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Journal of Research Administration



FROM THE EDITOR'S DESK





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From the Editor's Desk

Jennifer E. Taylor

Tennessee 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 we have moved into 2022 and moved past this last peak of COVID-19, we have been fortunate to benefit from our authors' hard work and support, the members of the editorial board, and our incredible staff. Collectively, they have given us the opportunity to assemble what we think is another exceptional issue of JRA characterized by high-quality, important manuscripts that address a range of key issues in Research Administration.

The manuscripts we are pleased to share with you range from those whose focus is fully international, to others that are more closely focused on the factors within institutions that provide important insights into how we may enhance the efficacy and success of initiatives in our home organizations. We are also pleased to include two manuscripts that may help those in research administration become better at telling and sharing, the importance of research with each other, and the broader communities that support and use our work. As always, we hope that researchers from across the globe 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 the challenges of collaboration among members of research teams, particularly research administrators, that are based in different countries across the globe. Dr. White-Jones identifies important elements that contribute to the success of such collaborations that hold important lessons for research collaboration globally and locally. Our second manuscript represents a topic that may be the first of its kind for JRA as it examines the use of Podcasting for research dissemination. Carla DeMarco describes efforts at the University of Toronto Mississauga to use Podcasts to promote, disseminate, and communicate more broadly research. She goes on to consider gaps in our knowledge base about the uses and utility of this ever-growing communications strategy for the research community. Dr. Santos and Ms. Bradao at the Instituto Politécnico de Bragança, Campus de Santa Apolónia, in Portugal return to the issue of the complexities of managing increasingly large, risky, and often uncertain research and development initiatives that bring growing challenges for research managers and administrators while attempting to provide direction to teams of scientists, companies, users, and other stakeholders. In this paper, the rationale for a new tool for R&D management based on design thinking principles is presented drawing on prior literature and a conceptual framework for a tool that can help research managers and administrators facilitate the successful development of the R&D initiative presented.

Taking a turn from research management to the processes required in successful proposal development, Karen Mosier from the University of Saskatchewan provides us with a deeper understanding of the complex roles and their elements in the art of grantsmanship. Her manuscript discusses the mechanisms that can serve as a basis for a set of tools to train grant seekers. Dr. Tran and Ms. Aziz from the University of South Carolina offer us a different perspective on faculty research development. This theoretical paper critically examines existing evaluation methodologies of faculty research development programs and builds on the scholarship to propose a new comprehensive faculty-centric evaluation model known as *The Comprehensive Evaluation of Return on Talent Investment Model (CERTi)*. Our final manuscript leaves us with a careful consideration of what can be the controversial question of "*...Should Internal Funding Programs Favor Faculty Who Are Already Productive?*" The team from the University of Miami examined whether applicants to an interdisciplinary internal funding program are already more productive than other faculty members, including those who apply for traditional (non-interdisciplinary) internal funding support. They were particularly concerned with whether high-achieving faculty members are simply using the availability of internal funds to boost their already high rates of productivity and, in so doing, not having the impact on an institution's research portfolio that is sought. As you read the results, I think you be pleasantly surprised!

This is my second issue as Editor-in-Chief of JRA. I continue to be excited about being given the charge to continue to help move our field forward, and I would invite you to email me directly with any input, questions, or suggestions you may have. The longer I am in this role, the more I appreciate the many people who support this work and their help as I have transitioned into this role. It is the team behind the Editor that is critical to the success of the Journal. First, the communications committee of JRA provides essential guidance and input on all phases of the Journal. Nathan Vanderford, my predecessor as Editor-in-Chief, is still graciously and generously available whenever I need to draw on his experience. Holly Zink, who serves as Deputy Editor, is an invaluable partner in what might otherwise be an overwhelming task. I want to be sure to recognize her hard work and intellectual contributions. 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. Without the countless hours, they contribute to the review process, the Journal and its continued growth would not be possible. This load has only grown as the number of submissions increases, and I thank them for never failing to come through for the Journal. 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 throughout my transition to the Editor-in-Chief role. Gina Cuevas, in particular, merits special recognition and thanks. She is the day-to-day beating heart of JRA – who ensures the production of the Journal meets the highest professional standards.

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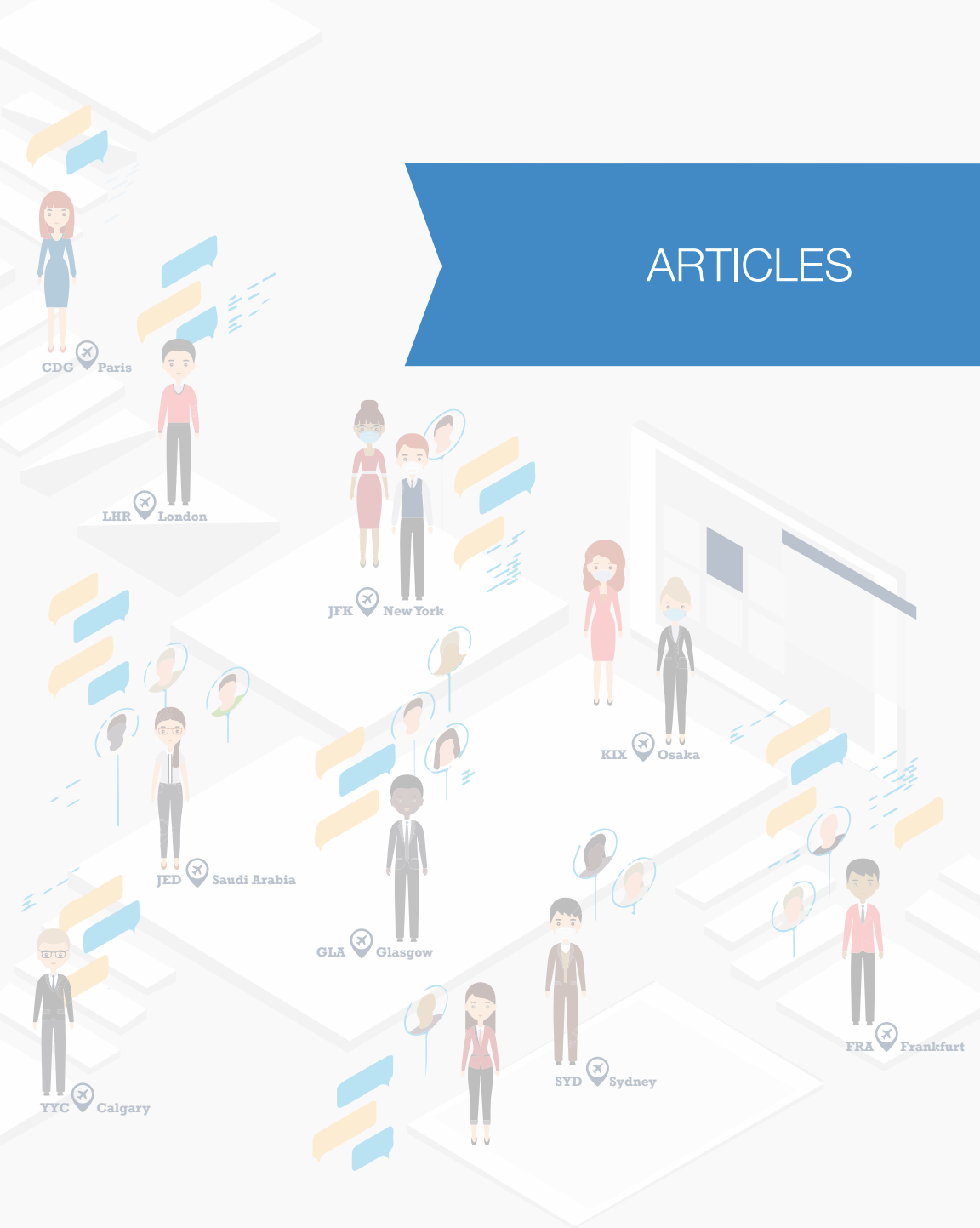
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ARTICLES



Value in the International Space: Examining the Challenges and Barriers on Research Administration International Research Teams

Angela White-Jones, Ph.D.
University of Central Florida

Abstract: *International research administration continues to draw significant interest in its practice. As projects and associated problems become more global, collaboration between teams in different countries also will grow in size and in complexity. This study set out to understand the challenges of such collaborative efforts by research administrators within international research teams. The result was an identification of characteristics that members of multi-national teams possess. The study found that training is critical to collaborative teams, cultural communication (or lack thereof) remains a significant barrier, and formal and defined roles and responsibilities for team members supports good governance. These observations beget best practices that can be used by research administrators and managers who participate in international team projects. It is recommended that a training and compliance mechanism be developed and customized per project. These mechanisms would discuss potential cultural differences, provide communication guidance, and specify roles and responsibilities for each team member so as not to duplicate efforts and to produce high levels of organization and coordination.*

Keywords: *Research administration and management, collaboration, partnerships, international research administration, multi-national teams*

Introduction

Research administrators are increasingly making significant contributions to development and delivery of complex research projects across the globe. While many research administrators contribute immense value when managing a research project in their home country, the introduction of partnering individuals or teams from other countries provides an additional wealth of opportunities and challenges in achieving efficacy and effectiveness. A number of studies have discussed international research administrators and the research administration as a profession (Kirkland, 2009), support between community and university research partnerships (Tremblay, 2015), demographics (Kerridge & Scott, 2018), or research partnerships between the community and universities (Bivens et al., 2015). However, few have explored the role that research administration can have in developing and assuring valuable research internationally, particularly within multi-national teams.

On a broader scale, working to manage and administer international research projects requires complete adherence to research integrity. Conflicts or neglecting to disclose relationships with

other foreign countries may jeopardize future funding for organizations, depending on conflict of interest policies and agreements. This has been particularly true among organizations in the United States; efforts have been made to combat undue misappropriation of grants and awards as well as intellectual property and research by foreign and domestic stakeholders (Balser et al., 2018).

The primary aim of this study was to understand the challenges of such collaborative efforts to research administrators within international research teams. The author reviewed existing literature on international collaborations as a framework to develop and administer an online international survey instrument for research administrators and managers. The aim of the survey was to identify the characteristics of their multi-national collaborative team experience in an effort to add to the existing knowledge base.

The specific objectives of this work were to understand how the role of research administration can add value to international research throughout a project lifecycle including set-up (pre-award), project management, and delivery (post-award). It sought to identify any challenges faced by research administrators when working with multi-national teams, and to suggest how these challenges may be overcome (e.g., via training, a common approach and process, appreciating cultural norms, etc.) to increase efficiency, effectiveness, and project success including recommendations, best practices, and deliverable production.

Literature Review

In research administration, collaboration can be considered a strategy that allows businesses, nonprofits, agencies, researchers, and other stakeholders to achieve a vision that would not be possible, or would not be as successful, if working independently (Gajda, 2004). While literature related to the specific processes of research administration team collaboration within multi-national groups is scant, studies on international research and collaborative practices are of value. As Coccia and Bozeman (2016) point out, research collaboration scholarship has received much attention in part due to its theory and process in shaping the research field. Because of this popularity there have been quite a few definitions of collaborative partnerships. It is useful in this research to provide a definition of collaborative partnerships. Gronski and Pigg (2000) defined partnerships within a collaborative approach as an “interactive process among individuals and organizations with diverse expertise and resources, joining together to devise and execute plans for common goals as well as to generate solutions for complex problems” (p. 783). As global competition in innovation continues for institutions, individuals, and countries alike, those stakeholders who collaborate with others may gain an edge.

Definitions of Collaboration

Collaboration has been found to be necessary for some singular entities to remain competitive in a growing research environment. Thomson et al. (2007) provide a conceptualization of collaboration in differing subjects. Because collaboration is at the heart of the idea of international research teams, it is important to explain its characteristics. First, collaboration is recognized as

a multi-dimensional framework (Thomson et al., 2007), with a potential distinction between national and international as one context. Second, as Kwiek (2020) states, academic type, national reward structure, and institution type are among the factors that influence scientists on engagement in international research collaboration. Third, collaboration, as a focus of research, enjoys a copious amount of study with much of the literature related to networking between stakeholders of all sectors (Segal & Gerstel, 2019). It is important to use these characteristics to define collaboration. This paper uses Thomson et al.'s (2007) definition of collaboration. In it, collaboration is defined as a process by which autonomous or semi-autonomous actors interact through formal and informal negotiation, jointly creating rules and structures governing their relationships and ways to act or decide on the issues that brought them together; it is a process involving shared norms and mutually beneficial interactions. This definition emphasizes that collaboration is a multidimensional, variable construct composed of five key dimensions, two of which are structural in nature (governance and administration), two of which are social capital dimensions (mutuality and norms), and one of which involves agency (organizational autonomy).

Project Management in Collaborative Teams

The critical need to develop a project management process for effective multi-national collaboration has been discussed within the context of clinical trials (Gist & Langley, 2007). It is important to understand the project management process because it informs the governance structure in research administration. Literature in this area outlines how adopting certain approaches to project management can streamline financial reporting, delineate a clear distinction in decision-making responsibilities in both management and investigation, and reduce risk for the team. Research administrators must be familiar with policy and governance on a variety of subjects in countries aside from their home country. These subjects include statutory and regulatory requirements, terminology and language, and the use of electronic application systems that are funder required (Langley & Oforu, 2007). Here, clinical trials show that rules are needed to be an effective team.

Specific subject matter literature further supports this point. Freshwater et al. (2006) states that in the area of international research collaboration, attention should be paid to geopolitical, religious, and social differences across healthcare systems. A literature gap occurs when studies do not explore the roles of research administrators in collaborations but simply on collaborations and when they may not accurately reflect the research administrators' points of view. There is still much to learn about the role of collaboration which can influence communication, professional development, relationship building, and cultural competency for research administrators.

Collaboration in the International Space

Literature in the international space outlines another important factor: the impact of cultural practice. Some argue that a focus on internationality is needed given the growing importance of collaboration in research and that attention should be paid to robust and effective delivery of project management in research. Spolander et al. (2014) state that though similar typology and terminology in the social work field are used at the international level, the nature, practice, context, and meaning of the practice is markedly different despite any consistent terms. Eglene and

Dawes' (2006) multi-national work found the importance of recognizing culturally equivalent concepts and cultural dynamics on multi-national research teams. Therefore, agreement and understanding of the terms and language used in research within international teams is vital. Science-based collaborations present opportunities to expand research to different parts of the globe. However, there is evidence that the success of these collaborations is limited by cultural or regulatory issues (Frenken et al., 2007; Ponds, 2009). Coccia and Bozeman (2016) discuss a National Science Foundation analysis which found an acceleration of collaboration patterns in primarily applied fields including medical sciences, social sciences, geosciences, agricultural sciences, and psychology. Contrasting this with basic fields such as math and physics which have yet to receive benefits related to collaborative work, research administrators may be focusing on specific disciplines.

Relatedly, perhaps due to growth and recognition of their importance, research intensive countries appreciate the extensive possibilities presented by successful partnerships. International research administrators will find that there is significant opportunity for collaborative research internationally. This is seen in the continued proliferation of partnerships through developing and emerging research-intensive countries (Langley & Ofori, 2007; Gist & Langley, 2007), professional associations (Langley & Ofori, 2007), and integrative educational collaborative spaces (Gallicchio, 2007) using models of best practices on improving technology, science, and compliance in order to make the process as seamless as possible for all organizations involved. Collaborative networks developed by research consortiums have committed to free and open sharing to produce generalizable research and information sharing (Vanderbilt & Gaiser, 2017).

Semali, Baker, and Freer (2013) describe the four determinants for a successful partnership between African countries and their multi-national counterparts in the United States as expertise, infrastructure, incentives, and patience. Therefore, while there is a healthy amount of literature related to the potential of international collaboration, there are barriers to general research collaboration and specifically multi-national team networks. Barriers may include history, language, cultural traditions, geographical accessibility, organizational resources, and individual participants' expertise and administrative knowledge (Kwiek, 2020; Hoekman et al., 2010, Freshwater et al., 2006; Luukkonen et al., 1992).

Compliance in Collaborative Teams

Finally, the issue of compliance warrants discussion among multi-national research teams. The United States has had several cases related to foreign interference with intellectual property and funding mechanisms (Bock, 2019; Goldberg, 2019; Silver, 2020). Undue interference can hinder researchers' ability to work with other researchers and administrators internationally (Balser et al., 2018), leading to problems recruiting talent from international spaces (Chu, 2020) and causing major fiduciary and in some cases criminal harm to institutions and individuals involved (U.S. Department of Education Office of the General Counsel, 2020). Chu (2020) states that to mitigate such risks, research administrators should work collaboratively with faculty, leadership, and managers to develop and implement controls that would protect institutions and researchers engaged in international work from foreign interference. A Department of Education report

(2020) states that auditing and best practices in auditing oversight are necessary to broker increased compliance. However, an important consideration about any new system or policy to prevent foreign interference is that it must avoid xenophobia, racial profiling, political rhetoric, and any other threats, and its communication must be clear and objective (Ellis & Gluckman, 2019). Chu (2020) infers that policies and procedures must emphasize “international support for a global workforce and international collaborations” (p. 15). Collaborative teams should take great care to draw on examples from a diverse group of people, languages, cultures, and modalities via training prior to team development and in concurrence with the research project..

Rationale for Study

The literature clearly presents some disparities that are worth further study. There have not been many contributions related to the transactional costs of collaboration or present gaps within international collaboration among teams, and especially not conducted from the perspective of the research administrator or research manager. Furthermore, the idea of international research collaboration is not a new concept; this theory has seen its share of trials and challenges. Semali et al. (2013) posit that many assumptions between developed nations and their emerging counterparts led to unsuccessful or barely successful outcomes for a number of reasons, including poor logistical support, immaterial guidelines and policy, inconsistent leadership, and meager financial resources. Many assumptions were rooted in passive stereotypes of emerging countries or in the control of the developed nations because they were the primary source of funding (“power of the purse,” if you will) and used the decision-making structure of larger universities or organizations.

Methodology

The survey was designed by the author and an SRAI mentor with expertise in international research administration. The author received ethical approval from the University of Central Florida (UCF)’s Institutional Review Board (IRB) prior to administering the survey. Copies of this protocol were made available to all respondents. Post-IRB approval, the survey was sent to the INORMS Council for review. After their approval, the finalized Qualtrics online survey was sent to individual members of INORMS institutions. To get a global perspective of persons, the INORMS Council was involved in assisting the dissemination of this survey. Research administrators were the target group, but previous or current participation within international collaborations was not a requirement for participating in the survey.

The survey was open from May 15 to June 30, 2020, for additional responses. The original sample yielded 77 responses. Due to the dissemination of the survey occurring during the height of the COVID-19 pandemic, multiple requests were made to remind respondents to complete the survey and the survey was extended beyond its initial one month period for a total of six weeks, providing another 65 completed responses with a total of 142 responses. After conducting a power analysis of the prospective sample, it was determined that the sample size was slightly smaller than the 80% power threshold; however, the size is equivalent to examples from the literature in this field, and even slightly larger than some relevant studies.

Throughout the pre-planning phase of the project, the author sought to understand the impetus for and value of international collaborations among research administrators and managers. This initial planning and research with their SRAI advisor contributed to the selection of which populations and characteristics would be the focus of the survey questions. The questionnaire was developed to gain perspectives on several areas: (1) experiences with international collaborations as a research administrator in any or every stage of a research project; (2) experiences with any challenges in research administration pertaining to working with multi-national/international teams; and (3) discussion of best practices related to outlined international collaborative experience(s). Demographical questions were also asked. The survey asked those participating to respond to open-ended questions, Likert-scale questions, closed-ended questions, and 'yes'/'no' questions. For open- and closed-ended questions, responses were coded to account for specific themes. Multiple themes within a response were coded separately to account for each theme.

The data in this paper stems from this survey, which is rooted in the existing literature but was also developed through the exploration and refinement of a framework built on the concepts of multi-national teamwork and collaborative enterprises. Additional considerations by research managers and administrators with experience in international collaboration were made throughout the process of methodological development. While the study was open to any number of participants, the sample size was produced with generalizability in mind so that the results could speak to the population and would be large enough to conduct the research yet still be manageable (O'Leary, 2017).

Analysis and Results

Demographic Summary

The following results from 142 respondents are presented by subject/topic/theme in accordance with the survey areas. The characteristics surveyed were selected to get a full picture of professional expectations and actions of those involved in international research collaboration. They are rooted in characteristics you may find in collaborative team literature with elements adjusted to fit the specific needs of a research administrator/manager.

Training and Development in Multi-National and International Collaborative Teams

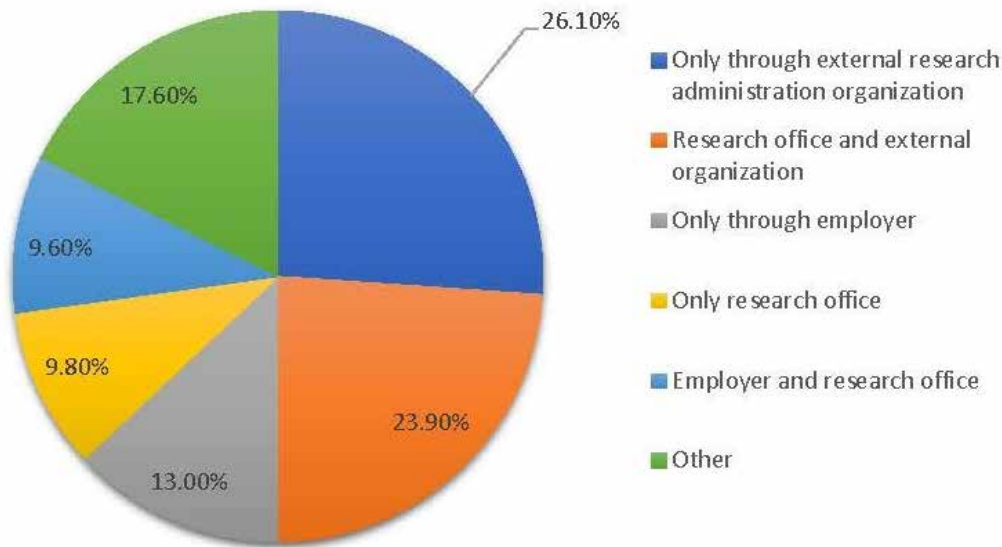


Figure 1. Training Methodology

[Click here for larger image](#)

Figures 1 and 2 depict the methods by which training was delivered. Training delivered via an external organization accounted for 26.1% of respondent experience, while 23.9% received a combination of research office training and external organization training. Only 13% received training solely through their employer. The nature of delivery tended to take place in person (51.1%), followed by training both in person and online (42.2%).



Figure 2. How Trainings Were Delivered

[Click here for larger image](#)

Figure 3 depicts the effectiveness of training. Of those respondents that received training, 46.5% believed the training and development received specifically to support international projects was moderately effective, followed by very effective (37.2%), extremely effective (14%), and slightly effective (2.3%).

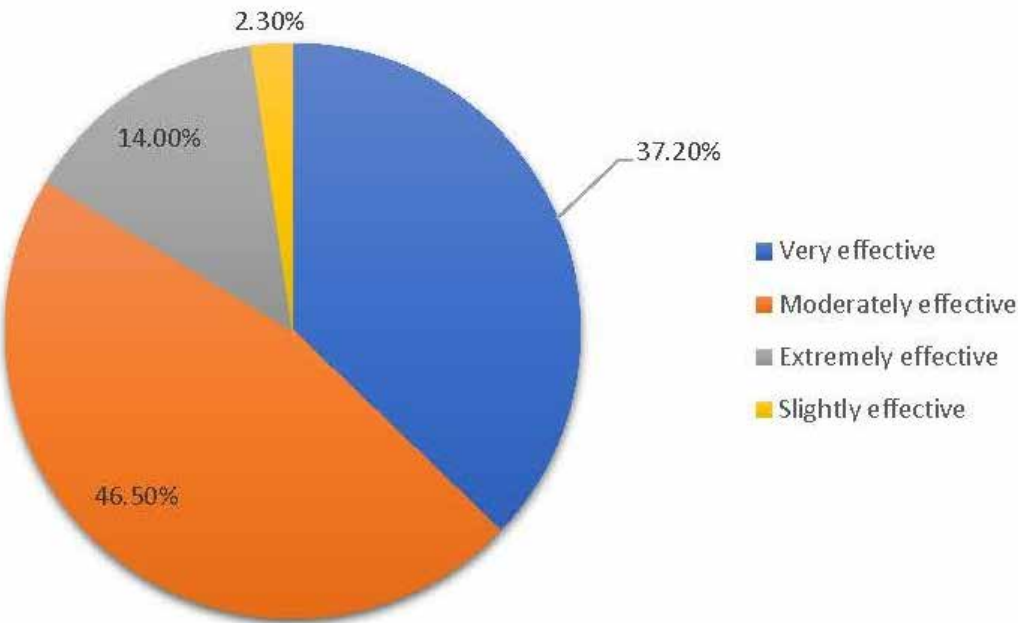


Figure 3. Effectiveness of Training and Development

[Click here for larger image](#)

A Pearson’s correlation was conducted to determine if there was a relationship between the delivery of training method and the respondents’ effectiveness ratings. The effectiveness of training was strongly related to the type of training received overall ($r = .842, p > .001$), with training delivered through an external organization more likely to be found very effective or extremely effective. Training received through an employer was more likely to be rated moderately effective.

Qualitative and Quantitative Summary of Survey Findings – Challenges & Barriers

Challenges encountered by research administrators when working in international projects

Various analyses were used to examine the responses related to identifying challenges or barriers when conducting multi-national collaborations (see Table 1). Findings indicated that there was an evenly distributed focus on what respondents found to be challenging, particularly in the top six barriers.

Table 1. Major Team Challenges/Barriers in International Research Administration Collaboration.

Challenge/Barrier	Percent Responded
General Communication (i.e. language barriers, time zone differences)	13.6
Compliance and Monitoring	13.2
Contract and Approval Process and Timelines	12.9
Policy Regulations and Export Controls	11.6
Fiscal Reporting/Accounting Requirements	11.3
Development of Relationships between Collaborators	10.9
Size of Team/Scope of Project	7.9
Deliverable Requirements and Deadlines	7.3
Intellectual Property	5.6
Dissemination of Information upon Completion	3.3
Other Issues	2.3

The most challenging areas were general communication (13.6%), compliance and monitoring (13.2%), and contract approval process and timelines (12.9%). Lesser barriers included information dissemination upon completion (3.3%), intellectual property (5.6%), and deliverable requirements and deadlines (7.3%). This suggests that people-centered issues such as interpersonal communication, compliance, and negotiation are among the most difficult challenges to overcome within a multi-national setting.

Support of translators in communication

Overall, most people (79.3%) have not used translators to overcome any communication barriers that may occur between team members during an international collaborative project. Of those that have not used translators, 35.2% indicated that they were ambivalent as to their use. This indicates the need to be at times selective of the investment of translators and ensuring that any communication solutions pick up on the nuances of the team, cultures, and languages. One size does not fit all.

Seventy-two percent of those that had used translators believed that the translators possessed strong knowledge of the languages and cultures and were of benefit to the project. Interestingly, 28% felt the translators did not have the necessary knowledge of the languages and cultures involved. A Pearson's correlation was conducted to determine if there was a correlation between the use of translators and the presence of communication issues. There was no statistically significant correlation between those that had used translators to alleviate barriers and those

that still reported communication issues ($r = .022$, $p > .001$). There were statistically significant correlations however, between those who had used translators and found that they have possessed strong knowledge of languages and cultures and those that had used translators to alleviate barriers in communication ($r = .618$, $p < .001$). This suggests that the use of knowledgeable and experienced translators within a team can add value to the efficiency and effectiveness of multi-national team projects.

Areas of support

Research administrators were asked what kind of educational support should be offered to team members in multi-national collaborative teams. They could select as many support offerings as they believe are needed. Educational support requirements were selected in the following way: regulations (15.7%), followed closely by intellectual property and related items (15.4%), funder regulations and expectations (14%), terminology, language, and typology (13.7%), stakeholder engagement (13.6%), routine auditing practices (12.5%), reporting requirements (10.2%), budget management (9.9%), proposal writing (6.1%), and other (2.6%).

Value added experiences in research administrative roles and responsibilities within international collaborations

When asked which areas would enhance formal agreements on roles and responsibilities among collaborators, respondents answered in the following manner: better defined roles and responsibilities (38.0%), followed by timelines and deliverables (29.6%), and policy language (26.1%).

As part of these roles and responsibilities, respondents were asked to describe their experience and the skills required in collaborating with multi-national teams. The experiences of each research administrator have been categorized into the following topics. The following is a synopsis of each category and experiences borne therein:

- *Relief of Administrative Burden for Principal Investigators:* Research administrators relieve the administrative load for principal investigators throughout much of their projects. Respondents mentioned that their role is to take the burden and stress of administration from the PIs, allowing them to concentrate on research. They also stated that being aware of the policies and procedures allows them to facilitate communication between collaborators. Other respondents viewed their position as neutral and helping to create relationships and build connections between individuals and institutions.
- *High Level of Organization and Coordination:* Research administrators often have an ability to organize and synchronize procedures and policies of a project as a value-added practice. Respondents stated that research administrators develop organizational skills and keep projects on track while adding value by being the single point of contact and taking on the role of coordination. One respondent mentioned, "It helps when we can build a relationship with a peer in the overseas institution who is in a similar research administration role though this isn't always possible especially when working with LMICs who may be under resourced."

- *Increased Knowledge and Experience:* Broad expertise and understanding of complex projects are crucial to the role research administrators can play, as they aid in knowledge transfer and enhance cultural experience and understanding. One respondent noted a key role is “Making stakeholders aware of fundamental differences in higher education structures, practices, and norms between partner countries.” For example, “similar-sounding terms can be used for fundamentally different levels/concepts which can lead to systemic confusion. Research administrators are ideally positioned to proactively and reactively identify, mitigate, and educate in relation to such issues—ideally before they escalate to fundamental misunderstandings that can cause delays.”
- *Understanding of Technical Role:* Appropriate handling of technical requirements, including policies and procedures, is another responsibility that is critical to international collaborations according to respondents. They stressed that understanding funder terminology, budgets, requirements, and compliance is paramount, as is clarifying requirements which explain implications of contracts or policies. Respondents specifically mentioned navigating funder terms and conditions to enable research in the face of funding restrictions and potential conflicts.

Discussion & Recommendations

The research managers and administrators provided invaluable insight into the characteristics of their work in international and multi-national team collaborations. They highlighted evolving anxieties related to the work, yet presented value-added experiences and recommendations that would aid in the development of best practices in international collaborations moving forward. The sample set was generalizable within the context of international collaboration scholarship in research administration, which provides confidence in the findings. The following are some points of reflection based on the analysis of this study. From these responses we infer best practices based on experiences encountered. These sections are based on the recommendations that respondents offered and what was inferred from the data.

Training is helpful to collaborative teams

Training is valuable both for specific project management competencies and knowledge of relevant governance and compliance requirements, but most importantly, training increases cultural awareness and understanding. These positive attitudes then seep into daily activities including negotiation, planning, communication, and shared understanding.

Research managers and administrators indicated that they have not received much formal training or development related to managing international collaborations. Those that had received training usually obtained it via face-to-face or peer-to-peer training from an external organization or external research organization and found it to be moderately to very effective. Very few found it to be minimally effective, indicating that training was helpful in the understanding of multi-national and collaborative teams. The findings strongly suggest that professional development and educational training are deficient within the space of complex international collaboration.

It is advised that multi-national teams receive more preparation and continual instruction to prepare those in different career or experience phases. Experts with this specific knowledge need to make this training more available to others for optimal success.

Cultural communication skill development and translation are useful when thoughtfully applied

While expanding training overall is a significant recommendation, understanding the importance of culture and language for communication skills is the key aspect of these findings. Specific skill training in areas such as complex reporting, export controls, and policy regulations and guidelines can also help research administrators and managers achieve success in managing a project with many moving pieces. Additional workshops or panels on action areas including timelines, deliverables, and expectations are an important part of the information dissemination process. The preference of the respondents in this survey was to conduct training face-to-face; however, given that the analysis was conducted in the middle of a global pandemic, adapting training to a virtual workforce via videoconferencing needs to work in concert with in-person training. Additionally, research administration and management organizations may want to invest in training during annual or biannual conferences and meetups. Most of these conferences are well attended by a variety of RMAs, and conference education may be an effective way to develop further proficiencies and attract potential partnerships.

Related to communication, translators were not used by a large majority of our respondents, and of those that had used them, over a quarter felt that the translator did not possess strong knowledge of the languages and cultures involved. This is to be expected considering that many of the people surveyed were on the fence about the utility of translator use in their project. Regarding the type of support respondents wanted in their work and training, most preferred education on stakeholder engagement, regulations, and intellectual property. The fact that preferences were so evenly distributed may indicate that each area has equal importance for team members. Therefore, the use of knowledgeable translators may prove an effective resource. Further research on the different experiences of using translators may be useful, as the study suggests there are a myriad of reasons, from financial costs to pinpointing a translator with a specific skillset, as to why their impact may not be effective. The general assumption is that translators are useful if they are highly qualified specialists and are integrated into the project team.

The study also suggests that research administrators need to be intentional and thoughtful when approaching cultural differences for each team member. Research administrators should be aware of cultural differences and sensitivities. It is recommended that individuals in these roles never assume that the international partner knows the way their institutions operate or the rules in their country.

Administrative support for collaborative teams is critical to high governance

There were some additional findings related to characteristics of the governance support of a multi-national collaborative project. The survey included numerous questions about formal agreements and how they can be better enhanced for collaborative teams. Agreements to develop the formal

roles and responsibilities of each member and the team holistically can aid the governance of the project. For those organizations that have formal agreements on roles and responsibilities, respondents stated that they would prefer better defined roles and responsibilities in the formal agreement. Several challenges were described as barriers in collaborative teams. Again, the resulting analysis depicted rather evenly distributed views on challenges, indicating that research administrators and managers face a variety of challenges that require attention.

Therefore, the study suggests a commitment to clarity and organization prior to the project, ensuring that project management is well-coordinated with clear duties, assignments, and functions for team members. When considering projects, it is vital to keep deadlines in mind, be aware of regulatory requirements of all concerned parties, archive all communications, and rely on formally defined roles and responsibilities of every person involved in the project. Another recommendation is to acknowledge all members of the team, recognizing shared work and goals. Every member of the team counts and being equitable in the work allows partners to share in tasks and be at the forefront of communication instead of receiving the details secondhand.

Experience is important for mid-career professionals

The results from the study indicate that research administrators have a variety of career-level experiences in research administration and management as well as experiences on and with international/multi-national collaborative teams. The experience level is not correlated with a high amount of collaborative activity, and therefore those that would like to take the opportunity to engage in international collaborative projects should feel confident to do so and seek out training opportunities.

