued by younger academics, compared to older academics in tenure positions. Surprisingly, despite its importance, only half of the participating universities had implemented policies that were dedicated to open access publishing, while the rest lacked awareness of the benefits of open access publishing. Evidently, according to these findings, a transparent need exists to increase the awareness and strategies of open access publishing within HEIs.

Lastly, research performance management is discussed in this current study's findings, with

more than half of the participating universities having access to bibliometric databases. While research performance management remains a cornerstone in the culture of HEIs, Niles et al. (2020) and Nygaard (2017) caution against performance measures used in HEIs. The authors caution against placing preference on articles over other methods of research dissemination such as grant proposals and policy-relevant documents, as these sources are crucial in maintaining the social relevance of academic research and underscore the vitality of institutions. Secondly, index scales and emerging ranking may evaluate performance, but disregard the sustainability of HEIs. The Green League Table, as adopted in the United Kingdom, tried to address these issues by utilizing a range of sustainability indicators to measure institutional performance.

The researchers in this current study sought to highlight current institutional policies, practices, and initiatives that encourage research productivity, to enable the sustainability of HEIs. The study's findings suggest that policies, practices, and initiatives set by HEIs should focus on research productivity, creating an institutional research culture, supporting research publications, and research performance management, in order to drive research productivity and contribute towards sustainability. While these areas of focus remain significant, several areas require further recognition for future research and practice. Increased attention needs to be directed towards faculty-student productivity. In this current study, the potential of faculty-student collaboration was highlighted, to increase research outputs while capacitating students with the required skills and competencies to assume research, or academic roles, once qualified. Ultimately, this would contribute towards the research-orientated culture envisioned by HEIs.

For this to be achieved, clear guidelines need to be developed to encourage student productivity and an evaluation needs to be implemented to establish the effectiveness of such a measure. Little is known about the effectiveness of varied strategies used to encourage the research productivity of students enrolled in postgraduate programs at HEIs. Secondly, while measures to support research productivity are extensively outlined in existing evidence, the concept of research productivity remains broadly defined. Consequently, the implantation and effectiveness of strategies introduced within the HEI environment often vary with little consistency. There needs to be a larger focus on the implementation of strategies that are geared towards research productivity, and their effectiveness, for the establishment of best practice guidelines which may be adopted across HEIs to promote research productivity as well as sustainability. Finally, more resources should be dedicated to address predatory publishing and open access publishing. While most universities are aware of predatory publishing, there needs to be a greater drive to develop policies that caution against predatory publishers and the harmful impact associated with the practice. Conversely, more resources need to be dedicated to establishing policies and practices to promote open access publishing, as well as to raising awareness about the benefits of the practice within HEIs.

Implications for Practice

Several implications for practice could be highlighted for HEIs from the findings of this current study. Firstly, Research Information Management and Research Data Management are key areas for the development of research-intensive institutions. These areas are likely to provide evidence-

based information to support optimal decision making within HEIs. There is a need for liaison between institutional research-related support divisions, such as information technology departments, libraries, and research and governance offices. Liaison between these divisions within HEIs is likely to create supportive and research-intensive environments, contributing to research excellence within HEIs. Lastly, inter-institutional collaboration and networking is important for benchmarking, as well as best-practice development, and should be encouraged further.

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A Framework for the Management of Research and Innovation Projects in Academic Settings

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Abstract: *The contemporary complex settings under which research and innovation (R&I) activities are executed in academic institutions calls for the definition of suitable management and administration approaches. To this end, (1) the existing literature on the management of R&I projects in the academia is reviewed; (2) major specificities of R&I projects are discussed; (3) recent trends in project management are addressed; and (4) a specific framework for the management of R&I projects in higher education is proposed. The proposed management framework is defined in eight pillars, namely: (i) clarification of scope and goals; (ii) use of standards; (iii) scalability and flexibility; (iv) workflow modelling; (v) use of tools, techniques and templates; (vi) existence of a "project board" or similar; (vii) adequate risk management; and (viii) organizational learning. The authors argue that it should be seen as a practical tool for university managers and administrators to apply a structured and comprehensive overview of key action areas that will increase the effectiveness, efficiency and impact of R&I project management and administration in academic contexts.*

Keywords: *higher education; third mission; research and innovation administration; project management; management framework*

Introduction

Besides the functions of teaching and research, higher education institutions (HEIs) are required to contribute to society through the creation, transfer, and exchange of knowledge and technologies, i.e. fulfill their "third mission", in close interaction with key societal stakeholders such as enterprises and local communities. The associated shift from discipline-based research ("mode 1") to interdisciplinary knowledge production, involving industry or service partnerships and increased social accountability ("mode 2") has led to deep changes in the organizational structure of research and innovation (R&I) ecosystems (Rajaeian et al., 2018; Wilts, 2000), and particularly of academic institutions (Emmert & Crow, 1989), namely in terms of project management practices (Wedekind & Philbin, 2018). Public research-performing organizations in general have been re-shaping their management and organizational structures towards a more

market-oriented approach, with a strong executive control approach also known as 'new public managerialism' (Shattock, 2010; Deem, 2017). In this new environment, public, academic, and private agents and their consortia seek to achieve innovative results across disciplinary, organizational, and national boundaries (Lippe & Vom Brocke, 2016). Also, HEIs, in particular, have taken on collaborative projects, seeking to increasingly secure funds from regional, national and supranational sources, and to access complementary knowledge and competencies.

In R&I activities, goals are ambitious by definition, the aims uncertain, and partners often have heterogeneous interests (academic-, business-, or policy-oriented). Consequently, the application of "standard" or "mode 1" management approaches tends to be displaced, since the setting of such multi-stakeholder R&I projects, "mode 2", is inherently different from "regular" new product development carried out by individual companies or public research labs (European Commission, 2014). In the latter, pre-specified product or service descriptions or requirements are provided by the "customer". In the former, a high level of creativity to produce novel outcomes is required. Often, the results are intangible, such as knowledge not yet incorporated into new products or services by the end of the project. Under "mode 2" R&I projects, managers must integrate individual and small-team research activities that demand high levels of creativity and innovation. However, funding bodies and institutions require clear work plans, perfectly defined and assigned responsibilities, and strict schedules, deliverables and milestones. This apparent contradiction calls for flexible and adaptable project management approaches.

Success or failure of contemporary R&I endeavors is, therefore, strongly linked to the project management practices adopted by institutions and teams along a collaborative and "open" context (as in open science, open innovation), under which new knowledge and technologies are developed and transferred to the society at large. Although the use of professional managers is increasing, on many collaborative projects a scientist is given the project management role in addition to scientific responsibilities. Unfortunately, this added responsibility is typically not accompanied by the necessary training or tools to fulfil the role. The result is an increased risk of missed performance targets and of inefficiently managed resources (Procca, 2008). Also, the acceptance of project management methodologies may not be the same in the academic institutions compared to industry mainly because generally university researchers lack the skills in managing and planning research projects (Ali Qalati et al., 2019; Chin et al., 2012). To try to mitigate this, Johnson et al. (2020) report the development and implementation of a project management community of practice at a university aimed at sharing best practices, tools, and resources among research project managers. Actually, academics tend to disregard the importance of project management elements and functions in the management of collaborative projects (Gist & Langley, 2007). Moreover, researchers may have competing obligations on their time, e.g. teaching, administration or other projects.

Thus, the management of R&I projects in academic settings requires different frameworks than those typically applied in "traditional" projects. The research question forming the basis of this study is: "Which should be the basic components of a project management framework adequate to the R&I endeavor in the academic sector?"

To answer this question, the research methodology used is based on documented action and

participatory observation. To that end, use is made of a case study: the *ValorNatural* project. This is one of the main multi-stakeholder research projects in Portugal dealing with the contentious topic of new natural ingredients for the agribusiness industry, funded by the Portuguese government under the country's Framework Programme 2014-2020 (Portugal 2020) within the European Structural and Investment Funds (ESIF) of the European Union (EU).

Literature Review

The application of project management tools to R&I activities is not new. Anderson (1967) addressed the adaptation of the program evaluation and review technique (PERT) for coordinating interdisciplinary manpower research in university setting. The research was developed to determine (a) the effect of PERT scheduling on researchers, (b) the familiarity of researchers with PERT and the extensiveness of its use, and (c) researchers´ attitude toward interdisciplinary research. It was found that (1) reaction to PERT was favorable, (2) approximately 50% of researchers were familiar with PERT, and (3) researchers were in favor of interdisciplinary manpower. The author concluded that PERT assists researchers in valuable and realistic planning for their projects. Liberatore and Titus (1983) developed an empirical study on the usage of quantitative techniques for R&I in "Fortune 500" industrial firms. The authors concluded that managers missed a thorough understanding of the budgeting techniques used by their organizations. Also, the authors noted that the initial training for research managers in project management should provide a broad-based introduction to the available methods and techniques, while emphasizing organizational "fit" considerations. These examples illustrate that early research on R&I project management essentially focused on planning and compliance with schedules, costs and budgeting. The work of Liberatore and Titus (1983) does nevertheless point out the need for adequate training of managers and for alignment of research management with the organizational culture and setting. Both issues are still relevant today, and require further research, as evidenced by the case study addressed herein in the context of the development of a new management framework for R&I projects.

Following the consolidation of the shift from "mode 1" to "mode 2" research setting, the focus of research on R&I project management has moved to a higher concern with conciliating academic and industrial approaches. This is mainly due to: (a) the need to align R&I with business needs in the increasingly common academia-industry collaborative projects, and (b) the fact that increased accountability of the use of public funds has led to the need for "standardized" project management practices.

Gist and Langley (2007) reported the use of PRINCE2 (a structured project management methodology, originally developed as a UK government standard for information systems projects) in a multi-national clinical trial. The authors addressed the challenge of ensuring that the project management tools add value to the project overall and are not perceived as an overly administrative burden. The paper takes into account the wider costs and benefits to researchers and funders of taking this approach and explores implications for research administrators and managers at institutions involved in large, complex collaborative research projects, whether clinical or not. A framework for research projects management based on three success-based

pillars was developed by Powers and Kerr (2009). The three pillars comprise: (a) a credible and recognizable definition of the desired state; (b) a credible and compelling measure of deviation from the desired state; and (3) a way to bring the project back on track. This approach focuses on reducing uncertainty in the early phases of research projects by developing short-term tasks with limited resources and restricting scope accordingly. This is clearly in line with industry standard agile project management methodologies. For this framework to succeed the authors highlight the need for a "functioning feedback mechanism, including the capacity to change the behavior of the researchers".

Chin et al. (2012) proposed a project management methodology to be applied in a university-industry collaborative research environment in Malaysia using reference industrial standards such as the Project Management Body of Knowledge (PMBOK), PRINCE2, Association of Project Management Body of Knowledge (APMBOK) and British Standard BS6079-1:2002. The primary outcome of Chin's study was a project management methodology guidebook for the initiation, planning, execution, monitoring and closing of research projects.

Binder et al. (2014) reported a combination of agile approaches with the international standard ISO 21500:2012 ("Guidance on Project Management"). The authors proposed a new "cocktail" system to complement waterfall-based project management models (such as PMBOK, where you complete a project as a step-by-step—linear or sequential—process) with flexible approaches (such as Scrum). It was found that the utilization of agile principles may struggle with business processes like knowledge and procurement management.

Philbin (2017) reported on the results of an exploratory study based on a systematic literature review, which was carried out in order to improve the understanding of the key features and issues arising from the application of project management principles to research projects. The dimensions analyzed were process, structure, people and technology. The paper included a synthesis of a proposed research agenda in order to advance the knowledge base on the management of research projects. The author pointed out that there is a need for empirical data on the management of research projects. The data reported herein on the management of the *ValorNatural* project contributes to the fulfilment of this identified need.

Wedekind and Philbin (2018) addressed the challenges of managing R&I projects in academic settings, in the context of a case study related to a European Union funded initiative, and the key role that project management offices (PMO) using PRINCE2 principles can play in this regard. The authors concluded by recommending an increase to the number of cases under investigation on this topic.

Pirro et al. (2019) developed a project management methodology specific for use in doctoral research projects, based on agile management practices.

These examples illustrate that in what concerns the use of formal project management for R&I projects, no ideal methodology exists and, often, a combination of concepts and approaches from different standards are needed to efficiently and effectively translate best practices from "traditional" project management to R&I endeavors.

In conclusion, there is a need for more holistic approaches to project management that account for the complexity of contemporary R&I endeavors. Therefore, this research paper aims at contributing to this topic by identifying common "pillars" of formal project management approaches that should be considered when developing management models for "traditional" projects and, in particular, R&I initiatives. Thereafter, the authors propose a R&I project management framework that facilitates structuring of project management methodologies and their practical application to planning, conducting and assessing of management activities for academic R&I projects.

Methodology

A two-stage methodology was adopted. The first stage reviewed the literature on R&I processes and on project management. For this, the Scopus database (Elsevier's abstract and citation database, covering approximately 36,377 titles from 11,678 publishers) was used employing search terms such as "research and innovation" and "project management". The following exclusion criteria were applied: 1) publications that did not include sufficient coverage of both topics, 2) publications that did not use any form of formal research methodology, 3) publications repeating concepts or analyses, and 4) publications not addressing academic contexts. The results presented herein are representative of the major findings. In the second stage, the authors conducted documented action and participatory observation, based on the main author's experience in working with the project *ValorNatural*.

The sources of empirical evidence used in this exploratory case study were documented action and participatory observation (primary sources) as well as documents and materials (secondary sources). The case study approach was selected as it is a form of qualitative research that analyses a phenomenon in its real environment, based on multiple sources of evidence, being recommended when the social and personal context is fundamental in understanding and interpreting the phenomenon (Franco & Haase, 2015). The research corresponds to a single case study. This method facilitates the exploration and capture of common characteristics and conditions of similar "projects" within the case (Yin, 2009).

The *ValorNatural* project was selected as an adequate and representative case study because it involved partners from industry, academia and interface organizations dedicated to technology and knowledge transfer. The consortium consisted of nine companies, two higher education/research organizations, two research organizations and one interface organization (not performing research). The disciplines involved included biotechnology, chemical engineering, mechanical engineering, electro-technical engineering, food science and materials science. The project was led by a company and coordinated by a higher education/research organization. Thus, its heterogeneous consortium composition, multidisciplinary and market-driven nature provided an adequate case study in the context of our research. The case study results validated the logical structure of the framework and showed its utility.

The Management of Research and Innovation Endeavors

In this section, key specific characteristics of R&I endeavors are discussed, in particular in HIEs. It is argued that these characteristics are those that make R&I projects differ from "standard" projects. Four main areas are addressed: (1) project preparation; (2) project context; (3) project uncertainty and (4) project human factor. Each one of these areas will be addressed in detail in the following subsections.

R&I Project Preparation: Where it All Starts

Every R&I endeavor begins with the identification of problems and/or opportunities, set in a particular context. Eventually, these needs will have to be evaluated and prioritized in the light of specific criteria such as urgency and opportunity windows. Inevitably, a research project proposal has to be developed. This involves the preparation of a document, more or less succinct, mentioning the need, goals, objectives, contextual benefits, high-level estimates of schedules, resources and financial requirements. Also, a preliminary risk analysis ought to be provided. This information will allow an informed priority setting among various competing projects that are being pursued at a given point in time. With regard to eventual benefits resulting from the project execution, these can actually be quite varied and could range from an increase of the image/visibility of the HEI to the development of some scientific expertise in a particular area. The relative importance given to each benefit should be clear in the project proposal. Also, though it may not be possible to do a detailed cost-benefit analysis for each and every project, it is nevertheless useful to have an idea of the total cost and benefits, including those at the utilization stage.

Often a R&I project needs external funding to be executed. This is increasingly the case in academic settings, namely in HEIs, and competition over resources made available by both public and private entities has been increasing steadily. The project may require a volume of resources not available at the host organization, or a set of skills and competencies that demand joint ventures with other organizations. Funders may be public, private or a combination of both. Their mission includes (but may not be restricted to) facilitating availability of funds and resources for R&I activities that are consistent with defined policies and priorities, which may not coincide with the researchers' interests and ideas.

Funders do expect a well-defined timeframe and budget for project implementation. This is often influenced by increasing accountability on the use of public funds (in the public sectors) and by the existence of "opportunity windows'" beyond which the sought novelty may vanish (in commercially or privately funded projects). Research is therefore implicitly delivered through projects that have a well-defined life expectancy timeline and resources pool that are used to provide deliverables within specifications and a predefined set of quality criteria. Thus, project management is particularly relevant when researchers compete for external resources, with donors requiring clear information on research plans and results.

The Project Context

The context of a R&I project includes the social, economic, political and technical conditions that surround any research endeavor. The impact of these, and other dimensions should be evaluated

beforehand (ex-ante), but also monitored during implementation (real-time), and assessed again after its conclusion (ex-post evaluation), including reasons for deviations from the expected initial impact.

A R&I institution ought to make sure that results of basic and applied research projects are accessible to a wider range of stakeholders, namely those that can implement and exploit the created knowledge and technology into new processes, products, services, etc. Usually, the success of these organizations is measured by the intellectual output, e.g. scientific papers, patents, and by successful transfer of knowledge and technology to the community, namely the enterprise sector. However, a R&I project should be a part of a wider institutional program and also address national, regional and/or supranational science policy priorities. These may include projects aimed at solving societal challenges (such as an unexpected pandemic), without clear and direct economic return to the organization itself. Therefore, priorities for research set by policy-making bodies (often themselves research funders) and host institutions must be taken into account in publicly funded projects. Actually, if the project is not aligned with high-level priorities and strategies, the chances to be funded in the first place are dim.

The needs of customers and end-users must be accounted for. Indeed, increasingly, R&I projects are framed in "end-user based" development contexts. So, in the first place, one must critically acknowledge and evaluate the real needs of those who will use the new knowledge or technology. This may seem obvious, but the fact is that traditionally R&I projects are created around what a researcher perceives to be a specific need or opportunity, seldom validated by the actual end users. Researchers and users' interests are potentially divergent. The researchers, often, tend to work on the scientifically most interesting problems. Consequently, the technologies emanating from such research may not be very relevant to the actual end users.

Every project must also consider the state of the art of the knowledge in the relevant scientific fields. Often researchers focus on scientific literature, not paying due attention to other sources such as patent and commercial databases. Technology available from such external sources is often overlooked, thereby resulting in missed opportunities for translational technology implementation.

The project manager has to acquaint him/herself with the institutional context under which the project will be implemented. Namely, a good knowledge and practice of administrative procedures is recommended. Also, who are the key institutional stakeholders? Would they "buy" the project's main idea? If so, the prospects of a smooth project execution may be higher. Moreover, R&I institutions use project portfolios to fulfil their strategic plans. So, how well aligned is the project idea with existing portfolios?

Finally, research projects are often inter-organizational, multinational and multidisciplinary. In these projects there are challenges associated with different national languages and cultures but also different professional and institutional languages and cultures. Under such circumstances, the manager needs to become a kind of "knowledge translator" with the responsibility of facilitating processes that make it possible for project participants to discuss and communicate about research created outside their own academic and institutional fields (European Commission, 2014). This

may be particularly challenging for early-stage researchers based in the academy.

Uncertainty

Quoting Albert Einstein: "If we knew what we were doing, it would not be called research, would it?". This summarizes perfectly one of the main characteristics of R&I projects: uncertainty.

The ambiguous nature of goals in many large R&I projects, namely if curiosity-driven, represents a particular challenge when managing a project of this nature (European Commission, 2014). Also, it is commonly stated that the outputs of research projects are difficult to convert into quantifiable measures. This is usually the case in basic research projects, which produce mainly knowledge, be it concepts, ideas or frameworks. Funders and peers often struggle to identify clearly associated benefits. This is not the case with applied research as quantifiable deliverables are usually more plausible.

The implementation of innovative R&I projects is usually accompanied by high risk (Biscola et al., 2017; Ernø-Kjølhede, 2000; Huljenic et al., 2005). Particularly in applied research, a major source of risk is the uncertainty in relation to the development of the concept, of the solution, and to the verification of the conformity of deliverables. Uncertainty may arise from the lack of exact knowledge about costs, duration, or quality of planned activities. The uncertainty in the project design phase can also arise as a result of the usual heterogeneity in teams. Different views may arise regarding specific objectives, solution performance levels, stakeholder motivation and expectations, data quality issues (e.g. needs identification), and issues with the perceived skills of available team members. Often, uncertainty is actually created by a lack of clarity among the project stakeholders regarding desired outcomes. This can in fact be remarkably difficult to achieve, namely when groups of people that have not worked together before are set up. In this case, even differing terminology, not to mention cultural aspects, may hinder agreement. The development of an interdisciplinary culture is generally limited in the sense that researchers are primarily concerned with their own organizations' research questions and, therefore, may contribute to conflicts in multi-partner projects (Wiesmann et al., 2008). Moreover, researchers may prefer not to share their detailed objectives with their own institutions or colleagues if they feel constrained e.g. by their organizations' policies on intellectual property. In such cases, some members of the team intentionally stay vague to keep from attracting notice from their own research offices (Powers & Kerr, 2009).

In order to obtain innovative results, researchers should have a risk-taking behavior, increasing the probability of failure. But then, how to cope with uncertainty? An approach based on alternative solutions, and an analytical search for optimal solutions using multicriteria methods could help. Also, adequate risk management methods should be used. For example, Bodea and Dascalu (2009) proposed a risk evaluation model for research projects based on fuzzy inference. It should be noted, however, that R&I project managers tend to focus on scientific and technical risks, neglecting other potential sources related e.g. with context changes (e.g. a need that is no longer) or stakeholder management (e.g. someone that changes from supporting to confronting). This is usually a source of significant impacts on the success of a R&I project, and can be mitigated by incorporating project management best practices during the project definition stage.

The Human Factor

If there is a single critical aspect in R&I projects that is the human factor. This has consequences at several dimensions, namely at the project leadership, team and stakeholders' levels. These aspects will be individually discussed in the following subsections.

Project Leadership

Leadership is a significant challenge for research managers (Amollo & Omwenga, 2017). Besides technical and scientific skills, a leader of R&I projects has to have strong transversal skills (e.g. negotiation, conflict resolution and communication skills) and complementary hard skills such as those related to entrepreneurship. The achievement of a balance among these sets of skills is notably difficult. Usually, the project leader tends to be more of a technical-scientific expert. This raises challenges for managers as well as those that are managed, that increase because of the intrinsic uncertainty in research projects (European Commission, 2014). Such uncertainty requires a high level of autonomy of project participants with specific expertise in specialist domains. Thus, one of the first challenges for a research manager is to find the right balance between controlling participants (e.g. steering and instructing) and facilitating individual participants (e.g. informing and assisting).