Further, the study suggests that the vast majority of respondents had direct experience of working in international teams. A majority of the respondents are early or mid-career professionals, having worked in the field for between two and 15 years. The study infers that it is important to support more junior RMAs or rising career professionals to be ready to take on this collaborative work with international partners. Finally, most respondents have had a singular title role but engaged in multiple activities in different areas related to project delivery. There are no statistically significant correlations from these groups, likely because respondents mentioned value added responsibilities that are specific to their project experience.

Conclusion

The study presents some best practices as to how international research collaboration can be better supported and facilitated by effective research administrators who find themselves managing these teams. Research administrators and managers are a valuable part of successful teams, but their role and impact may be overlooked. As internationalization of research increases, it is critical to ensure research administrators are appropriately trained to work effectively with the people, project management details, and compliance requirements of international teams. The training to develop such expertise, especially in cultural mindfulness, can be developed in several ways but requires focused attention from everyone involved: the principal investigators, the partner

institutions, and the research administration community. There is an opportunity to develop new best practices for early career or mid-career professionals through communication and education while giving senior professionals a chance to share their positive experiences and lessons learned about multi-national research collaborations.

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References

- Balser, J., Cauce, A. M., Drake, M., Loh, W., Stanley, S., Tabak, L., Wilson, R., & Zuber, M. (2018). *ACD working group for foreign influences on research integrity: December 2018 report*. Advisory Committee to the Director (ACD) Working Group for Foreign Influences on Research Integrity. Bethesda, MD: National Institutes of Health.
- Bivens, F., Haffenden, J., & Hall, B. (2015). Knowledge, higher education & the institutionalization of community university research partnerships. In B. Hall, R. Tandon & C. Tremblay (Eds.), *Strengthening Community University Research* (pp. 5-30). University of Victoria Libraries.
- Bock, E. (2019). NIH Investigates foreign influence at U.S. grantee institutions. NIH Record. <https://nihrecord.nih.gov/2019/10/04/nih-investigates-foreign-influence-us-grantee-institutions>
- Chu, T. (2020). The complex challenge of foreign interference in research administration and compliance. *Research Management Review* 24(1), 1–21.

- Coccia, M., & Bozeman, B. (2016). Allometric models to measure and analyze the evolution of international research collaboration. *Scientometrics*, 108, 1065–1084. <https://doi.org/10.1007/s11192-016-2027-x>
- Ellis, L., & Gluckman, N. (2019). How university research landed on the front lines of the fight with China. *The Chronicle of Higher Education*. <https://www.chronicle.com/article/how-university-research-landed-on-the-front-lines-of-the-fight-with-china/>
- Eglene, O., & Dawes, S. S. (2006). Challenges and strategies for conducting international public management research. *Administration & Society*, 38(5), 596–622. <https://doi.org/10.1177%2F0095399706291816>
- Frenken, K., Hoekman, J., & van Oort, F. (2007). *Towards a European research area*. NAI Publishers/RPB. <http://www.rpb.nl>
- Freshwater, D., Sherwood G., & Drury, V. (2006). International research collaboration: Issues, benefits and challenges of the global network. *Journal of Research in Nursing*, 11(4) 295–303. <https://doi.org/10.1177/1744987106066304>
- Gajda, R. (2004). Utilizing Collaboration Theory to evaluate strategic alliances. *American Journal of Evaluation*, 25(1), 65–77. <https://doi.org/10.1177%2F109821400402500105>
- Gallicchio, V. S. (2007). Administration of an innovative program of international cooperation: Success across the pond. *Journal of Research Administration*, 38(2), 203–210.
- Gist, P., & Langley, D. (2007). Application of standard project management tools to research – A case study from a multi-national clinical trial. *Journal of Research Administration*, 38(2), 51–58.
- Goldberg, P. (2019). MD Anderson researchers ousted as NIH and FBI target diversion of intellectual property. *The Cancer Letter*, 45(17), 4–8.
- Gronski, R., & Pigg, K. (2000). University and community collaboration. *American Behavioral Scientist*, 43(5), 781–792. <http://dx.doi.org/10.1177/00027640021955595>
- Hoekman, J., Frenken, K., & Tijssen, R. J. W. (2010). Research collaboration at a distance: Changing spatial patterns of scientific collaboration within Europe. *Research Policy*, 39(5), 662–673. <https://doi.org/10.1016/j.respol.2010.01.012>
- Kerridge, S., & Scott, S. F. (2018). Research Administration around the world. *Research Management Review*, 23(1), 1–34.

- Kirkland, J. (2009). Research management. *Perspectives: Policy and Practice in Higher Education*, 13(2), 33–36. <https://doi.org/10.1080/13603100902805383>
- Kwiek, M. (2020). Internationalists and locals: International research collaboration in a resource-poor system. *Scientometrics*, 124, 57–105. <https://doi.org/10.1007/s11192-020-03460-2>
- Langley, D., & Ofori, M. H. (2007). Celebrating a profession: The global perspective. *Journal of Research Administration*, 38(1), 39–43.
- Luukkonen, T., Persson, O., & Sivertsen, G. (1992). Understanding patterns of international scientific collaboration. *Science, Technology, & Human Values*, 17(1), 101–126. <https://doi.org/10.1177%2F016224399201700106>
- O’Leary, Z. (2017). *The essential guide to doing your research project* (3rd ed.). SAGE Publications.
- Ponds, R. (2009). The limits to internationalization of scientific research collaboration. *Journal of Technology Transfer*, 34(1), 76–94. <https://doi.org/10.1007/s10961-008-9083-1>
- Segal, S., & Gerstel, D. (2019). *Research collaboration in an era of strategic competition*. Center for Strategic & International Studies.
- Semali, L. M., Baker, R., & Freer, R. (2013). Multi-institutional partnerships for higher education in Africa: A case study of assumptions of international academic collaboration. *International Journal of Higher Education*, 2(2), 53–66. <http://dx.doi.org/10.5430/ijhe.v2n2p53>
- Silver, A. (2020, July 7). US National Science Foundation reveals first details on foreign-influence investigations. *Nature* 583, 342. <https://doi.org/10.1038/d41586-020-02051-8>
- Spolander, G., Engelbrecht, L., Martin, L., Strydom, M., Pervova, I., Marjanen, P., Tani, P., Sicora, A., & Adaikalam, F. (2014). The implications of neoliberalism for social work: Reflections from a six-country international research collaboration. *International Social Work*, 57(4), 301–312. <https://doi.org/10.1177/0020872814524964>
- Thomson, A. M., Perry, J. L., & Miller, T. K. (2007). Conceptualizing and measuring collaboration. *Journal of Public Administration Research and Theory*, 19(1), 23–56. <https://doi.org/10.1093/jopart/mum036>

- Tremblay, C. (2015). Knowledge, higher education & the institutionalization of community university research partnerships. In B. Hall, R. Tandon & C. Tremblay (Eds.), *Strengthening Community University Research* (pp. 31-40). University of Victoria Libraries.
- United States Department of Education Office of the General Counsel. (2020). *Institutional compliance with Section 117 of the Higher Education Act of 1965*. <https://www2.ed.gov/policy/highered/leg/institutional-compliance-section-117.pdf>
- Vanderbilt, K., & E. Gaiser. (2017). The International Long Term Ecological Research Network: A platform for collaboration. *Ecosphere* 8(2), e01697. <https://doi.org/10.1002/ecs2.1697>

Hear Here! The Case for Podcasting in Research

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Abstract: *Podcasting as a platform has broadly progressed into a popular resource for communication, including advancing knowledge, science, and medicine through research dissemination. First, there is evidence to indicate that podcasting has evolved into a “second wave” as an effective tool to be used in academia and that it can help disseminate research findings to reach other scholars in the field. However, there is also a growing body of literature to indicate it is being used more frequently to communicate, tapping into information that is primarily generated through scholarly work to reach a broader and more general audience. The purpose of this paper is to examine the following research question: How effective is the use of podcast technology for academic research dissemination, research communication, and promotion? This paper also took into account some podcasts representing research, notably VIEW to the U produced by the Office of the Vice-Principal, Research at University of Toronto Mississauga. This research also considered gaps in the current literature related to the effectiveness of audio outputs in research.*

Keywords: *podcasting; research; podcasting in research; research communications; research dissemination; digital technology; knowledge mobilization; communication; audio information*

Introduction

The podcast as a platform has evolved into an incredibly diverse and popular resource for information, and there is evidence to indicate it has advanced to a “second wave” as an educational tool (Berry, 2016; Biber & Heidorn, 2020; Bonini, 2015; Wake & Bahsen, 2016). Podcasts in academia can help disseminate research findings, showcase academic expertise and reach new audiences (Baelo-Allué, 2019; Harter, 2019; Kwok, 2019; Brumley et al., 2017). Podcasting can also help researchers or people working in research communications to highlight faculty members in a unique way that allows listeners to hear directly from a researcher about their work and academic path.

The purpose of this study is to examine the effectiveness of podcast technology for academic research dissemination, research communication, and research promotion. This paper took into account some podcasts representing research, notably VIEW to the U produced by the Office of the Vice-Principal, Research at UofT Mississauga (DeMarco, 2016–present). This research also considered gaps that may exist in the current literature related to the effectiveness of audio outputs incorporated into the research lifecycle.

Research Question

How effective is the use of podcast technology for academic research dissemination, research communication, and promotion?

It is also important to address at the outset the term “effectiveness,” which in its broadest term can be difficult to measure. Brumley et al. (2017) state that while metrics can help to identify how scholarly content might influence others or is further used, if we focus solely on metrics as a way to measure effectiveness, there is the possibility of making narrow judgements, both explicit and implicit, about the impact and intended audience of the content (p. 262). For the purposes of this study, the effectiveness of podcasting in academia will primarily take into account the power and potential to reach audiences, in academia and beyond, in order to make a scholar and their work more accessible to a larger range of people.

Context for Academic Podcasts

In her article, “Storytelling in acoustic spaces: Podcasting as embodied and engaged scholarship” (2019), author Lynn Harter chronicles the rise of audio recordings and their power to reach people. She writes that information and news were previously and primarily consumed via traditional or legacy media, including magazines and books, radio, television, and newspapers, but that new and emerging platforms have led to an increase in digital formats (p. 3). Harter cites the rise of the podcast and argues for making information available in an audio format based on two discussion points: “(1) Podcasting stretches the tendencies and capacities of academics toward multi-sensorial forms of inquiry and (2) it connects academics with broader publics” (p. 3). She regards her own foray into podcasting with *Defining Moments* (Harter, 2019–2020, <https://www.npr.org/podcasts/727287962/defining-moments>, produced in association with NPR) that serves as a companion platform to the journal *Health Communications*, for which Harter is an editor, as a new way for her to personify and engage with her scholarship (p. 3), as well as a way to make a connection with health-communication scholars, healthcare care providers, patients, and their families, as well as a broader audience interested in well-being, healthcare, and illness (p. 4).

As further support to include podcasts in a scholarly environment, resources have become available to help academics start their own podcast. One such model exists in the United Kingdom and has been operational for over a decade: *Research Podcasts* (<http://researchpodcasts.co.uk/>), which has a tagline of “Disseminate, communicate, educate,” state that their “strength is communicating complex research in an interesting and accessible way,” and that they aim to interview people to best showcase their work and themselves most persuasively. One of the team’s co-founders, Chris Garrington, says she produced her first research-focused podcast in 2008 and has produced over a dozen since then.

Podcasts with Specific Focus

Podcasts have also cropped up that focus on specific academic disciplines and may be intended for colleagues in a particular field as well as armchair academics: IEEE RAS Soft Robotics Podcast is all about the technology and research behind soft or continuum robotics (ElDiwiny, 2019–present); The Political Theory Review podcast from the University of Houston features scholars talking about their work and recent books in political theory and social and political philosophy (Church, 2017–present); and science-based podcasts, such as *Science vs* or *Gastropod*, which both include academics and draws on their expertise for a wide range of timely topics. *Gastropod* considers food via science and historical perspectives and is supported by the Burroughs Wellcome Fund in order to represent biomedical research (Graber & Twilley, 2014–present). In the case of *Science vs*, each show concludes with a citation count for their program just as an academic paper concludes with references (Zukerman, 2016–present). This crop of podcasts that all have science at their core are each carving out their own unique way to exist at the intersection of scholarly work and general interest.

General Audience Research-based Podcasts

A range of general-audience podcasts have also emerged that feature academics discussing their work, highlighting recent publications, and delving deeper into popular topics. Examples of this type of format are podcasts like *The Next Big Idea* (<https://wonderly.com/shows/the-next-big-idea/>), which has the tagline “[we bring] you the most ground-breaking ideas that have the power to change the way you live, work, and think,” and has showcased a range of academics from organizational psychologist Professor Adam Grant to neuroscientist Professor Daniel Levitin speaking about their work or specific questions defined by the zeitgeist, as well as notable academic thinkers and authors like Malcolm Gladwell, Susan Cain, and Daniel Pink driving the topics (Griscom, 2019–present). This podcast type is mostly intended for a lay audience seeking to explore concepts delineated by scholarly experts.

Literature Review

Research Communications

It has become increasingly important to think about research or science communications in academia (Brumley et al., 2017; Rankin, 2018; Rogers & Herbert, 2018; Udovicich et al., 2017). Most recently, there has been a more significant focus and surge in resources, including workshops, publications, as well as courses related to communicating research. For example, in Canada, a new pilot funding opportunity was introduced in January 2020 by the Natural Sciences and Engineering Research Council of Canada (NSERC is one of Canada’s leading funding agencies) called the Science Communication Skills grant (NSERC, 2020). The grant is one year in duration, and funds requested can be a maximum of \$20,000 (CAD). The mandate for this program is to promote particular branches of knowledge in order to foster a more robust Canadian culture of science, and they state in the overview on their website that improving science communication is critical for advancing science literacy and evidence-based data, as well as an opportunity to deflect

scientific misinformation. The NSERC fund aims to train researchers and students in science about effectively communicating science to a more general audience.

A History of Podcast Technology

According to Podcast Insights (<https://www.podcastinsights.com/podcast-statistics/>), which regularly compiles podcasting-specific data, there are over 1 million shows and more than 30 million episodes in circulation as of April 2020. This indicates significant growth (nearly doubled) since 2018 when there were approximately 525,000 shows and 18.5 million episodes according to Apple statistics, and that the consumption for podcast outputs has increased since the data also indicates more people are tuning in to podcasts than ever before (Edison Research, 2017; Samuel-Azran et al., 2019; Sullivan, 2019; Winn, 2021).

Along this vein, authors Brumley, Gilson, Mollett, and Williams (2017) wrote the book *Communicating your research with social media: A practical guide to using blogs, podcasts, data visualisations and video* with the intention, most broadly stated, to present a framework for academics about using social media to promote their work on a global scale (p. 1). The authors dedicate an entire chapter (5) to audio and podcasting, but first, to establish the landscape, define the “research lifecycle” as having six phases: “inspiration, collaboration, primary research, public engagement, dissemination and impact” (Brumley et al., 2017, p. 46). The authors significantly detail each stage and put forward their suggestions for employing social and digital media in order to optimize each function of the lifecycle.

For the chapter on audio and podcasts, the authors defined what podcasts are and their history (Brumley et al., 2017, p. 161): podcasting as a platform started in the early 2000s, and after some uptake lost their initial luster because of the cumbersome nature of having to download and transfer to another media player. However, the authors further state that podcasting has been reinvigorated thanks to several popular shows (e.g., *This American Life*, *Radiolab* and *Serial*) and easier access via direct download to smartphones as well as multiple podcast options (Spotify, iTunes, Google, YouTube), and that no matter what field a researcher, academic or student is working in, they can make the most of this podcasting revival and reach broader audiences in order to share their work from various parts of the research lifecycle (Brumley et al., 2017, p. 161).

Podcasting and Link to Listening Skills

In her book, *You're not listening: What you're missing and why it matters*, author Kate Murphy states that listening habits degrade over time if you do not make an effort to listen carefully. She states that “[if] you start listening to everyone as you would scan headlines on a celebrity gossip website, you won’t discover the poetry and wisdom that is within people” (2019, p. 20). Although Murphy is relating this notion to conversations with people, this same idea can be applied to listening to researchers on a podcast: the act of listening can be regarded as a gateway to new ideas and thoughts.

Further in her book, in a chapter on “The neuroscience of listening,” Murphy distinguishes between hearing and listening, with the former being more passive and a “forerunner” to the listening, which she describes as active. Murphy further states that those who are the “best

listeners” employ other senses in order to concentrate on what they hear: “Their brains work hard to process all that incoming information and find meaning, which opens the door to creativity, empathy, insight, and knowledge. Understanding is the goal of listening, and it takes effort” (p. 24).

Brumley et al. intimate a similar notion in their book related to the importance sound has in communicating academic information and how it took their work a step further than the blogs they were previously solely publishing (2017, p. 166). They also discuss how introducing information in a way that audio or podcasting allows can diverge from what may have been the traditional format, such as recorded lectures. They cite Tara Brabazon, a cultural studies professor at Flinders University in Adelaide, Australia, and her book *Digital dialogues and community 2.0: After avatars, trolls and puppets* (2012). In a chapter related to librarians podcasting, Brabazon states that sound allows listeners to slow down their understanding of ideas and words, to bring a heightened awareness of their environment, punctuating their workspaces, home life, and leisure, and that it fosters a sense of “quiet interiority.” She further states that because there is a bias toward the “visual” related to obtaining information theories, sound is not given prominent consideration. Brabazon expresses that the power of sound leads to a more profound introspection and is an absorbing experience in the acquisition of new knowledge (p. 166).

As it relates to listening and learning, there is an opportunity further to study these processes and the effective intake of information (Sharon & John, 2019). In their article “Does Modality Matter? The Effects of Reading, Listening, and Dual Modality on Comprehension,” authors Rogowsky, Calhoun and Tallal (2016) state that despite the increase in audio as a technological advance for consuming material “there is a surprising lack of empirical research that directly evaluates the effect of mode of input on comprehension” and that “a review of the research on adults yields conflicting results” (p. 1). They undertook a study using the same material processed in three different ways, and then administered the same comprehension test: 91 participants were provided the preface and one chapter of a non-fiction book and had to either listen to the digital audiobook version (group 1), read it on an e-reader (group 2), or do both (read and listen) simultaneously (group 3). The study accounted for certain variables, including gender, but overall found no significant difference between the various input modalities as far as comprehension was concerned. The authors state that there were several limitations related to the study, however, including that printed text was not made available, the level of language proficiency was not included as a variable (though all participants were educated and had a bachelor’s degree), and that the text used was non-fiction material.

Going forward, this is something that would require further study, and in particular, as it relates to podcasts, associations with information processing, listening, as well as retention. A study to test the rate of comprehension as well as memory retention when the information is read by a participant, perhaps in a transcribed version of a podcast, versus when the same details are heard in the actual interview and final output of a podcast, and a further group who listen to the podcast while reading the transcript simultaneously, could demonstrate a level of engagement and interest in the material presented in a podcast.

Podcasts as an Educational Tool

Podcasting and even some video outputs as pre-lectures are increasingly being incorporated in the classroom to communicate information and supplement traditional delivery methods, such as attending lectures and reading. When entering search terms in the U of T Library's database related to podcasting in education ("podcasting AND curriculum OR education OR learning"), roughly 400 articles come up that consider how podcasts and digital technology have been increasingly incorporated into the classroom over time. Articles such as "Designing a web-based learning environment using weblogs and podcasts" (Salam & Wang, 2009), "Faculty, are you ready for mobile learning? E-learners say they are geared up and ready to engage" (Corbeil et al., 2008), or "Creating a new mobile learning community with podcasting" (Seo et al., 2010), and several others all point to the usage of podcasting technology as a way to enhance learning in higher education.

Additionally, it is an established fact that students globally are mostly learning virtually due to COVID-19, and institutions have had to implement physical-distancing measures. Though this situation continues to unfold, educators and educational administrators, particularly in colleges and universities where students are often paying tuition, have had to integrate more resources into the curriculum and classroom (e.g., Ross & DiSalvo, 2020), and podcasting will likely become another more common teaching tool in the time to come.

Further considering this idea about incorporating audio into the curriculum, authors Biber and Heidorn (2020) at the University of West Georgia explore a teaching method that blends podcast-based learning and physical activity. They cite a study by Blakemore from 2003 that demonstrates how "[physical] activity increases blood flow to the brain, which stimulates enhanced cognitive functioning for learning and processing" (Biber & Heidorn, p. 1).

Their (Biber and Heidorn's) recent study took this a step further and mixed podcast listening with movement. In their article "Tailoring the walking classroom to promote college student engagement" (2020), Biber and Heidorn explore a teaching method that blends podcast-based learning and physical activity. The authors state that this study was based on the "Walking Classroom" delivery method implemented in some elementary schools. With the prospect of walking podcasts, Biber and Heidorn state they are an appealing and viable option for the instruction of college students because they are easy and free to produce, implement, and sustain (p. 2). They had students either walk an indoor track or head outdoors in small groups or pairs (to minimize any harm of walking alone while wearing headphones) and listen to a 15- to 20-minute podcast that was essentially a lecture and was recorded and accessed via a platform (Vocaroo), which also minimized other online distractions because it does not allow internet surfing. Not only did the majority of the students surveyed say they enjoyed this content-delivery method, they reported that they felt they were able to retain the information better while they were walking as opposed to sitting to read the material or seated in a classroom listening to a lecture. Students also expressed that they enjoyed the physical activity because prior to that they were either sitting at work or sitting while commuting and they felt their ability to focus on the material improved during the simultaneous walking and learning exercise (p. 2).

This prospect requires further study, but it would be interesting to pursue whether listening to a research-based podcast leads to better information retention instead of reading the same material. (See related discussion in *Observations on Podcasting and Link to Listening Skills* section.) This also harkens back to a previously stated fact (in the *Research Communications in General* section, and article by Harter, 2019) that employing the podcast platform also allows listeners to multi-task, e.g., they can consume a podcast while walking, commuting or carrying out other chores.

Historically, several authors (Berry, 2016; Barton & Merolli, 2019; Chen & Melon, 2018; Peoples & Tilley, 2011) have suggested incorporating podcasts and audio outputs as part of knowledge translation (KT). Some of these instances may be related to pedagogy and the use of podcasts as an educational tool, but also used as part of a broader KT plan and engage a more general audience for dense and complex topics, particularly in health-related fields. KT has become increasingly important in research, with at least one of the major funding agencies in Canada, the Social Sciences and Humanities Research Council of Canada, implementing as part of a grant application submission the Knowledge Mobilization Plan: a one-page document that requires researchers to outline how they plan to communicate their research findings

Podcasts as a Communication Tool

Brumley et al. (2017) outline how podcasting can expand possibilities, “diversify content,” and how the equipment for podcasting enables visits to “unexpected places” (p. 165). The authors chronicle their own podcasting experience, venturing out with researchers with a recorder and mics to Chinatown in London, UK, and produce a show about the migrant Chinese communities who are working and living in a particular part of the city, bringing a slice of life and the sounds of the streets to interested listeners (p. 165). In this regard, the authors state that they presented listeners with an opportunity to understand elaborate topics, such as identity and migration diaspora, and to immerse listeners in a whole new environment and potentially a different way to think about a topic (p. 166).

Further on this point, Brumley et al. posit that a podcast is a “unique tool for engagement” that enables scholars the opportunity to communicate and showcase their expertise in a more liberating way than the typical forms of academic knowledge mobilization allow (p. 170). They document a particular researcher, political science Professor Todd Landman from the University of Nottingham, who hosts his own podcast *The Rights Track* (2015–present, <http://rightstrack.org/>). They quote Landman as saying that podcasting has provided a new way to engage with an audience, and he likens the opportunity to a “fireside chat” that “allows listeners to hear experts discuss their work in their own voices, and allows the experts to express themselves more freely than in the usual academic forms of dissemination” (p. 170). In this way, podcasting enables engaging with an audience in a way that is not usually possible through traditional media platforms (p. 170).

There is a similar observation put forth by Roberta Kwok’s article (2019) about engaging with the research community through podcasts. In the study conducted by MacKenzie (2019), she emphasizes that podcasts can be an opportunity to reach out to other scholars, which can ultimately benefit an academic’s career. For example, Hugh Osborn, the podcast host of *Exocast* (2016–present, <http://www.exocast.org/>) and an astronomer at the Laboratory of Astrophysics

in Marseille, France, felt that inviting a senior researcher to be a guest on his podcast was a less intimidating or awkward way to meet them than if he were to approach them in a more formal setting, such as a conference, by way of example. In this regard, a podcast can help expand a person's network to include colleagues they might not have had previous opportunities in which to engage.

Podcasting as Research Dissemination

As a platform, the podcast can also be employed to make researchers, research, and an institution's environment more accessible. Much in the same way Williamson (2018) states in "AQR's podcast series dissects weighty topics" that their academic and research findings are frequently intense scholarly papers published in academic journals that are not understandable to a general audience, and that a podcast has the ability to be more discursive and make a topic more comprehensible. In addition, academic institutions are sometimes regarded as ivory towers or considered intimidating or inaccessible places of higher learning that someone might not have encountered before, and so giving "voice" to faculty members and academics who are making their work understandable to the average person allows for more engagement and accessibility, as well as the potential to reach people who may have been previously daunted by the scholarly aspects of a university.

By presenting academics in a podcasting format, listeners are introduced to scholarly experts who may otherwise seem inaccessible and that has the potential to reach an audience through social media and an aural format (Durrani et al., 2015; Gianetti, 2018; Middleton, 2016). In addition, audiences get to hear experts in their own voice, thereby humanizing them in a different way, which does not necessarily occur when reading a profile about them and their work (Murray, 2019). Increasingly social media, which includes the podcast platform, is allowing scholars to engage with an audience in a more contemporary way.

Conceptual Framework

In the case of *View to the U* (VTTU, DeMarco, 2016–present, <https://soundcloud.com/user-642323930>), a monthly podcast produced by the Office of the Vice-Principal, Research (OVPR) at UofT Mississauga (UTM), which is one of three campuses at the University of Toronto (UofT), the idea came about to explore a new platform in order to showcase researchers. Up until VTTU's inception, researchers at UTM were primarily showcased through the OVPR's website ("Research News" and also "Research on Campus" feature), and the UTM main page/newsroom site, as well as print publications, including a printed weekly paper at the University of Toronto called *The Bulletin*, that has since become a three-times-a-week e-newsletter called *The Bulletin Brief*. The VTTU podcast was also introduced as a way to tell more of a researcher's story (how they got into their particular field or explore a timely topic) in their own voice and allow for less editorial limitations or interventions, i.e., a 30-minute podcast output with the researcher talking enables more of their experience and insights to come through than a 750-word profile would allow.

To this point, Harter (2019) emphasizes the importance of a complete assemblage of sounds in podcasting, stating that "[voices], laughter, and other accompanying and contextually emitted

noises produce meaning beyond words uttered. Speakers' intonation and cadence, coupled with musical scores, convey meaning. Silences and pauses can be as powerful as spoken words" (p. 4). Harter further theorizes the notion about the role of the listener: first, podcasts can be heard in the "sonic" environment of choice, whether someone is opting to tune in while performing a quotidian task, such as getting ready for work or commuting, or taking a long contemplative walk; but also that there is an interchange that takes place between a host and their listeners, and beyond being passive, the one who is choosing to listen can feel motivated, moved, inspired or entertained, on top of having an opportunity to learn (p. 4). This was further impetus for the host of VTTU to start a podcast: the fact that it allows listeners to engage more intimately, but also multi-task, e.g., they can consume a podcast while exercising or carrying out other household chores, and they do not need to stop and read or watch a video. Also, in relation to the listening environment, Harter and a colleague, Bill Rawlins, define the process of podcasting as the "worlding of possibilities:" a way to change conditions for the listener, and she ties this into her second argument about engaged scholarship, which Harter says is a collaboration between a community and a campus that can result in the deepening of knowledge as a response to important challenges (p. 4).

The podcast as a platform can also be employed to showcase a particular researcher; as in the case of VTTU, the documentation enables further communication about that particular researcher. If someone were writing about one of the researchers featured and needed resources to help flesh out that person and their academic path, the podcast, which contains the thoughts, quotes, and opinions of the interviewee, as well as sometimes some personal anecdotes about their particular path in research, that could be useful background information for writing a profile. In some instances, it could be the impetus to cover a researcher's work: in the case of VTTU, after UTM Geography Professor Ron Buliung was featured, a writer for another online resource, Holland Bloorview, heard the interview and contacted Professor Buliung to profile him and his research in an article (Kinross, 2017); they then proceeded to reference and link to the VTTU interview in the article. In addition, the VTTU podcast is archived on the University of Toronto's institutional repository TSpace (<https://tspace.library.utoronto.ca/>) as well, so it can be accessed by anyone anywhere in the world who logs in to the UofT Library website.

Research Strategy

When it comes to research, asking the right questions is key for a successful study. Similarly, the VTTU podcast has also focused on asking questions of the researchers, about their work, their academic paths, but also centered around key themes: based on the specific 'seasonal' theme, questions have related to areas such as being a woman in academia, how the UTM campus and research has changed over its history as part of a 50th-anniversary year celebration, how their work is global in nature, and why they study what they study. Having themes has helped to focus each season of the podcast, and as Brumley et al. state in their reasons for why people should include podcasts as part of their research: "no topic is too niche" (2017, p. 171).

This relates to what author Roberta Kwok refers to as "Finding a niche" (p. 388) in her article, "How to make your podcast stand out in a crowded market" (2019). She cites a study by Lewis MacKenzie (2019) at Durham University in the UK, in which he considered the rise of science

podcasts over several years (“Science podcasts: analysis of global production and output from 2004 to 2018”). Kwok writes that MacKenzie, based on his research, advises researchers or communicators who may be contemplating starting their own podcast to zero in on a unique niche or an underrepresented field or an unusual format, such as science comedy (2019, p. 388). Kwok provides the *Why Aren’t You a Doctor Yet?* podcast (Lathbridge, 2017–present, <https://www.alexlathbridge.com/podcast>) by way of example: this is a podcast spearheaded by University of Bath biochemistry PhD student Alex Lathbridge in 2017. His podcast is meant to have more diverse, multicultural perspectives, which he found lacking in other science-based media, and includes general topics in technology and science in which he hopes to engage a young (ages 18–34), culturally diverse demographic as an audience (Kwok, 2019, p. 388).

Kwok also includes a statement by MacKenzie that the podcast affords an opportunity to engage that might make it a more satisfying endeavour even if the audience base is not huge: interactions from an audience through various networks can provide enough of a motivation for a podcaster to continue producing even if the audience base remains fairly small in scale (2019, p. 389). The VTTU host has experienced this with feedback received, primarily through email and social media engagement. By way of example, a national funder was tagged in a Tweet since one of the people featured on the podcast had received a grant through them, and they retweeted to their over 87K follower base. It also helps to stay motivated when there are hits or listens every day. Even if they sometimes trickle in at a slower pace (slower compared to when an episode first drops), it is motivating to see that there is at least enough interest for downloads to be continuous and to consider that people might be discovering episodes randomly on any given day around the world.

Further on this point, Brumley et al. propose that a podcast is a “unique tool for engagement” that enables scholars the opportunity to communicate and showcase their expertise in a more liberating way than the typical forms of academic knowledge mobilization allow (2017, p. 170). They document a particular researcher, political science Professor Todd Landman from the University of Nottingham, who hosts his own podcast *The Rights Track* (2015–present, <http://rightstrack.org/>). They quote Landman as saying that podcasting has provided a new way to engage with an audience, and he likens the opportunity to a “fireside chat” that “allows listeners to hear experts discuss their work in their own voices, and allows the experts to express themselves more freely than in the usual academic forms of dissemination” (p. 170). In this way, podcasting enables engaging with an audience in a way that is not usually possible through traditional media platforms (p. 170).

There is a similar observation put forth by Kwok’s article (2019) and engaging with the research community through podcasts. In the study conducted by MacKenzie, she emphasizes that podcasts can be an opportunity to reach out to other scholars, which can ultimately benefit an academic’s career. For example, Hugh Osborn, the podcast host of *Exocast* (2016–present, <http://www.exocast.org/>) and an astronomer at the Laboratory of Astrophysics in Marseille, France, felt that inviting a senior researcher to be a guest on his podcast was a less intimidating or awkward way to meet them than if he were to approach them in a more formal setting, such as a conference, by way of example. In this regard, a podcast can help expand a person’s network to

include colleagues they might not have had previous opportunities in which to engage.

Podcasting Showcase

Anecdotally, for the host of VTTU, there has been interest in learning more about using the podcast as a platform to highlight community members and researchers, particularly since science communications and innovative ways to profile people, in contrast from the traditional written profile, has evolved and podcasts have become easier to produce (Bonini, 2015; Kwok, 2019; Brumley et al., 2017). Since its inception, the creator/host of VTTU has become regarded as an “expert” in podcasting in research and was approached to serve as Chair of a podcast committee for the Society of Research Administrators International. In addition, she was invited to give six presentations on podcasting in academia:

1. UTM Cocktails & Catch-ups (Mississauga, June 2017 <https://twitter.com/michelleyca/status/870642354197327873>)
2. Canadian Association of Research Administrators (<https://cara-acaar.ca/>) National Conference (Ottawa, May 2018)
3. UofT Field Day (<https://fieldday.utoronto.ca/> Toronto, May 2019)
4. PSEWEB (<https://pseweb.ca/> Saskatoon, July 2019)
5. Society of Research Administrators International (SRA <https://www.srainternational.org/home/> San Francisco, October 2019)
6. SRA International (Virtual, October 2020)

Additionally, VTTU was written about several times in online articles: in University Affairs (<https://www.universityaffairs.ca/features/feature-article/podcasting-goes-school/>); UofT News (<https://www.utoronto.ca/news/radio-u-t-seven-podcasts-you-should-know-about/>); Higher Ed Communications (<https://higheredcommunications.com/2019/03/06/putting-utm-research-in-the-spotlight/>); and UTM’s student newspaper The Medium (<https://themedium.ca/features/view-to-the-u-utms-very-own-podcast/>).

Another update of note in 2020: with the coronavirus pandemic globally gripping institutions, forcing researchers and staff to sequester and avoid going to labs, offices, and campuses, VTTU and various other podcasts are still a platform by which to reach researchers. In contrast to video, a podcast can continue during the COVID-19 restrictions; video production is much more onerous to execute at the best of times (with lighting, b-roll, scheduling, etc., all part of the process), but it becomes even more challenging to carry out this work with the current physical distancing measures in place. Furthermore, it allows an interviewer to probe related topics, such as how a researcher’s work might have shifted or how their expertise could inform the pandemic and subsequent physical-distancing situation; there are so many research areas of interest and implications associated with both the virus proper (epidemiology, wellness, etc.), as well as the effects of the way the world has changed (economic, socioeconomic, how work has shifted, etc.). As an example, VTTU focused on questions related to the pandemic (e.g., how to talk to kids about germs at <https://soundcloud.com/user-642323930/samuel-ronfard>, weeding through

pandemic-related information at <https://soundcloud.com/user-642323930/beth-coleman>, what kind of art might be produced from this crisis at <https://soundcloud.com/user-642323930/john-paul-ricco>, how world leaders are dealing with the situation at <https://soundcloud.com/user-642323930/edward-schatz>) with researchers who have expertise in related fields and in these particular topics. In addition, platforms such as Zoom, Skype, and Microsoft Teams allow for connectivity and have a recording function that can be saved in an mp4 format and subsequently edited to transform into a podcast output. The technology has allowed podcasts to progress and thrive during a difficult situation.

Evaluate and Analyze the Emergent Concepts

Research Methodology

For the purposes of this study, the authors are using one particular broadly focused research-based institutional podcast as a model, VTTU, a monthly podcast that launched in January 2017 and showcased researchers from UTM's 17 different departments. VTTU now has over 43 tracks, more than 16,100 listens (at the time of this article), and approximately 356 downloads, on average, per episode. Quantitative data related to VTTU can be easily obtained through the SoundCloud platform, where one can consider a number of related statistics, including the top tracks played, as well as isolating a specific timeframe to see what months yielded the most listens, and where geographically podcasts are being accessed.

In addition, two surveys were conducted using a mixed-methods approach through the REDCap platform. People who participated in Survey 1 were the researchers interviewed for VTTU, and for Survey 2 listeners (either regular or infrequent) of the podcast participated; both answered a specific questionnaire designed for either an interviewee or a listener. Participants were recruited through email (to interviewees and to some regular listeners), as well as Twitter and the OVPR website, where there was a link to the survey that was available for a two-week period. The study includes both quantitative and qualitative data that was generated using the analysis that is automatically generated within REDCap.

In total, 25 of the 40 researchers profiled on VTTU responded to the interviewee survey, and 16 listeners responded to the listener-specific survey. The questions covered a range of themes, including whether the respondents listen to other research-related podcasts (for both interviewees and listeners of VTTU), but also specific questions related to VTTU, such as was there any follow-up for researchers who were profiled on the podcast, and for listeners, what motivated them to tune in to VTTU and did they feel they learned something from listening to the podcast.

Lastly, a one-on-one interview was conducted with Professor Sonia Kang in the Department of Management at the Institute for Management and Innovation. The questions asked of Professor Kang were meant to further explore the effectiveness of podcasting in a more specialized format, and to survey her on her experience in turning to podcasting to disseminate her findings and reach a new audience with the recent launch of her own podcast For the Love of Work. [See CASE STUDY - Researcher turned Podcaster.]

Results

Summary of Findings

Data generated by SoundCloud can be accessed and analyzed on their “Stats” page. In the case of timeframe, and just by way of example, the following figures are statistics from the SoundCloud platform for VTTU from January 2019 to January 2020. This data summarizes overall hits, which was roughly 300+ per month, with the greyed-out sections representing some of the less popular tracks. One can see that some of the top months for listeners were April, June, September, and November where the number of listens all exceeded 350. Most of the top-played tracks in this data visualization are either the podcast episodes that dropped that particular month or were recent additions to the VTTU season. In addition, SoundCloud provides data related to location and listening platforms: VTTU has been listened to in 50 countries (SoundCloud only lists up to 50, so it might have been listened to in over 50 countries), with the top three countries being Canada (11,540 listens), US (2,169), and Ghana (233); the top listening platforms are SoundCloud (8,388) with people using mobile devices (e.g., android and iPhones), and accessed either through the UTM website (via RSS apps) or other social media platforms like Facebook.

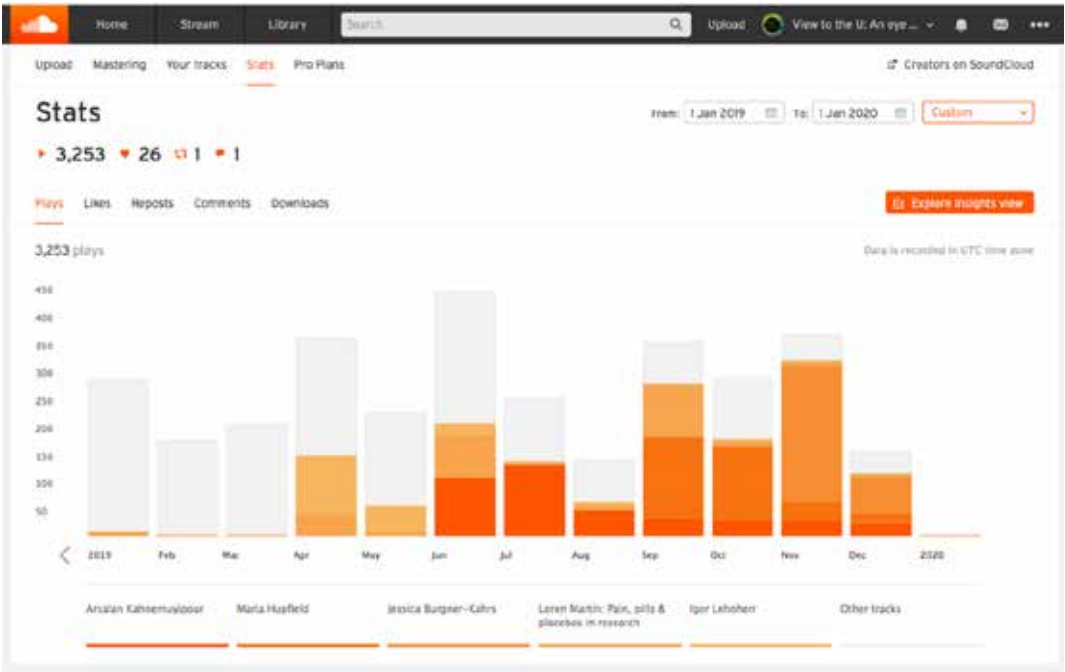


Figure 1. SoundCloud quantitative statistics

[Click here for larger image](#)

Survey quantitative and qualitative statistics

SURVEY – INTERVIEWEES

Once the podcast was posted, those featured on VTTU indicated that they were contacted by people who had heard the interview (13 of the 26 respondents): either by a graduate student who reached out to work with them after hearing the VTTU interview (3); by an international listener (3); and by media wanting to cover their work (2). Several respondents also said they further promoted the podcast through their own social media networks or on their website (14).

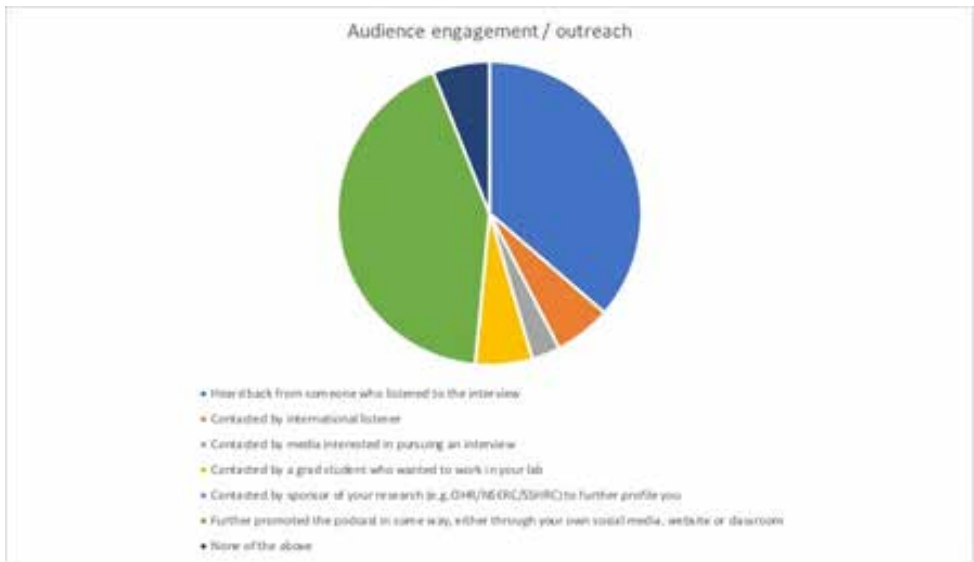


Figure 2. Audience engagement survey statistics

[Click here for larger image](#)

Another survey question related to being showcased via the podcast:

“What did you enjoy about being featured?”

Respondents could opt for multiple answers, and the results were as follows: Different format than a written profile (77.3%), Opportunity to explain work to a layperson (72.7%), Opportunity to engage a new audience (outside of field) (72.7%), Opportunity to engage a new internal audience (within institution) (77.3%), Public outreach (68.2%), Increase impact (40.9%), and Other (4.5%).

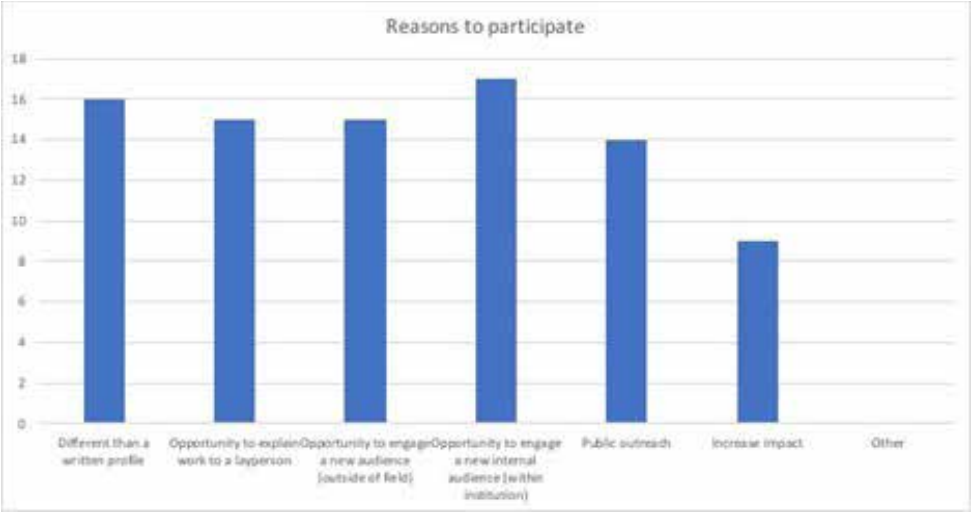


Figure 3. Interviewee participation survey statistics

[Click here for larger image](#)

Interest in research-related podcasts

One of the questions posed was whether the interviewees, who are all academics and researchers, listened to other research-related podcasts, and there are several who responded that they do: 39.1% said they listen to one or two; 26.1% said they listen to several; 4.3% said they subscribe to several research podcasts; and 30.4% said they listen to other podcasts, i.e., not research related.

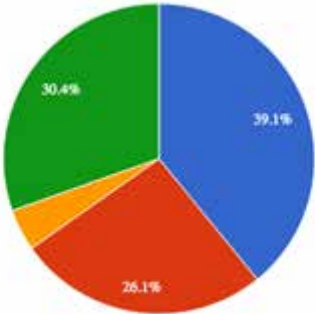


Figure 4. Research-related podcast survey statistics

[Click here for larger image](#)

Interviewees were also asked the following:

“Have you listened to any other episodes of VIEW to the U featuring your UTM colleagues?”

Many interviewees (42.3%) said they listened to one or two episodes; 38.5% said they have listened to several episodes; 7.7% said they subscribe to View to the U and try not to miss an episode; and 11.5% said they have not listened to any other episode.

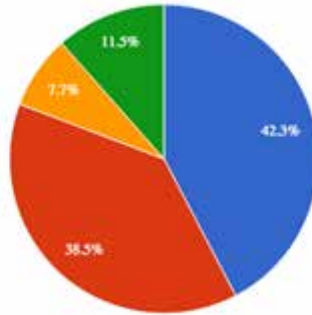


Figure 5. Interviewee-listener survey statistics

[Click here for larger image](#)

SURVEY – LISTENERS

Listeners of VTTU were asked a range of questions about listening generally (frequency, platform, etc.), which was a robust response, as well as why they listen.

“How often have you listened to VIEW to the U?”

Listeners indicated the following: once or twice (11.8%); a few times (64.7%); and I listen to every episode (23.5%).

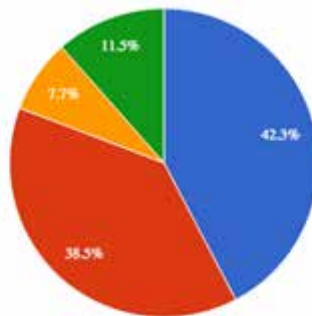


Figure 6. Frequency survey statistics

[Click here for larger image](#)

They were also asked about their reasons for listening and they could select multiple answers.

“What would motivate you to listen to an episode of VIEW to the U?”

The responses included the following: wanting to know more about a UTM researcher/research in general (58.8%); wanting to know more about a particular area of research (52.9%); wanting to find out more about a UTM researcher through a different platform (e.g., different from print), in their own voice, etc. (35.3%); wanting to listen to a locally made podcast (52.9%); only listen to episodes with researchers from your field or home department (17.6%); wanting to find out more about a researcher from another institution but in a field you are interested in (17.6%); UTM alumni/former UTM employee/faculty emeriti and want to stay connected to the work being done on campus (17.6%); all of the above (11.8%); or none of the above (0.0%).

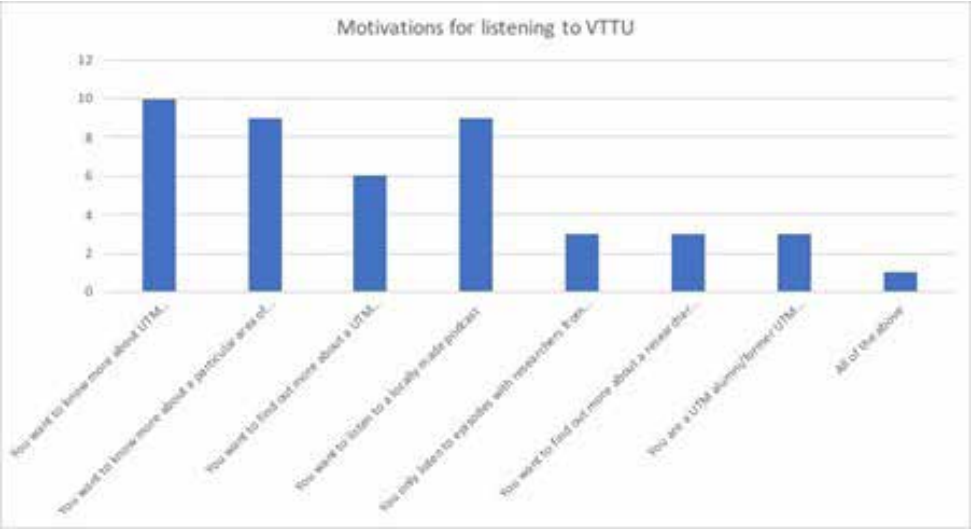


Figure 7. Motivation survey statistics

[Click here for larger image](#)

“Do you feel you learned something new by listening to VIEW to the U?”

When asked if they felt they learned something, the majority (88.2%) said yes, while 11.8% said they weren’t sure. (Respondents were given the option to say they had not learned anything new, but no one selected that as a response.)

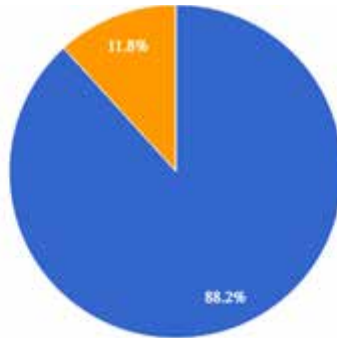


Figure 8s. Educational value survey statistics

[Click here for larger image](#)

CASE STUDY – Researcher turned podcaster: For the Love of Work

Starting a Podcast

Sonia Kang is an Associate Professor of Organizational Behavior and Human Resource Management in UofT Mississauga's Department of Management within the Institute of Management and Innovation, and she holds the prestigious title of Canada Research Chair in Identity, Diversity, and Inclusion. With support by an outside funder, Rogers Sports and Media, as well as Canadian podcast-production agency Pacific Content, she launched a podcast in October 2020 called *For the Love of Work* (Kang, 2020–present, <https://about.rogers.com/life-at-rogers/fortheloveofwork/>).

Professor Kang was not driving the initiative for this podcast starting out, but she was intrigued because she always wanted to start one as a form of outreach for her research, however, did not have the opportunity or time to pursue this goal. The show, which was spearheaded by Rogers, enlisted Pacific Content to produce it. The podcast was initially intended to be internal to Rogers employees: to foster a shared culture and unite the workplace with an “exciting engagement platform,” Professor Kang said. Pacific Content convinced Rogers to expand the podcast externally so that others, both inside and outside the organization, could better understand Rogers’ culture and values. Pacific Content created the basic concept for the podcast and then started auditioning hosts. As part of this process, they reached out to Professor Kang to see if she would be interested in reading for the audition. She did the reading and they thought she would be a good fit: they liked her voice and personality, but in addition, with her research insights and connections with other people in industry and academics working in this particular field, it would benefit the podcast’s output.

Intimacy During a Pandemic

The pandemic and subsequent shutdown occurred right around the time they were going to start producing, but Professor Kang was able to set up a makeshift recording studio in her house in order to read her scripts, and the crew at Pacific Content were equipped to do the post-production

from their respective workspaces. Further, a lot of the racial upheaval that took place earlier in 2020 sparked by the deaths of Breonna Taylor and George Floyd among others in the US, resulted in another episode that draws specifically on Professor Kang's work in diversity and inclusion.

This touches on another key point addressed by Brumley et al. (2017) regarding not only the immediacy that the format allows but also, about podcasts being driven by the zeitgeist: Professor Kang and the team were able to consider the racial upheaval that was taking place around the world and speak to that, with the research informing the themes in the show. Additionally, when the pandemic hit, people had to modify their work processes and environments, and Professor Kang was able to react to that organizational change as well since her expertise was beneficial in covering these topics. In this similar vein, the aforementioned shows like *Science vs* and *Gastropod* are able to react to things taking place in real-time. For example, when the pandemic hit *Science vs* offered many episodes related to things like infectious disease spread and vaccination development (Zukerman, 2016–present). A show like *Gastropod* taps into several timely topics, such as last year they did an episode on CRISPR, which a lot of people were talking about at the time, and how it relates to food science. Regarding the pandemic situation, *Gastropod* had an episode on the importance of sharing a meal with others, exploring whether the experience can be recreated on Zoom through the lens of science (Graber & Twilley, 2014–present).

Overall, when it comes to the *For the Love of Work* podcast, Professor Kang is involved with brainstorming, writing the scripts, as well as having input in the final edit. So far, she has been very satisfied with the outcome: by the time she hears a more finalized version of each episode, it has already been through a rigorous editing and finetuning process with the showrunners and producers. “I have really loved working with Rogers, and it's one of the best workplace cultures I've seen,” said Professor Kang said. “They really do prioritize the employee experience and care deeply about their people.”

Expanding the Series

Though *For the Love of Work* was intended to be a limited series of seven episodes, Professor Kang and the team at Pacific Content are already discussing a second season and are brainstorming ideas for future themes and episodes. Since the podcast only launched at the end of October, it is challenging to analyze metrics at this point, but based on what they have measured related to “retention” and “completion,” terms used for whether a listener stays with the episode until the end, they are happy with those numbers so far. Going forward, they will conduct a more in-depth analysis of how many overall listens they received, which they usually assess three to four months after a show's initial launch.

The team at Pacific Content (2021, <https://pacific-content.com/about/>), who specialize in podcast production, currently have over 30 podcasts that they have produced to “[help] some of the world's biggest brands to create and market compelling audio stories,” so they are in a prime position to help other academics and universities communicate their respective narratives and work. For Professor Kang, the collaboration has been relatively harmonious thus far, with her research expertise and connections helping to flesh out the interviews, which she will be getting more involved with and conducting herself. At the same time, Pacific Content will continue to

source other guests from the particular industry they are focused on to round out the roster of contributors.

Audience Engagement

With regards to audience engagement, Professor Kang echoes a sentiment expressed by Mollett et. al (2017). The authors stated that while research-related podcasts might not reach the same number of downloads that some popular podcasts receive; garnering perhaps 5,000 downloads for an academic output is a sharp contrast to the millions that a podcast like Serial might achieve. However, “compared to journal article downloads, which have a very modest reach, usually numbering in just the hundreds, these podcasts...reached a significant amount of people on platforms not usually associated with academia” (Brumley et al., 2017, p. 167). [More on this in the *Discussion* section.] Professor Kang said she feels a podcast can have a broader reach for her work and that it “can be more powerful than having a paper that few people are ever going to read.”

Professor Kang says this show has helped to communicate her research findings in a unique way, particularly in diversity and inclusion, and she has been able to reach a whole new audience and a more profound level of engagement. She receives lots of feedback, usually by way of email from people who have listened to the show and want to express that they enjoyed it, but people from agencies are also reaching out to let her know that they have suggestions for an ideal guest for future episodes. Professor Kang, who is a psychologist by training, stated the following: “Even though I ended up in a business school, my knowledge base comes from my psychology background, and I feel like I’ve been able to engage with that in a much broader and deeper way in the podcast than I usually do in my work.”

Lastly, Professor Kang encouraged other academics to use a podcast as another way to communicate their work and reach an audience. Her advice is for researchers to think of their podcast as “an auditory white paper” that highlights the “big picture message” and *why* people should care about the work. “I think these kinds of communications, like podcasting, are more about communicating the purpose of the work,” said Professor Kang. “I would say to zoom out from the research and don’t get caught up in all the details, but really think about the implications for broader society.”

Discussion of Findings

In the case of VTTU, with over 43 tracks and more than 16,200 listens, as mentioned previously in this paper, this is a small number when you compare it to mainstream podcasts that may achieve that many listens for one single episode. However, VTTU as a model can illustrate that a podcast can be a useful research dissemination and outreach tool, as well as a resource to showcase researchers, boost morale, and document research happening at an institution, and potentially engage campus stakeholders, outside agencies, alumni, and students. At its most basic level, VTTU came about to explore a new platform in order to showcase researchers and so far, it has abided by that goal. In addition, the analytics indicate it has reached audiences around the

globe, so it has the potential to reach people in countries who may find particular fields or topics of interest no matter where they reside.

Statistics

As demonstrated by the SoundCloud analytics, as well as the survey results and interview with Professor Kang, there is compelling data to support the inclusion of a podcast as part of an institution's communications efforts, whether it is a research office, alumni initiative, departmental communications plan, or career centre in higher education. Moving forward, the data included on a platform like SoundCloud can be analyzed and considered at any stage once a podcast is posted, and this can impact decisions, such as which researchers or themes one might want to highlight in the future for more uptake, or what time of year generates the most downloads in order to concentrate efforts in certain months.

For example, according to the SoundCloud statistics, Professors Loren Martin and Jennifer Stellar in UTM's Department of Psychology with 1,158 and 1,130 listens respectively (as of November 2020), garnered the most downloads. This may be due to certain influencing factors, including that Professor Martin promoted the podcast via a link on his laboratory's website and the interview with Professor Stellar was featured more broadly by a University of Toronto communications platform (an e-newsletter) that reached thousands of alumni, but this may also be an indication that their research may be of more broad interest, which could potentially be a topic for a future user-experience study. (Professor Martin's research focuses on issues related to chronic pain and empathy, and Professor Stellar studies how positive emotions can improve well-being.) However, in terms of strategic posting, the interview with Professor Stellar was posted in September 2018: the start of a new academic term and with a focus on mental-health positivity, but it could be an interesting comparison to post a podcast of this nature to be timed with a January drop date with people focused on a new year and resolutions, etc. The interview with Professor Stellar did receive most of its downloads at the end of December 2018, but again this coincided with the date that the newsletter was sent out and the podcast was subsequently promoted to all 300,000+ UofT alumni.

In the case of timeframe, as mentioned, the figures from the SoundCloud platform from January 2019 to January 2020 indicated that the top months were April, June, September and November. If one is producing a podcast, these stats can guide how they want to concentrate their efforts and take into account lower listenership, as one might expect in the summer, as well as at the start of a new year and academic term.

An interesting takeaway from the interviewee survey was the question related to being on the podcast. When asked what they enjoyed about being featured, overwhelmingly (77.3%) respondents indicated that they liked that it was different format than a written profile, 72.7% liked that they had the opportunity to explain work to a layperson, and to engage a new audience outside of their field, as well as an opportunity to engage a new internal audience within their institution (77.3%), public outreach (68.2%), and the opportunity to increase impact (40.9%).

This information very much aligns with some of the reasons people chose to listen, which provides

some insight into what might further entice people to tune in, and also whether they feel they learned something new from the podcast. Some of the strongest responses for why people chose to listen to VTTU included wanting to know more about UTM research or researcher in general (58.8%) or interested in a particular in area of research (52.9%), as well as wanting to find out more about a UTM researcher through a different platform in their own voice (35.3%) and the opportunity to listen to a locally made podcast (52.9%)

Recommendations

Conclusion

There is definitely a place for podcasts in academia and in the research milieu in particular. Though there are challenges, which will be addressed in this section; there are also steps one can take to overcome certain obstacles.

First, as it relates to the Case Study with Professor Sonia Kang and her podcast *For the Love of Work*. In this particular instance and the way this podcast materialized, which was partially an opportunity that presented itself though Professor Kang was interested in the medium prior, perhaps this is not an option or a consideration for other academics. As podcasts continue to emerge in academia, it would be worthwhile to study this further with a few more representative examples to compare other scholars and their experience in branching out with a podcast as a way to disseminate research findings, showcase their expertise, and interact with other researchers, practitioners, industry contacts, and various guests as a more contemporary form of knowledge mobilization.

Secondly, as Kwok suggests in “How to make your podcast stand out in a crowded market,” the podcast environment has become increasingly saturated with shows of all different stripes. Particularly related to science podcasts, and the work done by MacKenzie evaluating the medium of podcasting in science communication over the timeframe of 2004-18, he found that there were approximately 200 science podcasts in 2010 versus 952 science podcasts in 2018, though on average several of these outputs did not last beyond two years. Kwok states that while new technology and online resources have enabled a level of ease for producing podcasts, a lack of limitations or barriers might make it more difficult to secure a regular audience (2019, p. 388). However, later in her article she posits that promotion via social media and posting transcripts or episode notes on the podcast’s host site or website will make it easier to find through an internet search to help “reach listeners” (p. 389) and hopefully lead to longevity for the podcaster.

The host of VTTU has found that social media definitely helps to promote the podcast, as well as including the notes on SoundCloud where the podcast is hosted, and Spotify, and having the transcript online can help to draw certain people in via Googling. But an additional support for promotion is relying on institutional communications, local media, as well as the researchers themselves helping to highlight through their respective networks. In the survey completed by those interviewed, 50% of respondents indicated that VTTU should be “promoted more widely and broadly,” and 63.6% of respondents said they further promoted the podcast in some way, either through their own social media, website or the classroom. Additionally, some of the interviewees

who did help promote had a significant increase in downloads. As an example, Professor Loren Martin in the Department of Psychology has the most downloads for those featured on VTTU with over 1,160 downloads: he created his own SoundCloud page to feature the interview, as well as having a link to the episode featuring his interview prominently displayed on his website. The other interviewee with the second-most downloads, Professor Jennifer Stellar, also in Psychology, was featured in an alumni e-newsletter and her episode has over 1,130 downloads. The host has also relied on some of the funding agencies in Canada that get tagged in her social media, as well as reaching out to media personnel at agencies and traditional media, for further help in promoting the interviews.

Alternative Metrics or Altmetrics

This information all ties into another perspective in the literature: *altmetrics* for podcasting, and social media more generally, as a consideration incorporated into the research environment (Sugimoto et al., 2017). Altmetrics are the non-traditional metrics in the scholarly environment that are regarded as “an alternative or complement to more traditional citation impact metrics such as impact factor and h-index” (Altmetrics, 2021). Because social media and alternate platforms for research communications are factoring into scholarly work in a significant way, the podcast provides researchers, as well as those working in communications, the opportunity to highlight academic work and take a deeper dive into various areas of research, but also the outlet to reach a whole new audience.

In the article “Making the mission visible: Altmetrics and nontraditional publishing” (Bonnet & Méndez-Brady, 2017), the authors state that there is “an increased awareness of, and interest in, impact tracking tools that capture both traditional scholarship, like journal articles, and nontraditional scholarly and creative outputs, such as videos, podcasts, and newsletters” (p. 294). Additionally, findings suggest that there is an academic impact associated with altmetrics that is not entirely represented or captured by traditional metrics (Bonnet & Méndez-Brady, 2017; Sugimoto et al., 2017), and that platforms such as infographics, social media, and podcasts can significantly increase your altmetric scores (Thoma et al., 2018; Verhagen et al., 2014). On this point, in the case study with Professor Sonia Kang, she noted that a lot of people reached out to her, through email as well as social media engagement (primarily Twitter), and this can be another alternate way to regard impact that would not be captured in traditional impact metrics.

For as much as a podcast can reach a broader audience than some academic papers might, as mentioned earlier in this article (Professor Sonia Kang case study; Brumley et al., 2017), the number of downloads is likely to be much lower than some popular podcasts like *This American Life*, *Serial*, *99% Invisible*, etc. However, it is important for anyone starting a podcast not to get too mired in the metrics. In her article, Kwok (2019) states that podcast creators should keep in mind why they are making a podcast in the first place and she quotes Kat Arney, the Director of First Create the Media Ltd., which is a science-communications consultancy in Maidenhead, UK: “Some scientists want to improve communication skills, work with friends or just have fun” (p. 389). The host of VTTU has maintained this throughout the time she has been producing the podcast and has included it in her presentations on podcasting: the main thing is VTTU documents and serves as an archive of the history of research at UTM, as well as showcasing the

researchers at her institution, which was the mission at the outset. As an added bonus, it gets downloaded every day somewhere in the world.

The possibility for a podcast to create more of a sense of community is also a very viable outcome. As results of the VTTU study indicated, 58.8% of listeners wanted to learn more about UTM researchers or research in general and in their own voice (35.3%), but also over 52% wanted to listen to a locally made podcast or were alumni or staff looking to stay connected to the work being done on campus (17.6%). In Kwok's (2019) article, she talks about *The Taproot* podcast (Baxter & Haswell, 2017–present, <https://plantae.org/education/podcasts/the-taproot/>) that, among their plant-science topics, endeavored to show that certain challenges or struggles are common ground for researchers (p. 388), but they also tackled issues such as mental health in graduate students, which yielded favorable feedback from listeners on social media pleased to see their coverage of the topic (p. 389). In addition, a podcast allows perspectives from researchers that might diverge from other sources of information, that could in fact be erroneous or unbalanced, and is being presented in the media. Kwok cites the example of “Tabby’s Star” that was eliciting various (and somewhat outlandish) speculation in the news in 2015, and as a researcher in astronomy, Osborn used his podcast *Exocast* (2016–present) to debunk some of what was being presented in the media (p. 388).

In terms of the accessibility factor, which was previously mentioned, there are times when an academic expert can be difficult to understand, particularly if audience members are not specialists in the field. Kwok states in her article that it is sometimes difficult on a podcast that showcases specialized topics to achieve a fitting balance between technical language and information meant for a layperson (2019, p. 388). However, this can be further minimized by either having others listen to the more finalized edit to ensure the podcast is accessible in terms of its terminology, as they do in the *For the Love of Work* podcast, or else the interviewer can emphasize to the interviewee that the podcast is intended for a more general audience. As an example, at the start of each VTTU interview, (offline) the host reiterates to the researcher that any esoteric terminology they use should be explained, as well as any concepts or collaborators they mention should be fleshed out if the average person would not know who or what they are talking about. The type of podcast format, like VTTU, allows scholars to make their research and expertise more digestible to the average person: over 88% of listener-survey respondents indicated they felt they learned something from the interview, and over 72% of interviewees enjoyed having the opportunity to communicate their life's work as it relates to a particular topic to an average listener. Having the podcast platform also affords the opportunity to engage others in their field and perhaps also inspire young academics in their research area.

Starting a Podcast

Podcasting Partnerships

If a researcher wants to embark on a more professional podcast path, there are many companies, such as Pacific Content, who worked with Professor Kang, and Research Podcasts in the UK, that have cropped up in the past few years to help people produce podcasts, and this will presumably

continue as the podcast landscape continues to grow and gain popularity. But there are also universities and armchair podcasters—both academics and communications professionals—who will likely step up to create new audio content. As Mollett et. al. (2017) state, podcasts can be inexpensive to produce, as well as not require any special equipment, which is a great benefit. When the COVID-19 shutdown occurred, VTTU was able to continue production using the Zoom platform that was free to staff, students and faculty to record the audio component of the interview, and then employing the Audacity software program, which is free to download, in order to edit the output.

However, beyond companies who are poised to help produce podcasts, incorporating graduate students in the production of podcasts and to enhance KT is also another possibility. Working on a podcast would provide a graduate student the opportunity to actively engage in research (Mollett et. al state that “podcasts are research,” 2017, p. 169), knowledge mobilization and hone their skills in research, as well as become more proficient in science or research communications, which as stated previously is increasingly important in an academic’s career. In Kwok’s article, she mentions the instance of another podcaster from Brazil, PhD student in plant sciences, Marcos Vinicius Dantas-Queiroz, co-producer for three years of a science podcast *Dragões de Garagem* (Queiroz, 2012–present, <http://dragoesdegaragem.com/>): his work on the podcast is included on his CV and he hopes that the technical and communication skills he has honed working on the podcast will expand his academic-job prospects (2019, p. 388). This harkens back to an earlier point about career benefits, but also that including graduate students and postdocs in this kind of knowledge dissemination and communication can be advantageous all around. There is an instance of this endeavour in particular at the UofT’s Faculty of Medicine with the *Raw Talk* podcast (2016–present, <https://www.rawtalkpodcast.com/>), which is “a graduate student-run podcast at the University of Toronto about medical science, and the people who make it happen.” They have been producing episodes since 2016, and with each cohort who joins in the project, they get a range of fresh perspectives as new students come on board to work on the show.

Podcasting Skills

In terms of the skills necessary to produce a podcast: of course, having a background in broadcasting can be beneficial, however in her book *You’re not Listening*, author Kate Murphy talks about the producers at the popular National Public Radio (NPR) program, *Fresh Air* with host Terry Gross that is both a radio show and a podcast. Though a couple of the people from the eight-person production team did have radio-specific expertise, the rest “[came] from many different backgrounds, including a former waitress, film director, and folklorist” (Murphy, 2019, p. 116). When executive producer Danny Miller decided on the members that make up the *Fresh Air* production crew, he said the “key qualification he looks for when hiring producers is ‘good ears,’ meaning a superior ability to listen and detect what’s really going on in conversations” (p. 115). In following this principle, some of the technical skills with editing and recording can definitely be learned by an amateur podcaster, but if someone has the ability to identify the salient points in an interview or what Miller refers to as “having command of conversations” that would definitely give them an advantage for knowing what parts of audio to keep in and what to omit. Kwok also points out that there are several resources online to help a person get started (2019, p.