Finally, project managers face an additional challenge imposed by the high-level hierarchy of management structures of R&I institutions that might impose restrictions in terms of leadership of research projects.

The Team

R&I project managers in HEIs have only very little formal authority over project participants. Usually, they are not their subordinates but peers. Furthermore, not only does the project manager not have authority over the project participants but also many of these may only be working part time on the project and have many other constraints on their time, making it even harder for the project manager to obtain commitment from participants. Also, usually, the specialty of researchers' individual knowledge requires the enrolment of team elements with complementary and interdisciplinary skills and knowledge. However, there are intrinsic dilemmas with this. On the one hand, as mentioned before, the researchers' desire for a large degree of autonomy in their work and democracy in decision making must be conciliated with the need for strict project control (e.g., adherence to budget and time limits). On the other hand, the fact that researchers both co-operate and compete with each other in the project (for recognition that might influence positions, grants, etc.) may lead to conflict between the joint goals of the consortium and individual goals of researchers. Additionally, the knowledge asymmetry between the project manager and the individual researchers may also be a cause of tension.

Lippe and Vom Brocke (2016) estimated the amount of time spent on partner management at 20–50%, based on interviews of project managers in collaborative research projects. The European Commission (2014) found that the composition of the consortium may change along the way in about one third of the projects, based on an analysis of EU's FP6 and FP7 projects.

Thus, team-building is particularly important in research projects (Cristina & Mihaela, 2008). For example, Ernø-Kjølhede (2000) found that successful EUREKA projects (a private-public European R&I association) are often characterized by the development of strong social relations between participants.

In projects with a high performance rating, the coordinator shares information with other consortium members in a timely fashion, trusting them to deliver as needed, and discussing any issues person to person (European Commission, 2014). Thus, a R&I project manager who wants to be successful should consider managing by continuously building relationships and high trust levels and invest in one-to-one communication. He/she should favor a consensus-based decision-making model, rather than a hierarchical or formal management style. This should be complemented with an all-inclusive approach. These activities serve to align consortium partners' interests and contribute to the project success.

In short, R&I projects´ management is more associated with concepts such as team building, treating people as peers and personal charisma/knowledge than it is with authority, subordination and issuing orders. Moreover, adequate team reward and recognition mechanisms, tailored to each institutional context (e.g., project performance as criteria incorporated in assessment frameworks) should be used to promote the team members´ commitment to the project.

Stakeholders

The critical factor of a successful project is often related with management of challenges and opportunities, and with how project attained outcomes are perceived by researchers, funding bodies, governmental agencies, potential end users of the new knowledge and technology, and other key people. Thus, R&I projects´ management performance is enabled by a high frequency of contact and involvement of key partners (i.e. stakeholders) in substantial decision making.

Formally, stakeholders are people, groups or institutions that may influence, or be influenced by, the project. They are those ultimately affected, either positively or negatively by the project performance. This definition of stakeholder includes both winners and losers and those involved or excluded from decision-making processes. Key stakeholders are those who can significantly influence or are important to the success of the project. This wide definition clearly includes researchers along with other categories such as policymakers, extension officers, and relevant government and non-governmental organizations (Biscola et al., 2017). For example, the DRUSSA ("Development Research Uptake in Sub Saharan Africa"), project, led by the Association of Commonwealth Universities (2012), specifically addressed the effective use of evidence-based research by policymakers and practitioners.

Mention should also be made to the stakeholders represented by the administrative structures that support the execution of R&I projects. Often, there is an "us and them" perspective that adds difficulty to everyday project management tasks. Many scientists view administrators as unimaginative and not helpful, bureaucratic, "lovers of red tape", and bound by inflexible rules and regulations. On the other hand, many administrators view scientists as highly critical, allergic to paperwork and red tape, and breakers of rules and procedures. However, the increasing

recognition of research managers and administrators as "interface professionals" (Agostinho et al., 2020) ought to fade away the border line among these two views.

Adequate stakeholder analysis can help organizations to identify which institutional and individual actors are likely to favor and press for particular kinds of actions. It helps to identify appropriate forms of stakeholder participation in a R&I project. As evidenced in the previous paragraphs, R&I projects´ management is a people business.

The Management of Projects

Projects are regarded as temporary endeavors undertaken to create unique products, services or results (Project Management Institute [PMI], 2017). The essence of project management is to support the execution of an organization's competitive strategy to move towards its goals and deliver a desired outcome. Put simply, project management is a road map to get you from where you are to where you want to be.

Project management methodologies include a wide range of knowledge areas, provide a means of identifying the threats and opportunities associated with the project, and involve controlling costs, time, risks, scope, and quality through specific processes, tools and techniques. The scope of project management goes from conceptualization to closing with one objective in mind: to meet the requirements of stakeholders within budget and the given timeline. By using the right methodology, a project manager is able to identify and minimize risks, satisfy stakeholders' expectations, optimize resources and time usage, and internalize learning from the process.

However, project management does not provide a one-fits-all solution. Many effective project management paradigms, methods, tools, techniques and standards have been developed, from "classical" project management, represented primarily by PMBOK (by the Project Management Institute) and PRINCE2 (currently owned by AXELOS Ltd.), to flexible iterative and incremental agile methods (e.g., Scrum, Lean, Kanban). Other techniques and frameworks include the Logical Framework Approach (developed in 1969 for the U.S. Agency for International Development) and the standards developed by APMBOK and the International Project Management Association (IPMA), the ISO 21500:2012 standard for project management (based on PMBOK principles) and the British Standard BS6079-1:2002.

The approach to "traditional" project management can generally be expressed by the grouping of specific management high-level processes. For example, PMBOK is developed around five groups of management processes (Initiating, Planning, Executing, Monitoring and Controlling, and Closing) and ten areas of knowledge (Project Integration Management, Project Scope Management, Project Schedule Management, Project Cost Management, Project Quality Management, Project Resource Management, Project Communications Management, Project Risk Management, Project Procurement Management, and Project Stakeholder Management). These are usually considered to be "waterfall" methodologies with clearly defined sequential steps, although this observation is still controversial. On the other hand, "agile" methodologies are composed of several iterations or incremental steps and focused on life cycle management

stages (Plan, Sprint, Ship, Repeat). They are less formalized and allow the absence of an explicit description of a number of processes. As illustrated in the literature review section, hybrid methodologies combining aspects of each of the approaches have also been developed.

Which approach is better? It depends on the specific context of each project, namely from the organizational (e.g. nature of the partners), scientific discipline(s) and goals (e.g. market-driven or curiosity-driven) points of view. Table 1 highlights example advantages and disadvantages of major methodologies ("waterfall"—PMBOK, PRINCE2) and development approaches (Agile—Scrum), and example alternative frameworks (namely the Logical Framework).

As far as frameworks are concerned, the Logical Framework is a tool for the design, monitoring and evaluation of projects. It gives an overview of the objectives, activities and resources of a project. It also provides information about external elements that may influence the project (assumptions) and includes information on how the project will be monitored. A hierarchy of objectives in the form of short narrative descriptions is mapped to components of key management activities for evaluation, performance measurement and external conditions. Therefore, it presents the key items of the project in a manner which enables an effective visualization of connections between them. The logic of the project is, thus, exposed to scrutiny. It allows project managers to make the management objectives explicit from the beginning of the project. Moreover, it identifies critical assumptions which will influence the project success. A distinctive feature is that it helps to identify the sustainability of the project outcomes once the project has ended. In face of the above, the Logical Framework is definitely not a universal approach to all types of projects (namely development initiatives), but it does create conditions to understand what the project intends to do and how and what are the conditions for failure and success.

Table 1. Example Advantages and Disadvantages of Major Project Management Approaches

Project Management Approach	Advantages	Disadvantages
PMBOK	Collection of best practices from the industry. Templates and checklists available.	Heavy administrative load. May hinder creativity.
PRINCE2	Highly standardized. Templates and checklists available.	Heavy administrative load. Lack of flexibility. Does not cover all subjects relevant to project management.
Agile	Flexibility in scope and procedures. Low administrative load. Focus on team working.	Low predictability of resource usage. Difficulties in scaling up to large, complex projects. Insufficient knowledge management.
Logical Framework	Highly graphic. Transparency of management.	Lack of operational detail. Not applicable to every type of project, namely R&I.

A Proposed Development Framework

In this section, a framework for R&I project management is established. For this, based on the information presented previously, key features that should be observed when managing any type of project are collated. It then follows the formulation of a management framework specifically for R&I projects, based on the information presented before on key specificities of this type of projects, and on the information collected by the participatory observation carried out in the context of the ValorNatural project as a case study.

Whatever methodologies, approaches or frameworks are implemented for project management, eight key characteristics should emerge (Table 2). Their identification is based on the analysis of main characteristics of major project management approaches described previously. Thus, any project management approach should: 1) facilitate the clarification of the project′s scope and goals; 2) model the expected project workflow; 3) include adequate tools, techniques and templates to efficiently and effectively plan and manage the project activities; 4) consider a project "board" (or similar role) to supervise and evaluate the project progression by the use of a set of relevant indicators; 5) facilitate the identification, management and mitigation of risks; 6) allow for project scalability and flexibility to account for varied sizes and formats; 7) adapt projects to industry or governmental specific standards, but simultaneously to each organization's culture; and 8) facilitate organizational learning and maturity. Also, as discussed and justified above, it is argued that key characteristics should be considered when managing R&I projects, namely their 1) specific origin, 2) complex context, 3) high uncertainty and 4) complex human factor setting. Together, these guidelines form a proposal for a "R&I project management framework", illustrated in Figure 1.

Table 2. Key Characteristics of "Standard" Project Management Approaches

|	PMBOK	PRINCE2	Agile	Logical Framework
Facilitate clarity of project scope and goals	Project charter	Business case	Flexible project scope	Short and medium term outputs, long term goal
Based on standards but adaptable	Yes	Yes	Yes	Yes
Scalable, flexible	Yes, but need to be implemented at higher levels of the work breakdown structure in large, complex projects	Yes, but need to be implemented at higher levels of the work breakdown structure in large, complex projects	Yes, but need to be implemented at lower levels of the work breakdown structure in large, complex projects	Scalable, but difficulties when adapting to high uncertainty projects (e.g. variable outputs)
Model the project workflow	Standardized: Initiating, Planning, Executing, Monitoring and Controlling, and Closing	Standardized: Starting Up, Directing, Initiating, Controlling a Stage, Managing Product Delivery, Managing Stage Boundaries, Closing a Project	Flexible, Iterative: Plan, Sprint, Ship, Repeat	Standardized: "Logframe"
Provide tools, techniques, templates	Templates and checklist available	Templates and checklist available	Available, although kept to a minimum	"Logframe"
Provide a project "board" or similar role	Specific knowledge area for project integration management	Specific processes group for directing a project	Self-organizing project team	Graphic nature implies transparency of management
Ensure adequate risk management	Specific knowledge area for risk	Management of risks is a key element	Specific tools and techniques (e.g. "Risk Burndown Chart")	Identifies critical assumptions and risks
Facilitate organizational maturity, learning	Specific processes in the "closing" phase	Specific processes in the "closing a project" phase	Extensive communication, focused on teamwork, although weak formal knowledge management	Documented "Logframes"

Figure 1. Proposed R&I Project Management Framework

Case Study of Use of Framework

The proposed framework was developed and tested in the context of the *ValorNatural* project as a case study. Table 3 illustrates how the proposed framework applies to *ValorNatural*, namely how this R&I project deals with the eight pillars—plus four specificities included in the general framework proposed for R&I project management. This is further expanded in the following subsections.

Table 3. Application of the Proposed R&I Project Management Framework to *ValorNatural*

Key Characteristic	How it is Addressed in the Case Study
At the R&I activity level	
Origin	Industry-driven, multi-stakeholder project, sponsored by P2020.
Context	Set at the Project Charter, managed at the Project Management Board and at the Advisory Board level.
Human factor	The project leader is an industrialist and the scientific coordinator is a leading scientist; the project manager is a certified project management professional. Stakeholders are involved in the Advisory Board.
Uncertainty	A Risk Register is used and managed at the Project Management Board and at the Advisory Board level. Formal procedures kept to a minimum.
At the project management level	
Based on standards	PMBOK®
Scalable, adaptable	Formal procedures kept to a minimum.
Project workflow model	Detailed in the "Procedures Manual".
Tools, techniques, templates	Detailed in the "Procedures Manual".
Project "board"	A Project Management Board was set up.
Risk management	A Risk Register was implemented.
Organizational maturity, learning	Meetings and lessons learned are documented.

Specificities Identified as Key R&I Project Characteristics

Its Origin

The *ValorNatural* R&I project is coordinated by the Polytechnic Institute of Bragança (Portugal) and deals with the development of new additives and ingredients for the food and drink industry, based namely on by-products and side-products of the agrifood industry itself, and on new extraction and preserving technologies. It is a "large scale" project, as defined by the Portuguese Innovation Agency, that involves nine companies from varied sectors (food industry, biotechnology industry, processing equipment industry), four research performing organizations and a dedicated technology/knowledge transfer organization. The consortium is therefore quite heterogeneous, gathering organizations with different aims and cultures. The project´s duration is three years, concluding in August 2022, and the partners are geographically scattered in the north region of Portugal. The global investment reaches € 3.25 million. The project is co-funded by the Portuguese Government under the Portugal 2020 Partnership Agreement, through the European Regional Development Fund (ERDF), namely by the North Regional Operational Programme (NORTE2020). The approved project proposal defines the main goals, objectives, activities, deliverables, milestones, schedule, and cost over time. The development of the activities,

achievement of deliverables and milestones, and compliance with the predicted schedule and costs are monitored every six months by the Portuguese Innovation Agency.

The Context

The valorization of bio-based organic wastes and by-products has become an issue of great public and scientific concern, namely since the European Commission presented its Circular Economy Strategy and the related Action Plan "Closing the loop" (Carus & Dammer, 2018). The project is being developed in the context of the biorefinery concept (Clark & Deswarte, 2014). This valorization approach has been considered as one of the most promising pathways to attaining a resource-efficient circular bioeconomy since it is a way of decreasing human-induced environmental impacts, generate new market opportunities and use resources more efficiently (Nizami et al., 2017).

In order to ensure a common understanding across the partnership, the overall context is detailed at the project charter, and any changes are addressed at the Project Management Board and at the Advisory Board. The latter was set up specifically to provide independent, external feedback on the scientific, technological, economic and societal impacts of the project activities and results. The Project Management Board and the Advisory Board interact once per year.

The Human Factor

The consortium involves public and private entities, industry and academia, research performing organizations, higher education institutions, and "interface" organizations. Therefore, the profile of the 35 (in average) team members is quite varied, from the background, experience and activity points of view. In order to account for the inherently different perspectives, a management model was adopted where the project leader is an industrialist, the scientific coordinator is a leading scientist, and the project manager is a certified project management professional. Also, a "Project Management Board" was set up that includes representatives of all the involved organizations. Moreover, external stakeholders are involved as members of the "Advisory Board".

Uncertainty

The project foresees the development of new processing technologies that will lead to the production of new food/drink additives and ingredients. The associated risk is significant, not just from the scientific and technological points of view but also from the market point of view. In fact, competition in this sector is fierce and alternative products may be launched in the market before the project ends. The scientific and technological routes being pursued involve the development of new concepts and equipment, amenable to inherent difficulties. Moreover, compliance with regulatory legislation must be ensured for a successful market launch. Therefore, risk management is a key issue and a dynamic "risk register" has been implemented, that is managed at the Project Management Board and at the Advisory Board. Formal management procedures have been kept to a minimum, in order not to hinder creativity, needed to help to cope with the uncertainty associated with the foreseen scientific and technological developments.

The Eight Pillars Identified as Key Project Management Features

Clarification of Project Scope and Goals

The project scope and goals are summarized in a "project charter", developed at the project kickoff. It details the scope, general and individual goals and objectives. It is contained in several other documents such as periodic reports, so as to ensure a common understanding by all the partners involved in the project.

Based on Standards but Adaptable

The methodology adopted for project management is based on the PMBOK standard. Thus, an approach following the project management life cycle (initiation, planning, execution, monitoring and controlling, closing) is used. This was driven by the fact that the project manager is a certified project management professional (by the Project Management Institute). However, bearing in mind the widely different organizational and project management cultures existing in the consortium, a simplified approach was used to develop a "Procedures Manual" that could easily be incorporated in each organization's culture and practices. This is critical to ensure a common ground in terms of practices and rules involving such a heterogeneous consortium.

Be Scalable, Flexible

The project management model is implemented at higher levels of the work breakdown structure. At the activity level, the corresponding leaders can use the approach that the team agrees to best suit the purpose. Thus, for example, different activity leaders implement more or less formal practices.

Model the Project Workflow

The "Procedures Manual" details the project workflow inputs, tools, techniques, and outputs. It includes the templates needed to support key management and operational areas: project integration (including changes, issues and intellectual property management, and day-to-day project management tasks); scope, time and cost management (including resource and time usage reporting, project activities progress reporting and corresponding indicators); communication management and risk management. In order not to restrict undesirably the "freedom" of action needed to promote creativity at the scientific level, the "formal" procedures are kept to what is strictly needed to comply with the accountability and funding rules by the funder and at each organization level.

Project "Board" or Similar Role

A "Project Management Board" was set up to supervise and regularly evaluate the project progress, according to a set of metrics/indicators detailed in the project proposal (some determined by the project sponsor and the remaining defined by the involved scientific team). It is headed by one of the participating companies (the project leader) so as to keep the focus on the innovation side of the project. The project scientific coordinator comes from one of the participating scientific organizations and is a leading world-class scientist. As mentioned, the project manager, a scientist

himself, is a trained, certified professional project manager. An external, international "Advisory Board", working as a stakeholder forum, was implemented in order to ensure the compliance of the project with the established objectives from the scientific, technological and societal points of view. This board ensures that the project management is aligned with the contextual setting and that, this way, delivers the projected added value for this R&I initiative. Regular meetings gathering the individual scientific teams are held in order to promote communication, team spirit and work synergies.

Adequate Risk Management

Due to the high uncertainty associated with the R&I plan, particular attention is paid to risk management. This involves the use of a "dynamic" risk register (including mitigation measures) regularly updated by the individual teams and evaluated by the "Project Management Board".

Organizational Maturity, Learning

Organizational learning and maturity is promoted by the shared use of templates and dissemination of best practices to be adopted by other projects. The implementation of the described project management model has been shown to be both efficient and practical in the case study addressed herein.

However, it is acknowledged that for it to be successfully implemented in R&I projects, training in project management tools and techniques should be provided to scientific projects managers. Project management of R&I activities is in fact a particularly complex and difficult decision-making process, where adequate qualifications and competencies of the project manager are required. A project manager should manage the 'Five Ms': men, material, machine, money and motivating factors. But the duality between technical management and scientific management increases the challenges for a R&I project manager as typically their background is academic and technical project management skills may be lacking. Often this is not readily perceived due to a "halo effect", under which the team perceives the project manager to be as competent a manager as a scientist. In the *ValorNatural* project, it was observed that the allocation of a dedicated "scientific coordinator" and of a dedicated "project manager" can be utilized to mitigate this issue. Nevertheless, it was also observed that providing short training courses on project management to the scientific coordinator and activity leaders would have contributed to a more rapid understanding and adoption of the devised management model.

An additional lesson learnt from this case study concerns the efficiency and efficacy of communication internal to the consortium. The specific tools and techniques used included both "offline" and "online" mechanisms such as meetings at the consortium level every six months, an intranet as information repository and ad-hoc meetings at the activity level. This strategy was adopted as researchers initially perceived that in-person meetings should be limited to a minimum, and more time should be dedicated to scientific work. However, as the project progressed, it was clear that communication among the project partners wasn´t as fluid as desirable. Therefore, more agile communication strategies, such as closer and more regular contact between activity leaders, was adopted as a means to balance the communication need perceived by the project

management structure and by the scientific team. This issue derived from the typical "aversion" that scientists have in relation to formal and administrative practices. Usually, the time spent on such tasks is regarded as "lost time" that could otherwise be dedicated to scientific work. While initially the project management approach complied accordingly, the scientific team gradually acknowledged that more agile communication strategies not bonded to fixed meeting schedules should be adopted. This illustrated the need to balance structured project management approaches with more "fluid" and flexible approaches (as depicted in the proposed framework), in order to account for specificities of R&I projects.

Implications for Research Administrators

The roles and functions of research managers and administrators in academic settings include support to project proposal development (pre-award), project management and knowledge and technology transfer (post-award) (Schofield, 2013; Wedekind & Philbin, 2018). The proposed framework can support their role in R&I project management by providing a structured guide to key aspects that may influence decisively the success or failure of this specific type of projects.

Conclusions and Future Work

Contemporary "mode 2" knowledge production paradigm, including increased social accountability by higher education institutions, inherently requires interdisciplinary R&I projects to often engage different types of stakeholders, such as industry, governmental organizations, user's associations, and non-governmental organizations, with varied cultures and practices. R&I projects are characterized by uncertainty, creativity and complexity, elements that distinguish them from "traditional" and "standard" projects, to which the classical theory of project management is generally applied. Therefore, a fine balance is needed between implementing management approaches to support the efficient and effective delivery of projects while not compromising accountability, creativity and innovation. Managers and administrators at higher education should support a critical balance among major stakeholder needs, creative but unstructured processes, free ruling (even chaotic) and intensive knowledge-based activities. But, at the same time, in order to mitigate the uncertainty associated with R&I endeavors, there is a requirement for tight management.

This paper provides a systematic discussion on key aspects of the specificities of R&I projects management in academic settings and, based on documented action and participatory observation in managing the *ValorNatural* project, a framework is suggested that should be considered when managing R&I projects in a sound, efficient and enabling manner. Accordingly, the management model for R&I projects in academic settings should consider the following "pillars": 1) define scope and goals as clearly as possible; 2) be based on standards but flexible; 3) be scalable and adaptable; 4) a project workflow model must be developed; 5) tools, techniques, templates should be provided; 6) a project "board" should be in place; 7) appropriate risk management strategies must be implemented; and 8) organizational maturity and learning should be promoted.

In addition, the project manager should deal adequately with the specific areas where R&I projects clearly diverge from "traditional" projects, namely its origin, context, uncertainty and the human factor. In particular, the leadership function must be focused on integration management roles, and on a participatory and collaborative approach. Adequate time and resources that support improved communication between project team members, partners and stakeholders are essential in order to minimize eventual conflicting views that may compromise the project. Also, the management of R&I projects, namely in higher education, is ultimately facilitated by adequate involvement of key partners in substantial decision-making.

The proposed framework can be implemented by university managers and administrators in a straightforward fashion, as illustrated for the *ValorNatural* project.