389), and the host of VTTU has always emphasized this point in her presentation (particularly the blog by Kevan Lee: <https://buffer.com/library/podcasting-for-beginners/>).

In addition, there is the opportunity to partner with existing podcasts. For example, the path led to Professor Kang's (in the case study) podcast coming to light, with her being recruited as a host for her expertise in human resources and organizational management that fit with the podcast Rogers had envisioned and Pacific Content conceived. But there are podcasts that already exist one can consider, such as shows like *Ear Hustle* (<https://www.earhustlesq.com/>), which focuses on life in prison and the inmates at San Quentin State Prison (Poor et al., 2017–present). A researcher could potentially partner with this type of show and provide their expertise on prison, criminality, history of incarcerations, or the justice system; the possibilities are endless.

Resources to Sponsor a Podcast

There could also be the opportunity for sponsorship and podcasting in research. Though Professor Kang's experience was not specifically driven by her initiative to launch her particular podcast, if she had pitched the idea to Rogers Media, who was looking for a way to engage its employees, that could be a way to incubate a podcast. There have been instances of large-scale companies investing in producing a podcast, driven by wanting to educate a public and add to a current dialogue. The most prime example of late is that of the *Who We Are: A Chronicle of Racism in America* podcast (<https://www.vox.com/ad/21354746/who-we-are-podcast-racism-in-america>) that launched in September 2020 (Wallace & Robinson, 2020–2021). This was done with Ben and Jerry's (yes, the ice cream outfit) partnering with Vox Media to produce a six-part series on a history of racial injustice in America as a result of some of the recent racial upheaval in the US. They state on their website that in "the wake of the murders of George Floyd, Breonna Taylor, and so many others, America faces a racial reckoning—one that requires an honest look at the American history that has allowed white supremacy to thrive for the last 400 years" (Ben & Jerry's, 2020). The show features a range of experts on the topic, including several academics, to explore many different themes about the history of slavery and discrimination, and that their goal "is to educate and encourage audiences to dismantle systemic racism" (Wallace & Robinson, 2020–2021).

Other Opportunities

There are also opportunities that have emerged, such as the aforementioned NSERC grant to implement, strategize, and foster better resources for communicating science and research, as well as outlets like NPR, which produces many podcasts, and their Story Lab (<https://nprstorylab.submittable.com/submit>) "idea hub" that serves as an incubator for new segments, programs, podcasts, and shows. They state on their website that they "want to work with new talent that brings a fresh perspective," and to "keep innovating and leading in the podcast and radio world." This could easily lend itself as an opportunity for an academic or entrepreneurial research communications professional to put forward as a concept to explore further, and in addition could definitely provide a basis for how to pursue the crafting of potential podcasts in academia. There is also the potential, mentioned previously, to employ students in this endeavour to help enhance their skills in research while also expanding possibilities for reaching a wider audience. As evidenced over the past few years, a podcast can be produced even with restricted resources or

with the intention of doing a limited run in order to gauge uptake. Just as we are spoiled with the wealth of offerings of most streaming services, if you have clear direction on the type of podcast you want to put out in the world, you can likely produce a show that will find its rightful audience.

Lastly, in the words of American jazz singer Dianna Reeves who said “I think the only way for you to grow and evolve is to keep listening, keep moving forward, keep jumping in and trying to experience,” this is good advice to aspiring podcasters in academia and beyond.

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References

- Altmetrics. (2021, March 20). In *Wikipedia*. <https://en.wikipedia.org/wiki/Altmetrics>
- Baelo-Allué, S. (2019). Transhumanism, transmedia and the serial podcast: Redefining storytelling in times of enhancement. *International Journal of English*, 19(1), 113-131. <https://doi.org/10.6018/ijes.335321>
- Barton, C. J., & Merolli, M. A. (2019). It is time to replace publish or perish with get visible or vanish: Opportunities where digital and social media can reshape knowledge translation. *British Journal of Sports Medicine*, 53(10), 594-598. <http://dx.doi.org/10.1136/bjsports-2017-098367>

- Baxter, I., & Haswell, L. (Hosts). (2017–present). *The taproot* [Audio podcast]. <https://plantae.org/education/podcasts/the-taproot/>
- Ben & Jerry's. (2020, September 1). Introducing “Who we are: A chronicle of racism in America,” A new podcast in partnership with Vox Media. <https://www.benjerry.com/whats-new/2020/09/who-we-are-podcast>
- Berry, R. (2016). Part of the establishment: Reflecting on 10 years of podcasting as an audio medium. *Convergence: The International Journal of Research into New Media Technologies*, 22(6), 661-671. <https://doi.org/10.1177/1354856516632105>
- Biber, D., & Heidorn, J. (2020). Tailoring the walking classroom to promote college student engagement. *College Teaching*, 68(4), 1-5. <https://doi.org/10.1080/87567555.2020.1833177>
- Bonini, T. (2015). The 'second age' of podcasting: Reframing podcasting as a new digital mass medium. *Quaderns del CAC*, 41(18), 21-30. https://www.cac.cat/sites/default/files/2019-01/Q41_Bonini_EN_0.pdf
- Bonnet, J. L., & Méndez-Brady, M. (2017). Making the mission visible: Altmetrics and nontraditional publishing. *Digital Library Perspectives*, 33(4), 294-304. <https://doi.org/10.1108/DLP-01-2017-0002>
- Brabazon, T. (2012). *Digital dialogues and community 2.0: After avatars, trolls and puppets* (Chandos publishing social media series). Elsevier Science.
- Brumley, C., Gilson, C., Mollett, A., & Williams, S. (2017). *Communicating your research with social media: A practical guide to using blogs, podcasts, data visualisations and video*. Sage Publications Ltd.
- Chen, Z., & Melon, J. (2018). Evolution of social media: Review of the role of podcasts in gynaecology. *International Urogynecology Journal*, 29, 477-480. <https://doi.org/10.1007/s00192-017-3523-0>
- Church, J. (Host). (2017–present). The political theory review [Audio podcast]. Podomatic. <https://www.podomatic.com/podcasts/thepoliticaltheoryreview>
- Corbeil, J. R., Butler, J. W., & Valdes-Corbeil, M. E. (2008). Faculty, are you ready for mobile learning? e-Learners say they are geared up and ready to engage. *International Journal of Mobile Learning and Organisation*, 2(1), 48-61. <https://doi.org/10.1504/IJMLO.2008.018717>

- DeMarco, C. (Host). (2016–present). *View to the U: An eye on UTM research* [Audio podcast]. <https://soundcloud.com/user-642323930>
- Durrani, K., Gotkin, K., & Laughlin, C. (2015). Serial, seriality, and the possibilities for the podcast format. *American Anthropologist*, 117(3), 1-4. <http://anthrosource.onlinelibrary.wiley.com/doi/abs/10.1111/aman.12302>
- Edison Research. (2017, April 18). The podcast consumer 2017 [Blog post]. <https://www.edisonresearch.com/the-podcast-consumer-2017/>
- ElDiwiny, M. (Host). (2019–present). *Soft robotics* [Audio podcast.] IEEE-RAS. <https://www.ieee-ras.org/soft-robotics/podcasts>
- Giannetti, F. (2018). A Twitter case study for assessing digital sound. *JASIS&T: Journal of the Association for Information Science & Technology*, 69(5), 687-699. <https://doi.org/10.1002/asi.23990>
- Graber, C., & Twilley, N. (Hosts). (2014–present). *Gastropod* [Audio podcast]. <https://gastropod.com/>
- Griscom, R. (Host). (2019–present). The next big idea [Audio podcast]. *Wondery*. <https://wondery.com/shows/the-next-big-idea/>
- Harter, L. M. (2019). Storytelling in acoustic spaces: Podcasting as embodied and engaged scholarship. *Health Communication*, 34(1), 125-129. <https://doi.org/10.1080/10410236.2018.1517549>
- Harter, L. M. (Host). (2019–2020). *Defining moments* [Audio podcast]. WOUB Public Media, produced in association with NPR. <https://www.npr.org/podcasts/727287962/defining-moments>
- Kang, S. (Host). (2020–present). *For the love of work* [Audio podcast]. Rogers Media. <https://about.rogers.com/life-at-rogers/forthe love of work/>
- Kinross, L. (2017, May 4). Asha 'reshaped the way I look at the world' [Blog post]. *Bloom Blog*. Holland Bloorview Kids Rehabilitation Hospital. <https://hollandbloorview.ca/stories-news-events/BLOOM-Blog/asha-reshaped-way-i-look-world>
- Kwok, R. (2019). How to make your podcast stand out in a crowded market. *Nature*, 565(7737), 387. <http://dx.doi.org.myaccess.library.utoronto.ca/10.1038/d41586-019-00128-7>

- Landman, T. (2015–present). *The rights track* [Audio podcast]. <http://rightstrack.org/>
- Lathbridge, A. (Host). (2017–present). *Why aren't you a doctor yet?* [Audio podcast]. <https://www.alexlathbridge.com/podcast>
- Lee, K. (2021). *Podcasting for beginners: The complete guide to getting started with podcasts*. Buffer Marketing Library. <https://buffer.com/library/podcasting-for-beginners/>
- MacKenzie, L. E. (2019). Science podcasts: Analysis of global production and output from 2004 to 2018. *The Royal Society Open Science*, 6(1), 1-18. <https://royalsocietypublishing.org/doi/pdf/10.1098/rsos.180932>
- Middleton, A. (2016). Reconsidering the role of recorded audio as a rich, flexible and engaging learning space. *Research in Learning Technology*, 24(1), 28-35. <https://journal.alt.ac.uk/index.php/rlt/article/view/1690>
- Murphy, K. (2019). *You're not listening: What you're missing and why it matters*. Celadon Books, a division of Macmillan Publishers.
- Murray, S. (2019). Coming-of-age in a coming-of-age: The collective individualism of podcasting's intimate soundwork. *Popular Communication: The International Journal of Media and Culture*, 17(4), 301-316. <https://www.tandfonline.com/doi/full/10.1080/15405702.2019.1622117>
- National Public Radio (NPR). (2021). NPR Story Lab. <https://nprstorylab.submittable.com/submit>
- Natural Sciences and Engineering Research Council of Canada. (NSERC). (2020). *Science Communication Skills grant* (pilot). https://www.nserc-crsng.gc.ca/promoter-promotion/sciencecomm_eng.asp
- Osborn, H. (Host). (2016–present). *Exocast* [Audio podcast]. <https://www.exocast.org/>
- Pacific Content. (2021). *About*. <https://pacific-content.com/about/>
- Peoples, B., & Tilley, C. (2011). Podcasts as an emerging information resource. *College & Undergraduate Libraries*, 18(1), 44-57. <http://www.tandfonline.com/doi/abs/10.1080/10691316.2010.550529>
- Poor, N., Woods, E., & Thomas, R. (Hosts). (2017–present). *Ear hustle* [Audio podcast]. Radiotopia. <https://www.earhustlesq.com/>

- Queiroz, L. (Host). (2012–present). *Dragões de Garagem* [Audio podcast]. <http://dragoesdegaregem.com/>
- Rankin, J. G. (2018). *Sharing Your education expertise with the world: Make research resonate and widen your impact*. Routledge. <https://doi-org.myaccess.library.utoronto.ca/10.4324/9781351120982>
- Rogers, D., & Herbert, M. (2018). Podcasts and urban studies: Notes from the field; Sounds from the studio. *Urban Policy and Research*, 38(1), 66-73. <https://doi.org/10.1080/0811146.2019.1663726>
- Rogowsky, B. A., Calhoun, B., & Tallal, P. (2016). *Does modality matter? The effects of reading, listening, and dual modality on comprehension*. SAGE Open. <https://doi-org.myaccess.library.utoronto.ca/10.1177/2158244016669550>
- Ross, A., & DiSalvo, M. (2020). Negotiating displacement, regaining community: The Harvard Language Center's response to the COVID-19 crisis. *Foreign Language Annals*, 53(2), 371-379. <https://onlinelibrary.wiley.com/doi/full/10.1111/flan.12463>
- Salam, S., & Wang, Q. (2009). Designing a web-based learning environment using weblogs and podcasts. *International Journal of Continuing Engineering Education and Life Long Learning*, 19(2-3), 179-190. <https://doi.org/10.1504/IJCEELL.2009.025026>
- Samuel-Azran, T., Laor, T., & Tal, D. (2019). Who listens to podcasts, and why?: The Israeli case. *Online Information Review*, 43(4), 482-495. <https://doi.org/10.1108/OIR-04-2017-0119>
- Seo, K. K., Curran, A., Jennings, N. A., & Collins, C. M. (2010). Creating a new mobile learning community with podcasting. *International Journal of Continuing Engineering Education and Life Long Learning*, 20(1), 103-114. <https://doi.org/10.1504/IJCEELL.2010.031652>
- Sharon, T., & John, N. A. (2019). Imagining an ideal podcast listener. *Popular Communication: The International Journal of Media and Culture*, 17(4), 333-347. <https://doi.org/10.1080/15405702.2019.1610175>
- Sugimoto, C., Work, S., Larivière, V., & Haustein, S. (2017). Scholarly use of social media and altmetrics: A review of the literature. *Journal of the Association for Information and Technology*, 68(9), 2037-2062. <http://asistdl.onlinelibrary.wiley.com/doi/abs/10.1002/asi.23833>
- Sullivan, J. L. (2019). The platforms of podcasting: Past and present. *Social Media + Society*, 5(4), 1-10. <https://doi.org/10.1177/2056305119880002>

- Thoma, B., Murray, H., Huang, S. Y. M., Milne, W. K., Martin, L. J., Bond, C. M., Mohindra, R., Chin, A., Yeh, C. H., Sanderson, W. B., & Chan, T. M. (2018). The impact of social media promotion with infographics and podcasts on research dissemination and readership. *Canadian Journal of Emergency Medicine*, 20(2), 300-306. <https://doi.org/10.1017/cem.2017.394>
- Udovich, C., Kasivisvanathan, V., & Winchester, C. L. (2017). Communicating your research (part two): to the wider community. *Journal of Clinical Urology*, 11(3), 208-214. <https://doi.org/10.1177/2051415817743125>
- University of Toronto Institute of Medical Science. (2016–present). *Raw talk* [Audio podcast]. <https://www.rawtalkpodcast.com/index>
- Verhagen, E., Bower, C., & Khan, K. M. (2014). How BJSM embraces the power of social media to disseminate research. *British Journal of Sports Medicine*, 48(8), 675-676. <http://dx.doi.org/10.1136/bjsports-2013-092780>
- Wake, A., & Bahsen, N. (2016). Redefining radio: Implications for journalism education in an era of digital audio storytelling. *Radio Journal: International Studies in Broadcast & Audio Media*, 14(2), 231-242. https://doi.org/10.1386/rjao.14.2.231_1
- Wallace, C., & Robinson, J. (Hosts). (2020–2021). *Who we are: A chronical of racism in America* [Audio podcast]. Vox Creative. <https://www.vox.com/ad/21354746/who-we-are-podcast-racism-in-america>
- Williamson, C. (2018). AQR's podcast series dissects weighty topics. *Pensions & Investments*, 45(24), 8. <https://search.proquest.com/docview/2139167925/fulltext/274B75AB96D541E5PQ/15?accountidkqa252=14771>
- Winn, R. (2021, April 10). 2021 Podcast stats & facts (New research from Apr 2021). *Podcast Insights*. <https://www.podcastinsights.com/podcast-statistics/>
- Zukerman, W. (Host). (2016–present). *Science Vs* [Audio podcast]. Gimlet Media. <https://gimletmedia.com/shows/science-vs>

The R&D Canvas: A Design Thinking Tool for the Management of R&D Projects

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Abstract: *Research and Development (R&D) projects are inherently ambitious, complex, uncertain, and risky. On the one hand, they increasingly involve diversified groups of people and entities that gather around common goals, with different objectives for each one. On the other hand, science and technology policies promoted and implemented by public entities are gaining momentum, translating into more R&D funding opportunities but also into more competition and accountability for the use of public funds. Research managers and administrators are, therefore, faced with growing challenges when coping with all these aspects and leading teams of scientists, companies, users, and other stakeholders towards successful projects. Traditional project management frameworks have been used and adapted to help the R&D project manager. However, the potential of design thinking principles and practices in this context has yet to achieve its full potential. This is quite surprising bearing in mind that both R&D projects and design thinking share a central characteristic: the key role of creativity and co-creation in assuring successful initiatives. In this paper, the rationale for a new tool for R&D management based on design thinking principles is presented. The relevant literature is reviewed, and the concepts that previous researchers have suggested are analyzed. The interplay between classical project management approaches and the creativity-driven nature of every R&D initiative is rationalized. The findings are used to develop a conceptual framework for a tool which can help research managers and administrators in facilitating the successful development of R&D initiatives. The usefulness of the R&D Canvas to the research management and administration profession is centered on its multi-purpose usability as an effective planning and communication tool that facilitates the incorporation of creativity and co-development practices in the highly heterogeneous contexts characteristic of contemporary R&D endeavors.*

Keywords: *R&D management, project management, design thinking, creativity*

Introduction

Research and Development (R&D) is a major force driving competitive advantages. This is acknowledged by many governments that have increased the level of investment in science and technology by increasingly sponsoring R&D projects. Companies carry out R&D projects, namely collaboratively with relevant stakeholders (e.g. R&D organizations), in order to develop the knowledge needed to bring new products, processes or services to the market. Public R&D tends to be different from private R&D, because the former often has low alienability and is focused on high societal gains.

By definition, R&D projects are subject to unpredictable technological, time, goal, and cost uncertainties (Kuchta & Skowron, 2015), and are characterized by irreversibility in terms of sunk costs and inappropriability (Præst Knudsen et al., 2019). Moreover, they are typically composed by non-linear processes, variable project scope (due to internal and external factors), often long-lasting project life cycles, and high odds of “failure” (Farokhad et al., 2019; Chronéer & Bergquist, 2012). Planning, resource allocation and scheduling is particularly difficult due to the constant need to cope with changes in scope and in scientific approaches (Kuchta et al., 2017; Mikulskiene, 2014). Private and public institutions have different attitudes towards driven targets, motivation, and desirable results for R&D projects (Mikulskiene, 2014). This may lead to difficulties and issues in the context of public-funded initiatives where the separation between research projects and development projects tends to disappear. This is also reflected in the terminology used by public entities. For example, currently, the European Commission area dedicated to R&D is named “research and innovation”. While it is acknowledged that this may lead to greater societal appropriation of R&D results, it clearly adds complexity to managing R&D projects in this context. Thus, ideally, although some managerial differences still exist between R&D management practices in firms and in public institutions, a unified approach would be favorable for all involved parties. In this context, setting up abstract goals, having flexible planning, focusing on constraints and the context is recommended (Farokhad et al., 2019). Although phased-life cycle approaches are needed to clarify the whole process of R&D project management, non-linear management approaches should be defined to provide the chance for more creativity, flexibility in planning, iterative and incremental research stages, and improved control (Farokhad et al., 2019).

The role of research managers and administrators (RMAs) in R&D project management goes beyond administrative and financial functions and includes the provision of management services in areas such as integration management, knowledge management, human resource management, time management, communication management, and stakeholder management, to name a few. Moreover, RMAs contribute to mitigating communication and organizational culture barriers between scientific research, firms, and funding sources (public and private). Therefore, RMAs play an important role not just in the R&D proposal development (pre-award) and in the post-project technology and knowledge transfer but also in-between these two stages, i.e., during the post-award phase. In fact, Schofield (2013), in a study directed to RMAs, identified effective project management as an issue among critical success factors influencing knowledge transfer collaborations between university and industry. It was found that the project management context is particularly regarded by industrial partners, which correlates with previous findings

showing that a high level of bureaucracy and inflexibility of universities is a major barrier to collaboration. Moreover, project management aspects such as flexibility and adaptation, industry early involvement in the process, past experience of partners, and effective communication, were found to be enablers for successful knowledge transfer. Conversely, process complexity, multiple stakeholders with different objectives, geographic distance, complex information flow and logistics, and time pressure, were identified as barriers.

The role of the project management office (PMO) in particular in European research consortia has been addressed by Wedekind and Philbin (2018), from the perspective of research and grant management. The authors argue that the scope change, associated with a shift from traditional academic research projects to research and innovation projects, has created the need for professional project management and has provided a productive environment for PMOs to flourish in academic settings. The specific PMO roles identified for RMAs include supportive, controlling, and directive, although at different levels depending on the grant lifecycle stage.

Formal project management approaches are relatively common in firms. Several frameworks and methodologies have been successfully adapted to R&D projects in the private sector. Conversely, in the public sector the adoption of such practices is well behind. There are several reasons for this, including the fact that for public-funded R&D in public institutions there are no incentives to ending an R&D project before time or under the contracted budget. So, researchers try to achieve the most they can within the given time period and budget. This is not the case in private firms, where strict schedule and resources monitoring and controlling mechanisms are always put in place for the sake of effectiveness. This naturally influences the R&D project management maturity between private and public entities and makes it more difficult to develop and implement unified approaches. To tackle this difficulty, shared traits of R&D projects pursued in private and public organizations have to be used as a mutual language.

Every R&D process is creative by nature. By definition, an R&D project is a path to discover the unknown and solve problems with no apparent solutions. This means there is often no prescribed route, and under these circumstances, scientists with open and creative minds are often in the best position to make breakthroughs (Sternberg, 2006). The method of scientific discovery has evolved naturally over centuries and has been refined by many great scientists and philosophers from Aristotle to Popper (Cook, 2020). It involves observation, questioning, developing hypotheses, experimenting, analysis, and to conclude/communicate. On the other hand, the creative thought process can be described by a number of frameworks, including a popular four-stage process that was first described by Graham Wallas in 1926 (Cook, 2020): preparation, incubation, illumination, and verification. The preparation phase requires sensing of a need, exploration of the problem, reading, discussing, formulating, and analyzing many possible solutions. The critical step is an incubation period, which requires the scientist to let the information gathered in the preparation phase gently ripen and come together in new ways (e.g., questioning), after which can arrive the birth of a new idea or flash of insight (i.e., hypothesis). The final step in this model of the creative process is a short, but usually rapid, period of recording, verifying, and refining the idea (e.g., experimentally). Thus, creativity-related tools and techniques are crucial in R&D project management practices. Nevertheless, its full potential is still far from being tackled. Usually, such

tools and techniques are used only in the “idea generation” or “issue identification” phase that precedes the project itself. An example of a creativity-based tool for R&D project management is the Design Breakdown Structure (DBS) proposed by Diegel (2005), presented as a precursor to the traditional Work Breakdown Structure (WBS), and as allowing the idea generation process to be graphically mapped and monitored.

In face of the above, the authors propose the adoption of a new tool, based on design thinking principles, to aid the R&D project manager to focus its action in key areas while allowing the adoption of project management approaches tailored to each specific thematic area and performing organization. To this end, a literature survey is used to identify key areas that are recognized by researchers and practitioners as critical success factors and that allow to tackle the current fragilities and trends of the public-private R&D performing landscape. Next, design thinking tools are reviewed to identify concepts that could help to tackle these issues and capitalize on the creativity side of the scientific method. Finally, a new tool, the R&D Canvas, is proposed and its practical application illustrated by a case study. It is further explored how the R&D Canvas could strength R&D project management via this and supplementary design thinking-based tools, methods, and concepts such as creativity techniques, personas, and value network mapping.

The work is guided by the following overall research question: “Can design thinking tools and techniques facilitate R&D project management in contemporary research and innovation ecosystems?” To the best of our knowledge, this research question has never been addressed before by the specialized literature.

The paper is structured as follows. In the following section, the research methodology used is described. Next, the literature on project management and major specificities that characterize R&D projects are reviewed. This is followed by an introduction to design thinking, directed to its added value to R&D endeavors. Based on the analysis of the findings, the rationale for the R&D Canvas model and for each of its elements is presented, and its application to a case study is illustrated. The paper ends with the identification of major conclusions and future work.

Methodology

A heuristic framework combining a detailed literature analysis, subject matter experts consulting and use of a case study forms the basis of the research design. Findings from the literature were continuously validated through intensive interaction with practitioners as well as through observations in a case study. A qualitative case-study research approach was used, as according to Patton (2002), it is appropriate for investigating issues that are complex and difficult to quantify, as well as identifying themes, patterns, concepts and insights that are needed to understand such issues. This is used in combination with conceptual modeling and prototyping, which is consistent with design thinking principles. The research was organized into three stages (see Figure 1), accompanied by consulting of subject matter experts, namely project and research managers, and researchers:

Stage 1. Literature research / Theoretical grounding. Literature searches, selection and analysis of major papers related to the abovementioned topics were conducted. Relevant documents were searched in the Scopus database (titles, abstracts, keywords), with no temporal restrictions, and using the syntax ("project management" AND ("R&D project" OR "research and development project")). This resulted in 716 identified papers. The surveyed documents were analyzed to identify key concepts associated with the management of R&D projects. The research was carried out using a dedicated tool, VOSviewer software version 1.6.16, and its "text data mining" feature to develop a bibliometric map, to identify "clusters" of topics and their literature reference networks (Perianes-Rodriguez et al., 2016; van Eck & Waltman, 2010). This was followed by an in-depth analysis of 42 papers, covering the main "clusters", selected taking into account their relationship with the topics in each "cluster" and their connection with the extant relevant literature.

Stage 2. Prototyping of canvases. Prototyping sessions were held, with the participation of project managers, research managers, and researchers, to explore approaches to the conceptual and practical development of R&D canvases.

Stage 3. Application of results to a case study. The resulting R&D Canvas concept was applied to a case study, namely an R&D initiative concerning the valorization of residues from apple production, in the context of the circular bioeconomy concept.

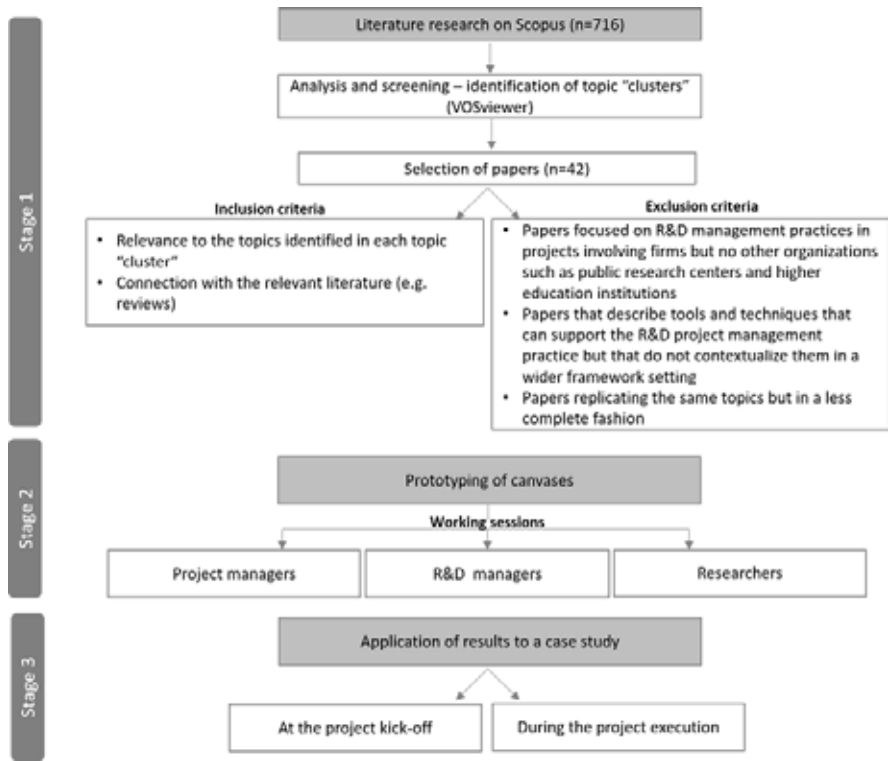


Figure 1. Methodological Procedure

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Management of R&D Projects

Projects are, by definition, unique endeavors, whose results are distinctive, oriented towards solving a problem or developing an opportunity, with specific results expected at points in time by applying certain resources and methodologies. Therefore, each project has its own specific deliverables, stakeholders, resources, and constraints. Although every project is managed, not all use project management principles (see the Heideggerian paradigm for project management [van der Hoorn & Whitty, 2015]).

The most striking feature of R&D projects is the fact that the outcomes might be very different from the initial specification but are still valuable for key stakeholders (namely firms, society, etc.). Although formality of R&D project management practices tends to increase from basic research to applied research and to development projects, managerial practices do in fact influence R&D project success (Vicente-Oliva et al., 2015). A certain level of proper planning and control through scheduling, monitoring and evaluation have been found to be among the necessary elements, which contribute to the success of new products and R&D projects (Magnaye et al., 2014).

Modern project management methodologies emerged in the late 1950s and since then several approaches, frameworks and methodologies have been developed. Generally speaking, these can be divided into three types: 1) waterfall, 2) agile, and 3) anything in between (i.e., hybrids). Waterfall approaches are characterized by well-defined, sequential phases. Agile approaches are iterative by nature. The level of ambiguity and/or risk and the level of customer involvement increases from waterfall to agile.

Hybrid approaches are increasingly common. Scrum-Stage-Gate hybrid (Cooper, 2014; Cooper & Sommer, 2020) combines scrum (agile) and stage-gate (waterfall). In order to increase the chances for such an integration to succeed, scrum should be applied as a “microplanning project management methodology”, while stage-gate maintains its “macroplanning” horizon (Brandl et al., 2018). Consequently, the approach by Cooper and Sommer is divided into three different planning levels: strategical (stage-gate), tactical (integrative model) and operational (scrum). According to the authors, it “generates a healthy tension between fixed planning and iterative problem solving”.

Other combinations of stage-gate and scrum are reported in the literature. For example, Binder et al. (2014) report a combination of agile methodologies with ISO 21500:2012 (a waterfall model based on PMBoK—the Project Management Body of Knowledge by the Project Management Institute). Reported benefits include meeting the financial, legal and procurement standards of large companies through its use of the ISO standard elements, while introducing the agility required to adapt to changing priorities and environments.

Albers et al. (2019) developed a method (agile systems design) that distinguishes between agile, sequential and hybrid development approaches and, depending on the development task, suggests a suitable approach. The differentiation of development tasks is based on the clustering of different

types of product attributes and the associated development paths for their concretization. The work was developed in the context of the early phase of automotive development.

The bibliometric study carried out in stage 1 shows (Figure 2) that key concepts related to research on management of R&D projects can be clustered into three main areas:

Cluster 1: focused on project management methodologies and metrics (e.g., “planning”, “control”, “integration”, “cost”, “performance”), and “knowledge” (at the interface with cluster 2);

Cluster 2: focused on the R&D project itself (e.g., “technology”, “solution”, “program”, “evaluation”, the latter at the interface with clusters 1 and 3, and, thus, overlapped with metrics and risk, respectively), its “context” (e.g., “funding”, “idea”, “science”) and “stakeholders” (e.g., “university”, “government”, “collaboration”, “partner”); and

Cluster 3: focused on “firms” (e.g., “investment”, “innovation”, “market”), “risk” and “uncertainty” (e.g., “decision making”, “project portfolio management”, “benefit”, “failure”).

Thus, it can be observed that:

- 1) Research on the management of R&D projects is closely associated with the participation of firms as a component of their innovation strategies;
- 2) The key management areas most frequently cited are related to: a) the context surrounding the project (taken broadly), b) its stakeholders, c) its inherent uncertainty and risk, d) metrics/indicators, e) knowledge and f) management approaches; and
- 3) These key areas, and related topics, are intricately connected but in the surveyed literature there is clearly a relation between a) participation of firms and uncertainty and risk management, b) its context, stakeholders and technology drive, and c) project management methodologies, metrics and knowledge.

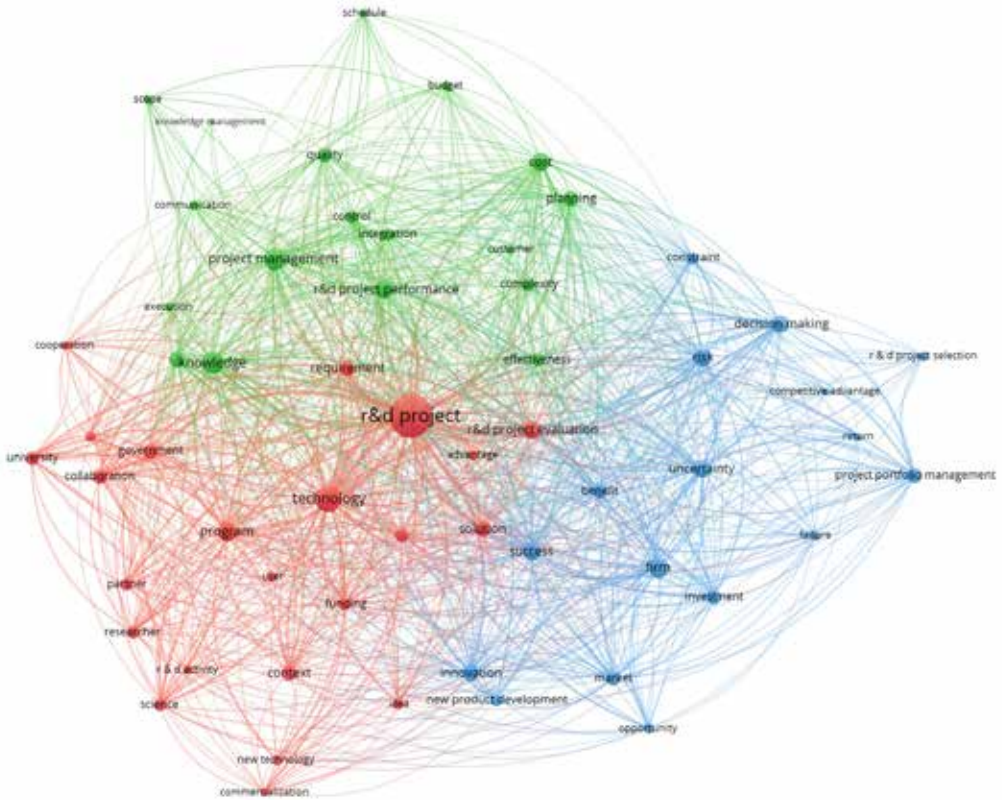


Figure 2. Bibliometric Map of the Surveyed Literature

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In the following sub-sections, we present a review of the abovementioned key areas of R&D project management. Accordingly, the following areas are addressed: 1) the context in which an R&D project is executed, 2) the influence of relevant stakeholders, 3) their risky and uncertain nature, 4) the need for performance metrics, 5) the importance of knowledge management, and 6) project management approaches.