The main limitations observed in this research are related to its use of a single case study for the development and validation of the project management model. Thus, future avenues for research include the validation of the proposed framework by increasing (a) the number and diversity of case studies, namely R&I projects from different subject areas (e.g. humanities, life sciences, social sciences); (b) implementation contexts (e.g. basic research vs applied research); and (c) locations (e.g. other continents) exposed to different cultures, practices and perceptions. This will enrich the framework by making it useful for a broader range of R&I project types and contexts. Moreover, it is intended to develop a survey to identify best practices in terms of specific tools and techniques perceived by practitioners as a key contribution to the success of R&I projects. This will complement the proposed framework with a toolset of practical artifacts that facilitate its implementation.

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Adapting the Joint Task Force Core Competency Framework for Clinical Research Professionals: A Canadian Paediatric Research Perspective

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Abstract: *Over the past 20 years, there has been a significant increase in the number and complexity of clinical research studies. As a result, Clinical Research Professionals (CRPs), a workforce critical to the success of clinical research, have seen commensurate increases in workload and responsibilities. Unfortunately, there has not been a parallel increase in the 'professionalization' of CRPs, and the lack of professional recognition and career development opportunities remain primary motivators for voluntary turnover in this workforce. The development of the Joint Task Force (JTF) Core Competency Framework (2014) was a seminal step in addressing these issues and has changed the dialogue within the clinical research enterprise from a focus on regulatory compliance to one of professional competency. Encouraged by peers in academic health science centres in the United States, the Hospital for Sick Children (SickKids) in Toronto, Canada undertook an initiative to adapt the JTF Framework to suit the Canadian context as well as incorporate the unique scientific and ethical considerations pertinent in child health research. The SickKids Clinical Research Competency Framework (SickKids CR-CF) is being used to support the professionalization of the local CRP workforce through 1) a standardized onboarding and orientation program for new hires; 2) creation of a novel, competency-based clinical research curriculum; 3) development of tools and processes to leverage the framework for professional development and career progression; and 4) job roles that are descriptive of the required competencies. The overall aim of such initiatives is to help increase participant safety, research quality and regulatory compliance as well as improve job satisfaction and institutional engagement among our clinical research workforce at SickKids.*

Keywords: *clinical research professionals, Joint Task Force Competency Framework, competence, competency, workforce development, professional development*

Background

The number and complexity of clinical trials has increased dramatically in recent years. From 2010 to 2020, the number of clinical trials registered on clinicaltrials.gov increased by over 300% (National Library of Medicine, 2021). Greater scientific and methodological sophistication coupled with the globalization of research has also significantly expanded the expertise required to manage a clinical trial safely and effectively (Brouwer et al., 2017; Getz et al., 2011; Sonstein & Jones, 2018; Speicher, et al., 2012). The majority of day-to-day activities for clinical trials are conducted by a highly diverse workforce, which may collectively be referred to as Clinical Research Professionals (CRPs). CRPs have a wide variety of job roles and titles, work in settings spanning the academic, industry, public and private sectors, and enter the field with diverse educational and experiential backgrounds (Sonstein & Jones, 2018).

As the number and complexity of trials has increased over time, the responsibilities of CRPs have grown. In today's clinical research environment, CRPs must have technical expertise in scientific communications, finance, ethics, data management, laboratory skills and so forth, but also require considerable strength in 'soft skills' such as problem solving, critical thinking, teamwork, and conflict management (Baer et al., 2011). CRPs working with vulnerable populations, such as children, need additional skills and knowledge to manage their unique complexities, including the maintenance of informed consent and assent across changes in cognitive capacity, or the need to engage with a broader network of family caregivers to ensure successful participant recruitment and retention.

For industry, CRP skills directly impact profitability, and they have been quick to implement formal training and certification requirements, as well as robust onboarding and training programs (Owens Pickle et al., 2017). However, only 40% of research conducted in the United States and Canada is sponsored by industry, despite their large economic footprint (National Library of Medicine, 2021). In contrast, academic researchers, who are heavily reliant on limited public funding, have been less inclined to seek professional qualifications over salary cost savings. In most academic institutions, beyond some form of post-secondary education, there is no required educational background or defined set of competencies to become a CRP and clinical research job descriptions do not necessarily reflect skill, experience or responsibility (Sonstein & Jones, 2018).

In academic settings, most CRPs acquire their skills 'on the job' as they are delegated responsibilities by the Principal Investigator (PI) (Speicher et al., 2012). Often, there are few institutional oversight mechanisms to ensure a new CRP's skills are a match for the demands of the research study onto which they are hired, and training for new CRPs is typically minimal and poorly organized (Owens Pickle et al., 2017; Sonstein & Jones, 2014). In a survey of over 450 CRPs based in academic health centres across North America, Owens Pickle et al. (2017) found that while 75% had baccalaureate or graduate degrees, 67% had no more than three years of clinical research experience when hired; 42% had less than a year. Training programs did not address this gap: 74% received less than two months of training in their new role, or no training at all (Owens Pickle et al., 2017).

Job satisfaction, engagement and retention are most negatively affected by the dissonance between responsibility and compensation (Coomber & Barriball, 2007; Cowin, 2002, as cited in Owens Pickle et al., 2017). CRPs are a critical workforce that has seen workload and responsibilities increase dramatically while salary levels have remained relatively flat historically (Getz et al., 2012). A SoCRA analysis published in 2015 found that, once adjusted for inflation, the median salary for CRPs actually decreased by 3.3% between 2010 and 2015. While salaries have been adjusted in many institutions and networks, low salary levels continue to be reported in others (i.e., the Children's Oncology Group (COG)—the National Cancer Institute's only paediatric clinical trial network) (Getz et al., 2012; Owens Pickle et al., 2017). Opportunities for achievement, stimulation, responsibility and advancement significantly affect an individual's valuation of the position and their engagement in the work (Owens Pickle et al., 2017; Pepe, 2010), whereas lack of role clarity, ambiguity of responsibility and poor recognition of achievement can result in demoralization. Among CRPs in particular, the lack of professional recognition and career development opportunities have been cited as primary motivators for voluntary turnover (Stroo et al., 2020).

Akin to the situation at original hire, some academic health research centres, organizations (i.e., Duke University) and networks (i.e., Oncology Nursing Society, United Kingdom NIHR, Regulatory Affairs Professional Society, and the Global Health Network) have developed a transparent institutional framework for recognizing growth in knowledge, skill and/or experience among CRPs over time (Sonstein & Jones, 2018). Such frameworks and resulting initiatives have been found to have a positive effect, decreasing CRP turnover by up to 30% in some cases (Stroo et al., 2020). However, there are still significant gaps and inconsistencies in the development and employment of such frameworks in academic health settings contributing to low job satisfaction, poor institutional engagement, and high attrition in these settings (Hornung et al., 2018; Sonstein & Jones, 2018). For example, it was reported that CRPs working in academic or private research settings had higher retention (10 times greater odds) in comparison to those employed in hospitals or academic health research centres (Buchanan et al., 2020). Retention of CRPs is critically important for the entire institution from a safety, regulatory and financial perspective. Not only is staff turnover incredibly expensive—estimated by one source to be $25,000 per CRP (Duke University, Stroo et al., 2020)—retention of skilled CRPs is a key factor in improving the overall quality of the research (i.e., participant retention, safety, data integrity and regulatory compliance) (Speicher et al., 2012; Stroo et al., 2020).

A Competency Framework for Clinical Research Professionals

To date, there has been limited 'professionalization' of the CRP role. Professionalization requires a focus on competencies—observable behaviours derived from the combination of an individual's knowledge, training and experience in a particular work process or environment (CIPD, 2021; Bullock & Trombley, 1999). A competency framework is defined as selected competencies and qualifications, knowledge, skills, and attitudes that embody a particular profession (Benayoune, 2017; Calvin-Naylor et al., 2017). Competency frameworks are like a road map to develop, enhance and/or refine an individual's capabilities incrementally, often progressing from

fundamental to advanced. The use of competencies and competency frameworks in performance management and development emerged in the early 1980s (Bolden & Gosling, 2006; Boyatzis, 1982), and the practice has increased over time, particularly in health-related professions (Batt et al., 2019). A framework approach ensures transferability and recognition of skills across jurisdictions, and often specifies maintenance of qualification requirements or pathways for professional advancement. Competency frameworks are now often seen as essential to achieving high institutional performance, and are used to support consistent recruitment practices, fair performance reviews, professional mobility, and the development of education and training initiatives, among other institutional best practices (Benayoune, 2017; CIPD, 2021).

In most other health related professions (i.e., medicine and nursing), entry level professionals are required to have a specific academic degree, often an internship or other hands-on experience, and have passed an examination which is administered under the aegis of a representative professional or licensure organization (Sonstein & Jones, 2018). There is no such structure for CRPs. College-based training programs in clinical research and professional societies granting certification for CRPs (e.g., SoCRA, ACRP) are primarily focused on regulatory requirements and Good Clinical Practice (GCP) rather than observable behavioural competencies.

In 2014, the Joint Task Force for Clinical Trial Competency (JTF) began work to create a universally applicable, globally relevant competency framework for the clinical research enterprise—the Harmonized Core Competency Framework for the Clinical Research Professional (Multi-Regional Clinical Trials, 2020). This work has moved the clinical research enterprise from a focus on regulatory compliance to that of professional competency, based on the belief that the most effective method to ensure quality clinical trial design, conduct and compliance is to ensure that those responsible for the various aspects of a clinical trial are, in fact, competent (Sonstein & Jones, 2018).

The JTF Core Competency Framework provides 47 specific competency statements within eight functional domains that define the attitudes, skills and knowledge required to design and conduct safe, ethical, and high-quality clinical research (Multi-Regional Clinical Trials, 2020). The 47 competency statements are further broken down into three levels—fundamental, skilled, and advanced—to ensure applicability across various roles and levels of experience in the clinical research enterprise (Multi-Regional Clinical Trials, 2020). The JTF Core Competency Framework has been widely utilized as a tool to define performance criteria, standardize job descriptions, and guide the development of education and training-related initiatives (Brouwer et al., 2017; Calvin-Naylor et al., 2017). However, there are several noted limitations: 1) Although ACRP and SoCRA have re-aligned their certification exams to that of the Framework, it has not been transparently incorporated in their offered training nor explicitly championed (Sonstein et al., 2018); 2) Developed with input from international and American stakeholders, there is a lack of applicability to the Canadian regulatory context (i.e., Health Canada) (Multi-Regional Clinical Trials, 2020); 3) The Framework does not include competencies required to work with vulnerable populations such as children; and 4) The Framework does not include competencies required by research designs and methodologies other than clinical trials (i.e., non-interventional, quasi-experimental, mixed methods, and qualitative).

Given the significant influence CRP performance, engagement and retention has on research quality, we adapted the JTF framework to support the professionalization of CRPs at the Hospital for Sick Children in Toronto, Canada. This paper describes the adaptation of the Framework and its use in creating: 1) a standardized onboarding and orientation program for new hires; 2) a novel, competency-based clinical research curriculum; 3) tools and processes to leverage the Framework for professional development and career progression; and 4) job roles that are descriptive of the required competencies.

About the Hospital for Sick Children

Founded in 1964, the Hospital for Sick Children (SickKids) is home to the largest, hospital-based child health research institute in Canada and was recently ranked as the top paediatric health care centre in the world (Newsweek, 2022). In terms of research intensity (research spending per researcher and as a percentage of total hospital spending), SickKids has ranked among the top three research hospitals in Canada for over ten years, consistently topping the list among research hospitals of comparable size (Research Infosource, 2021). The research conducted at SickKids ranges from discovery science to public and population health, and is supported by state-of-the-art facilities, technologies, and expertise (SickKids, 2020). At present, the SickKids Research Ethics Board (REB) oversees over 3000 open research studies involving human participants, their health data and/or biological samples. These studies are supported by over 400 CRPs.

Direct consultations with clinical research staff revealed that many feel available Canadian certifications are only 'good on paper' and do not accurately reflect their technical skills, job responsibilities or career trajectory. In part, this may reflect the lack of specialized paediatric content in adult-focused clinical research training programs. However, respondents suggested it has more to do with the mismatch between a CRP's skills or qualifications and the responsibilities that might be delegated to them by the PI, consistent with the literature cited above.

About the Office of Clinical Research Professionals (OCRP)

The Office of Clinical Research Professionals (OCRP) was established in 2020 as a hub of professional support for all CRPs at SickKids. The OCRP is housed within Clinical Research Services (CRS) and is financially supported by the SickKids Research Institute. The OCRP provides networking, personal and professional growth-related opportunities as well as facilitates access to information about best practices, regulatory changes, and institutional initiatives. As the institutional 'voice' for CRPs, the OCRP drives multiple clinical research communication channels including a monthly newsletter with over 950 subscribers, monthly Open Forum seminars typically attended by over 80 people, a Clinical Research Advisory Committee (CRAiC) composed of 35 CRPs, and it maintains informative intranet and SharePoint sites. Programs and resources leveraging the Framework are offered to the clinical research community through the OCRP to give them brand recognition and a single point of access.

Adapting the JTF Core Competency Framework at SickKids

The JTF intentionally set out to develop a single set of standards that could be adapted locally; users are encouraged to adjust the framework to site-specific practice cultures (Sonstein & Jones, 2018). At SickKids, a systematic and strategic approach was taken to review and adapt the JTF Framework to integrate Canadian research requirements, institution-specific policies and procedures as well as competencies relevant to child health research. The approach included broad and focussed community engagement and consultation, coupled with investment in dedicated educational expertise.

Clinical Research Professional Development Specialists

Key to the success of this initiative was the investment in a Clinical Research Professional Development Specialist (CRPD) role. Roughly equivalent to other educator roles in healthcare (nurse educator, physician educator, etc.), these specialists have expertise in pedagogy, educational theory, adult learning principles, as well as experience in clinical research. The role of the CRPDs is twofold: 1) coordinating and driving the efforts of clinical research stakeholders and subject matter experts (SMEs) in the adaptation process of the JTF Framework by identifying key requirements, developing case studies and activities to guide the review process, and facilitating opportunities for expert review and content validation; and 2) using the revised competency framework to develop a novel, competency-based clinical research professional development program for the CRPs at SickKids.

Training and Education Working Group (Working Group)

The Training and Education Working Group was formed to assist in the review and adaptation of the JTF Framework. The Working Group convened bimonthly or monthly over a period of nine months and included clinician and senior scientists, staff physicians, research ethics and quality assurance staff, project managers and coordinators as well as research trainees. The members systematically reviewed the domains, competency statements, and learning objectives of the JTF Framework. This resulted in revisions to, or development of, competency statements. The Working Group proceeded to review the revised and new competency statements using Bloom's Taxonomy to ensure they were levelled appropriately—fundamental, skilled, and advanced (in keeping with the JTF Framework) (Bloom et al., 1956). The Working Group continues to meet regularly and now works to inform the overall education program for CRPs at SickKids.

Stakeholder Engagement

The detailed analysis performed by the Working Group was validated, refined, and socialized with a larger group of CRP stakeholders. The CRP stakeholders included clinical research administrators, clinical research coordinators, clinical research nurses, clinical research managers, statisticians, research ethics coordinators, and senior leadership for clinical research at SickKids. Several strategies were employed to attain feedback from the stakeholders, including surveys, feedback forms, focus groups, and one-on-one interviews. Engaging and collaborating with a wide variety of stakeholders was an essential step to ensure the competencies were applicable to all CRP roles and study designs as well as to validate the newly added content. The feedback

attained from the stakeholders was shared with the Working Group and integrated accordingly in the adaptation of the JTF Framework.

Key Adaptions to the JTF Core Competency Framework

The SickKids Clinical Research Competency Framework (SickKids CR-CF) is comprised of eight Domains with a total of 43 Competencies expressed in three levels of expertise: fundamental, skilled, and advanced (Figure 1).

Figure 1.

The adaptations integrated Canadian provincial and national research-related regulations, institutional policies and procedures, a broader range of research study types and designs, as well as paediatric-specific scientific and ethical considerations (Table 1). To ensure that the SickKids CR-CF continues to remain relevant and up to date with the ever-changing child health research landscape, the competencies are reviewed on an annual basis.

Table 1. Adaptations to the JTF Core Competency Framework

1.	**Domain 2: Ethical and Participant Safety Considerations**
	a. Addition of 'standard of care': Due to a lack of pharmaceutical research in children, most standard paediatric treatment plans involve the use of medications 'off label'. However, the use of a drug 'off label' may also be part of a research protocol. CRPs in child health research require expertise in differentiating between the two and understanding how data acquisition, regulatory documentation and medical oversight might differ as a result.
	b. Inclusion of key research-related ethical processes in the child health research setting: assent, dissent, and capacity to consent.
	c. Integration of the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (TCPS-2), the joint policy of Canada's three federal research agencies – the Canadian Institutes of Health Research (CIHR), the Natural Sciences and Engineering Research Council of Canada (NSERC), and the Social Sciences and Humanities Research Council of Canada (SSHRC). As a condition of funding, the Agencies require that researchers and their institutions apply the ethical principles and the articles of this Policy.
2.	**Domain 3: Medical Product Development and Regulation of Research Studies using Medical Products**
	a. Included a wider range of products (drugs, devices, natural health, etc.) and to address the common practice of using marketed products in a new indication in the paediatric population.
	b. Added requirements for Canadian regulatory and oversight bodies, such as the institutional Research Ethics Board (REB), the Federal Health Canada Directorates, and their relevant application processes. United States-based references to IRBs and the FDA were retained as international multi-centre trials are common at SickKids.
3.	**Domain 4: Clinical Study Operations (GCP)**
	a. Included competencies related to handling biospecimens for clinical research
4.	**All Domains:**
	a. Inclusion of SickKids specific policies and procedures.
	b. Inclusion of Canadian Federal and Provincial privacy laws.
	c. Addition of patient and family/caregiver considerations
	d. Addition of a broader range of study types and designs beyond clinical trials (i.e., interventional, and non-interventional, mixed methods, and qualitative)

Implementation of the SickKids CR-CF

The application of the SickKids CR-CF to the clinical research enterprise has four lines of development to support the professionalization of the SickKids CRP workforce:

1. A standardized onboarding and training program for all new hires

2. A novel, competency-based clinical research curriculum

3. Tools and processes to leverage the framework for professional development and career progression

4. Job roles that are descriptive of the required competencies.

Standardized Orientation and Onboarding Program

The OCRP also tracks and manages the mandatory training for all new hires and applies a standardized orientation and onboarding program that introduces the competency framework as well as SickKids-specific processes and resources. More specifically, the onboarding program consists of the following key processes: 1) a one-on-one meeting with the OCRP Program Coordinator where the new CRP is welcomed to SickKids and is oriented to the nature and location of resources to support their work and role; 2) a comprehensive onboarding manual that includes information and resources about the SickKids CR-CF and its application(s) at SickKids; 3) automatic enrollment into an introductory course, "Getting Started with Clinical Research at SickKids," that addresses the foundational core competencies and highlights SickKids' clinical research processes, services and supports; and 4) subscription to the Clinical Research Newsletter and the OCRP mailing list. To date, 270 CRPs have had one-on-one onboarding meetings and 243 have attended Getting Started since its launch in 2020.

A Competency-Based Clinical Research Curriculum

The SickKids CR-CF was used to direct the development of a novel, competency-based clinical research curriculum for CRPs at SickKids. To our knowledge, this program is the first of its kind in Canada and in the paediatric context. The CRPDs, in collaboration with the Education and Training Working Group, SickKids stakeholders and SMEs developed and mapped out courses, workshops, tools, and resources to the respective Domain and level of expertise (i.e., fundamental, skilled or advanced) (Figure 2).

Figure 1. Education and training course domain and level matrix.

Click here for larger image

For example, for Domain 1: Scientific Concepts and Research Design, courses were developed pertaining to designing a research study, quantitative and qualitative research methodology as well as artificial intelligence and data science methodology. The courses were developed in-house and complimented by external courses purchased from the Collaborative Institutional Training Initiative (CITI) Program. A sample of the courses, course description, learning objectives and level of expertise are presented in Table 2.

Table 2. Sample of Courses for Domain 1

Course Title	Level of Expertise	Course Description	Learning Objectives
Designing a Research Study	Fundamental	A research design is the "blueprint" of a study as it provides the structure, framework, and systematic planning for the entire research process. The purpose of this module is twofold. First, the module will provide an overview of best practices for developing a research question and defining outcomes of interest; describe various clinical research designs; and approaches to assess the feasibility of the proposed research study. Second, the module will describe the key elements to be included in a research study proposal. Using case scenarios and interactive activities, learners will attain an understanding of the research design process and how to apply it in their own respective research studies.	1. To identify best practices for developing a research question, defining outcomes of interest & assessing feasibility. 2. To describe the key elements in a research study protocol. 3. To describe the importance of patient & family engagement in designing a study. 4. To differentiate between quality improvement projects & research projects.
Artificial Intelligence (AI): Introductions	Fundamental	The course provides learners with an introduction to Artificial Intelligence (AI), Machine Learning, Deep Learning, and Algorithms. Using different examples and case scenarios, learners will broaden their understanding of these topics in the context of health care and research.	1. To differentiate between Artificial Intelligence, Machine Learning, and Deep Learning. 2. To understand what is meant by an "algorithm". 3. To describe a machine learning "pipeline". 4. To gain insight into AI projects at the hospital.
Qualitative Research Design	Skilled	The course provides learners with an introduction to qualitative research, qualitative research designs and the respective strengths and weaknesses.	1. To describe what is qualitative research. 2. To describe the various qualitative research designs/approaches. 3. To understand the strengths and weaknesses of the various qualitative research designs/approaches.
Artificial Intelligence: Pitfalls	Skilled	The course provides learners with an overview of Artificial Intelligence (AI)-related pitfalls. Using different examples and case scenarios, learners will broaden their understanding of these topics in the context of health care and research.	1. To be able to describe examples of AI pitfalls. 2. To understand what are confounders in AI. 3. To understand why some algorithms fail to "generalize".

Courses are delivered both synchronously (either in person or virtually) by various SMEs (i.e., Machine Learning Specialists, Research Ethics Analysts, and Research Educators) and asynchronously in self-paced modules either on CITI or the SickKids' learning management system (SABA iLEARN). Synchronous courses are regularly offered to CRPs following an academic calendar year and asynchronous learning is available on demand. Our ultimate goal is to offer a full curriculum mapped across all domains and levels to enable CRPs to plan their own professional development progression through the curriculum.