Context

According to the project management contingency theory, management approaches should vary according to project type and contextual factors (Sauter et al., 2009; Shenhar, 2001). Recent advances include a context-specific approach that enables managers to select established project management knowledge according to changing needs along the project life cycle (Lippe & Vom Brocke, 2016). The context of a R&D project refers to the social, economic, political, scientific, technical, and environmental conditions under which it is formulated and executed. Typically, R&D projects tend to focus on scientific-technical and economic aspects, and other key areas such

as political and societal development objectives are not appropriately addressed. In particular, priorities for research set by policy making bodies (often themselves research funders) and host institutions must be taken into account. If the project is not aligned with high-level priorities and strategies, the chances to be successful will be significantly reduced due to insufficient institutional support. Also, who are the key institutional stakeholders? Would they “buy” the project’s main idea? How well-aligned is the project idea with existing programs or project portfolios? Are there any predictable issues regarding, for example, the negative impact of value-chain elements (such as family-owned SMEs) on specific social groups (such as handicapped citizens), or on natural ecosystems (such as protected areas)? If so, the relevant stakeholders (e.g., associations, NGOs) should be involved even before the project idea starts to gain consistency.

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. Not enough is known about the technology available from external sources, thereby limiting the innovative character of the project from the outset. This also has the advantage of avoiding eventual unintended intellectual property infringements.

Stakeholders

Stakeholders are persons, groups, or institutions with interest in the project. They are those who are ultimately affected, either positively or negatively by the project performance. This definition of stakeholder includes both winners and losers as well as those involved or excluded from decision making processes. Thus, R&D project management involves managing multiple stakeholders with conflicting stakes. They can cover a spectrum representing economic, environmental, and societal interests, with the potential for intense conflict between them. This includes researchers along with other categories such as policy makers, extension officers, potential end-users, relevant government and non-governmental organizations. Another important aspect that contributes to the complexity and dynamicity in managing stakeholders is their changing positions, interests, and importance over time. Topical developments in the theory and practice of stakeholder management in R&D projects include the systems approach developed by Elias (2016) to capture the conflicting positioning of multiple stakeholders.

Uncertainty and Risk

R&D projects inherently have a high level of uncertainty, as a result of only a partial knowledge of project end-products and their way of attainment being known (Biscola et al., 2017; Ernø-Kjølhed, 2000; Huljenic et al., 2005; Kuchta et al., 2017). Uncertainty may also arise from the lack of exact knowledge about costs, duration, or quality of planned activities, as a result of the usual heterogeneity in teams, or be created by a lack of clarity among the project stakeholders regarding desired outcomes.

A risk is an event characterized by some probability of occurrence and by the impact it may have on the project. Project managers tend to focus on scientific and technical risks, neglecting other potential sources that are related to context changes (e.g., a need that is no longer present), stakeholder management (e.g., someone that changes from supporting to confronting),

competition risks (e.g., competitors may be the first to develop a better product/process), etc. Risk tolerance from the project's sponsor (e.g., research council, company) may vary widely, and usually is relatively low. In particular, it is difficult for some sponsors to accept that the result of a research project may be negative, but still worthwhile. Proving that something is not feasible may be as valuable as proving that it works (e.g., by saving time on more research efforts). All these factors create additional difficulties in the process of risk identification, as well as planning of risk responses and risk monitoring.

R&D Project Metrics

To evaluate the attractiveness of project proposals, or the success of ongoing or completed projects, appropriate criteria should be determined. In the absence of adequate indicators, project results cannot be measured and compared against pre-specified benchmarks making it difficult to control outcomes. When implementing performance and success evaluation systems, tangible outcomes should be considered, such as patents or publications, but also intangible/subjective aspects such as the potential to generate future new R&D initiatives. Also, the choice of the most appropriate metrics should be based on the type of R&D, whether it is basic research, applied research, or technological development. The creation of a set of metrics to measure the effectiveness of R&D has been a major need for research managers for some time and is a particularly challenging task. The methods used range from simple screening procedures to sophisticated mathematical procedures, and are usually subdivided into the following categories: scoring models, multi-criteria decision-making models, comparative approaches, and economic models (Eilat et al., 2008).

Knowledge Management

Knowledge management is a vital issue, not only from the monitoring and controlling points of view but also from the project closure perspective, i.e., from the organizational maturity and learning points of view. Although there is always tacit knowledge hidden within project groups, knowledge should be adequately stored in documents (virtual, physical) to ensure an appropriate flow of information within and across the project and organization borders. A dynamic synthesis between tacit and explicit knowledge as a strategy of knowledge creation and adoption in each project stage is recommended (Faccin & Balestrin, 2018). On the other hand, creativity plays an essential role in the R&D process because it generates the ideas that will initiate the research activities and that will pave the way to the possible solutions. Ideas emerge at every level of the scientific process and they correspond to various challenges, such as responding to an issue, meeting a target objective, solving a problem, making use of knowledge, or understanding a phenomenon. But it is knowledge that makes it possible to put ideas to work. In addition, knowledge feeds creativity, and ideas stimulate research. Thus, the success of R&D projects relies largely on the effectiveness and efficacy with which knowledge management is implemented. Also, the use of success analysis as a framework can improve knowledge management in projects (Todorović et al., 2015).

Project Management Approaches

Currently, the dispersion and variety of project management approaches and of R&D activities poses difficulties in the selection of a management concept suitable for a particular type of R&D project. Jordan et al. (2005) showed that there are significant differences between types of projects along three dimensions: complexity of the work, size of the work, and the nature of the work. Also, other aspects such as “science vs. technology orientation of the work”, “small vs. large size”, and “specialized vs. complex work teams” influence the management approach. Kuchta and Skowron (2015) attempted to assign a specified management concept to a given R&D project type. The conclusion of their study is that most types of R&D projects, identified using the criterion of the degree of knowledge of their goals and methods of their implementation, should be managed by customized concepts of agile project management, when goals are known, but methods are not, or the other way around.

Design Thinking

Design is a multifaceted activity, which spans a wide variety of dimensions, from creating visual representations to conceiving, prototyping, and deploying a product or a service, to facilitating techniques such as hackathons, design jams and other similar participatory sessions that aim at directly engaging a variety of stakeholders in the design process. Design thinking is the non-linear process of inspiration (exploring opportunities), ideation (ideas creation, formulation, and validation) and implementation (the execution of an idea). It is a human-centered way of approaching innovation in R&D endeavors. It is widely acknowledged as a fundamental tool for product innovation, and it has also been identified as one of the key factors as the basis for success of technology-driven corporations.

Design thinking tools, methods, techniques, and activities such as visualization/materialization techniques can support creative processes as they help the stakeholders involved in the design process in alternating divergent and convergent thinking systematically. Rather than accept the problem as given, designers explore the problem and its context and may re-interpret or restructure the problem to reach a particular framing of the problem that suggests a route to a solution. It is thus a solution-focused thinking, distinct from the typical problem-focused strategies of scientists. It is also characterized by the use of abductive reasoning: designers infer possible solutions from the available problem information, their experience, and the use of non-deductive modes of thinking such as the use of analogies.

Another characteristic of design thinking is the co-evolution of problem and solution. Attention typically oscillates between the understanding of the problematic context and the ideas for a solution in a process of co-evolution of problem and solution. New solution ideas can lead to a deeper or alternative understanding of the problematic context, which in turn triggers more solution ideas.

The use of representations and models, such as prototypes, is closely associated with features of design thinking such as the generation and exploration of tentative solution concepts, the

identification of what needs to be known about the developing concept, and the recognition of emergent features and properties within the representations.

Co-creation, closely associated with design thinking, is a well-established topic in manufacturing research. In the last two decades, there has been a wide range of publications concerning the involvement of customers in the design of end products. Recently, Cui and Wu (2016) focused on the innovation stream and proposed three forms of customer integration for co-creation: 1) customer involvement as an information source, where the designers gather input from them and apply it to develop products that meet customers' needs; 2) customer involvement as co-developers, where customers develop products together with the designers; and 3) customer involvement as innovators, where customers are allowed to design their own products, which are then adopted and offered by the firm. Prototyping is a key instrument for co-creation (Boukhris et al., 2017). It enables the creation of shared mental models between all the participants and clears misunderstandings. It creates emotions through haptic experience which has a positive impact on the group's cohesion. It helps fostering coordination between the participants.

Design thinking methods such as "persona analysis", "value network mapping" and "customer journey" are commonly used in the development of new concepts, e.g., for the development of availability-oriented business models (Kölsch et al., 2017). Personas are "clearly defined, memorable representations of users that remain conspicuous in the minds of those who design and build products". By applying the persona concept, the social role of a person in a specific context is identified. This helps the developer to gain an improved understanding of a person's behavior. With the systematic approach of a "customer journey", it is possible to reflect on the relationship between the customer and the project result. The definition of the persona is only possible after identifying the structure of an ecosystem or rather the extended value network. The "value chain analysis" adds transparency to the roles and the relations between the different stakeholders.

The "journey map" tool is yet another example of a useful design thinking tool. Aguirre et al. (2017) used it to allow stakeholders to synthesize opportunity areas grounded in a more holistic understanding of the situation at hand. It represents both the human perspective and creative dimensions to a medium extent. Basically, it asks participants to look at a very complex situation, over time, from the perspective of the persons most affected by it.

Design thinking can also play an important role in team mobilization. According to Mikulskiene (2014), in order for teams in R&D projects to be mobilized: 1) objectives need to be defined together with the team planning to work on the project, 2) it is better to ask more questions than less and to define the real problem as to what needs to be solved at a particular phase of the project, 3) the team should be inspired to produce their input at every project stage, and 4) the team's input and feedback should be used for producing documents and to motivate people. The use of the above-described design thinking tools and techniques can be useful in this regard.

The uncertainty associated with R&D projects can be defined as a "wicked problem", which means that issues are not always obvious and explicitly known at the beginning of the process. The use of design thinking has been suggested as an appropriate framework for handling these

“wicked” problems (Luotola et al., 2017). Moreover, design thinking principles can be used to connect and combine the contribution of creativity resulting from multiple stakeholders, including companies and university academics in a process in which knowledge is openly shared and transferred across each institutional boundary (Secundo et al., 2019). By stimulating the creativity of managers, scientists, engineers and designers, organizations become more flexible, agile, intuitive, imaginative, and resilient and can face the increasing complexity and turbulence of competitive environments. Moreover, creativity, that is closely related to the scientific method, emphasizes the role of interactions between stakeholders and the combination of knowledge, ideas, and information. The final result is the process of generating and applying such creative ideas in specific contexts, such as R&D activities, thereby creating meaningful and sustainable value for the project stakeholders.

In short, design thinking can be effectively deployed as an instrument to facilitate creativity, to tackle uncertainty, and to translate and process information along all the phases of the R&D project life cycle

A New Tool: The R&D Canvas

Outline

Canvases are graphical tools analogous to commonly used design thinking tools such as “personas” and “journeys”. The most well-known canvas tool is the “business model canvas” (BMC), which is basically a representation of how an organization creates, delivers, and captures value from a product or service. The applicability and simplicity of the BMC has given it greater acceptance and dissemination. In the context of new product development (NPD), the business model canvas has been combined with the concept of the “technology roadmap” to provide a process integration perspective for idea or product concepts that are aligned to the current and future business needs of companies (Toro-Jarrín et al., 2016). Other uses of the canvas concept include the “creativity canvas”, as a knowledge and idea management model (Hausman, 2015).

Based on the canvas as a design tool, a tool specific to R&D processes is herein proposed: the “R&D Canvas”. Basically, it is a structured, hierarchical, graphically documented management tool used by the entire project team to work through the fundamental issues that must be overcome to reach the expected goals. The R&D Canvas acts a roadmap for the project and raises a shared awareness of both the issues that each team member faces, and the interconnectedness of all the issues. It forces the team to work as a coordinated, well-knit unit rather than as a team of isolated individuals. This roadmap is essential to allow the project manager to effectively manage the project. Because the R&D Canvas (Figure 3) acts as a central communication point between all project members, it helps to overcome cross-functional communication issues and allows the knowledge to flow between vastly different areas of expertise. Based on its contents and structure, when talking about the project management process, all team members are talking the same language. By using it, managers can identify areas where the available project information is sufficient and—more importantly—areas that require additional information and action.

For the R&D Canvas to be effective it must be used as a live communication tool, and much like any other project management tool, must be kept up to date and grow with the project. As it must be well documented to be truly effective, the documentation (particularly if computerized) acts as a knowledge database for future projects. When used with supplementary tools, methods, and concepts such as creativity techniques, personas, value network mapping, and in the context of collaborative project teams, the R&D Canvas gives the team the common understanding of the project that they need to achieve outcomes valuable to the key stakeholders. As illustrated below, it can be integrated with any existing project management framework or methodology.

Core to the R&D Canvas are its building blocks, which serve as a basis to describe the main areas of the developed model. Each “block” (“box”) contains recommendations, which guide the users and act as inspiration for completing the information base. A typical question during its usage could be: “In what way does the project fit the current stakeholder needs?”. The definition of each “box” (Figure 3) was based on the key areas for management of R&D projects identified above. In particular, the following areas and respective topics were considered:

- 1) Where it all starts: the “case”;
- 2) The evolution: context, stakeholders, knowledge, risk and key indicators; and
- 3) The conveyance of results: milestones and deliverables.

It is the graphical and structural nature of the R&D Canvas that makes it a powerful tool, as one can almost instantly see the relationships and hierarchy between the various elements that constitute the canvas. In Figure 3 a graphical representation of the interconnectivity among the key elements of the R&D management model is presented. In the next sub-sections, the rationale of each element (“box”) of the R&D Canvas is presented, and its usage instructions are described. It should be stressed that the “context”, “risk”, “stakeholders”, “knowledge” and “key indicators” boxes are dynamic, and their content must be updated, at least, at each milestone review point.

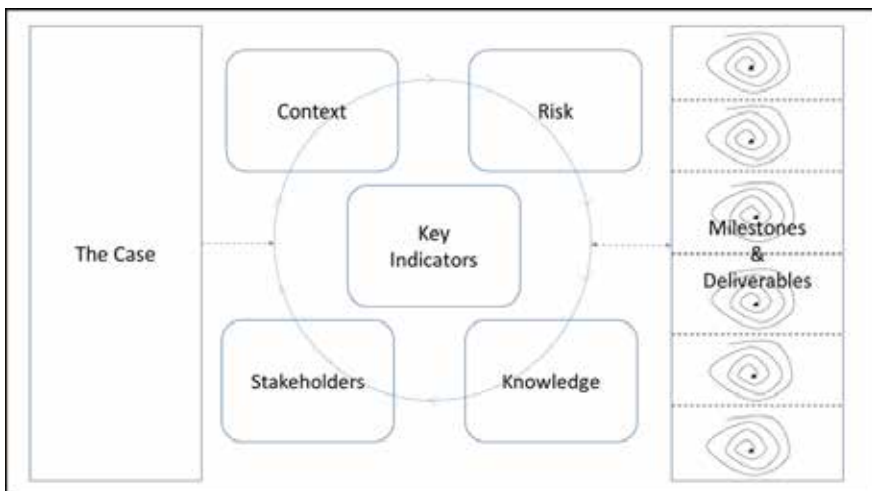


Figure 3. The R&D Canvas Concept

[Click here for larger image](#)

The Case

The “case” is a summary of the R&D project that should not change from the project idea generation phase until the post-project review. Thus, the following items should be developed with an adequate level of detail. The problems/opportunities and initial requirements must be identified, along with an outline of applicable solutions. This facilitates the definition of a coordinated set of decisions during the project planning, execution and controlling stages. Also, it is fundamental to define, in a clear way, the goals and objectives to be achieved. These should be solution-focused and not problem-focused. The project scope must be kept to the minimum level required to produce the deliverables and satisfy the stakeholders. The progressive refining of the project scope will be done during the planning of the activities needed to achieve each deliverable. The “case” should always be negotiated with key stakeholders. This part of the R&D Canvas is consistent with the Agile Principle on simplicity (the art of maximizing the amount of work not done is essential) and with common documents such as the Project Initiation Document and the Project Charter, in the PRINCE2 and PMBOK project management frameworks, respectively.

Example questions to be addressed include the following:

“What is the issue or opportunity that the project seeks to address?”

“To whom is it important and why?”

“Have you got any idea about how to tackle it?”

“So, what do you aim to achieve with this project?”

“Have the top stakeholders embraced the project idea?”

The Context

The context “box” must include dynamic user, scientific, technological, institutional and market requirements. The institutional context must include not only the alignment with the leading organization roadmap and policies, but also those of each entity when a consortium is set up to develop the project. Also, the high-level scope can provide an initial estimation of activities and resources. From this, a high-level estimation of budget and timeline can be obtained (consistent with the ISO 21500:2012 project management standard). These will contextualize the project from the resources point of view. From the scientific and technological points of view, the dynamic state of the art must be updated regularly. Social, economic, political, and environmental aspects must also be documented, as relevant.

Example questions to be addressed:

“How aligned is the project with governmental and institutional policies and priorities?”

“What do prospective end users of the project results think about it?”

“Are there any societal, political, competition-related or similar issues to be considered for the smooth running of the project?”

“What are the latest scientific and technological advances relevant to the project?”

“What are the key resources, without which the project would not be viable?”

“Are there any predetermined budget and timeline constraints?”

Stakeholders

The successful collaboration of different stakeholders to contribute to the development of novel ideas, concepts, and technologies involves information exchange and transfer. This requires the integration of diverse perspectives, experiences, competencies, and mindsets. In this “box” of the R&D Canvas, key stakeholders must be identified, and adequate management approaches must be defined. These must be reviewed regularly as stakeholders’ positioning and influence change through time, thus management approaches require a balanced combination of technical, interpersonal, social and communication skills, and emotional intelligence.

This is also key to agile project management approaches where it is advocated that projects must be built around motivated individuals and with the agile principles relating to daily stakeholder cooperation and to team development (at regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behavior accordingly).

According to Secundo et al. (2019), design artefacts can in fact ease the communication among stakeholders in collaborative R&D processes that often have different needs and interests, and speak different (technical) languages. Thus, the use of further design tools for stakeholder management, such as the “persona canvas”, “stakeholder map” and “stakeholder canvas” is recommended. Also, design artefacts such as sketches, various visualizations (e.g., 3D renders, data visualizations, motion graphics animations and videos) and prototypes at various degrees of refinement can be used to enhance communication among various stakeholders in R&D projects.

Example questions to be addressed include the following:

“Who may influence or be influenced, positively or negatively, by the project?”

“How will their pains and gains be considered by the project?”

“Has their positioning towards the project changed since the last review?”

Knowledge

The effective acquisition and transfer of knowledge is critical to support co-creation in R&D projects, and to allow value creation from the combination of existing knowledge. This includes interactions of personnel (communication), reports, lessons learned, publications, patents, and other knowledge assets. Simplicity is nevertheless essential for communication to be understood by all parties and to avoid information overload. Thus, “flexible” information collection strategies must be formatted. When knowledge is transferred across very diverse contexts (e.g., from academia to industry), knowledge needs to be translated to still be interesting and relevant (Secundo et al., 2019). Thus, design artefacts such as prototypes and visual representations, can be useful. In this “box”, the knowledge transfer principles must be outlined. This can include

practices related to project meetings, information repositories, reporting, and lessons-learned collection. Mentoring and post-project reviews are recommended.

Example questions to be addressed include the following:

“Are there any information repositories being used?”

“Which team communication practices are to be used?”

“When and how are face-to-face meetings taking place?”

“Are there any templates or tools for document generation such as reports?”

“How is mentoring put into practice?”

Risks

High-level risks should be identified in the initial phases of the project and updated during the planning, execution, monitoring and controlling of each major stage (that ends with the attainment of a milestone). The categories of risks should be as varied as possible, e.g., scientific, technical, cost, schedule, resource, stakeholder, context and quality-related, commercial, etc. Also, the key assumptions should be documented and monitored regularly. Although robust project risk management (e.g., based on fuzzy inference, or using Monte-Carlo simulations) are recommended, simple tools such as a dynamic database including risk identification, qualification, quantification, and response definition, aided by a visual representation of probabilities and impacts severity, such as the probability and impact matrix recommended in the PMBOK framework, can be useful approaches.

Example questions to be addressed include the following:

“What are the main assumptions being made with regard to the various project dimensions?”

“What are the most relevant threats and opportunities for the project?”

“Has the level of probability or impact of each risk changed since the last review?”

“What are you going to do about the most relevant risks?”

Key Indicators

Key indicators are used for high-level monitoring of the project progress and success. They must be defined based on the “multiple value creation” principle, that is, value creation for the involved entities, for the project key stakeholders and for society as whole. From the progress evaluation point of view, the focus should be on the application of process metrics and lessons learned in order to quickly identify the problem areas and be able to respond promptly. Progress measurement must be linked to the activities and so each milestone represents an important point in time when key indicators are evaluated. In particular, according to the waterfall project management principles, the control of the scope should be flexible to allow for changing requirements that

are supported by an impact analysis and accepted by the key stakeholders. Furthermore, and according to the agile principles, at regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behavior accordingly. This calls for the adoption of adaptable indicator evaluation systems, tailored to each project, whether it be scoring models, multi-criteria decision-making models, or comparative approaches. Nevertheless, due to their “simplicity” and usefulness, namely in what concerns communicating the results to the key stakeholders, the use of “balanced scorecards” in R&D project monitoring and evaluation should be considered (see, e.g., Eilat et al., 2008).

Example questions to be addressed include the following:

“How will you measure the added value of the project for the key stakeholders?”

“And for society in general?”

“What are the baseline values for performance and results assessment?”

“What are expected target values for the key indicators?”

“How is the project performing, in relation to the baseline and to competing initiatives?”

Milestones and Deliverables

Milestones are significant events in the development of the R&D project, similar to the gates in the stage-gate model of Cooper et al. (2020). They should provide the basis for project planning (Magnaye et al., 2014). In the R&D model proposed herein, milestones define key dates at which a major revision of the project takes place. In particular, the key indicators agreed at the project onset are reviewed. Achievements and changes are controlled (in line with waterfall approaches) and adapted to the benefit of the project stakeholders (in line with agile principles). In between milestones, project development stages occur. Each has its own life cycle, including initiating, planning, executing, monitoring, controlling, and closing of project activities. The actual approaches to be used in each stage will depend on the nature and requirements of each specific project and stage. For example, a combination of waterfall and agile methodologies may be the best approach for a 3-year project with relatively low uncertainty, whereas the Scrum approach may be more adequate to a 6-month project with high uncertainty. However, a distinctive characteristic of each of these stages is that they are iterative in nature, i.e., they are spirals. This means that the abovementioned life cycle (which is basically an extended Deming Cycle) is repeated within each stage as needed to achieve a specific milestone.

The milestones must have a pre-determined schedule, to allow for periodic project assessment. Also, internal and external dependencies of each Milestone must be identified, as well as the (progressively elaborated) key activities (WBS creation) and corresponding expected outputs (deliverables). A detailed scope can be prepared for each iteration, with a corresponding analysis of the impact of changes to the high-level scope and to other project elements such as time, costs, and quality. This is in line with the agile principle that states that the highest priority should be to satisfy the customer through early and continuous delivery of valuable outputs (e.g., software, in the original Agile Manifesto). The progressive elaboration will allow for an accurate schedule

and budget definition of each deliverable, to be assessed at each milestone review before the corresponding stage starts and once it finishes.

Example questions to be addressed include the following:

“Which are the milestones of the project?”

“Do they have any internal or external dependencies?”

“Are there any deliverables associated with each milestone?”

“Can you detail the work needed to achieve those deliverables?”

“Can you detail the resources needed to achieve those deliverables?”

“What are the budget and timeline associated with each deliverable?”

Case Study

The R&D Canvas tool was applied to a case study, based on an actual R&D initiative dealing with valorization of residues from apple production, in the context of the circular bioeconomy concept. Its rationale is described in detail in the next sub-section. In the next paragraphs the development of each R&D Canvas “box” is illustrated and, therefore, non-exhaustive. The usefulness of this new tool is demonstrated at two key points: at the project kick-off and during the project execution. Its usefulness at the project end is also addressed.

R&D Canvas for the Project Kick-off

At this point in time, the R&D Canvas is developed as a team effort involving the key stakeholders and led by the project manager. The use of design thinking tools (e.g., personas for stakeholder analysis), due to their co-creation basis, also facilitates team building. The team takes full ownership of the project and the project manager induces a participatory project development framework. The R&D Canvas will be available to all team members, ideally in a physical media (e.g., an A0 size paper sheet fixed on a wall). At the project kick-off, and probably during the first weeks, it is useful to include in each “box” a reference to the basic tools that will be implemented (illustrated below). Once the project is running smoothly, these can be omitted so as to not overload the canvas.

This first R&D Canvas rationale can also be used to develop a project proposal to be submitted for funding (internally or externally). The canvas contents include the major items typically requested by funding bodies. This will naturally depend on if the funding decision is internal to the lead institution or, for example, to supranational R&D funding organizations such as the European Commission. But the described benefits of its usage are also clear in this context.

For each “box” (Figure 4), the abovementioned example questions are used below to develop illustrative content. The actual “box” development must be carried out in a co-creation environment.

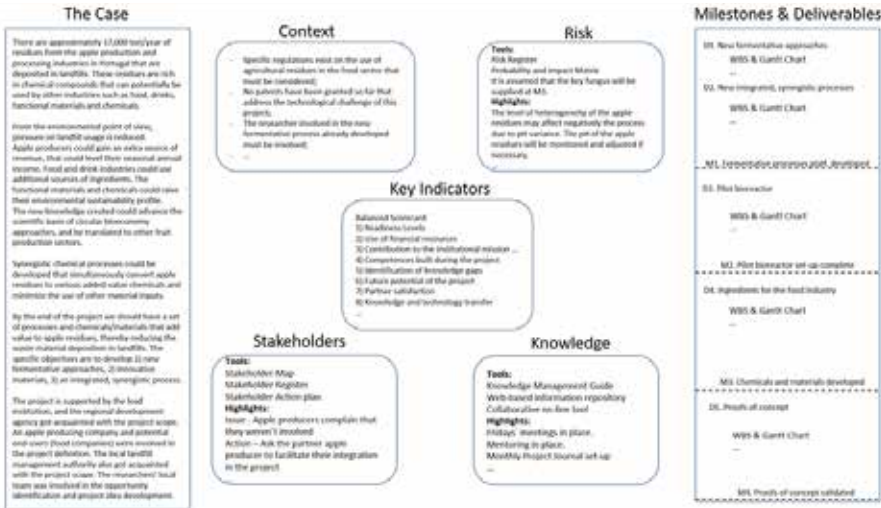


Figure 4. The R&D Canvas for the Circular Bioeconomy Case: At the Project Kick-Off

[Click here for larger image](#)

The Case

“What is the issue or opportunity that the project seeks?”

There are approximately 17,000 ton/year of residues from the apple production and processing industries in Portugal that are deposited in landfills. These residues are rich in chemical compounds that can potentially be used by other industries such as food, drinks, functional materials, and chemicals.

“To whom is it important and why?”

From the environmental point of view, pressure on landfill usage is reduced. Apple producers could gain an extra source of revenue that could level their seasonal annual income. Food and drink industries could use additional sources of ingredients. The functional materials and chemicals could raise their environmental sustainability profile. The new knowledge created could advance the scientific basis of circular bioeconomy approaches and be translated to other fruit production sectors.

“Have you got any idea about how to tackle it?”

Synergistic fermentative processes could be developed that convert apple residues to various added-value chemicals and materials and minimize the use of other material inputs.

“So, what do you aim to achieve with this project?”

By the end of the project, we should have a set of processes and chemicals/materials that add value to apple residues, thereby reducing the waste material deposition in landfills. The specific objectives are to develop: 1) new fermentative approaches, 2) innovative materials, and 3) an integrated, synergistic process.

“Have the top stakeholders embraced the project idea?”

The project is supported by the lead institution, and the regional development agency became acquainted with the project scope. An apple-producing company and potential end users (food companies) were involved in the project definition. The local landfill management authority also became acquainted with the project scope. The research team was involved in the opportunity identification and project idea development.

The Context

“How aligned is the project with governmental and institutional policies and priorities?”

The project is fully aligned with state science policies regarding circular bioeconomy. In particular, it contributes to several goals defined in the national agenda in this topic, namely the reduction of landfill occupation and the creation of new added-value chains in the food sector.

“What do prospective end-users of the project results think about it?”

Several food companies were approached and found the project results, namely new ingredients, valuable to their industrial processes, if several key specifications are met. This initial requirement list has been documented.

“Are there any societal, political, competition-related or similar issues to be considered for the smooth running of the project?”

Specific regulations exist on the use of agricultural residues in the food sector that must be considered. Fruit concentrate companies and cider producers may develop alternative uses for this residue before the project ends. The regional apple production is expected to decrease due to climate change.

“What are the latest scientific and technological advances relevant to the project?”

New fermentative process principles have been developed that may be useful. No patents have been granted so far that address the technological challenge of this project. Relevant processing equipment has been recently made available.

“What are the key resources, without which the project would not be viable?”

The project requires the existence of specific fungus material, currently not available. Also, the researcher involved in the new fermentative process must be involved.

“Are there any predetermined budget and timeline constraints?”

The budget should not exceed 150,000 euros as this is the budget limit for the typical call for proposals by the national science agency that could support the project. For the same reason, bearing in mind the competitiveness of the food ingredients market, the project timeframe should not be greater than two years. A preliminary estimate, based on previous data related to “analogous” activities allows one to predict a total budget of 125,000 euros and a development time of two years. The latter estimate has a high degree of uncertainty.

Stakeholders

“Who may influence or be influenced, positively or negatively, by the project?”

A stakeholder map has been developed that resulted in the project stakeholder register.

“How will their pains and gains be considered by the project?”

A Stakeholder Action Plan has been developed. It details the issues and corresponding actions to be performed. Highlights: Issue - Apple producers complain that they were not involved; Action - Ask the partner apple producer to facilitate the integration of other companies in the project.

“Has their positioning towards the project changed since the last review?”

The Stakeholder Register details the dynamics of stakeholder towards the projects. Highlight: cider producers now see the project as an opportunity to their businesses.

Knowledge

“Are there any information repositories being used?”

All the bibliographic sources and data arising from the project is stored at the web-based information repository, in accordance with the Project Knowledge Management Guide.

“What are the team communication practices to be used?”

Collaborative online tools are used in day-to-day communications. However, face-to-face meetings are preferable.

“When and how are face-to-face meetings taking place?”

Face-to-face meetings occur ad-hoc, outside the R&D center facilities, and gathering the key stakeholders relevant to the topics to be discussed.

“Are there any templates or tools for documents generation such as reports?”

The online reporting system must be used, following the procedure set in the Knowledge Management Guide.

“How is mentoring put into practice?”

Each junior team member is allocated a more experienced colleague as a mentor in the context of the project.

Risks

“What are the main assumptions being made with regard to the various project dimensions?”

It is assumed that the project will not last longer than two years. Also, it is assumed that the needed fungus will be supplied during the first three months of the project execution.

“What are the most relevant threats and opportunities for the project?”

The threats and opportunities have been recorded using the Risk Register. Highlights: the level of heterogeneity of the apple residues may negatively affect the process due to pH variance; the fermentative process may be tolerant to cellulose contents and, thus, be used with other fruits.

“Has the level of probability or impact of each risk changed since the last review?”

The Probability and Impact Matrix is updated weekly.

“What are you going to do about the most relevant risks?”

The risks action plan is documented in the Risk Register. Highlights: the pH of the apple residues will be monitored and adjusted if necessary.

Key Indicators

“How will you measure the added value of the project for the key stakeholders?”

A balanced scorecard has been developed, considering the interests of each key stakeholder. The following areas have been identified: 1) Readiness Levels (technology, innovation, societal and impact); 2) use of financial resources; 3) contribution to the institutional mission, objectives, and strategic vision; 4) competences built during the project; 5) identification of knowledge gaps; 6) future potential of the project; 7) partner satisfaction; and 8) knowledge and technology transfer.

“And for society in general?”

Using the Societal Readiness Level concept.

“What are the baseline values for performance and results assessment?”

Included in the developed balanced scorecard.

“What are expected target values for the key indicators?”

Included in the developed balanced scorecard.

Milestones and Deliverables

“Which are the milestones of the project?”

M1. Fermentative processes platform developed (month 6)

M2. Pilot bioreactor set-up complete (month 12)

M3. Chemicals and materials developed (month 18)

M4. Proofs-of-concept validated (month 24)

“Do they have any internal or external dependencies?”

M4 depends on M3. M2 depends on performance of supplier.

“Are there any deliverables associated with each milestone?”

For M1: D1. New fermentative approaches; D2. New integrated, synergistic processes

For M2: D3. Pilot bioreactor

For M3: D4. Ingredients for the food industry

For M4: D5. Proofs-of-concept

“Can you detail the work needed to achieve those deliverables?”

A high-level WBS has been developed for each deliverable.

“Can you detail the resources needed to achieve those deliverables?”

A preliminary Resource Breakdown Structure has been developed for each deliverable.

“What are the budget and timeline associated with each deliverable?”

A Gantt Chart was developed. The estimated budget for each deliverable has been documented and is as follows: D1 – 50,000 euros; D2 – 5,000 euros; D3 – 50,000 euros; D4 – 10,000 euros; and D5 – 5,000 euros.

R&D Canvas During the Project Execution

Once the project is running, the R&D Canvas (Figure 5) is updated accordingly and used 1) to keep the team aligned, 2) to provide a snapshot of the project status, and 3) as a high-level planning tool. The “box” describing “the case” is the only one that does not change. Its aim is to keep the team focused on the origin and reason of being of the project. Mention to project tools is removed as the team ought to be fully acquainted with these by now. It can be useful to use a “traffic light” or similar system to visually identify points needing attention. The work to be developed to achieve each deliverable is outlined by the corresponding team. For budget and schedule monitoring and controlling purposes, the high-level information is presented in a WBS and a Gantt Chart. But the actual management methodology to be used by each team may differ from one deliverable to another. For example, a deliverable consisting of a firmware component may be developed using Scrum principles, and a deliverable relating to a complex hardware component may use a hybrid agile-waterfall methodology. Naturally, this approach has to be adapted to each project uncertainty and complexity. Nevertheless, the R&D Canvas provides a management model that can fit whatever project management methodology(ies) is(are) considered adequate by the project team.

An example, non-exhaustive R&D Canvas is presented in Figure 5 for the case study. It reflects the following issues: 1) the pH of the apple residues does not vary significantly; 2) apple producers are not actively involved in the project; 3) the weekly project status meetings were changed to Wednesdays following a suggestion by the team; 4) the Project Journal (a one-page summary focused on the balanced scorecard in use) is now issued weekly; and 5) experiments at the lab are going well (milestone M1 was already achieved and the project reviewed by then), but the key fungus material was not delivered at month 3 as promised by the supplier.

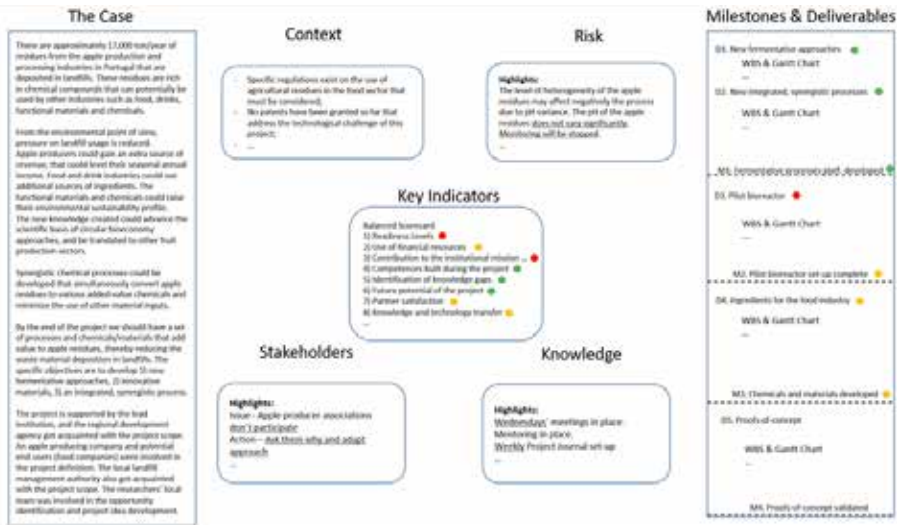


Figure 5. The R&D Canvas for the Circular Bioeconomy Case Study: During the Project Execution

[Click here for larger image](#)

R&D Canvas at the Project Closing

Once the project has ended, the dynamic R&D Canvas is used as a lessons-learned tool. The analysis of the project evolution, as documented in the canvas, facilitates the collection of practices, knowledge and results that could benefit future projects. Thus, this information should be gathered using the R&D Canvas boxes relating to context, risk, stakeholders, and knowledge. This document should be considered during the use of the R&D Canvas for the development of new initiatives.

Implications for Research Administrators

RMAs develop a varied portfolio of roles, including project proposal development, knowledge and technology transfer (Schofield, 2013) and, increasingly, tasks and responsibilities framed in project management offices (Wedekind & Philbin, 2018). In this context, the R&D Canvas

is proposed as a valuable multi-purpose tool to be used by RMAs: a) when intervening in the project/proposal delineation phase, due to its creativity-driven and co-creation nature; b) in the project kick-off as a team building tool; c) during project execution, as it facilitates the controlling and directive roles increasingly played by RMAs in the context of PMOs; d) for knowledge and technology transfer processes that can benefit from its structured knowledge collection feature, and e) during project closing, as a lessons-learned tool that contributes to continuous organizational improvement and maturity. In a nutshell, the R&D Canvas is suggested as a versatile tool that RMAs can use to improve their job efficacy and effectiveness.

Conclusions

Research and development activities are of paramount importance as driving forces bringing about societal advantages in the broadest sense possible. This is reflected in the increasing volume of public funds being allocated to multi-stakeholder initiatives, often focused on mission-oriented programs. R&D projects are characterized by non-linear processes and subjected to unpredictable technological, outcomes, schedule, and budget uncertainties. Several frameworks and methodologies have been adapted to R&D projects, with a certain degree of success. However, it is widely recognized that these hardly incorporate the intrinsic creativity and co-creation nature of contemporary R&D projects. In this context, the usefulness of design thinking tools and techniques was reviewed.

Based on a systematic literature review it was found that major R&D project development areas identified as key by the scientific literature and by practitioners are: the “case” support, the context description, the risk, stakeholders and knowledge management, the use of key indicators, and the use of adequately formulated and managed deliverables and milestones.

Following these findings, a new approach to the design and management of R&D endeavors, based on design thinking principles is proposed. A “canvas” concept was developed to account efficiently for the mentioned dimensions. Major advantages of the R&D Canvas include its graphic nature, its usefulness during all the phases of project management, and its usability in combination with formal project management approaches. As a visualization technique, based on solution-focused thinking, it facilitates stakeholders involved in the project design and management process in alternating divergent and convergent thinking systematically. This is particularly important in R&D projects due to the key influence that uncertainty and creativity play in this specific type of project. Also, the R&D Canvas acts as a knowledge database for future initiatives. Its usefulness is demonstrated at the project definition, kick-off, running and post-end evaluation and follow-up.

Research management and administration would benefit from the use of new tool from varied perspectives, ranging from the project proposal definition and grant application to the project execution and post-project knowledge transfer processes. It can be used as an effective planning and communication tool, that helps to incorporate creativity and co-development practices in the highly heterogeneous settings that characterize contemporary R&D endeavors.

Further field studies may now apply the R&D Canvas model in practice, alongside—or replacing—more “conventional” tools, and assess its effectiveness and the gaps to be addressed.

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References

- Aguirre, M., Agudelo, N., & Romm, J. (2017). Design facilitation as emerging practice: Analyzing how designers support multi-stakeholder co-creation. *She Ji: The Journal of Design, Economics, and Innovation*, 3(3), 198–209. <https://doi.org/10.1016/j.sheji.2017.11.003>
- Albers, A., Hirschter, T., Fahl, J., Reinemann, J., Spadinger, M., Hünemeyer, S., & Heimicke, J. (2019). Identification of indicators for the selection of agile, sequential and hybrid approaches in product development. *Procedia CIRP*, 84, 838–847. <https://doi.org/10.1016/j.procir.2019.04.229>
- Binder, J., Aillaud, L. I., & Schilli, L. (2014). The Project Management Cocktail Model: An approach for balancing Agile and ISO 21500. *Procedia - Social and Behavioral Sciences*, 119, 182–191. <https://doi.org/10.1016/j.sbspro.2014.03.022>
- Biscola, P., Bungenstab, D., Alves, G., Paula, N., & Freire, J. (2017). Assessment of project portfolio management on public research institutions: A case applied to agricultural research in Brazil. *Iberoamerican Journal of Project Management*, 8(2), 49–74.
- Boukhris, A., Fritzsche, A., & Möslin, K. (2017). Co-creation in the early stage of product-service system development. *Procedia CIRP*, 63, 27–32. <https://doi.org/10.1016/j.procir.2017.03.316>
- Brandl, F. J., Kagerer, M., & Reinhart, G. (2018). A hybrid innovation management framework for manufacturing - Enablers for more agility in plants. *Procedia CIRP*, 72, 1154–1159. <https://doi.org/10.1016/j.procir.2018.04.022>
- Chronéer, D., & Bergquist, B. (2012). Managerial complexity in process industrial R & D projects: A Swedish study. *Project Management Journal*, 43(2), 21–36. <https://doi.org/10.1002/pmj.21257>
- Cook, A. B. (2020). Scientific creativity through the lens of art. *Matter*, 2(5), 1072–1074. <https://doi.org/10.1016/j.matt.2020.03.021>
- Cooper, R. G. (2014). What's next? After stage-gate. *Research Technology Management*, 57(1), 20–31. <https://doi.org/10.5437/08956308X5606963>
- Cooper, R. G., & Sommer, A. F. (2020). New-product portfolio management with Agile: Challenges and solutions for manufacturers using Agile development methods. *Research Technology Management*, 63(1), 29–38. <https://doi.org/10.1080/08956308.2020.1686291>

- Cui, A. S., & Wu, F. (2016). Utilizing customer knowledge in innovation: Antecedents and impact of customer involvement on new product performance. *Journal of the Academy of Marketing Science*, 44(4), 516–538. <https://doi.org/10.1007/s11747-015-0433-x>
- De Reyck, B., & Leus, R. (2008). R&D project scheduling when activities may fail. *IIE Transactions (Institute of Industrial Engineers)*, 40(4), 367–384. <https://doi.org/10.1080/07408170701413944>
- Diegel, O. (2005). Breaking down innovation : New tools for project managing innovative projects. *The Public Sector Innovation Journal*, 10(3), 1–14.
- Eilat, H., Golany, B., & Shrub, A. (2008). R&D project evaluation: An integrated DEA and balanced scorecard approach. *Omega*, 36(5), 895–912. <https://doi.org/10.1016/j.omega.2006.05.002>
- Elias, A. A. (2016). Analysing the stakes of stakeholders in research and development project management: A systems approach. *R&D Management*, 46(4), 749–760. <https://doi.org/10.1111/radm.12122>
- Ernø-Kjølhed, E. (2000). *Project management theory and the management of research projects*. Copenhagen Business School.
- Faccin, K., & Balestrin, A. (2018). The dynamics of collaborative practices for knowledge creation in joint R&D projects. *Journal of Engineering and Technology Management - JET-M*, 48(April-June 2018), 28–43. <https://doi.org/10.1016/j.jengtecman.2018.04.001>
- Farokhad, M. R., Otegi-Olaso, J. R., Pinilla, L. S., Gandarias, N. T., & de Lacalle, L. N. L. (2019). Assessing the success of R&D projects and innovation projects through project management life cycle. *2019 10th IEEE International Conference on Intelligent Data Acquisition and Advanced Computing Systems: Technology and Applications (IDAACS)*, 1104–1110. <https://doi.org/10.1109/IDAACS.2019.8924298>
- Hausman, C. R. (2015). The Creativity Canvas: A business model for knowledge and idea management. *Technology Innovation Management Review*, 5(7), 50–59. <http://dx.doi.org/10.22215/timreview/914>
- Huljenic, D., Desic, S., & Matijasevic, M. (2005). Project management in research projects. *Proceedings of the 8th International Conference on Telecommunications (ConTEL)*, 2005, 663–669. <https://doi.org/10.1109/CONTEL.2005.185981>
- Jordan, G. B., Hage, J., Mote, J., & Hepler, B. (2005). Investigating differences among research projects and implications for managers. *R&D Management*, 35(5), 501–511. <https://doi.org/10.1111/j.1467-9310.2005.00407.x>

- Kölsch, P., Herder, C. F., Zimmermann, V., & Aurich, J. C. (2017). a novel concept for the development of availability-oriented business models. *Procedia CIRP*, 64, 340–344. <https://doi.org/10.1016/j.procir.2017.03.063>
- Kuchta, D., Gładysz, B., Skowron, D., & Betta, J. (2017). R&D projects in the science sector. *R&D Management*, 47(1), 88–110. <https://doi.org/10.1111/radm.12158>
- Kuchta, D., & Skowron, D. (2015). Classification of R&D projects and selection of R&D project management concept. *R&D Management*, 46(5), 831–841. <https://doi.org/10.1111/radm.12112>
- Lippe, S., & Vom Brocke, J. (2016). Situational project management for collaborative research projects. *Project Management Journal*, 47(1), 76–96. <https://doi.org/10.1002/pmj.21561>
- Luotola, H., Hellström, M., Gustafsson, M., & Perminova-Harikoski, O. (2017). Embracing uncertainty in value-based selling by means of design thinking. *Industrial Marketing Management*, 65(August 2017), 59–75. <https://doi.org/10.1016/j.indmarman.2017.05.004>
- Magnaye, R., Sauser, B., Patanakul, P., Nowicki, D., & Randall, W. (2014). Earned readiness management for scheduling, monitoring and evaluating the development of complex product systems. *International Journal of Project Management*, 32(7), 1246–1259. <https://doi.org/10.1016/j.ijproman.2014.01.009>
- Mikulskiene, B. (2014). Research and development. In *Research and development project management study book*. Mykolas Romeris University.
- Patton, M. Q. (2002). *Qualitative research & evaluation methods*. SAGE Publications.
- Perianes-Rodriguez, A., Waltman, L., & van Eck, N. J. (2016). Constructing bibliometric networks: A comparison between full and fractional counting. *Journal of Informetrics*, 10(4), 1178–1195. <https://doi.org/10.1016/j.joi.2016.10.006>
- Præst Knudsen, M., Tranekjer, T. L., & Bulathsinhala, N. (2019). Advancing large-scale R&D projects towards grand challenges through involvement of organizational knowledge integrators. *Industry and Innovation*, 26(1), 1–30. <https://doi.org/10.1080/13662716.2017.1409103>
- Sauser, B. J., Reilly, R. R., & Shenhar, A. J. (2009). Why projects fail? How contingency theory can provide new insights - A comparative analysis of NASA's Mars Climate Orbiter loss. *International Journal of Project Management*, 27(7), 665–679. <https://doi.org/10.1016/j.ijproman.2009.01.004>

- Schofield, T. (2013). Critical success factors for knowledge transfer collaborations between university and industry. *Journal of Research Administration*, 44(2), 38–56.
- Secundo, G., Del Vecchio, P., Simeone, L., & Schiuma, G. (2019). Creativity and stakeholders' engagement in open innovation: Design for knowledge translation in technology-intensive enterprises. *Journal of Business Research*, 119(October 2020), 272–282. <https://doi.org/10.1016/j.jbusres.2019.02.072>
- Shenhar, A. J. (2001). Contingent management in temporary, dynamic organizations: The comparative analysis of projects. *Journal of High Technology Management Research*, 12(2), 239–271. [https://doi.org/10.1016/S1047-8310\(01\)00039-6](https://doi.org/10.1016/S1047-8310(01)00039-6)
- Sternberg, R. J. (2006). The nature of creativity. *Creativity Research Journal*, 18(1), 87–98. https://doi.org/10.1207/s15326934crj1801_10
- Todorović, M. L., Petrović, D. T., Mihić, M. M., Obradović, V. L., & Bushuyev, S. D. (2015). Project success analysis framework: A knowledge-based approach in project management. *International Journal of Project Management*, 33(4), 772–783. <https://doi.org/10.1016/j.ijproman.2014.10.009>
- Toro-Jarrín, M. A., Ponce-Jaramillo, I. E., & Güemes-Castorena, D. (2016). Methodology for the of building process integration of Business Model Canvas and Technological Roadmap. *Technological Forecasting and Social Change*, 110, 213–225. <https://doi.org/10.1016/j.techfore.2016.01.009>
- van der Hoorn, B., & Whitty, S. J. (2015). A Heideggerian paradigm for project management: Breaking free of the disciplinary matrix and its Cartesian ontology. *International Journal of Project Management*, 33(4), 721–734. <https://doi.org/10.1016/j.ijproman.2014.09.007>
- van Eck, N. J., & Waltman, L. (2010). Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics*, 84(2), 523–538. <https://doi.org/10.1007/s11192-009-0146-3>
- Vicente-Oliva, S., Martínez-Sánchez, Á., & Berges-Muro, L. (2015). Research and development project management best practices and absorptive capacity: Empirical evidence from Spanish firms. *International Journal of Project Management*, 33(8), 1704–1716. <https://doi.org/10.1016/j.ijproman.2015.09.001>
- Wedekind, G. K., & Philbin, S. P. (2018). Research and grant management: The role of the Project Management Office (PMO) in a European research consortium context. *Journal of Research Administration*, 49(1), 43–62.

Deconstructing the Art of Grantsmanship: The Roles of the Storyteller, Grant Writer, Typesetter, Proofreader, Accountant and Reviewer

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Abstract: *Background: The content presents a conceptually powerful and attractive framework for understanding the proposal development process to capture the complexity of the steps that contribute to successful grant writing. Based on experiences from 15 years in research administration and using real-life examples, the author juxtaposes the diverse roles required of grants professionals in creating a competitive grant application. In the context of increasing university emphasis on attracting extramural grant funding, this timely article focuses on proposal development skills using a step-by-step process including a six-part analysis of each role within the framework, dividing the role into primary subtopics all highly relevant to each specific role. By deconstructing the art of grantsmanship, the whole suite of proposal development processes is considered with this approach with the intention that research development professionals will have solid actionable guidance in a cohesively planned delivery to capture the intricate mechanisms that translate to successful grantsmanship and acquire a set of tools to use to train grant seekers.*

Keywords: *Grantsmanship; Writing; Proposal Development Process; Research Administration*

Introduction

Grantsmanship is the art of obtaining research funding through the process of grant writing (Kraicer, 1997). Faculty need funding to carry out their research (Ebadi & Schiffauerova, 2015). Writing a successful proposal is an art in itself (Kraicer, 1997). The art of writing a grant application has become the lynchpin to having a successful research program (Mbuagbaw et al., 2013). Researchers who write more research proposals are typically rewarded more funding (Hippel & Hippel, 2015). Research administration is a burgeoning field around the world (Kerridge & Scott, 2018). Universities are continually increasing their funding for research support personnel (Shelley, 2010). Editing draft proposals, providing proposal development support, and grant writing portions of applications are a large part of research administrators' reported responsibilities (Preuss et al., 2020). Proposal development for large, multi-investigator project grants was the number one ranked research activity for research development offices (Ross et al., 2019).

To date, little research has been done to define the skills required by administrators to improve the quality of grant applications from academic institutions, and to understand the complexities of the proposal development process (Cunningham, 2020). Based on experiences from 15 years

in research administration and using real-life examples, the author discusses a powerful and timely framework using a six-part analysis to deconstruct the art of grantsmanship and juxtapose the diverse roles required of grant professionals in creating a competitive grant application. This whole suite of proposal development processes will provide a teaching tool for research development professionals in an easy-to-understand format to comprehend the intricate mechanisms that contribute to successful grantsmanship that can be used to train grant seekers.

Storyteller

Most research development professionals would likely agree, and as the author has seen many times over the years in her role as a Research Facilitator, that the major weakness of most grant proposals is the inability of the applicant to describe the proposed research in an interesting manner to pique the interest of the reader and to communicate the societal impact of the research findings as presented in the case below.

Example #1

I read his proposal. The proposal is written well and free of grammatical errors, but it is full of overly technical jargon. It has a rigorous methodology and three clearly defined objectives. The research that the applicant wants to conduct is clearly laid out. However, it is very boring to read and I can't figure out what are the clinical implications of the research findings.

Since there is an inherent need in proposal writing to communicate one's research plan in a narrative format, the first component to discuss in deconstructing the art of grantsmanship is the role of the "Storyteller". A good Storyteller can entertain, educate, enlighten, and teach people about issues that they may know nothing about (Clarke, 2009). The same is true for grantsmanship (Torpey, 2014). Storytelling puts the passion and creativity back into the grant writing process rather than just focusing on the technique and form of grant writing (Clarke, 2009). Storytelling is powerful. A grant proposal should be written so that it tells a powerful story (Clarke, 2009). Although a research development professional will more likely be involved in reviewing the proposal or possibly making minor edits to the text and not actually directly involved in writing the proposal, understanding the importance of telling a great story in grantsmanship is key to doing a thorough review (see Table 1).

Table 1. Roles of the Storyteller in Grantsmanship.

1. Tell the who, what, when, where, why, and how of the proposal
2. Demonstrate that the proposal is based upon the existing literature
3. Clearly outline the objectives and the importance of the research
4. Identify the primary research question and what can be accomplished
5. Establish the scientific merit of the proposal
6. Give sufficient details regarding the experimental design and methods

The following sections outline how Storytelling can be applied to Grantsmanship.

Tell the who, what, when, where, why, and how of the proposal

A good narrative uses an interesting angle to pull the readers into the story, present fundamental information, introduce the characters, establish a sense of time and place, build tension and conflict into the story (Clarke, 2009), and builds interest as to how the research is addressing a critical health problem (Burrow-Sánchez et al., 2016). A good story will tell the who, what, when, where, why and how of the event (Rogers, 2019). The proposal should tell the reviewers what is to be done, why it will be done, and who will be doing what, with the underlying message that the researcher is capable to do what is proposed (Streiner, 1996). Persuasive language must be used so the ideas presented connect with the reviewers on an emotional level. A good grant application will pitch the ideas outlined in the proposal and present a strong argument as to why the research should be funded (Walters, 2009). It should address the significance of the scientific question and be written with the intent to persuade like a consumer buying an advertised product (Liu et al., 2016). A well-crafted proposal will speak to the societal impact of the findings (Lee, 2016), communicate why the research is worthy of funding (Walters, 2009), and connect the dots between the study objectives, research questions, and the project deliverables (Wisdom et al., 2015). Storytelling approaches when used in grant writing are highly effective in terms of persuasion (Monte & Libby, 2018).

Demonstrate that the proposal is based upon the existing literature

The proposal should be written so that it is based upon and adds to the existing literature (Knafl & Deatrck, 2005). A common misjudgment is to make the background section too wordy (Sandler et al., 2005). The background should not be comprehensive but rather an analytical, concise review to identify current gaps in the literature and outline how this research will add to new knowledge in this area (Sandler et al., 2005).

Outline the objectives and the importance of the research

The primary goal is to outline what the objectives are and why the researcher is interested in undertaking this research project (Streiner, 1996). The writer must explain how the planned objectives (or aims) will address gaps in the scientific literature and outline the methodology best suited to test them (Knafl & Deatrck, 2005). The aims should demonstrate the problem, lead to a specific solution, and affirm the impact of the proposal on society and future research (Monte & Libby, 2018). The specific aims are very important as they will affect how the reviewers will perceive the rest of the proposal (Burrow-Sánchez et al., 2016).

The objectives (or aims) are key to shaping the development of the research grant application and should be to the point, declarative sentences that stand out for the reader, preferably in a bullet-point format (Pequegnat, 2010). Applications with too many objectives or questions often fail review as the proposed project may be perceived as being too ambitious (Sandler et al., 2005). Proposals with too many ideas and no focus are more likely not to be funded (Lee, 2016). Research designs where one aim cannot be completed if another aim fails should be avoided as

this is usually a red flag to the reviewers and most likely this research will not be funded (Monte & Libby, 2018).

Identify the primary research question and what can be accomplished

Care must be taken when writing the proposal to emphasize the primary research question and what can be accomplished from the study results (Sandler et al., 2005). The research question should be relevant and testable (Sandler, 2002) and identify the population group(s), type of exposure, control or comparison group, and the expected research outcomes (Sandler et al., 2005). The hypotheses should be compatible with the significant section and they need to connect back to the objectives of the study (Friedland, 2009).

Establish the scientific merit of the proposal

The single most important criteria in determining whether a research study should be funded or not is the scientific merit of the proposal (Schepers et al., 2000). Use each section of the proposal to its full potential to persuade the reviewers regarding the importance and workability of the proposed project (Wisdom et al., 2015). A successful proposal is compelling and should be written in such a way that it convinces the reader that there is a problem (Schepers et al., 2000) and that funding is required to carry out the proposed research (Sauer & Gabbi, 2018). The writer should always define the scope of the problem for the reader in terms of the burden of the disease as well as the associated costs to society (Knafl & Deatricks, 2005). Any limitations to successfully completing the proposed research project should be thoroughly and realistically discussed, otherwise the review board may use this as grounds for rejection of the proposal (Cuschieri et al., 2018; Inouye & Fiellin, 2005).

Give sufficient details regarding the experimental design and methods

Sufficient details regarding the experimental design and methods should be discussed in the proposal including study sample, data collection/procedures, outcomes, intervention (if applicable), data analysis and summary of strengths and weaknesses of the grant application (Inouye & Fiellin, 2005). It is especially critical to persuade the reviewers that the methodology in question is validated and previous research has been done using this method (Cushieri et al., 2018). Early consultation with a biostatistician regarding study design, data analysis plans, and sample size calculations will enhance the success of the research proposal (Inouye & Fiellin, 2005). Ethics requirements should be addressed within the proposal and appropriate documents attached with the grant application (Cushieri et al., 2018).

Grant Writer

A very common problem that the author has observed over the years when reviewing proposals is poor adherence to funding agencies' guidelines and the lack of attention to details as presented in the case below.

Example #2

I read her grant application. She didn't pay attention to the funder guidelines. When I added the required headings it became readily apparent that she was missing a couple of required sections that needed to be addressed in the grant proposal. Her font size was incorrect so I fixed this so her application would not be disqualified. Her title was vague so I added a couple of suggestions to revise it as the funding agency staff often use the title to find the right review committee for the grant application. The abstract was missing key components so I rewrote it as this is often the only part of the grant application that the majority of committee members read. I also made suggestions to limit the use of technical jargon and to define each concept for the non-expert reviewer. In addition, I scrutinized the first page and added any important information that was missing so that the reviewers didn't have to dig for it. Lastly, I also suggested that she highlight her team, her previous research, and her institutional support and add a timeline so that the reviewers could see at a glance that she could do what she promised to do in a timely manner.

Since there is an apparent lack of compliance with granting agency guidelines on part of the faculty member whether intentional or unintentional, and a propensity on the part of the researcher to rush through the grant writing process likely due to time constraints, the second component to consider when deconstructing the art of grantsmanship is the role of the "Grant Writer". Grant writers need to have strong research and writing skills and good interpersonal skills (Torpey, 2014). A good grant writer should be detail oriented, demonstrate multitasking abilities, and possess a high degree of organizational skills to juggle multiple tasks and adhere to the funding agency's guidelines and deadlines (Torpey, 2014). Being able to express their ideas clearly and succinctly and use creativity and persuasiveness to help a proposal shine above the rest are also important qualities of a great grant writer (Torpey, 2014). In order to do a thorough review of a grant proposal a research development professional must see himself or herself as a grant writer. In order to do this, understanding what a grant writer does is essential in providing high quality proposal development services (see Table 2).

Table 2. Roles of the Grant Writer in Grantsmanship.

1. Ascertain the funder’s guidelines for preparing a grant application
2. Determine if the proposal clearly states why the research should be funded
3. Confirm if the title of the grant application conveys the essence of the proposal
4. Check if the abstract summarizes all the details of the proposal
5. Investigate if the use of jargon and acronyms in the proposal is minimized
6. Ensure that all the requirements of the funding agency are addressed
7. Determine if the grant proposal dedicates the right amount of detail to each section
8. Create a grant proposal template to create a structure for the writer to follow
9. Determine if logical headings are incorporated to guide the reader
10. Check that all important information is in the first few paragraphs of the proposal
11. Confirm that any previous research done by the team is highlighted in the proposal
12. Affirm that the strengths of research team is showcased in the proposal
13. Determine if the proposal speaks to the researcher’s institutional support
14. Verify that the proposal includes a timetable to describe what will be done
15. Check that all the supporting information is included in the appendices
16. Ensure that the proposal is written with the intent to persuade

The following sections speak to the role of the grant writer in Grantsmanship.

Ascertain the funder’s guidelines for preparing the grant application

A good grant review starts by doing some background work to ascertain the funder’s guidelines for preparing a grant application, paying close attention to the details (Devine, 2009). A clear understanding of the objectives of the funding call and the criteria that need to be met to be eligible for funding are essential so that the project is matched to the most appropriate funding source (Schembri-Wismayer et al., 2018). Successful proposals link the research to the funding agency’s priorities and mission (Gemayel & Martin, 2017; Wisdom et al., 2015). Proposals can be returned without review or denied funding if the guidelines are not adhered to (Devine, 2009).

Determine if the proposal clearly states why the research should be funded

In order for a proposal to stand out above all the rest, it is essential to communicate to the reviewer not why the researcher requires funding, but rather, why this research study deserves to be funded (Schembri-Wismayer et al., 2018).

Confirm if the title of the grant application conveys the essence of the proposal

The title of the grant application is important (Brownson et al., 2015). The title is the very first thing that a reviewer will read and should convey the essence of the proposal and be as succinct as possible (Gotley, 2000). It should include the primary message from the study results (Liu et al.,

2016). The title should be short and succinct and mirror the actual subject matter of the research study (Walters, 2009). It should achieve impact without being too ambitious (Gotley, 2000). The title can be key as the reviewers may be more inclined to read applications with the most interesting titles or review committee members may use part of the title to refer to the project during the evaluation process (Friedland, 2009). A title should be concise and preferably no more than 200 characters with spaces (Monte & Libby, 2018).

Check if the abstract summarizes all the details of the proposal

The abstract is a collection of statements written to summarize the details of the research project using clear and precise language (Inouye & Fiellin, 2005). It is generally the first thing that the reviewers will read (Burrow-Sánchez et al., 2016) and needs to be written to engage and pique their interest (Inouye & Fiellin, 2005). All the information included in the project summary or abstract should match with everything discussed in the proposal including the objectives, collaborations, and budget (Schepers et al., 2000).

Investigate if the use of jargon and acronyms in the proposal is minimized

A well-written proposal will have finite use of jargon and acronyms to make it easier for the reviewer to read (Wisdom et al., 2015). The reviewer should not have to investigate each cited reference to understand the material being presented (Inouye & Fiellin, 2005). Jargon can impede the reader from perceiving the significance of the research being presented (Inouye & Fiellin, 2005).

Ensure that all the requirements of the funding agency are addressed

A research grant application usually has a common format such as a title, hypothesis, aims, significance, background, research plan, budget, and timetable (Gotley, 2000). Proposals will be evaluated on criteria such as the research question, expertise of the applicant and team, research approach, innovation, research environment, dissemination, gender balance, potential impact, relevance, ethics, and the budget (Lee, 2016; Roberts & Kaack, 2000; Sauer & Gabbi, 2018; Walters, 2009). Using an outline is a common practice to ensure all the requirements of the funding agency are met (Walters, 2009). The proposal should be reviewed to verify that each of the components involved in a typical proposal such as context/setting, rationale, literature review, methodology, collaborators, training of others, outcomes, research environment, personal background/experience, previous grant applications and dissemination are included in the proposal (Walters, 2009).

Determine if the grant proposal dedicates the right amount of detail to each section

A common mistake in grant writing is providing excessive background detail (Friedland, 2009). Check if the funding agency gives a breakdown of how many pages should be dedicated to each section, e.g., two pages to describe the research background and five pages to describe the research project (Walters, 2009). A good strategy to avoid lack of white space or going over the required page limit is to go through the proposal and cut out any repetitive sections (Walters, 2009) or, as a rule of thumb, allow no more than three paragraphs per section (Devine, 2009).

Create a grant proposal template to create a structure for the writer to follow

Grant proposal templates with common requirements for specific funding agencies can be offered to provide research development support to faculty (Wisdom et al., 2015). Any type of basic grant proposal template ensures that all essential sections are included in the application and creates a structure for the writer to follow (Snowball Fundraising, 2018). Granting agency specific templates can be developed specific to each funding agency. For example, the evaluation criteria can be copied off the funding agency website and pasted within a Word document and then separated into distinct sections. Next, the word limits for each section can be manually added for easy reference to ensure that the text included for each section does not go over the specified limit. The weightings for each section can be added to give a better idea of which sections of the grant application need more time and work because of the larger weighting. Lastly, the proposal under review can be pasted into the different sections of the grant proposal template. The beauty of using this writing aid is that it makes it readily apparent to the research administrator if one or more sections have not been adequately addressed in the final draft and it also makes redundant sentences or paragraphs stand out so they can be removed.

Determine if logical headings are incorporated to guide the reader

Clarity and flow are key to writing a successful grant application and these two essential components are dependent on the use of logical headings (Sandler et al., 2005). A good strategy is to use subheadings to summarize the information being presented in each section and break up the text for the reviewer, making the proposal easier to read (Burrow-Sánchez et al., 2016).

Check that all important information is in the first few paragraphs of the proposal

The wording used in the first few paragraphs is of key importance as it sends a signal to the reviewer that the topic is meaningful and that the study will result in valuable new knowledge (Knafl & Deatricks, 2005). The introductory paragraph should be written skillfully to create ambience and provide the background for the research and pull the reader away from everyday distractions into the realm of your research (Walters, 2009). The purpose of writing the first few paragraphs is to clue the reader to the importance of the potential study results and, more importantly, what this will mean in terms of clinical application and future research in this area (Knafl & Deatricks, 2005). The overarching plan for the proposed research should be introduced right from the get-go and written to give the educated nonexpert a basic understanding of the research in question, or contain enough detail should a reviewer be an expert on the topic, so that either type of reviewer can act as an advocate for your proposal during the review (Monte & Libby, 2018). Point out key ideas right off the bat and chop the text into small chunks to make the proposal easier to read like a newspaper (Brownson et al., 2005). Just like a magazine or newspaper has its top stories on the front page, check that the important information is not hidden deep within the grant proposal but is placed up front to be noticed right away (Brownson et al., 2005).

Confirm that any previous research done by the team is highlighted in the proposal

A good writer will capitalize on previous work done by the researcher or team members that is relevant to the proposed research and highlight this within the proposal (Inouye & Fiellin, 2005). Review the proposal to check that previous research in this area has been discussed, the study results are explained, and in particular, an explanation is given to describe how this research was instrumental in designing the current research study (Pequegnat, 2010). Preliminary data begets success. Verbose dialogue, brainy conjecture, or sweet assurances will never replace preliminary data when it comes time to judge the scientific merit of the research study (Scheepers et al, 2000).

Affirm that the strengths of research team is showcased in the proposal

Funders value teamwork (Wisdom et al., 2015). Check that the applicant has thoroughly explained to the reviewers why the research team is the right group of people to get the research done by highlighting team expertise, training, and experience (Burrow-Sánchez et al., 2016), how the work will be shared among team members and how the funding will be appropriated (Cuschieri et al., 2018).

Determine if the proposal speaks to the researcher's institutional support

A well-written proposal will describe in depth the researcher's institutional environment (Devine et al., 2009) and detail the support that is available to back the proposed research (Brownson et al., 2015). In other words, a well-crafted grant application will outline how the researcher's environment will contribute to their success (Monte & Libby, 2018). The score of a grant application will be weighted heavily on the significance of the research, research plan, innovation of the research, researcher expertise, and institutional supports for the applicant (Inouye & Fiellin, 2005). A reviewer will rate it as a strong proposal if it is woven throughout the grant application how the research environment will contribute to the probability of success of the researcher and describes any special features of the institution's scientific community and existing research collaborations (Brownson et al., 2015). A strong proposal will clearly indicate all the resources that are in place that the researcher will require to carry out the study (Lusk, 2004) and speak to the availability of facilities, space, equipment, and laboratory resources (Wisdom et al., 2015) in addition to personnel, IT support, and institutional resources (Burrow-Sánchez et al., 2016). Institutional support such as protected time to do research should also be included in this section of the proposal (Sauer & Gabbi, 2018).

Verify that the proposal includes a timetable to describe what will be done

It is imperative to check that the grant application includes a timetable as it will demonstrate to the readers that it is possible to complete what is outlined in the proposal in the requested time (Gotley, 2000). Specific dates, times and milestones will resonate with the reviewers that the investigator has thought through the planning process for completing the study (Knafl & Deatrck, 2005) in order to achieve the primary goal of the research (Burrow-Sánchez et al., 2016). The purpose of a prudent timeline is to allow reviewers to determine if enough time is designated for all parts of the study (Knafl & Deatrck, 2005).

Check that all the supporting information is included in the appendices

Having enough space to write in enough detail is always an issue in grant writing. Things such as interview questions, significant statements, coding categories, and analytic techniques can be included in the appendices if allowable by the funding agency (Knafl & Deatricks, 2005). Direct the reviewer to check out more details in the appendix. This section should be used to bolster the researcher's expertise and describe how the researcher will accomplish the proposed research (Knafl & Deatricks, 2005).