From April 2020 to March 2021, approximately 373 CRPs completed asynchronous courses and approximately 970 CRPs attended synchronous education sessions. Of the 970 CRPs, 690 were clinical research coordinators, 228 were clinical trainees (i.e., residents and clinical fellows) and 52 were research administrative staff. The value of combined pedagogical and clinical research expertise is reflected in participants' feedback:

> *"Presenter's knowledge about the topic was excellent, and material was presented in a manner that was easy to understand even by non-experts."*

> *"I liked that the presentation slides were detailed and easy to follow. The flow of the presentation was also very easy to understand and made this intimidating process feel a lot simpler."*

Our approach to curriculum development and delivery within the program is flexible and can be tailored to meet the unique needs, interests and responsibilities of the various CRP roles in the clinical research enterprise (i.e., clinical research coordinators, residents, fellows, junior clinician-scientists, research nurses, data management staff, administrators and so forth). Each role can be uniquely described by adjusting the relative weight of each competency domain, and then a leveled curriculum that is tailored to progression in that role can be created. For example, the Education and Training Working Group and CRAiC determined that the responsibilities of Clinical Research Coordinators, the largest group of CRPs at SickKids, are primarily focussed on Domains 2, 4, 6 and 8 of the SickKids CR-CF. Based on this feedback, content specifically targeting these domains was developed, with courses offered in all levels (fundamental, skilled, and advanced). Similarly, with guidance from scientists, medical faculty, and recent paediatric residents, the CRPDs developed a three-year, competency-based clinical research education program for paediatric residents. Domains 1, 2, 6, 7 and 8 from the SickKids CR-CF and the CanMED Physician Competency Framework were used to identify the competencies and create a leveled curriculum residents complete as they progress through their training and scholarly projects. This relatively inexperienced and time-strapped group appreciated this tailored approach:

> *"I thought that from the perspective of a trainee with minimal research experience, these sessions were quite comprehensive and thoughtful."*

> *"The program gives a nice and insightful summary of the research processes and protocols plus supportive entities that work in favor of research at SickKids. Also, I believe that all the provided tools, links and contacts are quite valuable for new researchers and residents."*

Competency-Based Professional Development Tools

Several tools and processes were developed to leverage the Framework for professional development and career progression, and transparently recognize the skills of this important workforce. This aspect of the project is particularly important because poor recognition of achievement is one element found to contribute to employee demoralization and disengagement (Hornung et al., 2018; Sonstein & Jones, 2018; Stroo et al., 2020). Our goals for this endeavour were: 1) raise the visibility and focus on competencies among CRPs; 2) increase and focus performance management activities among CRPs and their managers; and 3) heighten institutional recognition of achievement.

The first step was a Competency Tracking Tool. This tool enables CRPs to assess their own competency and plot an intentional course of professional development through the clinical research core curriculum. Constellations of achievement for CRPs across fundamental, skilled and advanced levels are recognized with an institutional Certificate of Achievement. To promote broader application of clinical research core competencies, the OCRP also provides templates and guidance for competency-based conversations and goal setting during performance assessments between CRPs and their respective manager/supervisor.

Finally, a micro-credentialing program is being developed. The program is in its infancy but will provide recognition of specialized skill development among CRPs. Micro-credentials recognize, by way of a digital seal or badge, skills and accomplishments that are not normally captured in resumes or academic transcripts. They are recognized outside of the conferring institution and can be publicly showcased in digital portfolios or social media feeds (eCampus Ontario, 2019). In our application, micro-credentials acknowledge the consistent application of time and effort across multiple clinical research core competencies to develop expertise in a particular skilled practice. Multiphase learning pathways including content education, practical/experiential training as well as formative and summative assessment are being developed for an internal pilot program focussed on the areas of teaching/training and clinical trial monitoring. Upon completion of the pilot phase of this program, SickKids will work with local institutions (i.e., colleges that provide clinical research diploma programs) to expand the internal micro-credentialling program to one that is industry-recognized and shareable/accepted with other employers or education institutions.

Refinement of the CRP Job Descriptions/Roles

As in most academic institutions, PIs function within SickKids as individual business units, so there is no institutional line-of-sight to the full complement of CRPs, their characteristics, qualifications, or activities. Further, there is no mechanism to ensure that new hires have the skills to manage the research activities assigned to them by their PI. Job descriptions provided by human resources are not based on clinical research competencies and span multiple pay categories. Without dedicated clinical research expertise within HR, or a technological force-function (such as that employed at Duke University; see Brouwer et al., 2017), investigators are free to choose whatever job role they wish within the 'research support' category. The outcome of such an arrangement is predictable: In 2018, we identified more than 80 job titles in use across the

organization describing a range of clinical research positions (i.e., administrators, coordinators, managers, and associates) carrying out a wide variety of research-related functions. To address these issues, CRS and SickKids' Human Resources (HR) are using the SickKids CR-CF to create competency-based job descriptions and the institutional processes necessary to best fit new hires to the skills actually required by the PI, similar to the seminal work described by Brouwer et al. (2017) at Duke University School of Medicine.

Lessons Learned

There have been several lessons learned in the process of adapting the JTF Core Competency Framework and applying it to the development of internal processes to support clinical research professionals. None of this work would have been possible without the deep, consistent and long-term engagement of a range of stakeholders. Frontline staff and PI researchers understand best what the needs, interests and capacity are for potential end users and supervisors. However, investment in dedicated pedagogical expertise was also critical: The CRPD specialists merged this input with the Framework to create a comprehensive yet flexible curriculum that is in keeping with the principles of adult education and sensitive to the challenges of busy healthcare professionals.

The independence and autonomy of PIs in most academic health science centres makes institutional initiatives of this nature uniquely challenging. Executive endorsement from multiple portfolios (Research, HR, Learning Institute in our case) is necessary, but that endorsement is not sufficient for successful implementation. While PIs may readily support objective competencies and continuing education (especially when it is offered on site and free), where application of the Framework impacts research funding, as it does with the job roles initiative, a great deal of communication and an extended timeline is needed to enable integration with the cadence of funding cycles. Institutional support and resources are critical over this period.

Constant evaluation and communication are integral to ensuring the clinical research community informs and adopts the program as it is developed, recognizing it as an iterative process that will continue to evolve as additional data and resources become available. Demonstrating return on investment for initiatives such as this can be difficult, especially in early days. Careful consideration of the data valued by various stakeholders at the outset is time well spent.

Conclusion

CRPs are a critical workforce within the clinical research enterprise. Over the years, CRPs have seen a significant increase in their workload and responsibilities without concomitant increases in average salaries. Coupled with limited professional recognition and career development opportunities, this environment has led to high levels of job dissatisfaction and turnover in this workforce, particularly in academic health care settings. Shifting the culture of the CRP workforce is imperative as it has implications on the quality, rigour, safety, and ethical conduct of clinical and translational research, which in turn, impacts patient care, treatment, and outcomes. The JTF Framework was developed to align the CRP workforce around a single and comprehensive

set of competencies, skills, and attitudes for conducting safe, ethical, and high-quality clinical research. The JTF Framework has been a seminal step in addressing the challenges encountered in this workforce and professionalizing CRPs by shifting the focus from regulatory compliance to professional competency. By engaging multiple stakeholders and expertise in adult education, SickKids adapted the JTF Framework to the Canadian context and the unique considerations presented by child health research. The SickKids CR-CF is being used to professionalize the local CRP workforce through several initiatives: 1) a formalized and standardized onboarding and training program for all new hires; 2) a novel, competency-based clinical research curriculum; 3) tools and processes to leverage the framework for professional recognition and career progression; and 4) competency-based job descriptions to match competency to responsibilities. The collective goal of these initiatives is to provide a professional environment that recognizes the unique skills of CRPs and encourages ongoing professional development. This in turn, will improve patient care, treatment and outcomes and support the SickKids mission of 'Healthier Children; A Better World' through high-quality innovation, research and discovery.

Authors' Note

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The University of Minnesota's Clinical Research Support Center Feasibility Review: An Objective Protocol Assessment Carving a Pathway to Study Success

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Abstract: *To initiate clinical research studies successfully and efficiently, it is critical to develop a strong, feasible, and well-written study protocol early in the start-up phase. The University of Minnesota's Clinical Research Support Center designed and implemented a structured Feasibility Review process in 2018 that addresses common start-up challenges such as poor study design, inappropriate outcomes, and limited resources. This process has been shown to turn an unfeasible study into a well-designed protocol that is IRB-approved with few protocol-related stipulations and well prepared for execution. It has also educated study teams on how to write better-quality and more robust protocols for subsequent studies. Once a draft protocol is available, the entire process takes just six working days and is free of charge to investigators, study teams, and departments.*

From 2018-2021, one hundred sixteen Feasibility Reviews (n=116) have been completed across eight schools or colleges. Mean satisfaction scores for study team members who responded were high (N=126, M=4.71 ± 0.5) on a 5-point Likert-type scale. Most respondents (96%) indicated that they planned to modify their protocol based on reviewer feedback. Open ended/ qualitative feedback was highly positive with most responses centered around the helpfulness of feasibility review, the high level of expertise, and fast turnaround time.

The Feasibility Review is a valuable and multifunctional program providing timely expert guidance to study teams to efficiently and successfully launch and execute clinical research studies. It can be easily replicated, adapted, and implemented at other institutions to increase the quality and efficacy of academic research.

Keywords: *feasibility review, protocol development, study start-up, clinical and translational science*

Introduction

Anyone who has conducted a clinical research study at an academic institution knows how complex and challenging the process can be. Barriers to successful execution often begin during start-up and may include poor study design, inappropriate outcomes, the length of time protocol development can take, and limited resources to navigate the process (Al Dalbhi et al., 2019; Alak et al., 2014; Campbell et al., 2015; Cullati et al., 2016; Djurisic et al., 2017; Duley et al., 2008; Gallagher et al., 2013; Higgins et al., 2010). The impact of these barriers can be far-reaching and include potential lost opportunities for extramural funding and industry partnerships. It can also lead to investigator frustration and disengagement, reduced collaboration across institutional departments, wasted time and effort for participants, and ultimately, fewer meaningful studies, discoveries, and translations (Yordanov et al., 2015). In a competitive research environment, it is critical to have a well-written and feasible protocol to get through the IRB process smoothly and be successful in execution.

In 2006, the National Institutes of Health (NIH) launched the Clinical and Translational Science Awards (CTSA) program with the goal of supporting a network of research institutions

working together to improve the translational research process to provide "more treatments to more patients more quickly" (National Center for Advancing Translational Sciences, 2015). One challenge that the CTSA program is charged with tackling is developing innovative processes to increase the quality and efficacy of translational research. This often starts with protocol development and assessment of trial feasibility.

Currently, more than 50 medical research institutions across the nation receive CTSA program funding. When surveyed, 64% indicated their institutions offer some form of an assessment of trial feasibility or a similar service, however few have been documented in the literature. Rockefeller University's Center for Clinical and Translational Science developed the Navigation Program which uses a structured supportive guidance process to expedite protocol development to the standards of good clinical practice (GCP), focusing on research ethics and integrity (Brassil et al., 2014). However, one limitation of this program is the length of time the process could take with some studies reaching 400 days before completion.

Vanderbilt University's Institute for Clinical and Translational Research implemented a Research Design Studio system that assembles a panel of three to six research faculty to provide guidance in hypothesis generation, study design, grant review, implementation, analysis and interpretation, manuscript review, and translation (Byrne et al., 2012). However, new or different research personnel participate in each studio, potentially leading to disparate and/or conflicting feedback.

Indiana University's Clinical and Translational Sciences Institute employs Project Development Teams that also help to accelerate the research process from initial concept to external funding (Sajdyk et al., 2015). However, investigators are sometimes so early in the research development process, the overall study design and resources necessary change, requiring additional meetings and/or starting from scratch.

In 2018, the University of Minnesota's (UMN) Clinical Research Support Center designed and implemented a formalized and structured Feasibility Review process that addresses these limitations and quickly helps investigators develop strong, feasible, and well-written protocols ready for Institutional Review Board (IRB) submission and successful execution.

Methods

Development of the Feasibility Review

Earlier in 2017, the UMN convened a design studio as part of its initiative to establish the Clinical Research Support Center; a "one stop shop" for investigators and study teams providing a full scope of resources to help ease the start-up burden. Under the leadership of the steering committee, cross-functional stakeholders were identified and invited to participate in twice-monthly design studio sessions for four months.

Thirty-four participants, including diverse faculty from different departments, research support staff, and institutional leaders were charged with conducting more than 100 interviews with individuals from the greater research community to gather feedback on the UMN's clinical

research process in its current state, what was working well, and what were the frustrations. Opportunities were collated and common themes identified, which included the need to assess study readiness and provide support for navigating the research process. This led to the concept of the Feasibility Review and subsequent process development to put the idea into action.

Feasibility Review Process

The Feasibility Review is managed by a team of approximately five Clinical Research Specialists from the Clinical Research Support Center. The Specialists are responsible for meeting with investigators and study teams who are in the process of protocol development. The Specialists assess investigator needs and help study teams create complete protocols by offering guidance, feedback, and language specific to their study needs. Once a protocol is complete, it is eligible for a Feasibility Review.

The team of Specialists review up to two draft protocols per week, along with consent forms, recruitment materials and budget, if available, with a broad panel of experts. This panel includes representatives trained in the Feasibility Review process (further referred to as "experts") from biostatistics, federal regulations (FDA), informatics, recruitment, monitoring, facilities, clinical/hospital partners, community engagement, accounting, local IRB regulations, and biorepository/lab pathology. Experts take one week to review the materials and provide feedback, guidance and suggestions through a shared review form in Google Sheets. See Figure 1 for example review prompts.

Figure 1. Panel of experts with example review prompts.
Note: Each expert has several review prompts.

Click here for larger image

Within one week, the Specialist facilitates a Feasibility Review group meeting with all experts and the study team. The experts discuss the protocol section by section to present their feedback, talk through any challenges or barriers, and suggest creative solutions. This meeting takes approximately 1.5 hours and is held via Zoom.

Within 24 hours, the Specialist provides a written summary of the feedback to the study team outlining strengths, opportunities for improvement, resources, action items, and all experts' contact information for follow-up support. The entire process takes six working days from sharing materials with experts to providing the study team with the written summary and is free of charge to study teams and their departments. See Figure 2 for a timeline of the Feasibility Review process.

Figure 2. Timeline of the Feasibility Review Process.

Next Steps/Follow-up Support

Study teams are encouraged to make changes to their protocol based on the Feasibility Review comments and to send a final version back to the Specialist. The Specialist then shares the final protocol with a Regulatory/Recruitment Specialist to develop/revise consent forms, recruitment flyers/ads and other participant-facing materials, and submit for regulatory review (IRB, FDA and others as required).

After study approval, the Specialist offers the study team study activation support. This often entails guidance, resources, and planning to address financials (i.e., billing and expense tables), clinical operations planning (i.e., delegation of authority), lab/specimen management (i.e, lab orders), data capture and management plans, and opening to accrual. Study activation support can include weekly or bi-weekly meetings and often includes the Specialist, Principal Investigator (PI), Project Manager, and Study Coordinator.

Promoting the Feasibility Review

The Feasibility Review is advertised and promoted across the University through various channels,

including new faculty and staff orientations, departmental meetings, department websites, e-newsletters, blog posts, professional development seminars, email communications, and through referrals from experts and previous study teams. The UMN IRB may also recommend a Feasibility Review for studies that were previously disapproved or deferred.

Ongoing Quality Improvement

Ongoing quality improvement is an integral part of the Feasibility Review process. All study team members who participate in the review are invited to complete a 4-question survey assessing their overall experience with the process, whether they plan to modify the protocol based on reviewer feedback, what they liked most, and how the process can be improved.

The entire expert review panel (including the Specialists) meets each quarter to reflect on past reviews, highlight successes, discuss ways to improve the process, review responses from the survey, and engage in team building. One improvement opportunity that was identified involved reformatting the shared review form to better align with the IRB's protocol template. This improvement resulted in better understanding and adoption of reviewer feedback by study teams as it is now more explicit where in the protocol a suggested change should go. Another improvement involved increasing the number of experts from six to eight, with the addition of an expert from recruitment/research facilities and clinical trial monitoring. This improvement resulted in a more comprehensive and thorough review. Team building activities are among the experts and Specialists and include 'getting to know you' icebreakers, games such as trivia and special recognition or 'shout outs' to those who have gone above and beyond over the past quarter.

Even with a comprehensive Feasibility Review, the IRB may find an area of the protocol that requires further development or explanation. These requests for clarification are also supported by the Specialist and noted for quality improvement. By following the protocol all the way through the approval process, the Specialist is able to help resolve requests, note other issues that were not addressed during the review, and devise new prompts to help experts better address these issues in the future.

Results

Study Characteristics

As of December 31, 2021, the Clinical Research Support Center has completed 116 Feasibility Reviews across eight UMN schools or colleges. Most studies came from the Medical School (85%) in the Department of Psychiatry & Behavioral Sciences and Department of Medicine (both at 18%), followed by the Department of Pediatrics and Department of Rehabilitation Medicine (both at 13%).

The majority of the studies were investigator-initiated (97%; as opposed to business and industry) and written in the institutional biomedical protocol template (65%). Thirty-one percent used a randomized clinical trial study design with the primary purpose of treatment (40%). Most studies

were single-site (88%), and most did not require an Investigational New Drug Application (IND) or an Investigational Device Exemption (IDE; 55%).

Thirty-five percent of PIs were newer to research (having completed less than three clinical trials) while the remaining 65% were more experienced (having completed three or more clinical trials). Sixteen percent of PIs returned with a second, third or fourth protocol for review. See Table 1 for all Feasibility Review characteristics

Table 1. Feasibility Review Characteristics

	N (%) or Mean ± SD
Number of Reviews (January 2018 - December 2021)	116
Schools or Colleges*	
Medical School	99 (85%)
School of Nursing	5 (4%)
School of Public Health	4 (3%)
School of Social Work	2 (2%)
School of Dentistry	1 (1%)
School of Kinesiology	1 (1%)
College of Science & Engineering	1 (1%)
College of Education and Human Development	1 (1%)
Study Type	
Investigator-Initiated	112 (97%)
Business & Industry Sponsored	4 (3%)
Protocol Type	
Biomedical	75 (65%)
Social	25 (22%)
Other	16 (14%)
Study Design	
Randomized Clinical Trial	36 (31%)
Cohort Study	23 (20%)
Cross-sectional Study	22 (19%)

Before & After Study	20 (17%)
Case Series	6 (5%)
Case control Study	4 (3%)
Other	5 (4%)
Primary Purpose	
Treatment	46 (40%)
Basic Science	16 (14%)
Diagnostic	10 (9%)
Health Services Research	10 (9%)
Supportive Care	9 (8%)
Prevention	8 (7%)
Device Feasibility	7 (6%)
Screening	2 (2%)
Other	8 (7%)
Number of Sites	
Single-site	102 (88%)
Multisite	14 (12%)
Investigational Product	
Device	25 (22%)
Drug	24 (21%)
Device & Drug	3 (3%)
No Investigational Product	64 (55%)
Principal Investigator Experience	
Completed less than 3 clinical trials	41 (35%)
Completed three or more clinical trials	75 (65%)
Repeat Study Teams	
Returned with a second, third or fourth protocol for review (n=83 unique Investigators)	13 (16%)
Number of Experts Involved Over Time	
2018 (n=26)	6.27 ± 2.50
2019 (n=33)	8.06 ± 2.84

2020 (n=30)	8.83 ± 2.97
2021 (n=27)	8.15 ± 2.86

*Note the relative size differences of the schools. For example, the Medical School has 1,081 full-time faculty compared to the School of Public Health that has 118 full-time faculty.

Providing Valued Support

Mean satisfaction scores for study team members who responded were high (N=126, M=4.71 ± 0.5) on a 5-point Likert-type scale with 1.0 representing a "poor" overall experience and 5.0 representing an "excellent" overall experience. Most respondents (95%) indicated that they planned to modify their protocol based on reviewer feedback. Open ended/qualitative feedback was positive. Most responses centered around the helpfulness of feasibility review, the high level of expertise, and the fast turnaround time. See Figure 3 for study team feedback.

Figure 3. Study team feedback.

Case Studies

The benefits of the Feasibility Review process are demonstrated through case studies of three unique research projects.

Case Study 1

The first case is an investigator-initiated, longitudinal comparison of three groups of adolescents, using a device for measuring neurophysiological processes that was considered a non-significant risk investigational device exemption (NSR-IDE). This study was written in the biomedical protocol template and the PI was brand new to research at the UMN. The PI was referred on to a Feasibility Review by a colleague who had previously taken part in their own Feasibility Review.

The study included utilizing transcranial magnetic stimulation with electroencephalography and resting-state functional magnetic resonance imaging, and a follow-up at 3-6 months post intervention. Potential challenges with IRB approval and successful execution included an underdeveloped consent process, working with a vulnerable population (depressed adolescents with suicidal behavior), and minimal compensation allocated for participant time and effort.

After the Feasibility Review, the study team strengthened their protocol by incorporating reviewer comments on abbreviated Part 11 compliance due to the NSR-IDE, best practices for screening, consenting and assenting participants, additional safeguards for vulnerable populations, and feedback on adequate compensation for participants. They also worked with a Regulatory/Recruitment Specialist to develop consent/assent forms and participant-facing materials for submission to the IRB. The study required a full IRB review and was deemed greater than minimal risk.

The study was approved by the IRB with two minor protocol-related stipulations and received special acknowledgment noting how well-designed and clearly written the protocol and consent documents were. The PI also provided positive feedback through their experience survey, writing "[t]he process was very well organized and efficient. Reviewers' comments were well explained, and suggested changes/additions to the text of the protocol were very helpful. It was both educational and immensely useful as a PI who is new to the University." This case demonstrates how the Feasibility Review can limit the incidence of protocol-related IRB stipulations by anticipating and addressing potential challenges and concerns before a protocol is submitted to the IRB.

Case Study 2

The second case is also investigator-initiated, but was a cross-sectional study with no investigational drug or device. This study was written in the social protocol template and the PI was also relatively new to research at the UMN. This study came to the Clinical Research Support Center for a Feasibility Review after referral by the IRB, who had initially disapproved the study. Main concerns focused around the confidentiality and privacy of participants, recruitment methods that violated IRB policy, and possible coercion of participants due to an unmitigated power differential. This study was at high risk of abandonment based upon PI frustration and potential wasted time and effort.

After completing the Feasibility Review, the study team revised their study design (including new and compliant recruitment strategies suggested by the experts), addressed the privacy concerns, and mitigated the power differential to safeguard against coercion. The revised study was then IRB approved with only one minor protocol-related stipulation. This case demonstrates how the Feasibility Review can turn an unfeasible study into a well-designed, well-written protocol approved by the IRB and ready for successful execution. The PI was extremely pleased with the results of this study and returned to the Clinical Research Support Center for guidance and support on a subsequent project a few months later.