Ensure that the proposal is written with the intent to persuade

Ensure that the applicant has written the proposal with persuasion, like selling a product to a customer and receiving payment, or in research terms, to get the buy in from the reviewers, so that the applicant receives the funding to do the proposed research project and presents the product—the study findings (Lusk, 2004). To get a good score from the reviewers the proposal needs to be written in an understandable and convincing way to persuade them that the proposal under review is exemplary among all the other applications (Lusk, 2004). For a quick reference when writing a grant application use the OUTSTANDING approach (see Lusk, 2004).

Typesetter

The number one problem that the author has seen over the years when reviewing faculty grant applications is the lack of readability of the proposal as presented in the case below.

Example #3

I read his proposal. It was extremely well-written and void of grammatical errors. The research was laid out in a logical manner with a detailed methodology and clearly outlined objectives. However, my eyes kept slipping down the page. His complex methodology was confusing. I made suggestions for him to add more white space and add more headings to make it easier for the reviewers to read. I also added a couple of suggested tables so several blocks of text could be removed. Lastly, I included a sample figure that he could use that summarized his complicated methodology so that the reviewers could see a snapshot of his research program at a glance.

Since there is an apparent need to make grant proposals more readable for the reviewers and organize the material so the information presented is easy to understand and grasp, the third component to examine when deconstructing the art of grantsmanship is the role of the "Typesetter". Typesetting is the technique of deciding where to place text on a page with adequate white space. Typesetting is all about what is perceived with the eye and what message is given to the beholder. The one who reads it discerns it without thinking about it at the subconscious level (Reedysblog, 2018). The goal of a typesetter is to create the ultimate reading experience. Typesetting is important as it makes your message easier to read thereby contributing to the impact of your writing (Reedysblog, 2018). In order to do a thorough review of a grant proposal a research development professional must think like a typesetter. Understanding what a typesetter does is essential to providing high quality proposal development support (see Table 3).

Table 3. Roles of the Typesetter in Grantsmanship.

1. Check that the text doesn't appear crowded
2. Confirm that there is space between paragraphs and sections
3. Check that there is ample white space in the proposal
4. Employ use of bullets to break up the text
5. **Incorporate bolding** to draw attention to relevant parts of the proposal
6. Utilize figures or tables to increase the readability of the proposal

The following sections demonstrate how Typesetting can be applied to Grantsmanship.

Check that the text doesn't appear crowded

Check that the applicant doesn't use trickery or try to jam as many words as possible into the proposal by reducing the size, squeezing the margins, or using single line spacing instead of double spacing for the text (Gemayel & Martin, 2017). Otherwise, the proposal will look like a blur of words with endless rows of text with no figures or tables to break up the text (Gemayel & Martin, 2017).

Confirm that there is space between paragraphs and sections

Review the proposal for white space to make the text look less crowded (Pequegnat, 2010). A grant application that is written with readability in mind (Brownson et al., 2015) will have space between paragraphs and between sections (Inouye & Fiellin, 2005).

Check that there is ample white space in the proposal

A grant application that has lots of white space has a better chance of being funded than a proposal with crowded text and lack of spacing (Sandler et al., 2005). A well-crafted proposal will include the right amount of white space to break up the text for the reader to make it easier to read (Sandler et al., 2005). To improve the readability of the proposal, a general rule to keep in mind is to include as much white space as possible, so the reviewers' eyes don't slip down the page when they are trying to review the grant application (Monte & Libby, 2018).

Employ use of bullets to break up the text

Don't hesitate to recommend use of bullets in the proposal as this type of formatting is a great way to break up the text for the reader and to make it easier to go through which will facilitate a positive response from the reviewer (Devine, 2009).

Incorporate bolding to draw attention to relevant parts of the proposal

Check the proposal for use of bolding to make important points and phrases pop out for the review panel (Gemayel & Martin, 2017). Bolding is recommended to draw the eye of the reviewer to the most relevant parts of the proposal so that they are not overlooked (Devine, 2009).

Utilize figures or tables to increase the readability of the proposal

To keep the reviewer happy and increase the readability of the proposal, check that the applicant has included figures to explain complicated concepts and complex methodologies (Gemayel & Martin, 2017; Lusk, 2004). Tables, figures, and diagrams are a great way to meaningfully communicate important information to the reader and can save space in the proposal by eliminating narrative descriptions (Lusk, 2004). A diagram can summarize in a very small space what normally takes several lines of texts to elucidate (Gemayel & Martin, 2017). Using figures to explain the study design and research objectives are recommended to act as a visual guide to navigate the reviewer through the proposal (Monte & Libby, 2018). Check the tables and diagrams that they are designed with careful thought as a grant application that is easy to understand will enthruse the reviewers (Sandler et al., 2005). Exceedingly elaborate tables and crowded figures should not be used as the reviewers do not have time to waste to decipher the results (Schepers et al., 2000).

Proofreader

One of the most common errors that the author has observed over the years in her role as a Research Facilitator when reviewing faculty grant proposals, is incorrect grammar, spelling mistakes, and unclear wording or messaging as presented in the case below.

Example #4

I read her proposal. She was clearly an expert in her field. Her institutional support was clearly outlined. The strengths of her team were highlighted. Her hypothesis was clearly identified and her objectives were meticulously laid out. However, the grant application was full of spelling mistakes and grammatical errors. Most importantly, the importance of her research wasn't clear to me. I found a couple of sentences stating the significance of her research study buried deep several pages into her grant application. After copying and pasting the material to the first page, I paraphrased these sentences to avoid repetitious text and at the same time to make the information readily available for the reviewers.

Since lack of proofreading is a reoccurring problem in faculty grant proposals, the fourth component to deliberate when deconstructing the art of grantsmanship is the role of the "Proofreader". The qualities of a good Proofreader include attention to detail, strong communication skills, and superior knowledge of grammar and spelling (Job Description and Resume Examples, n.d.). The Proofreader is responsible to detect and correct errors in the document, verify spelling and grammar, check for inaccuracies in the text, add missing or fix misplaced punctuation, and check the images, tables and/or charts for accuracy (Job Description and Resume Examples, n.d.). Understanding everything that is involved in doing a good proofread is vital information for a research development professional to know in order to conduct a thorough review of a grant proposal (see Table 4).

Table 4. Roles of the Proofreader in Grantsmanship.

1. Check for spelling mistakes or poor grammar
2. Confirm that the application is complete and filled out correctly
3. Check that the proposal is formatted correctly
4. Verify that the message of the proposal is clear
5. Confirm that any repetitious text is eliminated

The following sections elucidate the role of the Proofreader in Grantsmanship.

Check for spelling mistakes or poor grammar

A badly written, unorganized, and incomplete application with spelling mistakes and grammatical errors will make the applicant look bad and cause the reviewer to doubt the applicant's ability to produce quality, cutting edge research (Gotley et al., 2000). Check that the proposal is void of grammar and syntax errors, spelling mistakes, or errors in word usage or punctuation (Wisdom et al., 2015).

Confirm that the application is complete and filled out correctly

Attention to detail in preparing the research grant application is crucial; it affects how well the research proposal may be interpreted as an indicator of the likely excellence and preciseness of the research (Liu et al., 2016). A good grant professional will scrutinize the proposal to make sure that all sections of the application form are complete and filled out correctly (Gotley et al., 2000) and it is easy to read and understand (Inouye & Fiellin, 2005).

Check that the proposal is formatted correctly

Check the funding agency requirements to make sure that the proposal is formatted correctly, e.g., font type, font size, citation format, image restrictions, length restrictions, so the reviewers are not irritated by having to evaluate a grant application that reads more like a rough draft due to lack of proofreading (Gemayel & Martin, 2017). Proposals with tiny print and crowded text without proper line spacing will be noticed as the reviewers are quick to spot if a research proposal does not follow the formatting requirements (Schepers et al., 2000). Verify that the proposal does not go over the page limits or it may not be reviewed and not complying with the required formatting will make a bad impression with the reviewers (Schepers et al., 2000).

Verify that the message of the proposal is clear

When reviewing the final revision of the proposal with a critical eye, it is imperative for a research development specialist to make sure that the message is clear and logical (Walters, 2009). A badly written grant application without proper organization and structure can obstruct the ideas being presented and impede the message from getting across to the reviewers (Gotley et al., 2000). The reviewers need to comprehend what the researcher is trying to say in the proposal (Gotley et al., 2000). If a reviewer must struggle to figure out what the research project is about, it is likely that a high score will not be assigned to the proposal (Liu et al., 2016).

Confirm that any repetitious text is eliminated

As a grant professional, it is important during the final review of the researcher's proposal that repetitive phrases or sections are removed, and any unnecessary words, phrases or sentences are eliminated (Walters, 2009).

Accountant

One of the most commonly overlooked areas of a grant application that the author has noted over the years in her role as a Research Facilitator is the budget and the accompanying budget justification. This can cause great confusion among the reviewers and likely result in a lower overall score if not rectified prior to submitting the application package to the funder as presented in the case below.

Example #5

Her proposal was extremely well written and free of grammatical errors and spelling mistakes. There was good use of white space and headings and a figure was used to show at a glance the proposed research. However, when I looked at the budget there were several issues that needed to be addressed. The totals in the budget section did not match the totals in the proposal so I asked her to fix this. In her budget justification, she asked \$25,000 for supplies which sounded high so I asked her to explain in detail what supplies were needed to conduct her research so that the reviewers didn't think she was padding her budget. I also noticed that she had forgotten to add benefits for her research assistant so I asked her to fix this. She identified three graduate students in her budget justification but she didn't indicate how long each one would be hired or what they would do. I asked her to add the students' names if possible to show the reviewer that she already had these students in place. Also, she asked for money for two graduate students and didn't specify where the money for the third student would come from. I told her that if she had graduate funding for this student that she should add this to the budget justification as this would strengthen her application. Lastly, I asked her to relate her budget items back to her research objectives and clearly identify which individuals would work on each objective.

Since numerical errors are routinely commonplace in the budget and often pertinent details are lacking in the budget justification, the fifth component to contemplate when deconstructing the art of grantsmanship is the role of the "Accountant". An Accountant's responsibilities include such things as bookkeeping, accounts preparation, budgeting, preparing financial statements, assisting with auditing, and financial investigation (Reed, 2020). Although a research development professional will more likely be involved in reviewing the budget or possibly suggesting changes to the budget and/or budget justification and not actually directly involved in budget planning, understanding the role of an Accountant is crucial to conducting a thorough review of a grant application (see Table 5).

Table 5. Roles of the Accountant in Grantsmanship.

1. Verify the amount of funding asked for in the budget is acceptable
2. Check that the budget is well thought out and accurate
3. Confirm that the budget justification includes all the pertinent details
4. Scrutinize the budget so that there are no mathematical errors
5. Check that the numbers given in the proposal match with the budget

The following sections illustrate the role of the Accountant in Grantsmanship.

Verify the amount of funding asked for in the budget is acceptable

Most funding agencies give a specific amount of funding for a particular funding opportunity. In cases where there is no limit stated, the research support person should check the range of funding given out in previous competitions to ascertain the budget range supported by that agency (Higdon & Topp, 2004).

Check that the budget is well thought out and accurate

In addition to having a cutting-edge research question with a solid plan to test it, a research development professional must also check that the proposal has a reasonable, well thought out plan for the budget (Patil, 2017). The budget is the main event of a research grant application so consequently, budget items should reflect everything described in the research proposal (Walters, 2009). During the review of the final grant application, it is important to verify that the budget is an accurate appraisal of the funding needed and only includes required items that are necessary to complete the proposed research (Wisdom et al., 2015). A grant professional should scrutinize the budget rigorously to check for and flag any exorbitant costs such as excessive travel, extravagant equipment purchases, high salary costs, and unreasonable number of graduate students (Schepers et al., 2000). The research support person reviewing the budget should also check for sufficient detail to adequately justify each expense for each component of the project which is necessary to guarantee accountability on behalf of the researcher (Devine, 2009). The description of in-kind services in the budget justification should be sensible and include the types of services being offered and the duration for each (Schepers et al., 2000).

An exact, detailed budget is necessary to get funding to carry out the proposed research (Higdon & Topp, 2004). The purpose of an accurate budget is to sway the reviewers that the researcher understands all the complex details of planning the study and all the associated costs to complete the research have been calculated (Sandler et al., 2005). As a grant professional, do your homework and determine what expenses the funding agency will allow (Walters, 2009) as the reviewers will frown upon inappropriate budget requests (Lee, 2016). Check carefully that the proposal does not discuss more research projects than what is accounted for in the budget (Wisdom et al., 2015). Remind your faculty that it is always a good idea to include publication costs in the budget (Schepers et al., 2000).

Confirm that the budget justification includes all the pertinent details

A research development professional should always check that the budget justification clearly explains whether individuals are hired to work full time or part time on a project, how long they will be hired and on what project(s) (Devine, 2009). Benefits and overhead (if applicable) should be calculated and outlined in the budget (Schepers et al., 2000). A good proposal development professional will give extra attention when reviewing the budget justification to make sure that the researcher has described the research personnel and the name, title, previous training and experience, percentage time they will work on the study, and a succinct description of their role in the proposed research is included (Pequegnat, 2010).

Scrutinize the budget so that there are no mathematical errors

A review of the researcher's budget prior to the submission of the grant application will include thoroughly scrutinizing the numbers to verify that all the totals add up correctly (Wescott & Laskofski, 2011). The numbers outlined in the researcher's proposal should match the numbers in the budget section (Streiner, 1996) as any inaccuracies that are missed during the grant application review will likely cause the reviewers to question the researcher's ability to handle all the details associated with conducting a research study (Wisdom et al., 2015).

Check that the numbers given in the proposal match with the budget

A grants professional should check the budget for compatibility with the methods. This is a common mistake for faculty to make because as the project unfolds, research questions are altered, and sample size changes, relevant expenses may be neglected in latter drafts of the grant application (Higdon & Topp, 2004).

Reviewer

The author in her role as a Research Facilitator has attended many grant writing workshops and seminars over the years. The one recurring theme that emerged from attending these events was the need to use care and attention in crafting a proposal as a sloppily prepared grant application that lacks readability will irritate the reviewers as presented in the case below.

Example #6

His proposal was not clear. It was full of overly technical writing and had lots of confusing abbreviations. It read like a methodology paper. It was evident that it hadn't been proofread. There was a lack of white space and headings. I reread it three times but I couldn't figure out why the research was being conducted and what was the impact of the research findings. There was no identification of the problem or the burden of the disease. It had four objectives which appeared overly ambitious for the length of the project. The abstract was missing important components. The feasibility of the study wasn't demonstrated. The strengths of the research team to conduct the research and the institutional support were not discussed. I thought to myself if I can't understand the grant proposal and I took several hours to review it, how would the reviewers

who only had a limited amount of time to spend on each application grasp the significance of the proposed research and what kind of mood would they be in after reading this grant proposal in its current form?

Since there are common grant writing mistakes that can weaken a proposal and discredit a researcher with the review panel, the sixth component to delve into when deconstructing the art of grantsmanship is the role of the “Reviewer”. It is important to be able to see the grant proposal from the perspective of the reviewer (Brownson et al., 2015). A reviewer is responsible to be knowledgeable about the funding agency policies and guidelines, assess, adjudicate and deliberate each grant application at the review committee meeting(s), and suggest a budget and term to support the proposed research (Canadian Institutes of Health Research, 2020). In order to conduct a thorough review of the proposal, a research development professional must think like a reviewer and be on the lookout for any common grant writing flaws that need to be corrected prior to submitting it to the funding agency (see Table 6).

Table 6. Common Grant Writing Mistakes That Can Irritate a Reviewer.

1. The grant proposal does not conform with the funding agency’s requirements
2. The proposal is written in overly technical language
3. The literature review does not cite relevant people who work in this field
4. The grant application is written without paying attention to detail
5. The proposal does not tell a compelling story
6. The proposal does not communicate the need for the research
7. The abstract is incomplete
8. The proposal does not have clear and realistic aims
9. The grant proposal is not clear and concise
10. The grant application does not demonstrate the feasibility of the study
11. The proposal does not highlight the credibility of the research team
12. The grant application does not confirm the researcher’s institutional support
13. The study is not well designed
14. The proposal does not stand alone from the appendices
15. The proposal does not communicate the significance of the research findings
16. The proposal does not include any diagrams to explain complex ideas
17. The grant application does not include a timeline
18. The budget is not well thought out
19. The researcher’s CV is lacking in experience and expertise

The following sections highlight common mistakes that can irritate the reviewer and how to fix them prior to submission.

The grant proposal does not conform with the funding agency's requirements

Before you begin to review the grant application, check the funding agency's website for its mission and vision and for listings of projects that they have awarded funding and then review the grant proposal accordingly (Sauer & Gabbi, 2018). Make sure that the applicant has conformed to these requirements or this oversight may irritate the reviewers and ruin the researcher's chances for success from the onset (Gemayel & Martin, 2017).

The proposal is written in overly technical language

Consider who the reviewers are, and why they were chosen (Streiner, 1996). Content area experts may be selected while others may be chosen because of a specific technique that the researcher is using or because of their knowledge in research methodology or statistics. These latter people may know little about the faculty member's specific area of research, so it is important that the applicant writes in non-expert language (Streiner, 1996). The availability of experienced reviewers is limited (Brownson et al., 2015) so screen the proposal for use of overly technical terms and rather substitute down to earth, understandable language as the panel of reviewers are likely to have different areas of expertise (Sauer & Gabbi, 2018).

Remind the applicant that scientific technical terms and research field-related abbreviations should be avoided so the reviewers don't have to waste time to search the references to understand what the writer is trying to say in the proposal (Inouye & Fiellin, 2005). Caution the applicant to keep in mind that not all the reviewers will be experts in this field especially in smaller funding agencies, so double check the proposal is written with words that they can comprehend so they can understand the point that the researcher is trying to make (Streiner, 1996).

The literature review does not cite relevant people who work in this field

Ask the applicant to do research and find out the list of reviewers that could be assigned to critique the proposal. Ask the researcher to look to see if it includes any people who work in this field and ask them to consider referring to their work in their own literature review to demonstrate that the applicant is aware of all the work being done in the content area (Pequegnat, 2010).

The grant application is written without paying attention to detail

Scrutinize all the instructions of the grant agency carefully, paying strict attention to all the details as grant applications that do not conform to the guidelines can be returned without review (Devine, 2009). A lack of attention to detail in the proposal may result in a lower score as the reviewers may doubt the applicant's competency to carry out the research (Lusk, 2004). Check carefully that the applicant doesn't try to trick the reviewers and cheat on formatting requirements by using small fonts, trimming margins, and adopting single line spacing throughout (Gemayel & Martin, 2017). The reviewers value good quality figures, proper formatting, and thorough proofreading to remove typographical and grammatical errors so make sure your review of the proposal is meticulous (Wescott & Laskofski, 2011).

A well done, correctly formatted, and complete grant application creates a sense of responsibility and accountability to the project in the eye of the reviewer about the applicant so your role in reviewing the grant is critically important to the success of the grant application (Wescott & Laskofski, 2011).

The proposal does not tell a compelling story

The proposal must attract the interest of non-expert reviewers who won't have much time to commit to read the proposal in depth (Wisdom et al., 2015). Reviewers only have so many hours in a day to commit to reviewing grant applications. Most reviewers decide their impression about a research grant application in a short space of time so make sure as you read the proposal that it scores high in terms of readability, clarity, conciseness, and formatting, and that it tells an interesting and convincing story (Brownson et al., 2015). A good writer will use compelling language to persuade the reviewers that the proposed research is important, breaks new ground, and contributes significantly to address a gap in the current literature in this area of research so double check that these important components are not missing in the proposal (Wisdom et al., 2015).

Most importantly, you should scrutinize the proposal to double check that the writer has explained why the problem is an important issue that needs to be addressed (Streiner, 1996). A study can be planned with care and attention to detail, but if the reviewers read the applicant's proposal and the content comes across as boring, the researcher's chance of being funded is very low (Streiner, 1996). Consider the situation of the reviewers. They review multiple grant applications at a time so it is your responsibility as a research development specialist that the proposal is easy to read so you don't make their work more difficult. If they become irritated with the applicant, the researcher's chances of getting a good review are greatly reduced (Streiner, 1996).

The proposal does not communicate the need for the research

As you review the proposal check that the applicant is telling a compelling story that persuades the reviewers to endorse their idea (Burrow-Sánchez et al., 2015). If the expert reviewers do not see the reason or "need" for the research, they will be less likely to endorse the research even if it has a sound study design and methodology (Sauer & Gabbi, 2018). Critical appraisals of the science and a well laid out and up-to-date literature review section aid the reviewers to grasp the importance of the proposed project (Lusk, 2004). Ensure that the applicant has made the most of every section within the proposal to convince the reviewers of the project's importance and feasibility (Wisdom et al., 2015).

The abstract is incomplete

The project summary or abstract introduces the applicant's project to the reviewers so ensure the researcher gives considerable attention and energy into formulating it (Lee, 2016). The abstract is considered by many to be the most crucial component of the grant application because it is used by agency staff to direct the grant proposal to the appropriate review panel and is often the only part read by the non primary reviewers (Liu et al., 2016). The abstract provides a vital opportunity to solicit a positive reaction from the reviewers (Brownson et al., 2015). As you review the

proposal you need to check that it includes a concise background or literature review, specific aims, objectives, or hypotheses, significance and impact, relevance to society, the innovativeness of the project, methodology, and expected results (Brownson et al., 2015). Most importantly, the abstract should address how this research will address gaps in the literature and influence practice and policy to improve health (Brownson et al., 2015) so if any of this information is missing you should make suggestions to the applicant to tweak the abstract to improve it.

The proposal does not have clear and realistic aims

The specific aims section is a crucial element of a proposal (Russell & Morrison, 2010) because it is one of the first things reviewers will read, impacting how they will perceive the rest of the grant proposal (Burrow-Sánchez et al., 2015). Read the specific aims carefully to ensure that they guide the reviewers to have a good understanding of the research and instill them with passion for the proposed project (Burrow-Sánchez et al., 2015). Remind the applicant that if he/she does not sell the project to the reviewers within the specific aims section, it is unlikely that the grant proposal will receive a high score (Burrow-Sánchez et al., 2015). Check that the aims, preferably two to four aims at most, are reasonable and not overly ambitious and they provide the underlying basis on which the proposal was written (Brownson et al., 2015).

If the specific aims section is bewildering, dull, or contentious then reviewers may be less inclined to speak on behalf of the researcher's proposal (Monte & Libby, 2018). A proposal may go unfunded if it confuses or alienates the reviewers (Gotley, 2000). Verify in your review that reasonable and scrupulous methodologies are used to address each of the aims and test the hypotheses (Burrow-Sánchez et al., 2015).

The grant proposal is not clear and concise

As a grant professional, remind the applicant that reviewers are human, so it is critically important that they can easily comprehend what the researcher is planning to do and why this research undertaking is so important (Gemayel & Martin, 2017). Check that the proposal is written in such a way that it is succinct and straightforward, introduces a persuasive argument, and the message is easy for the reviewers to fathom and grasp (Lusk, 2004). Remind the applicant to prevent reviewer fatigue, strive for clarity and conciseness, and avoid verbosity so the reviewer doesn't have to search through a proposal to figure out the gist of the ideas being presented (Schepers et al., 2000).

Emphasize to the applicant that reviewers are typically busy researchers themselves who will be reviewing the grant application with time borrowed from other important activities. Point out to the researcher that the reviewers will likely not be an expert in their own field and most likely, they will have a limited amount of time to review the grant proposal. During your review, make every effort to make suggestions to the applicant to make the proposal clear, concise, focused and void of jargon (Inouye & Fiellin, 2005). Make sure that the relevance and impact of the proposed project is crystal clear (Inouye & Fiellin, 2005). Advise the applicant that if the reviewer cannot understand the ideas presented and must strive to comprehend the information presented within the proposal, the result will likely be a less than favorable review and a low score (Liu et al., 2016).

The grant application does not demonstrate the feasibility of the study

Check that the proposal is written to persuade the reviewers that the hypothesis is testable, and the research design is appropriate (Wescott & Laskofski, 2011). As you review the grant application, verify that the reasons why the methods and techniques that the researcher is planning to use are both acceptable and sufficient to finish the study and will either back or negate the hypothesis (Roberts & Kaack, 2000). Investigate the proposal that it convinces the reviewers that the study design is reasonable and well thought out and that the study outcomes are attainable. Most importantly, check that the applicant has included a small pilot study or other preliminary research that has been done relevant to the proposal to demonstrate that the study is achievable (Sandler et al., 2005).

References are also important as reviewers may conduct a literature search to assess if the proposed study is innovative, appropriate, and precise (Liu et al., 2016). Advise the applicant that if the references in the literature review are not current, it may be seen as a red flag to the reviewers that the researcher hasn't stayed abreast of new studies in this area of research (Streiner, 1996).

The proposal does not highlight the credibility of the research team

Admonish your faculty member that it is critical to persuade the reviewers that the research team is qualified and skilled (Sandler et al., 2005). Detailed narratives are vital to communicate the principal investigator's skills and competence and help the reviewers comprehend the proposed work (Lusk, 2004). Preliminary data is essential as it allows the reviewers to appraise the knowledge and abilities of the research team (Liu et al., 2016). Ask the applicant to consider adding more experienced researchers to the team, if necessary to demonstrate to the reviewers that the proposed team has the needed know-how and training (Brownson et al., 2015).

The grant application does not confirm the researcher's institutional support

When reviewing the proposal, it is critical to confirm that the applicant assures the reviewers of adequate institutional support (Sandler et al., 2005). The infrastructure and equipment must be sufficient and the environment of the institution favorable to carry out the proposed research needs to be described in the proposal (Roberts & Kaack, 2000). The reviewers have no way of knowing what resources and support are available at each institution so remind the applicant to outline office space, labs, administrative staff, IT support, and other institutional support that will be available to carry out the research project (Burrow-Sánchez et al., 2015).

The study is not well designed

During your review, determine if the applicant has pitched the study design and methodology to the reviewers so they will be enthusiastic about the proposal during the review process (Lusk, 2004). Point out to your faculty members that reviewers will favor approaches to data analysis that are well thought out and break new ground (Wisdom et al., 2015). Most importantly, remind your faculty members to let the reviewers know the limitations of the study design and provide logical reasons for the choice of design (Streiner, 1996). Although the reviewers need a thorough overview of the proposed experiments, they do not seek detailed descriptions about standard experimental procedures (Gotley, 2000).

The proposal does not stand alone from the appendices

Remind the applicant that the reviewers are busy people who may not have time to read the appendix materials so the faculty member shouldn't put important aspects of the science that are crucial to the review in the appendices (Brownson et al., 2015).

The proposal does not communicate the significance of the research findings

During your review, it is essential to check that the applicant has informed the reviewers of the public health issue the proposal is addressing as well as its impact on society, how the study will investigate the problem, and how the study findings will impact future research in this field (Burrow-Sánchez et al., 2015). Check the proposal so that it is written with a clear message for the reviewers as to how the proposed research will address an existing gap in the literature and advance scientific knowledge (Burrow-Sánchez et al., 2015). Verify that the significance section is written as if the aims are achievable to persuade the reviewers as to why this research should be funded (Burrow-Sánchez et al., 2015). Review the significance section for effective use of headings to effectively guide the reviewers through it to point out key achievements (Burrow-Sánchez et al., 2015).

The proposal does not include any diagrams to explain complex ideas

Counsel your faculty member to help the readers understand the hypothesis and the main objectives/aims of the research, and to consider using a diagram as visual graphics to express in one glance what it could take many lines of text to explain (Gemayel & Martin, 2017). Point out to the applicant that a proposal that looks like a blur of text with no spaces and no diagrams will likely irritate your reviewers (Gemayel & Martin, 2017).

The grant application does not include a timeline

Check that the proposal incorporates a timeline as it is essential to show the reviewers that the researcher has thought through the important aspects of the project and how they relate back to the overall goal of the project (Burrow-Sánchez et al., 2015). This type of visual aid enables reviewers to assess in one glance the probability of completing the project within the required time frame (Burrow-Sánchez et al., 2015). Explain to the applicant that the reviewers will utilize the timetable to assess if enough time has been designated for each component of the study and the time each team member will spend on the project is sufficient (Knafl & Deatricks, 2005).

The budget is not well thought out

Communicate to the investigator how important it is to demonstrate to the reviewers that the study is well thought out and all the resources needed to complete the research are included in the budget (Knafl & Deatricks, 2005). As you review the budget, check that the researcher's expenses are justified as to why they are needed to complete the research project to achieve a more favorable evaluation from the reviewers (Patil, 2017). Caution the faculty member that reviewers are usually well aware of the costs of research so tell them to refrain from asking for overly exorbitant amounts of money in the budget as the reviewers can tell if the applicant is padding the budget and will likely be perturbed by any extravagant requests (Gotley, 2000).

Although it is uncommon for a grant application to be rejected based solely on the budget, advise the researcher not to falsify the numbers or ask for more money than needed so the reviewers don't think the applicant is trying to trick them (Streiner, 1996). Verify that the proposal doesn't describe more research than what is asked for in the budget, otherwise the reviewers will likely think that the researcher doesn't understand the monetary requirements to complete the research project (Lusk, 2004).

The researcher's CV is lacking in experience and expertise

Remind the faculty member that the most relevant question that will be discussed around the reviewer table is whether the researcher has the necessary experience and expertise to complete the proposed research (Streiner, 1996). Prompt a new investigator that has a sparse number of publications or limited funding to seriously consider having co-investigators on the team whose areas of expertise are essential to conduct the research study (Streiner, 1996).

The Juxtaposition of the Diverse Roles in Creating a Competitive Grant Application

The art of grantsmanship can be deconstructed into six distinct roles: Storyteller (see Table 1), Grant Writer (see Table 2), Typesetter (see Table 3), Proofreader (see Table 4), Accountant (see Table 5) and thinking like a Reviewer to avoid common grant writing mistakes (see Table 6). This framework is meant as a teaching tool to give guidance to research development professionals in an easy-to-understand format to comprehend the intricate mechanisms that translate to successful grantsmanship and acquire a set of tools to train grant seekers.

The interconnectedness of the six roles within the process development process is shown in Figure 1. The order in which these steps are completed is not as important as long as each of the steps is undertaken to guarantee a thorough review of the grant proposal. There is potential overlap among the six roles which is not an issue as achieving excellence is the standard in grant writing.

Note the cyclical nature of the proposal development process (review/revise/repeat) and how going through each of the five steps and then adding the perspective of the reviewer can lead to revisions and a more polished form of the proposal. This method can be repeated and lead to a second or third round of revisions with the ultimate goal of producing a highly refined final grant application that will be deemed fundable by the granting agency.

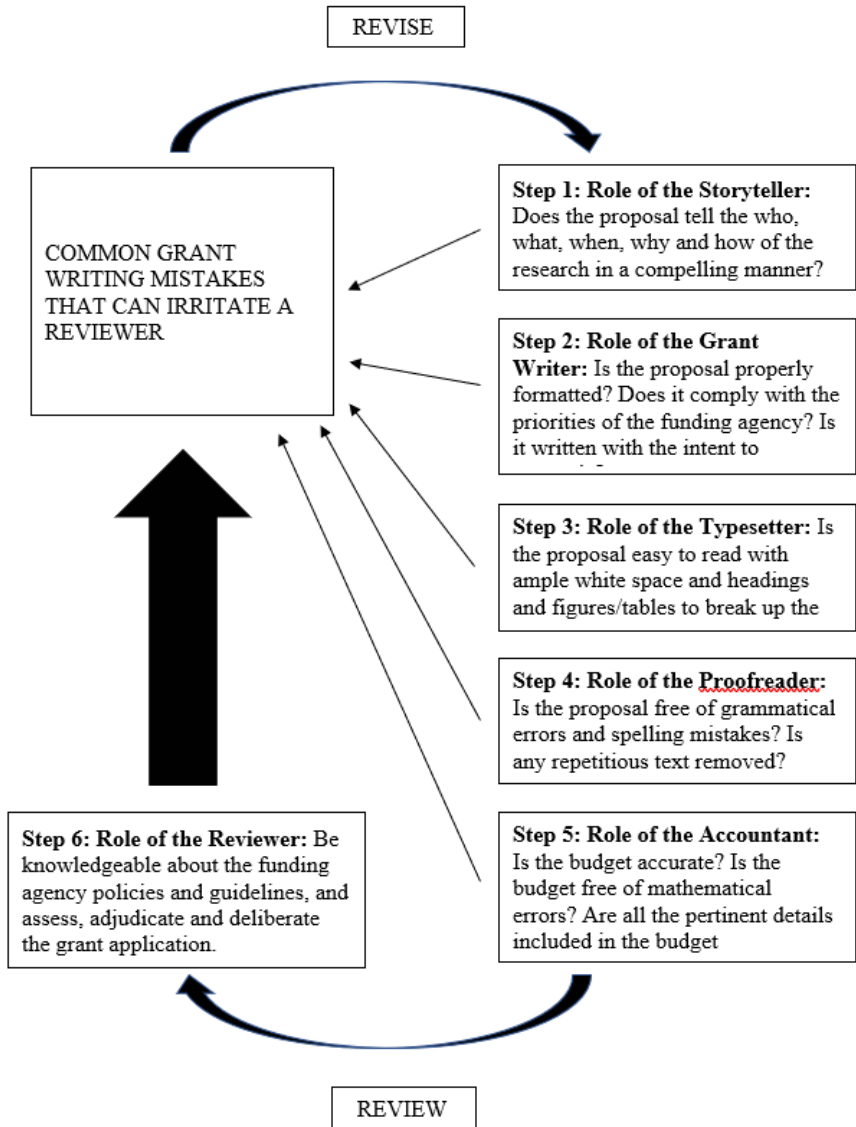


Figure 1. The Juxtaposition of the 6 Roles Within The Proposal Development Process

[Click here for larger image](#)

Conclusion

In the current broad context of increasing university emphasis on attracting extramural grant funding, this powerful and attractive framework is timely to understand the complexity of the steps in the proposal development process that translate to successful grant writing. This six-step analysis of each role within the framework includes: the Storyteller to help rewrite the proposed research in an interesting manner and pique the interest of the reader; the Grant Writer to help the applicant adhere to funding agency guidelines and pay attention to the details; the Typesetter to examine the grant application for readability; the Proofreader to check the proposal for incorrect grammar, spelling mistakes and unclear wording or messaging; the Accountant to check the budget and the accompanying budget justification so the numbers given are accurate; and lastly, taking the perspective of the Reviewer as common grant writing flaws can weaken a proposal and discredit the researcher with the review panel.

By deconstructing the art of grantsmanship, the whole suite of proposal development processes is considered with this approach with the intention that research development professionals will have solid actionable guidance in a cohesively planned delivery to capture the complexity of the steps that translate to successful grantsmanship and acquire a set of tools to use to train grant seekers.