Case Study 3

The third case describes a portfolio of studies. These four studies were all investigator-initiated (by the same PI) and written in the biomedical protocol template. Unlike the two cases above, this PI was experienced in conducting research at the UMN. Three of the studies used a prospective cohort design while one was a randomized clinical trial, and one study included an NSR-IDE. This PI was referred for a Feasibility Review by their department administrator who had heard about the process through a seminar presentation.

After completing their first Feasibility Review, the study team incorporated much of the feedback received into their second study (strengthening the protocol before it even made its way to a review). Further feedback received from the second review was incorporated into their third protocol and so on for the fourth protocol. The first study was IRB approved with five minor protocol-related stipulations, the second study was approved with four minor protocol-related stipulations and the third and fourth studies were approved with no protocol-related stipulations. This case demonstrates that with each subsequent Feasibility Review, the instructional value of a review can lead to enhanced PI capabilities and to better quality, more robust protocols, as many expert comments can be adapted for subsequent studies. See Table 2 comparing case study characteristics.

Table 2. Case Study Characteristics

	Study Design	*Investigational Products*	*Principal Investigator Experience*	*Risk Level*	*Level of IRB review*	*Number of protocol-related stipulations*	*How this case demonstrates the value of a Feasibility Review*
Case study 1	Cohort Study	Device	Completed <3 clinical trials	Greater than minimal risk	Full review	2	The Feasibility Review limits the number of protocol-related stipulations by anticipating and addressing potential challenges and concerns, before they get to the IRB.

Case study 2	Cross-sectional	No investigational product	Completed <3 clinical trials	No greater than minimal risk	Expedited review	1	The Feasibility Review can turn an unfeasible study into a well-written protocol approved by the IRB and ready for successful execution.
Case tudy 3a*	Randomized clinical trial	No investigational product	Completed 3+ clinical trial	Greater than minimal risk	Full review	5	With each subsequent Feasibility Review, the instructional value of a review can lead to better quality, more robust protocols as many expert comments can be adapted for subsequent studies.
Case study 3b*	Cohort Study	Device	Completed 3+ clinical trials	Greater than minimal risk	Full review	4	
Case study 3c*	Cohort Study	No investigational product	Completed 3+ clinical trials	No greater than minimal risk	Expedited review	0	
Case study 3d*	Cohort Study	No investigational product	Completed 3+ clinical trials	No greater than minimal risk	Expedited review	0	

*Note the same principal investigator for case studies 3a-3d.

Discussion

The entire research process, from identifying the problem to formulating a hypothesis to collecting and analyzing data, is intrinsically challenging (Eapen et al., 2014; Ellis et al., 2001; Higgins et al., 2010; Kao, 2003). Many clinical research study teams struggle, and occasionally fail, during the start-up phase due to a lack of resources and support navigating the study design and protocol-writing processes. The University of Minnesota's Clinical Research Support Center has designed and implemented a Feasibility Review process that addresses limitations of similar programs by quickly helping investigators develop strong, feasible, and well-written protocols ready for IRB submission and successful study execution.

The Feasibility Review is implemented in just six working days at no cost to investigators, study teams, or departments. This ensures that time and resources are used most efficiently and encourages participation. The Feasibility Review also includes a designated panel of experts trained in the Feasibility Review process, as opposed to using ad-hoc faculty panels for each review. This helps to ensure consistency of reviews, camaraderie of reviewers, 'boots on the ground' experience, and limits the amount of training required for each new review session. Finally, the Feasibility Review requires a complete protocol for a study to be eligible for review. This reduces duplicative work when expert support and guidance is given to a study team too early in the research development

process, leading to additional examination and/or repeating the Feasibility Review.

Though a relatively new support process, the Feasibility Review has helped produce numerous high-quality protocols across several schools and departments with both new and experienced investigators. It has been shown to turn an infeasible study into a well-designed protocol, approvable with few or no protocol-related stipulations, and well prepared for execution. The Feasibility Review has also taught study teams how to write better quality, more robust protocols for subsequent studies. Feedback from study teams has been overwhelmingly positive with most indicating their overall experience with the Feasibility Review process as "excellent." Finally, the participation of experts continually engaged in the process demonstrates their continued commitment to providing valuable support to research teams across the University.

Although the Feasibility Review has shown great promise and continues to grow each year, there are some limitations worth noting. First, the review has been found to be most helpful for investigator-initiated studies, as opposed to business and industry sponsored studies, which are often rigidly structured by the sponsor. The Clinical Research Support Center continues to expand its capacity with a multisite working group and exploring adaptations to better accommodate business and industry sponsored studies. Second, the Feasibility Review does not give guidance on whether a study should move forward. Instead, the goal is to support study teams in developing the most robust, feasible, and well-written protocol possible. Despite these limitations, the Feasibility Review capability has been well received by the UMN research community and continues to grow and adapt each year.

Next steps include quantitatively assessing its impact on study approval and start-up timelines and how the program helps study teams meet enrollment goals. Considerations are also being made to expand the program to include grant reviews. It is clear, however, that the Feasibility Review is a valuable, cross-functional program providing timely expert guidance to study teams to efficiently and successfully launch and execute clinical research studies and to educate investigators as well. It can be easily replicated, adapted, and implemented at other CTSAs to continue the charge of developing innovative processes that increase the quality and efficacy of academic research

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Reconfiguring the Research Administration Workforce: A Qualitative Study Explaining the Increasingly Diverse Professional Roles in Research Administration

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Abstract: *The research administration profession is in a time of significant change. The traditional jack-of-all-trades role has become more fragmented into specialized advanced roles, with a more recent focus on research development. Workflows are increasingly becoming more electronically automated. The introduction of graduate degrees and professional certifications has introduced a new complexity within the office hierarchy. Moreover, recent global events have shifted the profession into a remote working environment, causing industry-wide voluntary employee turnover as employees consider new opportunities, work/ life balance, and cost of living ramifications. This qualitative study used semi-structured interviews to capture research administrators' experiences within four research questions: 1) how is a traditional research administration professional role defined today; 2) how does the chain of command respond to new professional roles; 3) how has the standardization of professional knowledge through education and certifications impacted the workforce; and 4) how does the distribution of tasks become fluid to get work done between the different research administration professionals? Practical implications of this research include understanding that traditional research administrator roles are flat with no hierarchy or room for professional growth within the individual or collective research offices. The creation of promotion opportunities in order to provide professionals a pathway to rise in ranks and achieve higher titles and commensurate wages is vital to the future success of the profession. Another practical implication of this research is the call to begin raising awareness of the professional certifications outside of the research administrative profession in order to gain further distinction and notoriety within the research landscape. The increased need for educational degrees, especially doctoral-level work, in order to gain academic reputation is restrictive to the future of the profession. The profession of Research Administration is in a time of rapid expansion. The aim of this study is to clarify the development of new*

professional roles in research administration. In doing so, this research maps the emerging extended professional roles and provides insight into the social and administrative processes that drive the development of these extended roles.

Keywords: *workforce; professional roles; research administrators; workflows; certification; education; workforce development*

Introduction

In response to shortages in the workplace and the persistent changes in scientific funding and its workforce, national authorities and research organizations have endorsed inter-professional work and task substitutions. Consequently, the research administration workforce has diversified in several directions with formalized roles for research assistants, specialized roles for departmental and compliance administrators, advanced roles for research leadership, and new roles for new services, such as research development (Currie et al., 2009). This workforce reconfiguration demonstrates a growing international trend in research administration policy to redistribute support services on the basis of professional achievement rather than historical workforce hierarchies and roles (Currie et al., 2009; Goodman, 2019; Salvatore et al., 2018; Sanders & Harrison, 2008). Additional data is required to clarify the development of new professional roles in research administration. The current research maps the emerging extended professional roles and provides insight into the social and administrative processes that drive the development of these extended roles.

Persistent changes in scientific funding and the research administration workforce have dramatically impacted the availability of research administrative support services worldwide. Consequently, the research administration workforce has diversified in several directions with formalized, specialized, and advanced professional roles and new roles for new services, such as research development. This study contributes to what is known about the current international research administration workforce landscape from the perspectives of research administrators who are experts on research support delivery. This study helps us to understand the current landscape of the research administration workforce. Findings from the study may be used to help organizations determine research administration policies regarding workflows and hierarchy, and/or resource allocation to improve research support and better serve research faculty.

Background

Seventy years ago, research administration as a profession did not exist. The first professional titles included department administrator or coordinator, program manager, executive/administrative assistant, and the like. In the last 50 years, the research administration workforce has undergone transformative changes in response to the ever-changing regulatory landscape and the general expansion of the research enterprise. Fifty years ago, the NIH budget was just under $1 billion as compared to the 2021 budget of $43 billion. There were nine institutes; now, there are 27 Institutes and Centers, each with a specific research agenda (Peterson, 2021). Over the years, to comply with increasing federal regulations, but also in response to significant increases in the

national budget, research administration has become a highly specialized profession with on-site and multiple external sources of training and education. The profession now requires individuals from a broad spectrum of professional backgrounds, including science, accounting, engineering, ethics, law, finance, and non-profit management. It has transformed from paper to digital communications and workflows, greatly facilitating the growth and speed of research innovation. Research administration has developed into a critical leadership role at universities and non-profits. However, the formalized professional roles of the research administration workforce have not yet been mapped and are not fully understood (Goodman, 2019).

The literature on workforce reconfiguration and new role development is centered on professional jurisdiction, or the central hub in which a certain profession claims valid control over a domain of work by way of its expertise. Andrew Abbott coined this concept in the late 1980s to indicate professions' right to control particular services and activities (Abbott, 1988). Professional groups claim exclusive authority because their work is grounded in specific knowledge, including indeterminate and experiential tacit knowledge, yet situated and embodied in practice (Freidson, 1988). A growing body of literature shows a significant impact of the introduction of new roles on jurisdictional claims (Currie et al., 2009; Huising, 2015; Salvatore et al., 2018; Sanders & Harrison, 2008). The concept of professional jurisdiction is helpful in defining the traditional role of research administrators and understanding how hierarchies and process workflows may be developed to encompass role diversity in the future.

Professional work is increasingly shaped by the interests and routines of employers—aligning professional expertise with organizational and commercial needs (Evetts, 2011). Recently, authors have argued that professions respond and adapt to an organization's needs and incorporate the organizing work themselves, redefining 'organizing' as one of their core competencies (Noordegraaf et al., 2014). This more dynamic evolvement of professional roles can lead to a more diverse professional work, thereby shifting professional jurisdictions. The exact extent of this diversity across research administration is yet unknown, as are the drivers of this change and their interactions. This paper aims to provide additional insight into the evolution of extended professional roles in research administration and examines the drivers of extended professional roles.

This study contributes to what is known about the current international research administration workforce landscape from the perspectives of research administrators that are experts on research support. This study aims to clarify the development of new professional roles in research administration. The four questions guiding this research are: 1) how is a traditional research administration professional role defined today; 2) how does the chain of command respond to new professional roles; 3) how has the standardization of professional knowledge through education and certifications impacted the workforce; and 4) how does the distribution of tasks become fluid to get work done between the different research administration professionals?

Methods

This is a qualitative study using 16 semi-structured interviews to capture research administrators' experiences with research administration support. Participants were research administration professionals or leaders with a convenience sampling in the United States. Interviews were conducted using a semi-structured interview script via video-conferencing software and were audio-recorded to preserve data integrity. Interviews lasted approximately 15 to 45 minutes and were conducted in English. Recordings were transcribed verbatim, and the transcripts were then analyzed to allow common themes to emerge within the four research questions.

Interview Script and Strategy

An interview script was used to reduce variation. The interview script ensured that each participant was asked the same questions in the same manner to help ensure consistent data collection. The use of a predetermined interview script also enabled the interviewer to avoid general discussion and instead ask focused questions to get focused answers. This practice also ensured the conformability and dependability of the data, while also demonstrating the research expertise of the study team.

Member-checking was used as a tool to validate the accuracy of the data, provide evidence of credibility, and promote trustworthiness within the study. Within 72 hours of the interview, the interviewee was sent a full verbatim transcript of their interview in a Microsoft Word file. Interviewees were then given 72 hours upon receipt to review the file for accuracy and validate what they said and meant. The 72-hour window provided a sense of urgency while allowing enough time for a full review. If the interviewee made changes and provided an edited Microsoft Word file, that new file was used for data analysis. If they provided changes in another format, such as written comments, the researcher then made edits and returned it to the interviewee once more for another review, with a request to return within 72 hours of receipt. If no confirmation was received from the interviewee within 72 hours, the researcher assumed that the transcript was correct, and the original file was used for data analysis. To help reduce the possibility of no confirmation, the researcher explained the member-checking process before and after the interview to set expectations.

Study Procedures

This is a qualitative interview study. The study team interviewed research administration professionals in different roles (e.g., departmental, leadership), from different organization types (e.g., public, private), across all United States regions using a semi-structured interview script. The semi-structured interview design was appropriate to gather rich data related to experiences with research administrative support services related to extended professional roles in research administration support teams. Using purposive sampling to ensure qualified participants, the researchers interviewed experts from a variety of roles and organizational types to maximize variation in perspectives. Potential participants were sent a recruitment email inviting them to participate in a research study. Interested participants responded to the research team, and interviews were scheduled promptly.

The study team interviewed all those who agreed to participate and completed the scheduling and consent process. Interviews were scheduled at a time that was convenient for the participant and interviewer and took place over the phone or via a video-conferencing software (e.g., Zoom and Microsoft Teams). Respondents were asked to sign an information sheet after answering all their questions in place of an informed consent document consistent with flexible IRB standards. Inclusion criteria for the interviews were that participants were research administrators with some level of experience with research support at their organization. Individuals who do not have knowledge of their organization's research services or who do not speak English were excluded from the study.

Data Analysis

We used the four domains of the interview script as an a priori codebook for initial coding. Then, within each domain, we conducted detailed inductive coding, allowing themes to emerge. Our goal was to describe the range of participant experiences within each domain, adding valuable context to research administrator workforce experiences. This study does not use blinding or masking.

The research team used hand-coding to label and organize the qualitative data to identify themes. Inductive coding, also called open coding, was used to start from scratch and create codes based on the qualitative data itself. After reading through the data to get a sense of the general themes, the researcher assigned the first set of codes and placed them into a hierarchical coding frame. The researcher then went back through the data again, line by line, to code the data in more detail. A second member of the research team then repeated this same process to ensure accuracy in the qualitative analysis.

The study team interviewed 13 participants before the first data analysis. An additional three participants were then interviewed with the same approach and interview script. Moreover, a second data analysis was then undertaken. As no new themes were then added, study saturation was reached at 16 participants.

Results

The first author identified a ranked list of 34 research administrators at the Director level or above for inclusion in the study. Participants were ranked according to their level of knowledge and expertise within the field. Of those contacted, 15 responded and followed through with scheduling a research interview. Those 19 who did not respond after two follow-up communication attempts were not included in the study. All research interviews took place via video-conferencing platforms (e.g., Zoom or Microsoft Teams). The average length of interview time was 20 minutes. Only 6 participants returned a corrected or modified interview transcript. The remaining 10 participants approved and accepted the original interview transcript verbatim.

Sixteen participants interviewed represented small (4, 25%), medium (6, 37.5%), and large (6, 37.5%) academic research institutions from around the United States, including the Southeast (6,

37.5%), Southwest (3, 18.8%), Midwest (3, 18.8%), Northeast, (2, 12.5%), and West Regions (2, 12.5%). The majority of participants held a Director position (6, 37.5%), followed by Executive Director (3, 18.8%), Manager (2, 12.5%), Assistant Vice President (2, 12.5%), Vice President (1, 6.3%), Senior Director (1, 6.3%), and Assistant Director (1, 6.3%).

We present our findings under four headings, corresponding to the four a priori domains (Table 1). Under "How is a traditional research administration professional role defined today?" we describe the traditional values that have remained the bedrock of our profession. And yet, the research organizational chart has become more chaotic as institutions attempt to meet the increased need with a single professional catch-all role. Under "How does the chain of command respond to new professional roles?" we describe how the profession has matured and introduced layered career pathways, more specialized roles, to keep institutions competitive within the broader research landscape. Under "How has the standardization of professional knowledge through education and certifications impacted the workforce?" we categorize several focused graduate study programs and professional certifications that demonstrate a broad knowledge and niche expertise in the profession. Working knowledge, on-the-job training, and experience are still the main currency with which Research Administrators demonstrate expertise to those outside the profession. Finally, under "How does the distribution of tasks become fluid to get work done between the different research administration professionals?" we describe how institutions have begun to add hierarchy within professional roles. Junior clerical roles have been created with the intent to free up working managers to innovate and troubleshoot broader workflow problems. Historically and industry-wide, Research Administration was a purely reactive role. As the profession has matured and more institutions have introduced layered career pathways, more specialized roles have been created to keep institutions competitive within the broader research landscape. We illustrate the results with quotes and extracts of observational notes from the study interviews.

How is a traditional research administration professional role defined today?

The traditional research administrator perpetually lacks a standard occupational definition (Collinson, 2007; Gabriele, 1998; Pringle, 1989). In fact, the professional has lacked a clearly defined role for so long that a measure of fluidity has become part of our occupational identity in academic research as the workplace "significant others" (Collinson, 2007). In comparison with 'permanent' academic faculty and staff who are perceived as core professionals, the traditional research administrator is still often termed as periphery support staff (Collinson, 2007). Attempts to define the traditional role focus primarily on the management administration of research grants and projects, including proposal development, project and award management, financial monitoring and accounting, and some degree of compliance (Kerridge & Scott, 2018; Silva, 2018).

Specialization between pre-award and post-award has enabled professionals to extend their roles and carry out administrative tasks relatively independently from other aspects of the research lifecycle. As professionals develop expertise and administrative routines in a particular area, the definition of a "traditional research administration" has changed. According to participants, the traditional research administrator still provides understanding, innovation, safety, service, and structure to the research enterprise.

Table 1. A Priori Domains and Coding Matrix

Initial Coding Domain	Level I	Level II
Research Administrator Role	Provides Understanding	
	Provides Innovation	
	Provides Safety	
	Provides Service	
	Provides Structure	
Chain of Command	Chaotic Organizational Chart	Centralized Vs. Decentralized Vs. Hybrid
	Role Title Changes	Match Existing Workload
		More Autonomy
		Reassignment Or Redistribution
		Creation Of Hierarchy (Research Administrator I, II, III)
	VPR Turnover	
	New Roles to Meet New Need	Clerical Roles
		Compliance
		Information Technology
		Social Media
		Budget
		Veterinarian
		Proposal Development
Certification vs. Education	To Get the Job	
	To Get Promoted	
	Professional Societal Memberships	
	Certifications Recognized in Field, Worthless Outside	
	Unique and Personalized Journey	
Workflows	Streamlining Using Technology	
	Policies Create Order	
	COVID Aftereffects	Voluntary Turnover

The traditional research administrator provides insight. Participants indicated they are considered a jack-of-all-trades and a generalist. They possess a wide range of skills and abilities and do everything under the sun. Their general role is a catch-all label that is not clearly identifiable and often varies the gamut. The traditional research administration professional role has become more fractured over the years as the funding landscape and regulations have become more complex.

> *"It's a kind of catch-all label. If you were to call up an institution and say, 'How many Research administrators are working in your institution?' They could not give you that number, because we're not identified as researcher administrators."*

> *"It really varies the gamut, depending on what position you're in. It goes anywhere from finding the funding information, to helping with the proposal and budget against the application, to the sponsor accepting the award, making sure compliance is in place, the post award administration, the issuing of sub-agreements, the financial reporting, compliance in the area of animals, humans export controls—you name it."*

The traditional research administrator provides innovation. Participants indicated their work is at the center of research development. They often provide support in the pre-award phase and perceive they are critical in elevating principal investigators and their work. As staff who help researchers put projects together, they are instrumental in increasing researchers' understandings of key extramural elements such as funding agency requirements.

> *"We provide some project management, particularly on the monsters or the very large, complex proposals, which also generally have lots of money attached to them. We are taking those principal investigators, and then seeing if you can take them to the next level and go for federal funding."*

> *"We want a mixture of faculty fully equipped to engage in research because that is part of their tenure and promotion. We are working with them to help them understand the funding agency, to help them build out their projects to see where they are going to be competitive. How they may need to rethink things. A lot of hands-on work with them."*

The traditional research administrator provides safety. To some degree, research administrators provide guidance on the more complex rules and regulations on almost every level. According to participants, their knowledge is instrumental in ensuring compliance and safety through all levels of the organization. Furthermore, they are, by far, the experts when it comes to bureaucratic requirements both inside and outside of the institution. These activities provide safety for the institution and principal investigators.

> *"Basically, the interface between the faculty, the researcher, and the whole bureaucratic requirements for preparing, developing, submitting a proposal, and then dealing with it if you actually get it. That interface is quite broad. It requires a wide range of skills and analytical ability to be done well."*

> *"Their role is pretty much advisory, guidance, and helpfulness. The Research Administrators are very much detailed-oriented on tasks with a focus on accuracy of data entry and understanding*

the sponsors regulations inside and out. The traditional research administrator has been a combination of those two roles."

The traditional research administrator provides service. Research administrators are advisors in a highly political workplace. They rely on diplomacy and rational thinking to provide constant guidance to our principal investigators. Research administrators know who does what and can answer any question.

"It requires a whole networking skill, though. Formal and informal. Political skills, mostly actually dealing with your associate, you know your Associate Director for Research, your upper-level people, because sometimes issues are more political than logical. As far as being driven by certain rational thinking."

"I think traditionally, people think about the people that help you get the money, and then the people that help you manage the money."

The traditional research administrator provides structure. Participants indicated research administrators are the middle spoke of the wheel regarding research and project management expertise. They use adept networking skills to corral people and keep principal investigators up to date and on track.

"Research administrators are responsible informally for being the middle spoke of the wheel. They're responsible for pretty much knowing who does what in the rest of the university that a faculty member might have to ask. So, they, they don't have to necessarily know the answer, but they have to be able to either get the answer themselves or send the faculty in the right direction to get whatever information they need."

"It is related to deliverables and corralling people if you will—corralling information and essentially setting up the faculty member for success. I think that's probably the main overall understanding of what we do."

From the interview data, it was apparent that research administrators play a key role in active work required to build and maintain the research enterprise. Extended professional roles into pre-award and post-award arenas depend on local, and sometimes even individual department arrangements. Across all institutions, the traditional role was defined in some measure through "pre-award" and "post-award" activities. An example of a general role is the departmental research administrator, who may handle all pre- and post-award administration aspects. An example of a specialized role is a pre-pre-award or research development administrator assigned to help investigators identify funding opportunities and grow grant writing skills. The diversification of the general role often mirrors the diversification of the research portfolio of a single department, university, or institution.

"In general, in the past, the roles were always really well defined and very simple. There was pre-award, and they helped you put in grants. And then there was post-award, and they helped do accounting on grants. But as things have evolved over time, there's all these other niches and roles that have been created. Now there's pre-award analysts and billing teams and post-award

contract. People that do different contracts, because some are federal and some are other types. That the rules have become more abundant, and the lines with which we used to previously define those rules are less clear."

Similarly, a comparison reveals diversity in tasks among professionals with the same job title, e.g., research administrator, research coordinator, grants, and contracts manager. Hence, the exact role of a traditional research professional, including tasks, competencies, and responsibilities, may differ between institutions. This implies that although the findings of this study provide insight into the increasing diversity in individual roles, they cannot easily be generalized across the global workforce. Furthermore, the diversity in the definition of a traditional role complicates the comparison of new extended professional roles. We cannot compare professional roles based on job titles. Hence, the main advantage of this study is on the development of new roles in diverse contexts.

"But, remember, these positions are different in the universities and comparable positions don't necessarily have the same title. Everywhere else there is an Associate or Assistant Vice President position, and we don't have that here. So, sometimes it's hard to measure apples to apples. But we look out into the world, and we see what everybody else is doing, what's the industry norm. For instance, I saw a need for merging the IACUC and IBC administration offices together under one supervisor because those two units work interactively. And I thought I was the first person to do that, but then the market showed several others. While surprised, it was also reassuring and afforded a level of validation, that I'm not crazy. I mean it's nice to think that we have reinvented the wheel and now everybody's going to copy us, and sometimes that happens; but it's also validation to see that, yes, this is an industry norm, and it worked well with some high-powered institutions, even if they don't use the same title."

While participants communicated that research administrators are important providers of structure in their institutions, they also stated there is great variation in what that structure looks like. Research administrators may share skills like networking and project management, but there are an increasingly number of niche jobs, and job duties may vary even within similar—or exactly the same—job titles. Participants conveyed that this constant evolution and increasing variation makes it difficult to generalize trends in the research administration workforce.

How does the chain of command respond to new professional roles?

New specialized professional roles have been created at some institutions to help research faculty overcome certain barriers, including research development and grant writing, facilitating data collection and statistical analysis, advising on federal regulations and policies, and offering technical assistance or clerical support to reduce paperwork burden (Cole, 2010; Evans, 2011). When these new specialized roles are created, the research organizational chart often becomes more convoluted and chaotically disorganized, leaving teams unsure of the proper workflows.

Interview data showed that traditional research administrator roles are flat. There is "no hierarchy" within the individual or collective research offices. There are "no promotion opportunities" that provide professionals a pathway to rise in ranks and achieve higher titles and commensurate

wages. This revelation ties back to the idea of the traditional role as a "generalist—everyone does anything" and, therefore, the need for separation and promotion is negated.

> "When I got here, it was a really flat organization. Not a lot of career opportunities. People tended to leave because there was nowhere to go. So, I have created a structure with Team Leads to give some people the opportunity to do some supervisory responsibility and have a lower-level management responsibility. And then, more recently, I've taken the opportunity to put a couple of those into Assistant Director positions. Again, the idea, and I faced this at other universities is, how do you keep people? How do you get people that are highly knowledgeable? And your high performers, that you don't want to leave, what can you do for them?"

Similarly, the research organizational chart is traditionally convoluted and chaotically disorganized. While most institutions agree on either a centralized, decentralized, or hybrid model of managing pre- and post-award activities, the workforce hierarchy between these structures is blurred. One emergent theme in the interviews was a marked vacancy and high turnover rate in the Vice President of Research role in each institution. Constant turnover in the highest levels of the research hierarchy leads to constant change within the flows and patterns of the organizational chart.

> *"Have you ever seen the plans for one of the old Heathkit radios? That is what the organization chart for research administration looks like. ...Chaotically."*

> *"I think that for me that the distribution of responsibilities is probably appropriate. You know I can't judge if it's right or wrong. I also again know a little bit more about how it works. My guess is that people who are less familiar with that structure, which is probably most people besides me, and the people who work there, struggle to understand how, how it all works together."*

> *"There's been some turnover, there's been some reassignment of tasks, and we're about ready to start a major reorganization."*

The kind of work and responsibilities delegated to research administrators in extended roles differs among individual professionals and is also situated. The need to simply keep things going encourages the introduction of new roles. The fluidity of the workplace enables individuals to participate in complex situations. Yet what they actually do depends on their professional background and acquired competencies. Interviewees noted that role title changes are common to address extended roles and responsibilities. An outdated professional title is changed to match the existing workload (e.g., already doing the work of a promoted role) or give the individual more autonomy (e.g., a working manager). These types of title changes often result in the reassignment or redistribution of tasks among existing professionals or may result in a new hire. Hence, locality or 'situatedness' plays a critical role in the (re)allocation of tasks. The differences in tasks and responsibilities, the organizational embeddedness of professionals, and the situatedness of the work, limit continued development of extended professional roles and may even lock professionals into their workplace.

"Those team leaders worked out well, I think. The staff, what they said was, they appreciated someone closer to them, someone who knew all the ins and outs, and knew the processes, and really could be that subject matter process matter expert. ...And right now, we are 10% above where we were last year. So, if you think about the volume increase, my help of carving just small amounts of time just so they would keep being the subject matter experts is getting harder and harder to do. ...they're doing less and less of those more managerial kinds of things. ...a lot less of that process, policy development, a lot less of that kind of stuff."

"By far, the most advantageous change in the creation of new professional role lies in the creation of position hierarchy (Research Administrator I, II, and III) creating a professional pathway to promotion."

"Human Resources does try to create a semblance of career paths for research administrators, and for Sponsored Research as well. They started with a Sponsored Research Administrator I, and then a II, and a III; but nobody wants to be a I. If it failed, it may be because no one wanted to be a level I, and there was a lot of criticism of the level III criteria. Then there are level III's who want to be an Assistant Director level. The "career path" gave supervisors a way to justify increased salaries as their scope of responsibilities. I suspect that we are not the only university where research administrators struggle with salary compression, heavy workloads and high stress environment."

The creation of new roles to meet new needs was marked in specific target areas related to compliance, communication, and niche research areas. Specialization enables professionals to extend their role and carry out administrative tasks relatively independently from their peers as they develop expertise and routines in a research area. An example of a specialized technical role would be a Research Information Technology Data Analyst. New roles forecasted for research administration are in research information technology, research compliance, social media/ research communications, and proposal development/grant writer. This last role in proposal development was flagged as a more traditional task that has fallen by the wayside and needs to be revived in order to provide a more day-to-day proactive approach to research portfolio development.

"I would want to see someone take on a role of a communications position, that dealt only in communications from the research office. I think that's what's lacking. Many times, we fall to the background and we're only available when people need us. But then we're not really communicating very well. And so, it's not just communicating about the work that has to be done but it's communicating about all kinds of things, like all these wonderful things that are happening, you know, keeping track of what's going on in the government, creating online forums for faculty groups, moderating those types of things."

"We have a new role that was designed to sit between research administration and the Principal Investigator to support the Investigator if they have a question about a grant application, financials, contract, clinical trial—anything—they can just go to their business partner, the expert on where to go and how to get a problem solved. So, the idea is that a Principal Investigator has one contact to deal with any problem, or to troubleshoot any issues. I think that there was a

general recognition that a lot of investigators didn't feel like they knew how to solve problems, and there weren't enough people in the departments to be able to solve them. Because of all the growth and expansion, there was some recognition that in order to help faculty keep up with all of the things they were going to need that somebody to help and hold their hand through it."

"I would say the pre-award team is stable, the contracts team is stable. I think the ones that are really where we really evolved have been more on the technology information systems side, you know, putting in a new pre-award system ... I think there's been a lot of investment and a lot more roles around the integration of the technology with both the workflow of the research administration team, but also the workflow of end users."

Research administrators protect their jurisdiction by distributing non-specialized work to others. From the interviews it was apparent that new low-level clerical roles needed to be created to free experts to troubleshoot and respond to higher-level administrative issues. This lower-level clerical role incorporates a more generic perspective, considering and responding to the general administrative aspects of research.

"It has been, I think, very helpful in making that pipeline and we're able to see a lot more turnaround, that's probably the biggest turnaround that I have seen. With more people working kind of at the lower level or the first point of contact type of positions, it does free up management to troubleshoot and problem solve when something occurs, or to work on some of the more complex proposals and funding."

"I don't think my new role affected their workflow. There was a lot of trepidation. Like "you're not allowed to talk to Principal Investigators about budgets." You know, the territoriality was definitely there, everyone was like, "Don't you infringe on what we do. We tell faculty and you're not going to tell them." So, it's politically fraught. I had to spend a lot of time building trust.... So, it was a gradual increase in trust, and learning and networking, just building those bridges."

"So, there needed to be somebody that was kind of managing everything on the ground so that person is in charge of the day-to-day tasks as they directly relate to the Office of Research. They tap their Directors... and they empower them, and it funnels down that way."

"[Low-level clerical roles] help us practice fighting fires, help us be proactive, give someone a chance to think and not only think about the question or the problem they have, but the bigger context. Like okay so, 'I've heard this question now three times, what could we put in place to help mitigate that next time?' Right? And there's not a lot of time, truly not a lot of time, for that planning and thinking."

How has the standardization of professional knowledge through education and certifications impacted the workforce?

The standardization of professional knowledge is evidenced through an academic identity, "an identification with intellectual traditions and groups, with departments or disciplines, with academic peer-groups, networks and learned societies" (Delamont et al., 1994, p. 149). The formal academic identity of research administrators has grown exponentially in the last decade

due to, in part, the creation of professional certifications and formalized graduate education.

This section describes two directions in which the standardization of professional knowledge has impacted the research administrative workforce: 'to get the job' which involves generalization on key activities, and 'to get promoted,' which involves increasing the level of expertise in a narrowly defined area.

To get the job, a bachelor's degree is required (master's degree preferred) at most institutions, although on-the-job training and experience is highly prized in lieu or in addition to any formal education. While most institutions do not require a professional certification to land the job, it is highly encouraged as it shows the candidate has the fortitude and knowledge to complete the certification requirements. To get promoted, a master's degree is required (doctoral degree for the most senior positions) at most institutions, and individuals must be at least eligible to sit for certification—if they are not already certified. In most cases, certification is required within a specific time limit of accepting the position. Whether hired or promoted, on-the-job training was equally important as education and certification.

> "Position-specific, obviously, but most of the time we have a minimum requirement of a bachelor's degree. If you're looking for a management position, minimum requirement is a master's degree. We really want people to have been educated to have a degree, because it shows some focus. We don't require you to be certified. But, we like it when you do because it shows that you have put the effort forward. We don't require you to have engagements with other institutions or organizations, but if you do that just means more networking for us, and more visibility for organizations. It's important."

> "Even for the new roles I'm creating or the existing roles, my approach has generally been at least a minimum of a bachelor's degree for kind of a broad overview, depending on what the task are more interested in experience and relevant skill sets."

> "Part of what my goal is, as well as to professionalize the workforce, ...ensuring that people have the professional development that they need, the opportunities that they can get. I do look at credentials. But I also looked at what people can do, right? So, a lot of what I'll do in an interview, whether they have the credentials or not, I'll ask them a question I know is specific to what they do. And if they can explain it to me, then I feel comfortable that they can do it and they understand. If they can't walk me through that, then I have some concerns that they don't know what they're doing. ...Sometimes we have to do a better job explaining the "why" to a Principal Investigator rather than what the policy is. If the policy is x, just telling them they can't do it because the policy is x is not helpful because faculty members are built to question. So, if you can link it back to a "why," then it helps them understand that it's not just a gatekeeper. So, we're committed to trying to do that."

> "We tend to hire people who have had at least some clinical trials experience ...so they have a little bit of an understanding what of the importance of accuracy and the importance of timeliness, not guessing. If you don't know find out. Because guessing will get you in trouble. And I think they do a really good job on that. I have two folks who are certified. One came to me certified and the

other certified while he was here. And they are among my leaders, as far as being able to field some questions that the team has. They have weighed-in a little bit more strongly on revision of guidelines. And I think that that extra background, gives them more of a basis to feel comfortable in giving up those opinions, and now they have to get the chops to back it up."

Research administration certifications are recognized within the field by fellow professionals and colleagues but are worthless to those outside the profession. It was apparent in the interviews that certifications are essential only to those within the research administrative profession. Educational degrees, especially doctoral level work—regardless of degree specialization—are the only recognition that research administrators receive outside the workforce.

"I got my Ph.D. while I was doing this in 2009. And, having a PhD after my name makes faculty that much more comfortable. I mean you can see it, because, 'oh, she may not be a subject matter expert but she's another Ph.D.'"

"In my opinion, credentials like the CRA are most valued by colleagues in the field. They know how hard it is, the CRA exam is comprehensive, and having this credential provides greater credibility. But, it is no substitute for a PhD. What I am seeing is the research administrator profession is increasingly higher-degreed, higher-credentialed. For example, research administrators specializing in contracts increasingly have JDs now. Ten years ago, the staff person that drafted your proposal budget was just really good with spreadsheets. Now, the post-award side of the house requires more sophisticated skills and specialized knowledge. We have people that are in the post-award side that are actually accountants. I think that professionalizing the field of research administration is a really good trend for industry. However, this may also create a barrier to those who wish to enter the field."

"For those who aspire to be a Director of Research at an R1 university, progress toward your PhD matters. My advice to anyone who is mentoring early career research administrators, encourage them, 'if you work in a university, take classes.' Advance your education, earn the credentials, and professional success will be more attainable."

Finally, research administration societal memberships across almost all participants were standard expectations to keep individuals apprised of developments in the field.

"If I asked you to tell me about compensation reporting in uniform guidance, and that's going to draw a blank—that's not something that I think is acceptable in this profession. It's not that you have to be an expert, but you have to know where to find information. And that to me is like one of the biggest things, if you don't get out of your own little space. You don't talk to people if you're not engaged on the list or if you're not at least attending virtual events like workshops and webinars, then you're not growing professionally, that's really not good for your institution because it means that you're not imparting that new knowledge to the groups with whom you work. For our faculty to come to us and tell us about regulations is embarrassing to me. We need to know this stuff."

"The staff that I've hired have had no connection to research administration or outside educational resources before, they just never had those opportunities presented to them. So, they came here

like, 'Oh, well you're going to pay for that [conference attendance]?' I responded, 'Yeah, that's my expectation. You're going to continue to be educated. That's why we're doing this.' And the answer is 'You're the best.'"

How does the distribution of tasks become fluid to get work done between the different research administration professionals?

As with most occupations, research administration has more than its fair share of red tape, and corresponding rule bending, rule breaking, and workaround behaviors (Bozeman et al., 2021). And despite the dawning of the 21st century, many research administrators are still carrying a physical manilla-beige envelope with a printed sheet of copy paper with a red "sign here" flag around campus.

"We're still using that good old 12th-century technology of paper and ink. …I have a big stack of pink folders with little stickies. I decided that everything that I needed to know for my job, I learned in kindergarten. Write in the lines, write neatly, play nicely with others, and put the stickers in the right place. …It's amazing that we are using the same technologies that were used to sign the Magna Carta. …But that's going to be changing. We're actually implementing e-binders, in the next two months. We are about three months into that process. And we're now getting to the point of getting other departments engaged."

"You know, there's still a lot of walking the paper around campus nonsense. Yes, believe me. And when you're really complicated, each department is special or different. When you're decentralized to such an extent that little state has their own cultures, their own requirements. 'This is a way we do it.' We have different stakeholders. So, attempts to try to standardize are interesting. People learn a lot."

The use of policy and procedures to create and define order within research workflows is common in most institutions, if at varying degrees of effectiveness.

"We all know each other and we know what each other does. We are working through the lifecycle of an award. We all understand what the process is, and where we fit in the process. And as we are growing, we are we are growing in our library of processes, and procedures and policies. We are we are in that growth phase where you can't call somebody and just get something fixed, because it's large enough become a process. That's part of the growing pains of where we are, what we need to do."

"We've been without a full time Vice President for Research for about several years. It's really interesting because we are in this really weird state of inertia. …We have all these floating policies [that] haven't been made permanent procedures. So, we are just flying by the seat of the pants sometimes. That's the only thing I would say has really thrown us a little bit for a loop …we've had a lot of turnover at the highest ranks, at the highest levels."

The coronavirus SARS-CoV-2 (COVID-19) pandemic has forced the hand of many institutions to move the research enterprise into a fully virtual remote work opportunity. While some institutions are either unable or unwilling to make this virtual leap, others have fully embraced

the remote professional, leading to an industry-wide voluntary turnover. Research administrative professionals are joining the global resignation movement to land new remote positions that offer higher wages and clear pathways to promotion.

> *"I think that what we're seeing now is a high level of turnover in research administration, because they're working from home, and they're burning out—faculty are too. The workload balancing is hard to do when everyone's in-person and they can talk to them. And it's almost impossible to do when people are remote. ...And, as research administrator roles pivot to hybrid or fully remote jobs, it is critical that we communicate about workload balancing and workflows. This is an area that technology can play a larger role. ...I think communication and technology will be key as flex work is going to change the way that we work and how we manage people."*

> *"I will say that this past year or so with COVID is hard to look at as a normal year. It's been crazy, and we have a new wave of people transitioning in and out. I would say traditionally the post-award office has been a revolving door. I'm thinking that perhaps some of this restructuring is probably a combination of the people in charge and the type of job, a banker's job. People love you when you can help them get money, but they don't love you when you tell them what they can and cannot do with the money. So, I think as an outsider looking in, that's a hard position to endure for long periods of time."*

Many campuses have only recently started initiatives to streamline administrative tasks using technology. While new technologies facilitate the development of specialized roles (e.g., research information technology), the distribution of tasks can become more complicated if the hierarchy is unclear. The use of technology plays a large role in the distribution of tasks and ensuring work completion between different research administration professionals. And, as more professionals bridge the gap between remote work, the role of technology and distance will continue to influence the fluidity of team productivity.

Discussion

Research Administration used to be very simple: pre-award and post-award. Likewise, the Research Administrator professional hierarchy was very flat, providing no career pathway for professionals and forcing everyone to become a generalist jack-of-all-trades. However, as compliance and regulatory issues become more complex, more individualized specialized roles were developed. Further still, when the number of research proposals per institution grew, the research organizational chart became more chaotic as institutions attempted to meet the increased need with a single professional catch-all role.

Attempts to professionalize Research Administration have led to several focused graduate study programs and professional certifications that demonstrate a broad knowledge and niche expertise. While a master's degree and professional certification are encouraged for employment or promotion, these designations are still more prized and recognized within the profession. Working knowledge, on-the-job training, and experience are still the main currency with which Research Administrators demonstrate expertise to those outside the profession. Advanced degrees, most notably a Ph.D., are required to respect outsiders, such as a Principal Investigator.

Institutions have only recently begun to add hierarchy within these professional roles. Junior clerical roles have been created with the intent to free up working managers to innovate and troubleshoot broader workflow problems. Titles have been reassessed and changed to reflect current workloads more accurately and provide access to higher salary brackets. Titles are also changed or updated to give an individual employee more autonomy. Institutions may also reassign or redistribute tasks among existing personnel to improve workflows. Finally, institutions are creating new stratified titles, e.g., Coordinator I, II, and III, to provide a career pathway that promotes employee development and retention.

As institutions made the journey from simple pre- and post-award to a more varied hierarchy of professional roles, the individualized research development support role was lost. Administrators spent more time on the mechanics of proposal submission and award management. Historically and industry-wide, Research Administration was a purely reactive role. As the profession has matured and more institutions have introduced layered career pathways, more specialized roles have been created to keep institutions competitive within the broader research landscape.

Most recently, institutions have made the shift to create new research development roles within the "pre-pre-award" space. These roles are intended to proactively start writing fires and stimulate a collaborative and engaged research community. The grant writer or research development role is often designed to provide individualized support for Principal Investigators, set them up for success in the funding marketplace, and actively take their research to the next level. Research development is critical to elevate the prestige of the research enterprise, and it is quickly becoming an essential role.

From the interviews, it was apparent that each research administrator experienced a unique and personalized professional journey. No one chose this profession from the start but instead landed in their position through a series of happenstance situations. This 'jungle gym' approach to the career ladder is perhaps one reason it has taken so long for the profession of research administration to formalize.

The profession is in a time of significant change. The traditional jack-of-all-trades role has become more fragmented into specialized advanced roles, with a more recent focus on research development. Workflows are increasingly becoming more electronically automated. The introduction of graduate degrees and professional certifications has introduced a new complexity within the office hierarchy. Moreover, the coronavirus SARS-CoV-2 (COVID-19) has shifted the profession into a remote working environment, causing industry-wide voluntary employee turnover as employees consider new opportunities, work/life balance, and cost of living ramifications. The profession of Research Administration is in a time of rapid expansion.

There are some limitations of this study that need to be mentioned. First, the findings are based on 16 qualitative interviews. Although the participants were selected carefully, we cannot exclude different experiences with new professional roles in institutions not represented within this small sample. This small sample size is acceptable for qualitative work, and study design methods strove to achieve maximum variation. Although qualitative saturation was achieved, there could still be counterfactual cases that were not discussed in this study. Finally, this study is based in the United

States and does not provide international perspectives.

We see at least three relevant avenues for future research. First, it would be interesting to relate these findings to a larger and more international cohort of research administrative professionals to investigate how transferrable the findings are to other countries. Second, it would be interesting to investigate the effect of diversification of research administrative teams on the effectiveness and efficiency of the research enterprise. Although there is some evidence that professional diversification and extended roles may help improve team efficiency, it is largely unknown how this may affect institutional research outcomes and the research administration workforce as a whole. Finally, additional research regarding the requirement of advanced degrees, most notably a Ph.D., to earn the respect of outsiders, such as a Principal Investigator, and for job advancement, is an interesting topic that merits further review.

Conclusion

The profession is in a time of significant change. The traditional jack-of-all-trades role has become more fragmented into specialized advanced roles, with a more recent focus on research development. Workflows are increasingly becoming more electronically automated. The introduction of graduate degrees and professional certifications has introduced a new complexity within the office hierarchy. Moreover, recent global events have shifted the profession into a remote working environment, causing industry-wide voluntary employee turnover as employees consider new opportunities, work/life balance, and cost of living ramifications.

Practical implications of this research include understanding that traditional research administrator roles are flat with no hierarchy or room for professional growth within the individual or collective research offices. The creation of promotion opportunities in order to provide professionals a pathway to rise in ranks and achieve higher titles and commensurate wages is vital to the future success of the profession. Likewise, the revelation that research organizational charts are convoluted and chaotically disorganized provides room for improvement. Immediate focus can be paid to clarify the boundaries between pre- and post-award activities. Another practical implication of this research is the call to begin raising awareness of the professional certifications outside of the research administrative profession in order to gain further distinction and notoriety within the research landscape. The increased need for educational degrees, especially doctoral-level work, in order to gain academic reputation is restrictive to the future of the profession.

The profession of Research Administration is in a time of rapid expansion. The aim of this study was to clarify the development of new professional roles in research administration. In doing so, this research maps the emerging extended professional roles and provides insight into the social and administrative processes that drive the development of these extended roles.

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Reconfiguring the Research Administration Workforce: A Qualitative Study Explaining the Increasingly Diverse Professional Roles in Research Administration

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Abstract: *The beginning of the COVID-19 pandemic required research institution administrators and researchers to make rapid and unprecedented decisions about whether research should continue and in what form. In the fall of 2020, we conducted a national survey of 930 federally-funded principal investigators (PIs) who continued in-person research during the early months of the COVID-19 pandemic. We investigated researcher perceptions of what shaped their choices about conducting in-person essential research and managing personnel during this time. Several quantitative survey questions asked about PI perceptions of institutional policies serving as barriers and facilitators to decision making, and these responses to qualitative questions were coded when they made reference to the role of administration in their decisions. Using this subset of data, we analyzed how administrative decisions at the institutional level affected downstream experiences of researchers. By jointly interpreting the quantitative and qualitative data, we identified 10 concrete lessons that can inform administrator decision making and best practices in preparation and response to crisis shutdowns of research if and when they happen in the future.*

Keywords: *Crisis planning, best practices, COVID-19, research shut-down, stakeholder feedback, resilience*

Introduction

In response to shortages in the workplace and the persistent changes in scientific funding and its workforce, national authorities and research organizations have endorsed inter-professional work and task substitutions. Consequently, the research administration workforce has diversified in several directions with formalized roles for research assistants, specialized roles for departmental and compliance administrators, advanced roles for research leadership, and new roles for new services, such as research development (Currie et al., 2009). This workforce reconfiguration demonstrates a growing international trend in research administration policy to redistribute support services on the basis of professional achievement rather than historical workforce hierarchies and roles (Currie et al., 2009; Goodman, 2019; Salvatore et al., 2018; Sanders & Harrison, 2008). Additional data is required to clarify the development of new professional roles in research administration. The current research maps the emerging extended professional roles and provides insight into the social and administrative processes that drive the development of these extended roles.

The global pandemic caused by COVID-19 produced an unprecedented crisis in research communities. At the outset, it was generally accepted that certain research activities should be continued in-person, on-site during the pandemic, especially those activities directly related to the crisis and "essential" research activities. However, in the absence of a unified national public health policy, applicable directives and guidance for the continuance of on-site research activities were left to be determined by state and local governments and individual research institutions. Administrative leaders at research institutions were required to make countless unique and rapid decisions, including: a) which research projects could continue on-site and which could not; b) what restrictions and protections should be required for on-site research; c) who would be allowed to conduct research on-site; and d) how to provide necessary resources to comply with these determinations. These decisions were made during times of constantly changing informational and public health landscapes during which information about risks and protections was often conflicting and evolving.

Prior to the pandemic, some scholarship and guidance about effective administrative leadership in times of crisis did exist. This literature emphasizes the importance of collaboration and social interaction (Raelin, 2016, 2018) as well as preparation, readiness of emergency measures, response, recovery, and reconstruction (Kapucu & Van Wart, 2006). It also makes the case that the prioritization of physical safety must be followed closely by the emotional and psychological wellbeing of the stakeholders involved (Hutson & Johnson, 2016). This literature also brings attention to the importance of resilient critical infrastructure, defined as systems that deliver critical services during times of crisis. It acknowledges that sometimes resilient strategies, such as built-in redundancy and stockpiling of resources, can come at the cost of efficiency, at least in the short term (Carvalhaes et al., 2020; Chester & Allenby, 2019). Qualities of effective administrative leadership identified in the literature include benevolence, reliability, competence, honesty, and openness (Sutherland, 2017). Finally, flexibility has been shown to be the cornerstone of organizations that adapt well to crises (Deverell & Olsson, 2010).

More specific guidance for research administrators preparing for a crisis came out prior to the pandemic in a report called "Strengthening Disaster Resilience of the Academic Biomedical Research Community: Protecting the Nation's Investment" from the National Academies Press (Carlin et al., 2017). Authored by a multidisciplinary committee dedicated to the topic, this report focuses on the importance of resilience, defined as "the ability to prepare for, absorb, recover from, and more successfully adapt to adverse events (p.138)." This report emphasizes the importance of planning for disasters ahead of time, ensuring the preservation of research data, samples, reagents, and animals, as well as anticipating funding needs and changing governance structures.

In spite of this existing scholarship, most academic research institutions, like the rest of the world, were caught unaware and unprepared by the pandemic. They were forced to respond quickly with little guidance either from the government or from existing shared or internal policies. Additionally, administrators faced competing demands from different directions, including public health authorities, public opinion, institutional leaders, funders, as well as the faculty, staff, and students working within research institutions. These demands put administrators in the difficult position of needing to develop policies that balanced safety and productivity, need for interaction and need for isolation, need for process and need for expediency, all while managing limited resources made even more limited by the pandemic. At research institutions, one key stakeholder group was the leaders of research teams that required guidance and policy from their institutional administrations. These Principal Investigators (PIs) also had to deal with competing demands of their own, including the safety and the financial solvency of their labs, the differing needs of themselves and their research personnel, and the need to pivot their research quickly and with transparency. PIs had to make decisions based on institutional directives that would affect their research and research teams, including decisions about staffing and conducting on-site research.

To better understand the experience of PIs during this crucial stage of the pandemic, our team conducted a quantitative and qualitative survey of federally-funded PIs who were conducting "essential research" in the spring of 2020. The purpose of the survey was to examine the experiences of researchers who were permitted to continue doing on-site research during this time. While the focus of the survey was on the perspectives and decision making of researchers, these choices did not happen in a vacuum. We found that the ways PIs made decisions about the continuity of their research during the early months of the pandemic were influenced by the decisions made at the institutional level. Quantitative survey questions about facilitators and barriers to making decisions frequently referred to the role of institutional policies. When asked to reflect on best practices and lessons they had learned in their own words, PIs' comments frequently focused on the role of institutional-level practices.

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[1]While the scope of this report was preparations for disasters more broadly, including natural disasters, political interruptions, loss of electrical grid, etc. as well as pandemics, many of the guidance applies to pandemics since many pose similar challenges.

Through the analysis of this subset of survey data referencing administration, we derived 10 lessons to guide future administrative decisions should a need arise to quickly and significantly alter the structure and function of research again. These lessons encompass the entire chronology of decision making, from preparing for emergencies prior to their occurrence, to the process of developing and implementing plans, to ensuring compliance and revisiting plans in light of changing circumstances. These lessons focus on issues of timing, fair processes, communication, and the content of policies. Further, such lessons have potential to equip administrators with flexibility and resilience when crises occur that impact the research within their oversight. Taking these lessons seriously can empower administrators to navigate future emergencies with forethought, fairness, and effectiveness.

Materials and Methods

In the fall of 2020, our research team was funded by the National Science Foundation to create and administer a survey to examine the experiences of federally-funded researchers whose research continued on-site during the initial onset of the pandemic in the U.S. This study was reviewed and approved by the Washington University Institutional Review Board (IRB# 202006012). We presented survey respondents with an informational consent form before they proceeded to complete the survey.

Using online, publicly accessible listings of federal grant awards—the National Science Foundation Award Search database and the NIH RePORTER database—we created a list of actively funded NIH and NSF PIs. An email was sent to all PIs in this database soliciting participation to complete an anonymous fifteen-minute online survey asking about their experience transitioning to on-site "essential research" while other research was shut down or transitioned to being done remotely. The surveys were administered between September and November 2020. Demographic information about survey respondents is provided in Table 1.

Table 1. Participant Demographics

Variable	Frequency n (%)
Gender (N=893)	
Male	484 (54)
Female	385 (43)
Other/Prefer not to answer	24 (3)
Ethnicity (N=892)	
Hispanic/Latino	33 (4)
Not Hispanic/Latino	789 (89)
Prefer not to answer	70 (8)

Race (N=898; select all that apply)	
White	669 (75)
Black or African American	9 (1)
Asian	143 (16)
American Indian or Alaska Native	4 (<1)
Native Hawaiian or Pacific Islander	0 (0)
Prefer not to answer	78 (9)
Funding source (N=930)	
NSF	261 (28)
NIH	557 (60)
Both NSF and NIH	112 (12)
Research institution type (N=929)	
Academic medical center	362 (39)
Liberal arts college	26 (3)
Private university	143 (15)
Public university	359 (39)
Other	39 (4)
Disciplinary field (N=930)	
Social Sciences	26 (3)
Health Sciences	189 (20)
Biological Sciences	587 (63)
Physical Sciences	102 (11)
Other	26 (3)
Faculty rank	
Assistant professor	134 (15)
Associate professor	251 (28)
Full professor	477 (54)
Other	30 (3)

The survey inquired about perceptions of the institutional guidance investigators received about essential research work, the types of research activities that were classified as "essential" at their institutions, and their priorities and perceived effectiveness when making difficult decisions about lab operations. Two team members (AA and TM) analyzed the quantitative survey responses using descriptive statistics (i.e., frequencies and percentages). Participants were able to skip items or end the survey at any time. We retained participants in the final sample who completed ≥

60% of the survey items. We report the effective sample size for each separate item to account for missing responses.

The survey ended with demographic questions and three open-ended questions:

1. What key lesson(s) do you think principal investigators or institutions can learn from your experience conducting research during the pandemic?

2. What are your biggest concerns about ramping up research activities?

3. Is there anything else you want to comment on?

Of the 930 PIs who completed surveys, open-ended comments were provided by 706 (75.8%) of them. Two other team members (SSC and SB), along with two graduate assistants (AB and JO), analyzed these qualitative open-ended responses. Upon review, the content of the three questions overlapped to such a degree that the decision was made to analyze the responses as a whole by respondent, not by question. Qualitative responses were uploaded into Dedoose qualitative analysis software, and the two team members (SSC and SB) inductively identified key themes and concepts from a subset of 50 PI responses to create a set of descriptive codes. Their codes were compared and reconciled. After clearly defining each code operationally in the codebook, SSC and SB trained the two graduate students on the codebook and how to apply the codes to participant responses. Next, all four team members deductively coded the same set of 50 PI responses using the codebook. The team compared, discussed, and reconciled their code application, reaching consensus on the codes. This process of consensus ensured shared agreement on appropriate code application before continuing to code the remaining responses. The remaining PI responses were divided among qualitative team members with two people coding each set of responses and continuing consensus meetings to ensure coding reliability. The pairs of coders met weekly to discuss and reach consensus on unclear participant responses and code applications.

This paper focuses on the results of quantitative and qualitative survey data related to the role of administration in shaping PI experiences. The key quantitative survey items about institutional guidance and institutional-level factors were framed as barriers and facilitators to PIs' decision making during that time. Barriers were defined as factors that made decisions more difficult. Facilitators were defined as factors that made decisions easier to make. The qualitative data included were coded as comments that referred to, or had direct implications for, administrators at the respondents' research institutions. Twenty-seven percent (190/706) of PIs had excerpts coded in this category. The four qualitative team members each inductively and independently read the narrative text to which this code was applied and identified lessons emerging from these codes. The team then compared and discussed these lessons, which revealed significant overlap. Based on these deliberations, the lessons were then refined into a list of 10 lessons learned for administrators.

Results

A subset of survey questions specifically asked PIs to reflect on the quality and impact of institutional administration on their decisions about staffing and conducting on-site research during the pandemic. These questions and their answers are reflected in Table 2.

Table 2. Quantitative Survey Results Related to Institutional Policies N=930[2]

Survey question		Yes n (%)	No n (%)
My institution's definition of "essential research" was clear[3]		691 (74)	182 (20)
My research group had sufficient time to make the transition to essential research on-site[4].		591 (64)	254 (27)
Experienced as barriers to decision-making	Institutional guidance that was too vague	382 (42)	529 (58)
	Conflicting guidance from different levels within my institution	359 (39)	554 (61)
	Lack of resources for protecting personnel who worked on-site	311 (34)	599 (66)
	Institutional guidance that was not relevant to my type of research	255 (28)	655 (72)
	Lack of institutional guidance	229 (25)	682 (75)
	Institutional guidance did not give me enough discretion in my choices	217 (24)	696 (76)
	Lack of institutional guidance regarding how to keep personnel safe	185 (20)	726 (80)
	Institutional guidance that was too specific	134 (20)	774 (85)
Experienced as facilitators to decision-making	Having autonomy to make my own decisions	589 (66)	298 (34)
	Feeling that my institutional leaders trust me to make good choices	577 (65)	313 (35)
	Feeling that I am supported by institutional leaders or colleagues	570 (64)	317 (36)
	Institutional guidance was communicated quickly	538 (61)	348 (39)
	Institutional guidance that gave me discretion in my choices	514 (58)	372 (42)
	Institutional guidance was sufficiently detailed	517 (58)	370 (42)
	Feeling that I could talk to institutional leaders for help if I wanted	505 (57)	383 (43)
	Feeling that administrators at my institution were handling the situation well	502 (57)	385 (43)
	Trusting the administrators at my institution in general	475 (54)	410 (46)

[2]Totals for separate items may not add up to total N and 100% due to missing values.

[3]This survey question also had a "neither" option chosen by 57(6%) of respondents; Yes reflects "somewhat agree" to "strongly agree" responses; No reflects "strongly disagree" to "somewhat disagree" responses.

[4]This survey question also had a "neither" option chosen by 79(9%) of respondents; Yes reflects "somewhat agree" to "strongly agree" responses; No reflects "strongly disagree" to "somewhat disagree" responses.

These results demonstrate several important insights about administrative decisions during the COVID-19 pandemic. Among the PIs who responded to the survey, a little over half (57%) believed that their institutions handled the situation well and that this facilitated their decision making during the pandemic. A similar percentage (54%) trusted their administrators and even more (64%) felt supported through the process. On the other hand, it appears that PIs negatively perceived specific aspects of administrative plans and guidance on their decisions. Forty-two percent of respondents struggled with guidance that was too vague, and 25% said they lacked guidance altogether. In direct contrast, a smaller percentage struggled with guidance that was too specific (15%). More concerning, 28% said institutional guidance was not relevant to their type of research. These conflicting experiences appear to put administrators in a bind, since the more general the guidance, the more likely this guidance will cover all research, but also the more likely it will be vague and lack specific details for researchers (which 58% said was a facilitator of quality decision making). In any case, the larger issue seemed to be conflicting guidance, which 39% of researchers experienced as a barrier to making good decisions.

From these quantitative results, it is clear that administrators faced difficult challenges to meet the often conflicting and multifaceted needs of their faculty. This invites us to explore more deeply how researchers were affected by administrators' choices. The open-ended answers provided by the faculty PIs provide this insight, and a picture of best practices emerges from the themes identified. Table 3 presents a summary of these lessons. In the remainder of this section, we will define and explain each lesson, including illustrative quotes. Last, in the Discussion section, we will provide concrete recommendations for how institutional leaders can respond to recommendations.

Table 3. Lessons Learned

STEP 1: Preparing for a Crisis
Lesson 1: Create standing crisis plans.
Lesson 2: Create a stockpile of basic resources required in crises.
STEP 2: Developing a Plan
Lesson 3: Incorporate diverse input.
Lesson 4: Be flexible.
Lesson 5: Trust PIs, do not micromanage.
Lesson 6: Prioritize general safety along with crisis-specific safety.
STEP 3: Implementing a Plan
Lesson 7: Be attuned to timing.
Lesson 8: Communicate the plan clearly and consistently.
Lesson 9: Adapt to changing circumstances and learn along the way.
Lesson 10: Enforce policies fairly.

STEP 1: PREPARING FOR A CRISIS

Lesson 1: Create standing crisis plans.

For many PIs, their open-ended comments indicated the importance of preparation before a crisis like a pandemic strikes. Some commented that while some types of emergency plans exist at academic institutions (e.g., natural disaster, biosafety, and fire), it is important that broader crisis plans for research shutdowns exist as well. Although this lack of planning and disaster preparedness is not unique to research institutions, the type of preparation needed is unique (Wigginton et al., 2020).

> PI 304: This time my university was feeling its way through the crisis, doing the best they could. I hope the Covid-19 experience will lead to a more structured response next time.

> PI 342: There was a significant deal of uncertainty as the university shut down in stages. A contingency plan for a pandemic situation, should it repeat, would greatly enhance the ability to plan ahead.

> PI 18: Broadly speaking, advance planning is critical. I think my institution did a good job issuing guidance and allowing us to reopen in a safe manner.

> PI 90: The institution needs to have multiple plans prepared for different types of work conducted on campus.

Besides general comments about the need for preparation, respondents suggested that these plans needed to cover several specific issues. They should include not only contingency plans for how to pivot in times of crisis, but also plans for when and how to exit from that plan as time progressed.

> PI 608: Although it's yet another layer of administrative burden, it would be good to have a required 'shutdown plan', just like IACUC and biosafety etc.

> PI 487: Having a return to work policy is critical because it was never obvious when to return to more "normal" work.

> PI 201: It's still not entirely clear how we can ramp up and with whom. This required a lot of back-and-forth.

Lesson 2: Create a stockpile of basic resources for emergencies.

In addition, adjusting research policies required resources, often resources that were not available when they were needed. These needed resources varied and included personal protective equipment (PPE), COVID testing, technology, lab funding (including bridge funding), transportation, and parking. By knowing what basic resources are necessary to conduct research in emergencies, administrators can avoid imposing "unfunded mandates." We heard from researchers that institutional policies that required specific practices and behaviors (e.g., mask-wearing and sanitation) failed to be effective when researchers lacked the required resources (e.g., masks and sanitizer) to be able to comply. Feedback from researchers can provide administrators with insights about what types of resources may run short in times of crisis.

PPE and Testing

A third of respondents in the survey said that they lacked resources for protecting personnel. This indicates that institutions were caught unprepared and that, in the future, PPE resources could be stockpiled and prioritization of testing could be emphasized to prepare for future emergencies.

> PI 199: No available resources from the institution for PPE and sanitization. I requested many items through the proper channels within the institution and was not provided with anything. At each level I worked through, no one had any idea the scale of what we needed (one box of disposable masks for a department, including research students isn't sufficient) or who was in charge of making decisions. Initially had to be out of pocket.

> PI 687: While safety was an obvious concern, we had stocked up on PPE before the shutdown despite the institutional shortage.

> PI 1006: We were fortunate to have regular testing services for asymptomatic people returning to campus for work.

> PI 963: TESTING TESTING TESTING. We still have concerns about whether people can get tested, how they do so, how they find out their results quickly, what the requirements are for reporting positive cases, how we can address noncompliance with guidelines among local labs, etc.

> PI 103: Regular testing at my institution and the wider university campus has kept the Covid-19 infection rate low, 0.01%.

Technology and Tech Support

Respondents also commented on the need for technology and technological support when required or asked to work from home, or when coordinating work with those working from home. This meant that those working remotely need to have access to the hardware and software required to conduct their work as well as information technology (IT) support to assist with connectivity issues.

> PI 961: Importance of infrastructure (home computers, microphones, cameras, Zoom etc).

> PI 1183: At my institution, IT personnel were furloughed or offered early retirement to the point that critical aspects of remote work received no IT support, or support was delayed to the point of being a significant barrier to work.

Transportation

An unexpected resource issue that arose stemmed from shifting transportation needs. Taking public transportation to and from work and on campuses was risky, especially early in the pandemic, and many people lacked safer modes of transportation or parking at their institutions. While some of this is outside of administrative control, devoting resources to subsidizing parking spaces near the university for those who, in normal times, could use public transportation, or providing safe shuttles and ride-sharing options that posed lesser risk, may be helpful options.

PI 598: Biggest concern: transportation—I think the university is taking proper precautions, but getting from home to the university is questionable. Not enough parking for everyone to drive, public transit mask-wearing and distancing is unreliable. This is making people nervous, even if not yet directly leading to known spread of the disease.

PI 125: My biggest concern was that public transportation was and still is required for me to get to work.

PI 466: Institutions need to think about transportation issues, offer free parking.

PI 78: We are in a major city, and most students don't own cars, but most people now (including me) don't feel safe taking public transportation, so that is another complicating factor.

PI 971: The institute provided free parking so employees who were relying on public transportation could more safely use their own vehicles.

Bridge Funding for Labs

Although an obligation shared between institutions and research funders, many respondents indicated that they struggled to comply with administrative requirements without supplemental funding to cover the interruption in work and the funding to get started again.

PI 938: It feels that the University administration and leadership doesn't really care about how much it cost individual labs to shut down and then restart. Labs took a huge blow in terms of financials, supplies, animals, and progress for careers, yet there is nothing tangible that has been provided to help.

PI 651: Institutions pass on "unfunded mandates" by requiring distancing, reduced staffing, use of PPE etc. but don't provide tangible resources to accomplish them.

PI 1140: My Institute, [removed for anonymity], provided a bridging the gap fund (research grant) to junior faculties. Further, my startup is fully available. I do not need to furlough any of my lab members, I actually have a slight salary raise, instead of salary cut. Our safety officers provided free supplies of surgical masks and ensured high standard for safety. I feel very supported.

STEP 2: DEVELOPING A PLAN

Lesson 3: Incorporate diverse input.

Understanding that one size does not fit all, the administrative challenge of developing plans for pandemics and other crises is complex. There are numerous stakeholders and expectations, and administrators can be (and are) criticized for being too specific or too vague, too early or too late, too directive or too hands-off. While the quantitative results of the survey indicated this challenge of satisfying the needs of everyone, the qualitative comments gave insight into how to navigate this challenge better. A common view among PIs was the benefit of gaining input from diverse

stakeholders to design a plan that is as responsive to the needs of the community as possible.

> PI 173: Administration needs to be willing to communicate and listen to plans; mine was. When the initial "essential work only" call came out, plant research was not considered. I responded quickly and immediately new guidelines were issued that included plant stocks as essential. I also had a worker dealing with a child care issue and the administration listened carefully to the issue and worked with me to find a safe solution so that the worker could attend to critical plant stocks.

> PI 172: It was chaos. . . I think having a more diverse group of people with diverse needs in positions making decisions would have been extremely helpful.

> PI 695: Listen to the actual folks spending time in labs when coming out with institutional guidance, and show some empathy that you understand how impactful this is for junior faculty, or postdocs and graduate students.

> PI 291: Institutions need to communicate with stakeholders ranging from faculty to staff to students with more clarity and engage them in decision-making processes.

Lesson 4: Be flexible.

The ambivalence found in the quantitative data regarding vague or specific, general or narrow administrative guidance was borne out and explained in the qualitative data. Even after using input from stakeholders to design a plan that does not omit important considerations, another common theme among PI responses was that no plan can fit all research contexts without flexibility and the ability to be adapted on the ground.

> PI 161: One-size-fits all measures administered in a top-down fashion are ineffective at universities because of the diverse nature of the research in individual labs and the diverse makeups of the labs (size, percentage of undergrads vs grad students vs postdocs).

> PI 8: One of the glaring issues was an assumption that all research was lab or bench research. Initial guidance from my institution was reasonable, but very focused on biomedical and bench related lab research. That left many PIs feeling like the guidance was simultaneously too specific, too vague, and not appropriate.

> PI 28: Flexibility by the many institutions I work with to offer me a platform for arguing whom among my team should be allowed on-site and who should not (as well as why) was effective. I appreciated the implicit understanding that I know my team best and that I was given autonomy to set priorities.

Likewise, universal requirements, such as the maximum number of people allowed in a lab, are not responsive to the different contexts on the ground and their implications for safety.

> PI 575: It would have been nice if campus leaders actually walking (sic) through different laboratories and realized the complexity of different spaces, the needs for overlapping personnel for projects, etc.

PI 497: I feel that most of the decisions at my university were based on arbitrary metrics. For instance, we were limited to a percentage of the workforce being able to come into lab, taking no account of the actual space available for distancing.

Finally, certain types of researchers felt that their unique circumstances were entirely disregarded by administrative policies. Most notably, respondents who were field researchers, plant researchers, or those who conducted qualitative research felt left out.

PI 8: Institutions need to have a broader understanding of the research being conducted—not just the most common type of research.

PI 132: Guidelines must encompass the wide range of research that is conducted, not just traditional wet lab bench research.

PI 221: Field research is fundamentally different from lab/on campus research but rare enough on my campus that the default guidance wasn't always applicable and I had to push to get the relevant permission/protocols.

Lesson 5: Trust, do not micromanage.

The significance of discretion and autonomy to a large percentage of respondents was clear in the quantitative results of our study. In their open-ended comments, many faculty PIs noted the diversity in lab personnel makeup, research functions, and various other socio-structural elements that are department-specific. While institutional-level policy and guidance was needed, PIs recommend that certain decisions should be left up to the faculty who know their local context the best. Sixty-five percent of respondents experienced being trusted by their administration as a facilitator to making good decisions. Conversely, the term "micromanage" came up frequently as a critique.

PI 695: Trust your faculty to make good decisions. Don't start to micromanage them weeks and months after we figured out how to balance personal safety with some level of continued productivity (in that order).

PI 128: Institutions should learn that their decisions should be logical and follow general established guidelines from CDC etc., leaving specifics to PIs, rather than trying micromanaging everything.

PI 633: Allow PIs to make decisions about essential personnel as the PI (sic) know their lab members best. Blanket edicts that everyone has to work from home does (sic) not serve PIs whose research depends upon on-site performance.

PI 145: Important to trust PIs and give them a "voice" in managing their own laboratory.

Lesson 6: Prioritize general safety along with crisis-specific safety.

Quantitative survey responses reflected the importance of researchers' perceptions of support and trustworthiness of their administration. Suspicion that institutional administrators were making decisions that did not prioritize safety came across in the qualitative data and likely

undermined perceptions of support and trustworthiness. While many respondents experienced their institutions as prioritizing the safety of researchers, several respondents commented that the plans made by their administration appeared to prioritize profits over safety measures.

PI 527: My institution made safe parameters that I felt I could work in.

PI 1195: My institution has prioritized buildings and endowments over people, especially young people. I think it should be the opposite.

PI 503: Allowing people to safely work through the shutdown led my institution to apply for $150M in grants.

PI 447: We went back to work too soon—for the sake of scientific productivity. Now with the fall/winter rise of cases in the Midwest the situation is, if anything, far less safe than it was last spring. There is no indication that my institution will compromise and support further reductions in laboratory staffing. Sadly, there will likely need to be casualties for that to happen.

In addition, several comments indicated that in order to comply with COVID-19 safety measures, PIs were forced to put themselves and others at greater risk. This indicates that crisis policies should not lose sight of the fact that although one type of risk is increased, others still exist and should be weighed accordingly.

PI 181: COVID-19 safety has usurped other safety concerns in some instance: for example, we are still following strict 'critical' research only policies, and are limited to one person per vehicle. We had a serious accident recently that totaled a vehicle; thankfully the driver was fine. However, the incident may not have occurred if people had been traveling together. I will now be asking for permission for two people to travel together for travel safety reasons (with masks on, in front/back seat).

PI 251: We had some safety concerns in the shop. We wanted to limit spaces to one person, but for safety reasons, we don't want people using cutting tools, like a table saw, when they are alone.

PI 29: I was concerned about potentially dangerous work conditions due to heat in the greenhouse and alternatives to mask wearing when personnel work alone.

STEP 3: IMPLEMENTING A PLAN

Lesson 7: Be attuned to timing.

The timing of guidance is a distinct challenge during pandemics. Institutions need to communicate plans in a manner that makes sense with the timeline of unfolding events. While "not too early, not too late" seems to be the trite and facile answer, responses that addressed timing suggest possible strategies for administrators to determine when to convey information.

> PI 148: Institutions need to make quick, clear, and definitive decisions and keep PIs informed as the process of a safe campus return is evaluated.

Those who had concerns about guidance being too quick often took issue with premature directives that were irreversible and detrimental to research.

> PI 675: My biggest regret is complying with the institutional requests to severely cull our mouse colony. This has done irreparable damage to multiple investigators' research programs, setting back progress of many trainees for months if not years, while having minimal benefit to the institution during the shutdown. Those PIs who chose to disregard these requests are much happier about their decisions.

Many PI criticisms about guidance being too quick were about the amount of time granted to be able to comply with institutional guidance.

> PI 938: Need much more lead time for a shutdown operation than was given. Experiments were cut short or left unfinished.

> PI 181: Provide clear guidance and definitions and sufficient time to complete paperwork and receive permissions before restrictions go into effect.

Positive experiences reflected constant communication as well as time to prepare for required actions.

> PI 1086: I was given an unofficial heads up about a week in advance to accept a shutdown of the labs. This gave the chance to wind down experiments, store/secure critical samples, and start making a plan for personnel. Early warning (even if just a few days) made a big difference in preparing. Ultimately they shut the labs several days before they had planned to close, but we were prepared because of the early and frequent communications.

On the other hand, several other comments noted that guidance was issued too late. PIs who commented on the guidance itself focused on the delay in mask mandates and other safety policies already recommended by the CDC, but not legislated yet by their state.

> PI 667: We also did not have a mask mandate (or any policy on masks) in early to middle days in the spring, as the state did not have one yet. This caused confusion in the lab and led to several personnel arguments about safety and masks. We had one that didn't want to wear a mask at all until the governor declared the mandate.

Again, more comments about being too late focused on the inability to comply without adequate time to plan.

> PI 861: I feel their initial response to the pandemic was disorganized and immediate. Plans for return to research were not revealed until 7 days prior to a return and resulted in a great deal of stress and hassle for all involved.

Lesson 8: Communicate the plan clearly and consistently.

As indicated by the quantitative results, administrative guidance frequently lacked key information and was perceived as vague and inconsistent. Since trust is enhanced with transparency, in times of uncertainty and changing guidance, it is even more important to keep communication open and continuous. The clear impact of this strategy manifested in the starkly different experiences of PIs who said their institutions communicated well versus those who had more negative experiences.

> PI 480: Our university did a really good job communicating. They told us in early March what options they were considering and what evidence they would use to make a decision and they gave us a deadline for making the decision. University administration stuck to that plan. Once we were fully stay at home with the exception of essential workers, they hosted a weekly zoom session to communicate updates and answer questions. The leader of these meetings was always clear about what was known and unknown and always followed up with updated information on the unknowns the following week.

> PI 334: My institution did a fantastic job. They clearly explained the decision to shut down in accordance with state guidelines, provided us with lots of information about what was required of us and the potential impact on research programs, processed requests to perform essential duties very quickly and worked with each laboratory and research program. Given the circumstances, I learned a lot about the values of my research institution.

Some, unfortunately, had the opposite experience.

> PI 37: Although I generally trust the leadership at my institution, it is unclear what factors are guiding their decisions, and they have not clearly communicated with the faculty.

> PI 483: The institutional leaders who should have been taking the lead on providing guidance were all but silent at my institution. I was happy to have a department chairman who provided a clear and consistent message.

> PI 367: We received conflicting messages from leadership about the need to comply with essential research orders (institutional leadership) and the need to maintain high productivity (department chair level). I think this mixed messaging has added to the stress of faculty members at my institution, particularly those with child care issues. A more consistent message from the top down and acknowledgment of the stress that faculty are facing would have been welcomed and appreciated.

Lesson 9: Adapt to changing circumstances and learn along the way.

Rather than inconsistency, many PIs appreciated policy changes which were perceived as welcome adaptations to changing circumstances. The plans enacted by institutions need to be able to adjust and reflect changes in the public environment. As time goes on, developments may require shifting of institutional guidance. The need for clear communication in how to adapt while also maintaining safety is key.

PI 172: I think that my institution, in particular, was scrambling to come up with guidelines that didn't have to be changed and in the end were too vague and no one really knew how to enforce them. I [also] think having flexible working plans codified into the university policy in the first place would have made this all better.

PI 312: Institutions/administrators need to be clear about the logic/reasoning used when they make rules. They should quickly reconsider their rules and find alternatives if it becomes clear that rules instituted to accomplish one goal, end up penalizing a subset of the group.

PI 667: Guidance needs to be a constantly evolving thing during a pandemic, as a pandemic is also an evolving thing. During the early days of the pandemic we also had protests occurring and there was no guidance as to how to address essential employees/students who were attending mass gatherings until weeks afterwards.

Lesson 10: Enforce policies fairly.

Some PIs remarked with a high level of vitriol that different labs and different members of the community complied with administrative guidance and requirements to varying degrees. This resulted in not only disjointed safety efforts, but also uneven impacts on productivity and feelings of unfairness.

PI 596: Uneven following of directives led to some investigators continuing to work, whereas others completely stopped their work. This may lead to substantial differences in productivity and ability to submit grant proposals.

PI 687: As with other crises, there were people who clearly abused the "essential research" designation to get ahead while others shut down.

PI 285: Be aware of biases in the interpretation of the guidelines lead to disparities in who was approved to work.

While PIs indicated that they do not want to be micromanaged (Lesson 5), in most cases they did appear to expect their administrations to consistently enforce the policies that they developed to prevent this perceived unfairness.

PI 447: The fact that the other labs in the building were not enforcing masking and social distancing. The administration did not enforce the guidelines. There were cases of COVID spread. My lab folks were very frustrated with the people in these other labs.

PI 667: . . .the institution took a "look the other way" attitude. There were some labs working at full capacity on regular research and it was encouraged by their department chairs (this was told to me secondhand). While other labs shut down completely. This creates unfairness at the institution and unfairness applied universally.

This indicates that simply developing policies is not enough; rather, these policies need to be consistently enforced to be perceived as fair and equitable. This is especially important given the competitive environment of research. Our open-ended comments indicate that those who were

already compliant would welcome this enforcement and not perceive it as an overreach since the behavior of those outside of their labs (other research groups, staff, etc.) is outside of their control.

Discussion

The results of our survey indicated many ways that institutional leadership could, and often did, address the pandemic well in spite of its unexpected nature and severity. Many of the comments about successful administration referred to processes suggested in pre-existing leadership literature such as advanced planning, communication, and transparency, but made them much more concrete and actionable. While researcher experiences provide only one perspective about the decisions at research institutions, their lessons should be interpreted within the wider literature on leadership and adaptability produced both prior to and emerging during this pandemic. This evidence-informed interpretation of PI experiences can provide administrative leaders with best practices for all stages of a crisis. Below we discuss some of the ways their lessons dovetail with existing literature to provide concrete recommendations that can prepare research institutions for future pandemics and other crises that disrupt research.

STEP 1: Preparing for a Crisis
Lesson 1: Create standing crisis plans.
Lesson 2: Create a stockpile of basic resources required in crises.

Respondents to the survey called for a structured, institutional response based on a pre-existing contingency plan with nuance to address the types of research being conducted at the institution. This plan should not only include how and when to halt in-person research but also how and when to start it again. They also emphasized the importance of institutional resources to support such a plan, including resources for PPE and testing, technology support, transportation, and bridge funding for labs.

Guidance has also emerged on how to plan for when and how to ramp research back up and stabilize after a pandemic's risk has eased. Six U.S. research universities collaborated to share guidance documents for their phased ramping up plans (Wigginton et al., 2020). These policies have overlapping recommendations for adhering to public health guidelines, prioritizing the health and safety of the workforce, and establishing fair and transparent processes. Likewise, other universities and university systems have collaborated on phased ramp-up research approaches, many based on the Principles and Framework Guiding a Phased Approach to Restarting University Research Activity developed by University of California, Berkeley in partnership with Vice Chancellors for Research and Vice Presidents for Research from the University of Washington; University of California, Los Angeles; University of California, San Francisco; and Stanford University and borrowing liberally from planning documents at many other institutions (Research Recovery Committee, 2020).

STEP 2: Developing a Plan
Lesson 3: Incorporate diverse input.
Lesson 4: Be flexible.
Lesson 5: Trust PIs, do not micromanage.
Lesson 6: Prioritize general safety along with crisis-specific safety.

When discussing how institutional leaders should develop a plan, researchers' comments put flexibility, transparency, and input from stakeholders as central. This markedly reflects the current literature in leadership as well as the aforementioned literature on research institution resiliency, both of which make specific recommendations that reflect researchers' insights.

The National Academies report mentioned in the introduction emphasizes that:

> The principal investigator (PI) is the central focus of research efforts. PIs and their laboratory members are in the best position to understand the specialized needs of their specific research. To promote a resilient laboratory and protect their research, PIs should actively engage in disaster planning with institutional leadership (Carlin et al., 2017, p. 9).

Likewise, the concept of "collective leadership" has risen to prominence in leadership literature (Cullen et al., 2012; Day et al., 2004; Friedrich et al., 2009; Gronn, 2002). Everyone within the organization may not be a leader in the sense of having a formal leadership position or title, but institutions can be led effectively by engaging the relevant expertise of multiple individuals at appropriate times. This approach requires sharing of information, collaboration, and joint decision making in order to make best use of the diverse skills and expertise of individuals (Friedrich et al., 2009). While this type of group leadership and decision making can be challenging when time is of the essence, if integrated into the planning phase, it is much more feasible. Advanced input from stakeholders would allow the plan to reflect their diverse situations and concerns. Doing so would also address the problem of researchers feeling that their particular circumstances were neglected by institutional plans. Likewise, collective decision making enables transparency and allows for expectations to be set appropriately such that details about the timing, type, and priorities of the plan would be known and agreed upon ahead of time. This would also enable local research teams to develop their own plans, which fit within the plans of the institution as a whole. These types of transparent and trustworthy processes have been shown to increase compliance (Martinson et al., 2006; Schweitzer & Gibson, 2008; Tyler & Blader, 2003).

While the details of a pre-developed plan would have to leave out the specifics of a particular emergency, many of the predictable crisis issues such as financial planning, communication plans, priorities and goals of the plan, as well as appeals and enforcement of the plan could be specified in advance and adapted to specific circumstances. Likewise, the process for modifying the plan (e.g., who would be involved, when and how it would be done) could be specified in advance.

STEP 3: *Implementing a Plan*
Lesson 7: Be attuned to timing.
Lesson 8: Communicate the plan clearly and consistently.
Lesson 9: Adapt to changing circumstances and learning along the way.
Lesson 10: Enforce policies fairly.

Many of the lessons about implementing a plan should follow directly from the first two steps, if done properly. Planning ahead when there is time to plan would enable administrators to cultivate stakeholder buy-in, as well as a coordinated process, for navigating pandemics and other emergencies. Pre-articulated communication plans that are formed collaboratively with numerous stakeholders should determine what will be communicated and when and should set expectations for researchers accordingly (Giorgini & Mumford, 2013; Marta et al., 2005; Mumford et al., 2017). Pre-formed chains of communication between what the NAS report calls "parallel authority streams" would avoid the challenge of researchers receiving different messages from different parts of the institution. Advanced planning would enable researchers to know how to obtain more resources, on what timeline, and with whom to communicate. Business continuity plans paired with a robust, stakeholder-informed understanding of intricacies within different research areas would enable administrators to build in specification and avoid reliance on a "one-size-fits-all" plan. Finally, while being adaptable and flexible amid changing circumstances is a challenging aspect of plan development, having a process to expediently assess changing circumstances with pre-articulated goals and priorities would enable this process to be done more consistently and less haphazardly.

The thorny issue of fair enforcement could be addressed in two ways. First, involving research stakeholders in the planning process increases buy-in as well as the perception that the rules and policies are fair. Empirical research shows that people tend to violate norms and rules more frequently when they believe them to be unfair (Martinson et al., 2006; Schweitzer & Gibson, 2008; Tyler & Blader, 2003). Second, how an institution enforces its plan, through incentives or penalties, locally or from the top-down, through increased documentation or other surveillance mechanisms, can all be determined ahead of time. Giving researchers a voice in how the plan will be enforced makes it more likely that the plan will be responsive to their needs while simultaneously reducing the need for punitive approaches to enforcement (Morrison, 2011).

Conclusion

Our findings have direct and useful implications for research institution administrators who want to better prepare for future emergencies when research operations are disrupted. Effective research administration during crises requires attention to the diverse needs of research faculty and staff members, as well as the incorporation of their perspectives into planning and the execution of plans. By examining surveys of researchers during the pandemic, it is clear that research institutions were faced with a daunting task of addressing diverse needs of faculty, both in terms of their professional and their personal situations. Our survey provides insights into

potential blind spots, such as transportation challenges and broader (i.e. non-crisis) safety issues and provides guidance into how the conflicting and multifaceted needs of researchers can be planned for and accommodated in a practical and effective way. The pandemic has shown both how resilient, yet vulnerable, researchers and research institutions are during times of crisis. The complete impact of the COVID-19 pandemic on researchers and the research enterprise has not yet been fully realized. It is the obligation of administrators and researchers alike to learn from this experience and prepare so that when the unexpected happens, they can mitigate the harms that we are only now beginning to understand. Administrative leaders at academic institutions hold great power and thus bear great responsibility to thoughtfully lead their institutions through future crises. We hope that this discussion can provide guidance toward that end.

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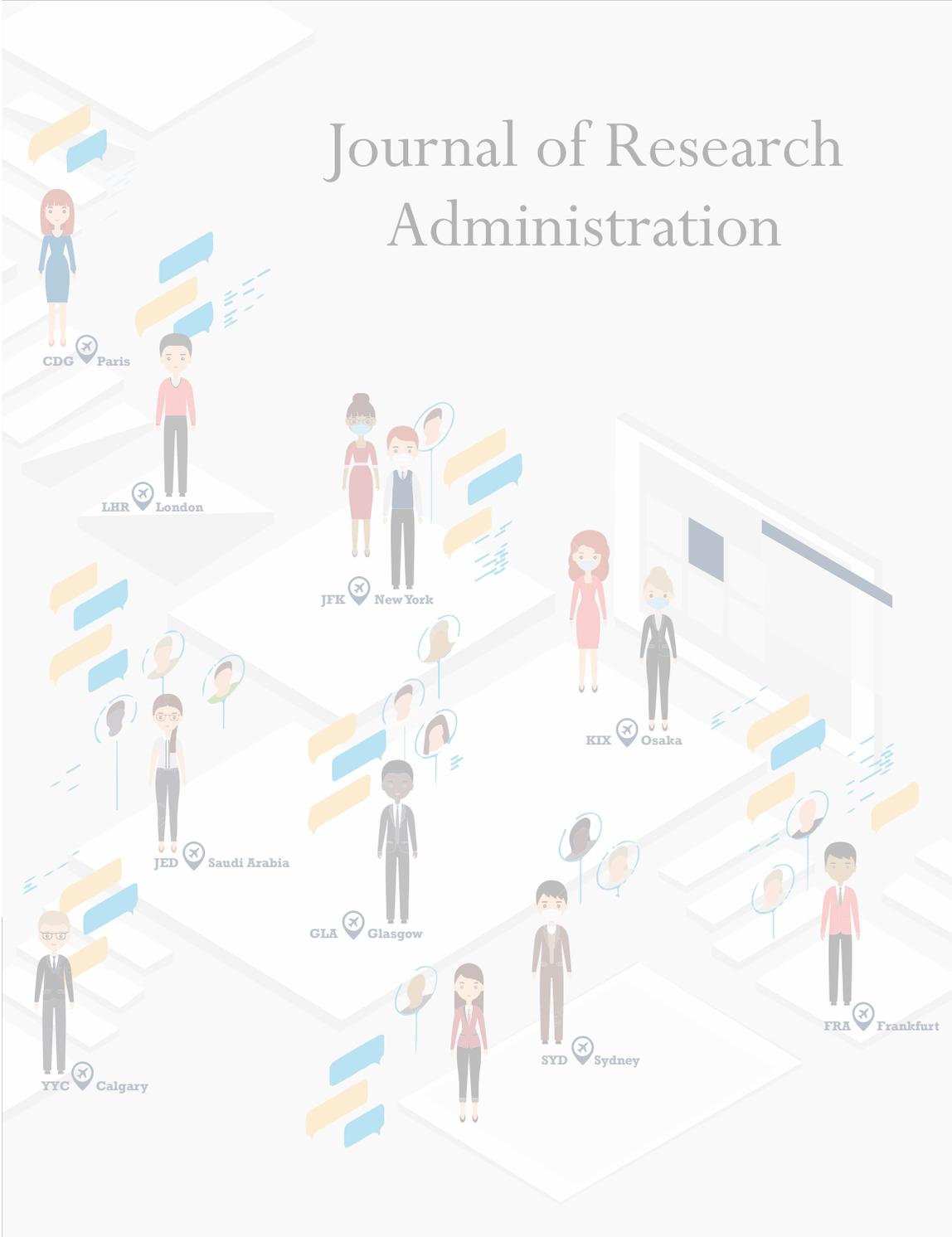
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