Authors' Note

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References

- Brownson, R. C., Colditz, G. A., Dobbins, M., Emmons, K. M., Kerner, J. F., Padek, M., Proctor, E. K., & Stange, K. C. (2015). Concocting that magic elixir: Successful grant application writing in dissemination and implementation research. *Clinical and Translational Science*, 8(6), 710-716. <https://doi.org/10.1111/cts.12356>
- Burrow-Sánchez, J. J., Martin, J. L., & Imel, Z. E. (2016). Applying for grant funding as a Counseling Psychologist. *The Counseling Psychologist*, 44(4), 479-524. <https://doi.org/10.1177/0011000015626272>
- Canadian Institutes of Health Research. (2020, November 11). Peer review manual – Project. Retrieved November 5, 2020, from <https://cihr-irsc.gc.ca/e/49564.html>
- Clarke, C. A. (2009). *Storytelling for Grantseekers: A guide to creative nonprofit fundraising*. (2nd ed). Jossey-Bass.
- Cuschieri, S., Schembri-Wismayer, P., & Grech, V. (2018). WASP (Write a Scientific Paper): Writing a research grant—2, drafting the proposal. *Early Human Development*, 127, 109-111. <https://doi.org/10.1016/j.earlhumdev.2018.07.014>
- Cunningham, K. (2020). Beyond boundaries: Developing grant writing skills across higher education institutions. *Journal of Research Administration*, 51(2), 41-57.
- Devine, E. B. (2009). The art of obtaining grants. *American Journal of Health-System Pharmacy*, 66(6), 580-587. <https://doi.org/10.2146/ajhp070320>
- Ebadi, A., & Schiffauerova, A. (2015). How to receive more funding for your research? Get connected to the right people! *PLoS ONE Jul 29;10(7)*, e0133061. <https://doi.org/10.1371/journal.pone.0133061>
- Friedland, A. J. (2009). *Writing successful science proposals* (2nd ed.). Yale University Press.
- Gemayel, R., & Martin, S. J. (2017). Writing a successful fellowship or grant application. *The FEBS Journal*, 284(22), 3771-3777. <https://doi.org/10.1111/febs.14318>
- Gotley, D. C. (2000). Grantsmanship: Achieving success in research funding. *ANZ Journal of Surgery*, 70(4), 297-301. <https://doi.org/10.1046/j.1440-1622.2000.01815.x>
- Higdon, J., & Topp, R. (2004). How to develop a budget for a research proposal. *Western Journal of Nursing Research*, 26(8), 922-929. <https://doi.org/10.1177/0193945904269291>

- Hippel, T. V., & Hippel, C. V. (2015). To apply or not to apply: A survey analysis of grant writing costs and benefits. *PLoS ONE*, 10(3), e0118494. <https://doi.org/10.1371/journal.pone.0118494>
- Inouye, S. K., & Fiellin, D. A. (2005). An evidence-based guide to writing grant proposals for clinical research. *Annals of Internal Medicine*, 142(4), 274. <https://doi.org/10.7326/0003-4819-142-4-200502150-00009>
- Job Description and Resume Examples. (n.d.). Proofreader job description, duties and responsibilities. Retrieved April 10, 2019 from <https://jobdescriptionandresumexamples.com/proofreader-job-description-duties-and-responsibilities/>
- Kerridge, S., & Scott, S. F. (2018). Research Administration around the world. *Research Management Review*, 23(1), 1-34.
- Knafl, K. A., & Deatrick, J. A. (2005). Top 10 tips for successful qualitative grantsmanship. *Research in Nursing & Health*, 28(6), 441-443. <https://doi.org/10.1002/nur.20099>
- Kraicer, J. (1997, May 5). *The art of grantsmanship*. Retrieved February 8, 2021, from <https://www.hfsp.org/sites/default/files/webfm/Communications/The%20Art%20of%20Grantsmanship.pdf>
- Lee, Y. (2016). Tactics for seeking and obtaining funding in academia. *Family and Consumer Sciences Research Journal*, 45(1), 12-16. <https://doi.org/10.1111/fcsr.12177>
- Liu, J. C., Pynnonen, M. A., St John, M., Rosenthal, E. L., Couch, M. E., & Schmalbach, C. E. (2016). Grant-writing pearls and pitfalls: Maximizing funding opportunities. *Otolaryngology—Head and Neck Surgery*, 154(2), 226-232. <https://doi.org/10.1177/0194599815620174>
- Lusk, S. L. (2004). Developing an outstanding grant application. *Western Journal of Nursing Research*, 26(3), 367-373. <https://doi.org/10.1177/0193945903261843>
- Mbuagbaw, L., Morfaw, F., Kunda, J. E., Mukonzo, J. K., Kastner, J., Zhang, S., Kokolo, M., & Thabane, L. (2013). Tips for charting the course of a successful health researcher career. *Journal of Multidisciplinary Healthcare*, 6, 163. <https://doi.org/10.2147/JMDH.S44738>
- Monte, A. A., & Libby, A. M. (2018). Introduction to the specific aims page of a grant proposal. *Academic Emergency Medicine*, 25(9), 1042-1047. <https://doi.org/10.1111/acem.13419>

- Patil, S. G. (2017). How to plan and write a budget for research grant proposal? *Journal of Ayurveda and Integrative Medicine*, 10(2), 139-142. <https://doi.org/10.1016/j.jaim.2017.08.005>
- Pequegnat, W. (2010). *Grantsmanship: Necessary but not sufficient strategies for success*. In Pequegnat, W., Stover, E., & Boyce, C. (Eds.), *How to write a successful research grant application* (pp. 1-7). Springer. https://doi.org/10.1007/978-1-4419-1454-5_1
- Preuss, M., Eck, K., Fechner, M., & Walker, L. (2020). Research development and its workforce: An evidence-based compendium for higher education and other environments. *International Journal on Studies in Education*, 2(1), 1-25. <https://doi.org/10.46328/ijonse.12>
- Reed, K. (2020, January 6). *Accountant job description*. Totaljobs. Retrieved May 10, 2019 from <https://www.totaljobs.com/insidejob/accountant-job-description/>
- Reedsyblog. (2018, October 26). *What is type setting? Your guide to interior book design*. Retrieved April 17, 2019 from <https://blog.reedsy.com/what-is-typesetting/>
- Roberts, J. A., & Kaack, M. B. (2000). Grantsmanship*. *The Journal of Urology*, 163, 1544-1548. [https://doi.org/10.1016/S0022-5347\(05\)67676-8](https://doi.org/10.1016/S0022-5347(05)67676-8)
- Rogers, T. (2019, January 12). *How do you write a snappy and succinct news lede?* ThoughtCo. Retrieved April 19, 2019 from <https://www.thoughtco.com/how-to-write-a-great-lede-2074346>
- Ross, R., Reeves, J., Scarpinato, K., & Pelham, M. (2019). Success factors for university research development offices and activities. *Journal of Research Administration*, 50(3), 107-124.
- Russell, S. W., & Morrison, D. C. (2010). *The grant application writer's workbook: National Institutes of Health version*. Buellton, CA: Grant Writer's Seminars and Workshops.
- Sandler, R. S. (2002). Writing clinical grant applications. *Inflammatory Bowel Diseases*, 8(3), 196-200. <https://doi.org/10.1097/00054725-200205000-00007>
- Sandler, R. S., Lewis, J. D., Robuck, P. R., & Sands, B. E. (2005). Funding and grantsmanship. *Inflammatory Bowel Diseases*, 11(suppl. 1), S34-S37. <https://doi.org/10.1097/01.mib.0000184847.54063.fe>
- Sauer, R. M., & Gabbi, C. (2018). Grantsmanship: What? Who? How? *European Journal of Internal Medicine*, 57, 22-24. <https://doi.org/10.1016/j.ejim.2018.10.006>

- Schembri-Wismayer, P., Cuschieri, S., & Grech, V. (2018). WASP (Write a Scientific Paper): Writing a research grant–1, Applying for funding. *Early Human Development*, 127, 106-108. <https://doi.org/10.1016/j.earlhumdev.2018.07.013>
- Schepers, J. S., Sadler, E., & Raun, W. R. (2000). *Grantsmanship hints*. *Agronomy Journal*, 92(1), 1. <https://doi.org/10.2134/agronj2000.9211>
- Shelley, L. (2010). Research managers uncovered: Changing roles and ‘shifting arenas’ in the academy. *Higher Education Quarterly*, 64(1), 41-64. <https://doi.org/10.1111/j.1468-2273.2009.00429.x>
- Snowball Fundraising. (2018, April 17). *The fundamental grant proposal template: 8 crucial components*. Retrieved November 5, 2020 from <https://snowballfundraising.com/grant-proposal-template/>
- Streiner, D. L. (1996). “While you’re up, get me a grant”: A guide to grant writing. *The Canadian Journal of Psychiatry*, 41(3), 137-143. <https://doi.org/10.1177/070674379604100302>
- Torpey, E. (2014, September 5). Grant writer. Retrieved November 5, 2020 from copywriterhawaii.blog.fc2.com/blog-date-201809.html
- Walters, M. W. (2009). *Write an effective funding application: A guide for researchers and scholars*. Johns Hopkins University Press.
- Wescott, L., & Laskofski, M. (2011). Grant writing tips for translational research. In Espina, V. & Liotta, L. (Eds.), *Methods in Molecular Biology Molecular Profiling* (vol. 823), 379-389. Humana Press. https://doi.org/10.1007/978-1-60327-216-2_25
- Wisdom, J. P., Riley, H., & Myers, N. (2015). Recommendations for writing successful grant proposals. *Academic Medicine*, 90(12), 1720-1725. <https://doi.org/10.1097/acm.0000000000000811>

Enhancing Institutional Competitiveness: The CERTi Approach to Assessing Faculty Research Development Efforts In Higher Education

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Abstract: *Faculty Research Development (FRD) in higher education institutions (HEI) is often implemented haphazardly and rarely evaluated. In this paper, we introduce a robust assessment framework (CERTi) that utilizes an overarching (Macro-level) adult-learner faculty-centric theoretical framework which incorporates using qualitative, quantitative, and economic evaluations (Micro-Level) to assess FRD efforts at HEI conjointly. The framework's cyclical approach begins by assessing FRD program effectiveness, followed by an in-depth examination of implementation practices to assess FRD program efficacy, then measures program return-on-investment (ROI), ultimately repeating the process for continuous improvement.*

Keywords: *Research Competitiveness, Strategic Research Development, Researcher Talent Development, Faculty Research Development, Research Financial Management, Research Development Evaluation*

Introduction

Recent economic turmoil has forced higher education institutions (HEI) to consider reducing expenditures in faculty research development areas (FRD). Research development (RD) represents "a set of strategic, proactive, catalytic, and capacity-building activities designed to facilitate individual faculty members, teams of researchers, and central research administrations in attracting extramural research funding, creating relationships, and developing and implementing strategies that increase institutional competitiveness" (NORDP, 2019, para. 3). Before implementing such cuts, HEI should conduct robust assessments of their efficacy, including whether they are likely to bring in more revenue than they cost to operate. These assessments were critical in the context of governmental divestment in HEI and mounting public pressure against tuition hikes that forced HEI to rely on external sources of funding more heavily (Cronan, 2012) and are even more critical during economically uncertain times. This theoretical paper critically examines existing evaluation methodologies of FRD programs. It builds on the scholarship to propose a new comprehensive faculty-centric evaluation model known as *The Comprehensive Evaluation of Return on Talent Investment Model (CERTi)*.

The paper begins with a robust literature review to understand existing measurement and evaluation methodologies used to assess FRD programs' efficacy. It then presents a new unique approach that combines multiple evaluation frameworks from varying scientific disciplines into a comprehensive approach to evaluation that advances theory on adult professional development (PD) in a higher education setting. This holistic assessment approach relies both on macro and micro levels by utilizing an overarching (Macro-level) adult-learner faculty-centric theoretical framework that incorporates using 1) qualitative, 2) quantitative, and 3) economic evaluations (Micro-Level) to jointly assess RD efforts at HEI. Specifically, it begins with Kirkpatrick (1994) seminal Human Resource Development (HRD) framework. It then includes Evans (2011) (RD) conceptual framework that elucidates what can be learned from implementing FRD programs to improve their delivery and maximize their potential effectiveness. Finally, it utilizes principles of economic evaluations (i.e., CBA-Cost-Benefit Analysis) to measure FRD program ROI. To demonstrate the model's utility, we present a case study of an FRD program for grant acquisition to illustrate the applicability of the evaluative framework for practice and scholarship. As HEI face an era of declining public financial support, an atmosphere wrought by accountability demands, and increased requests for financial ROI, *CERTi's* approach is ever more critical to evaluating FRD programs' efficacy and advancing scholarship.

Background

One of the most critical resources that HEI possesses is its faculty. Developing faculty represents an investment in institutional human capital. This investment, whether in the areas of teaching, research, or service, bears returns in many forms (i.e., better student outcomes, more publications, and higher rates of research grant acquisitions) (Freel et al., 2017; Haras, Taylor, Sorcinelli, & von Hoene, 2017; Morrison et al., 2014). As a culture of growing reliance on grant funding emerges at public research universities, research, and tenure-track faculty, once held to research publishing and instruction performance standards, became increasingly held to a grant acquisition one. This shift from a "publish or perish" to a "grant or perish" measure of performance is manifest as the ability to obtain external funding became a core criterion for hiring and evaluating faculty (Musambira, Collins, Brown, & Voss, 2012). Competition between universities for limited federal grant funds and reduced funding for federal agencies (AAAS, 2019) created a need for FRD. As research productivity becomes a standard measure of performance for faculty, FRD has manifested itself on the scene in HEI as a field concerned with developing faculty research skills. This new facet of faculty development has taken many forms (e.g., grant writing workshops, seminars, and professional training). However, increasing in popularity among HEI is the use of cohort-based, peer-led faculty mentorship programs designed to leverage the expertise and experience of senior faculty with successful track records of grant acquisition, to mentor new and junior faculty as they seek external grant funding (Van der Weijden, Belder, Van Arensbergen, & Van Den Besselaar, 2015).

FRD Evaluations

Recently, several studies have examined FRD program effectiveness, implementation, and return-on-investment. The larger share of that research examined FRD program effectiveness (i.e., whether faculty recipients of FRD programs are more likely to increase their chances of securing external funding) (Feldman et al., 2012; Gardiner, Tiggemann, Kearns, & Marshall, 2007; Jagsi, Griffith, Jones, Stewart, & Ubel, 2017; Longo et al., 2011; Newgard et al., 2018; Paul, Stein, Ottenbacher, & Liu, 2002; Steiner, Curtis, Lanphear, Vu, & Main, 2004). In comparison, not many researchers have scrutinized their implementation practices to ascertain what can be learned from implementing such programs to improve their delivery and maximize their potential effectiveness (Tsen et al., 2012). Lastly, few researchers delved into assessing their ROI (e.g., CBA and CEA) (Kulage & Larson, 2017; Lunsford, Baker, Griffin, & Johnson, 2013; Villar & Strong, 2007; Wingard, Garman, & Reznik, 2004).

HEI invests in FRD programs on the premise of a positive ROI. Examining current literature on the effectiveness, implementation practices, and ROI of these programs highlight limitations. First, most studies examining these programs' effectiveness lack randomization (RCT) or control measures (CM) for confounding, rendering findings suspect about the program's actual effect (Fox et al., 2016). Second, failing to account for the moderating influence of program fidelity of implementation (FOI) per program guidelines can skew results (O'Donnell, 2008). Third, a mere measure of program effectiveness (e.g., grant dollars acquired) that neglects to compare the total cost of provision of the program in a formal CBA cannot produce necessary information to determine if the program was financially worth university investment (Levin, McEwan, Belfield, Bowden, & Shand, 2017). Although a rigorous examination of each area is crucial, the literature's most noticeable gap is that past researchers did not examine FRD programs' robustness concurrently, comprehensively, and in totality, which this research addresses. Table 1 lists a sample of previous FRD program evaluation research and highlights their non-concurrent and non-comprehensive evaluation methodology. Additionally, they were non-RCTs, lacked control measures to control for confounding, did not account for FOI's moderating influence, and failed to conduct a sound economic evaluation to measure ROI.

Table 1. Literature

Study	Effectiveness		Implementation	ROI
	RCT	CM	FOI	CBA
(Paul, Stein, Ottenbacher, & Liu, 2002)	x	x	x	x
(Steiner, Lanphear, Curtis, & Vu, 2002)	x	x	x	x
(Gardiner, Tiggemann, Kearns, & Marshall, 2007)	x	√	x	x
(Santucci et al., 2008)	x	x	x	x
(Brown et al., 2008)	x	√	x	x
(Longo et al., 2011)	x	x	x	x
(Tsen et al., 2012)	x	x	x	x
(Kulage et al., 2015)	x	x	x	√
(Libby et al., 2016)	x	√	x	x

CERTi Development

Macro-Level

The Comprehensive Evaluation of Return-on-Talent-Investment Model (CERTi) is grounded in an adult learner, faculty-centric theoretical framework. Introduced by Lawler and King (2000), the four-stage Adult Learning Model for Faculty Development illustrated in Figure 1 serves as the overarching macro-level theoretical framework for CERTi. The model incorporates multidisciplinary adult learner-centric approaches from various scientific disciplines (e.g., adult learning, program development) to comprehensively guide adult learning PD evaluation.

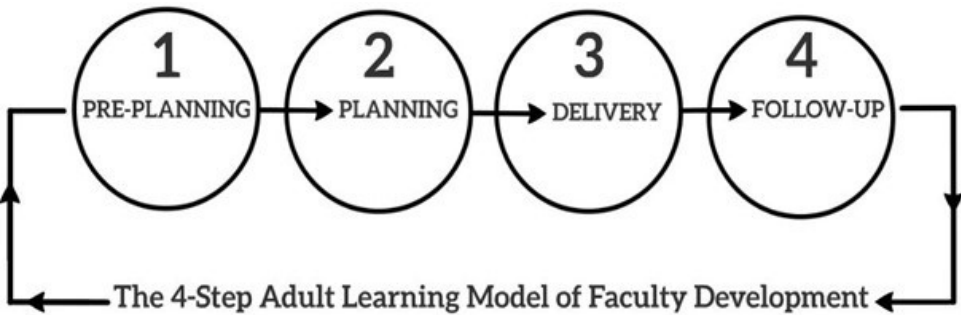


Figure 1. The Lawler & King Model

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The *Pre-planning* stage is undergirded by an insight into the purpose underlying the development process, how it relates to institutional mission, and resources required to support development efforts. The *planning* stage stipulates that the development process should be faculty-centric in that faculty interests, experiences, and capabilities should underlie the development process. The *Delivery* stage is dependent on a successful assessment of adult learner needs (i.e., pre-planning) and preparation (i.e., planning). Delivery is presumed under this theory to stem from a need for development that considers adult learner inputs, institutional context, best practices, implementation processes, and progress monitoring. The final stage, *Follow-up*, assumes that development does not end with one adult learner program. Adult learning within the context of higher education faculty development is a cyclical process that should consider faculty feedback to produce a more improved development program for continuous performance improvement. Faculty empowerment underlies this stage by applying newly acquired knowledge on the job; hence, a rigorous evaluation process post-implementation to improve the development program's future iterations is encouraged.

This adult learner-centric model provides an overarching macro-level approach that guides an evaluation of adult learning efforts within a higher education context. Developers of FRD programs in HEI are encouraged to employ multiple assessment methods to comprehensively analyze faculty feelings towards development events, knowledge attainment, and learning transfer. However, the model does not provide an actionable plan for operationalizing such efforts. Embedding a multi-pronged micro-level evaluation framework within this adult learning model, as recommended by its' authors, is essential to an efficacious and holistic evaluation approach of FRD programs. To this end, *CERTi* extends this adult learning theoretical framework by advocating for a three-pronged (Micro-Level) approach consisting of 1) qualitative, 2) quantitative, and 3) economic evaluations to jointly assess FRD programs at HEI.

Micro-Level

Guided by the adult-learner, faculty-centric macro-level theoretical framework, the *CERTi* Model relies on a multidisciplinary micro-level assessment approach. First, it begins with the Kirkpatrick (1994) pivotal four-stage HRD evaluation framework for FRD 1) program effectiveness (i.e., quantitative assessment). It then supplements that framework with the Evans (2011) RD conceptual model that elucidates what can be learned from 2) the implementation of FRD programs to improve their delivery and maximize their potential effectiveness (i.e., qualitative Assessment). Lastly, the framework is broadened by the principles of economic evaluations (Levin et al., 2017) to systematically account for total program cost associated with the provision of an FRD program in comparison with its total benefits to determine 3) program ROI (i.e., economic Assessment).

1. *Program Effectiveness (Quantitative Assessment)*— PD can facilitate the attainment of HEI goals through numerous mechanisms, including the improvement and preparation of the current and future job performance of the workforce. The benefits of PD are widespread, ranging from improved student outcomes (Yoon, Duncan, Lee, Scarloss, & Shapley, 2007) to faculty retention (Kena et al., 2016). Unfortunately, HEI rarely evaluates PD programs

despite their importance, and when they do, the rigor is often questionable (Astin, 2012). As FRD programs become essential to HEI financial sustainability, HRD evaluations of such programs become more critical. While there is often a debate about the disconnect of academic scholarship with field practice, HRD work can serve as a decision and explanatory science to provide actionable information to support practitioners. It does so by solving field-based problems and advancing scholarship, simultaneously addressing rigor and relevance.

Almost every mention of employee evaluation begins with Donald Kirkpatrick's seminal work. Kirkpatrick developed the most well-known and used evaluation models in the field, commonly referred to as the "four steps to evaluation." Illustrated in Figure 2, Level 1 (Reaction); assesses participants' PD favorability, engagement, and relevance to their jobs. Level 2 (Learning); evaluates the change in knowledge, skills, attitudes, confidence, and commitment based on participation in PD. Level 3 (Behavior); gauges changes in job behavior resulting from PD to identify learning transfer. Level 4 (Results); appraises targeted outcomes of PD.

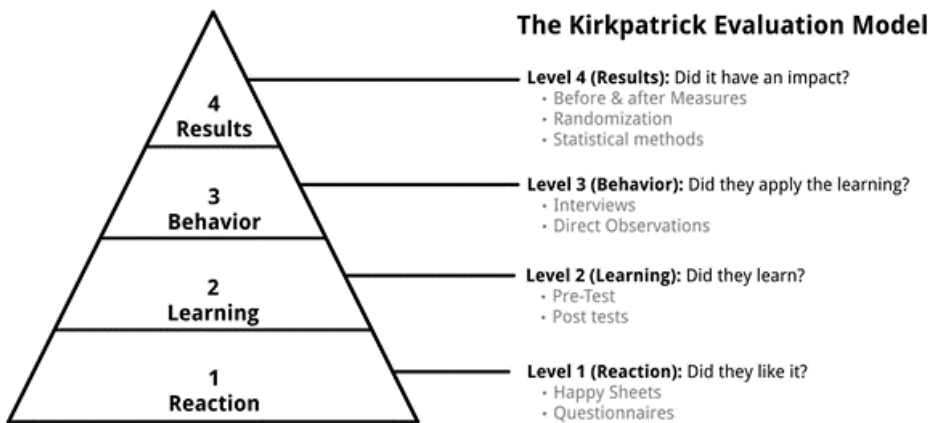


Figure 2. The Kirkpatrick Evaluation Model

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Kirkpatrick's Model's simplicity and pragmatism made it the most widely used model by practitioners in the evaluation field and most cited in the literature. While Kirkpatrick's evaluation framework provides programmatic quantitative (e.g., surveys) insight regarding FRD program effectiveness (i.e., measures of participant reactions, knowledge attainment, and transfer, and organizational impact), it fails to broaden our understanding theoretically about the 'why.' For example, why did some participants have a favorable reaction to training vis-a-vis their counterparts? Why did some participants attain knowledge while others did not? Why were some able to apply what they learned when back on the job while others failed to do so? It is essential to understand what underlies these attitudinal, intellectual, and behavioral changes to further our understanding.

2. *Program Implementation (Qualitative Assessment)*—RD is defined as "the process whereby people's capacity and willingness to carry out the research components of their work or studies may be considered to be enhanced, with a degree of permanence that exceeds transitoriness" (Evans, 2011, p. 21). Evans introduced a qualitative conceptual assessment model of RD, as illustrated in Figure 3. She presents three developmental components: attitudinal, intellectual, behavioral, and their respective subcomponents or foci of change.

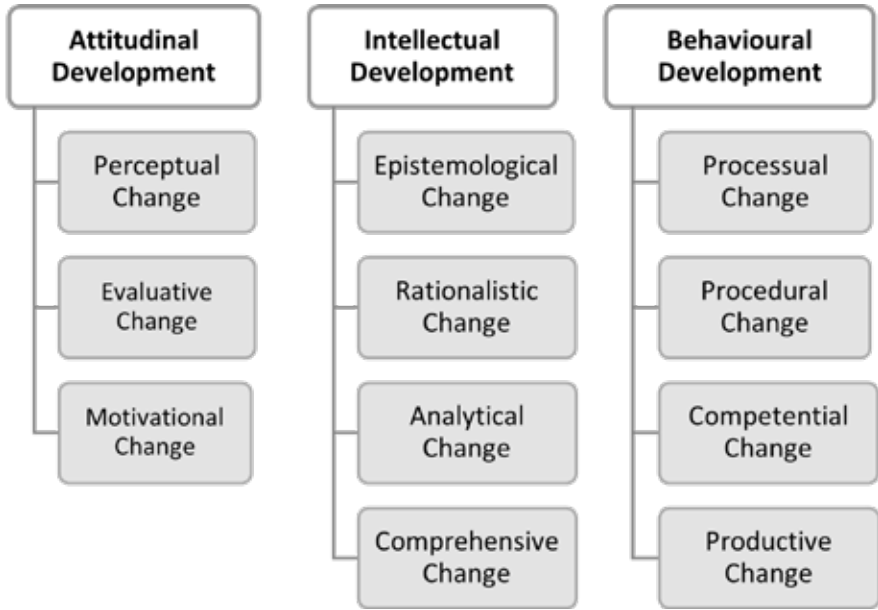


Figure 3. The Evans RD Model

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Attitudinal development is the process by which people's attitudes are modified and has three subcomponents of change: a) Perceptual—change to perceptions, viewpoints, beliefs, and mindsets concerning research as a component of one's work; b) Evaluative—change to research related values, including the minutiae of what they consider important or what matters to them about doing research; and c) Motivational—change to the levels of job-related morale and job satisfaction relating to their research activity. *'Intellectual development'* is the process by which knowledge is modified and has four subcomponents of change; a) Epistemological—change to research related knowledge structures, b) Rationalistic—change to the extent and nature or reasoning applied to research, c) Analytical—change to analyticism (i.e., ability to break research into workable parts), and d) Comprehensive—change relating to grasping new and previously untenable research-related concepts. *'Behavioral development'* is the process by which performance is modified and has four subcomponents of change; a) Processual—change to research practice (i.e., conducting the various elements or research-related activities), b) Procedural—change in the

capacity to manage procedures with research-related practice, c) Componential—change involving enhancement of research-related skills and competencies, and d) Productive—change in research output (e.g., grant acquisitions).

Evans postulated that positive modifications in these areas would yield greater research productivity (e.g., grant acquisitions) through research capacity enhancement. These developmental components, along with their foci of change, provide a detailed accounting of why change might occur during a developmental process. They are congruent with Kirkpatrick's level-based evaluation model, commonly depicted as a triangle. Substituting Kirkpatrick's first and second levels that only provide quantitative assessments of participant reactions and learning (i.e., surveys and pre-post test) with Evan's qualitative assessments (i.e., participant interviews) yields a more in-depth analysis of participant attitudinal and intellectual development. This combined approach allows for a better understanding of why development occurs or not, instead of just reporting on what took place during the development process in the first two development levels. The third level (i.e., behavior) represents an overlap between Kirkpatrick's and Evan's frameworks. Hence this level's assessment commences both quantitatively and qualitatively. For example, utilizing a quantitative assessment of how many participants in an FRD program submitted a grant proposal to a funding agency can be examined parallel to conducting interviews with those participants to delve deeper into their behavioral development to understand better how the program changed their behavior relating to research and grant funding activities. The fourth level (i.e., results) is research productivity (i.e., grant acquisition), which is quantitative. For this stage, employing rigorous analytic techniques to control for selection bias and confounding variables to best estimate a causal link between the program and its outcome is recommended, which is especially important in the absence of randomization. Figure 4 illustrates this combined qualitative/quantitative evaluation approach by integrating Kirkpatrick's and Evan's evaluation models.

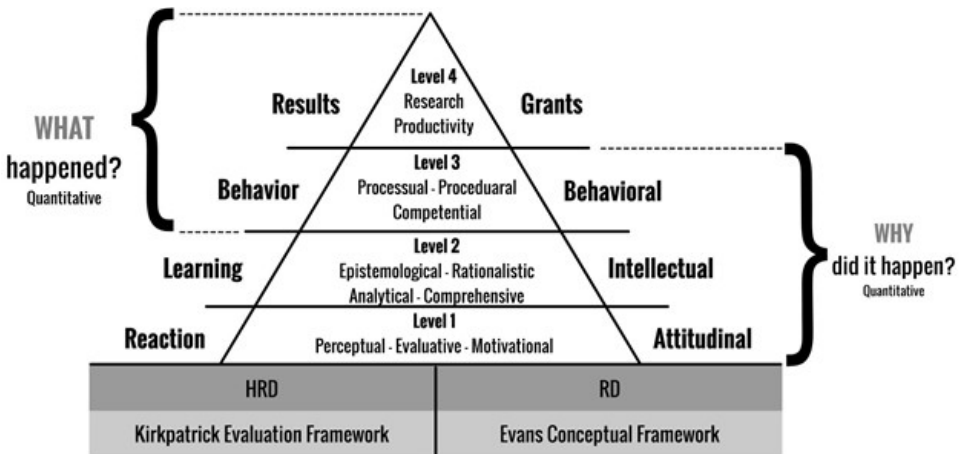


Figure 4. Kirkpatrick/Evans Combined Frameworks

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3. *Program ROI (Economic Assessment)*—RD is an intensive process. It drains institutional resources, such as faculty and administrator time and effort. HEI hope RD efforts result in a positive ROI in the form of grant revenue exceeding financial input invested for its operation. The Kirkpatrick/Evans combined approach can provide a quantitative measure of FRD program effectiveness and a qualitative measure of its' implementation fidelity. Nonetheless, it neither accounts for the total cost associated with the provision of such programs nor does it compare that total cost to their total benefit (i.e., grant dollars acquired) in a formal cost-benefit analysis to ascertain program ROI. Adding a fifth step to the Kirkpatrick/Evans model, which employs a sound cost analysis (i.e., calculation of all FRD program resources) then comparing it to program outcome (i.e., total grant revenue) in a formal cost-benefit analysis, provides for a rigorous economic assessment of RD efforts at HEI. This step is significant in light of the new financial norm that HEI finds itself in, characterized by governmental divestment, mounting financial pressures, and demands for efficient public funds use.

This three-pronged micro-level evaluation approach provides education leadership with resolutions to the following questions: "What Happened?" during an FRD program, "Why did it happen?", "How much did it cost?", and "Was it worth it?". Levels 1-2 of the evaluation model qualitatively (e.g., participant interviews) assess participant attitudinal and intellectual development. Level 3, both quantitatively and qualitatively (e.g., institutional record, surveys, and interviews), homes in on participant attitudinal, intellectual, and behavioral development. Level 4 quantitatively assesses program results (e.g., grant acquisitions). Level 5 concludes with conducting a formal cost analysis to cost out the total cost associated with FRD program provision (e.g., salaries, fringe benefits, facilities), which can then be compared to its' outcome in a formal CBA to ascertain program ROI as illustrated by Figure 5.

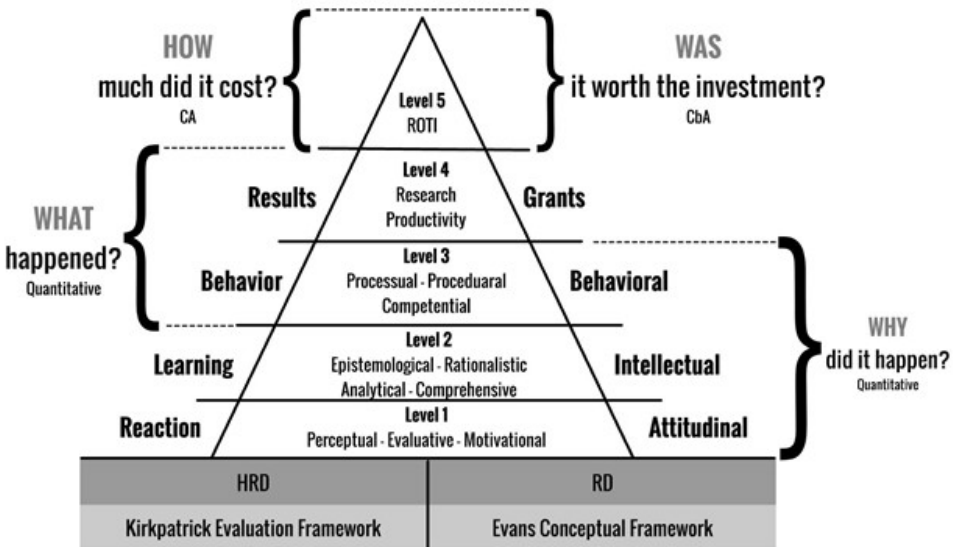


Figure 5. Micro-level Approach

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Combined Approach

CERTi utilizes a five-step process mentioned by Stolovitch and Keeps (2006) that uses Logic Models (LM) as a systematic approach to operationalizing *CERTi*'s macro-micro approaches to assess FRD program efficacy comprehensively. The approach consists of 1) Developing an LM representing the program-as-intended, 2) Identifying measures of key program indicators, 3) Developing an LM representing the program-as-implemented, 4) Comparing program-as-intended to program-as-implemented LM, and 5) Improving the program. LM assist in understanding the FRD program theory of change. They holistically describe/illustrate how and why desired change happens within a particular context. They map out the "missing middle" between what a program does (i.e., its' activities) and how these lead to desired goals (i.e., its' impact). As illustrated by Figure 6, LM are flowcharts that summarize a program's critical elements, such as '*Inputs*', resources needed to operate the program (i.e., human, financial, organizational, or material). '*Activities*' are inputs' allocation or events, while '*Outputs*' are activities' direct/immediate results. '*Outcomes*' are short-term, intermediate, and longer-term results evidenced by specific changes in participant skills, knowledge, behavior, performance, and '*Impact*', which is the ultimate change to the organization resulting from the program. (McLaughlin & Jordan, 2004).

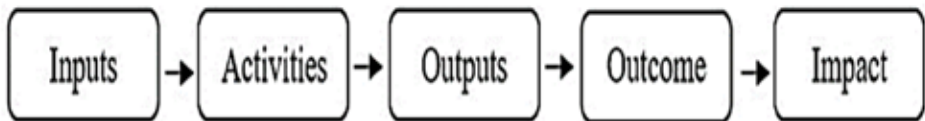
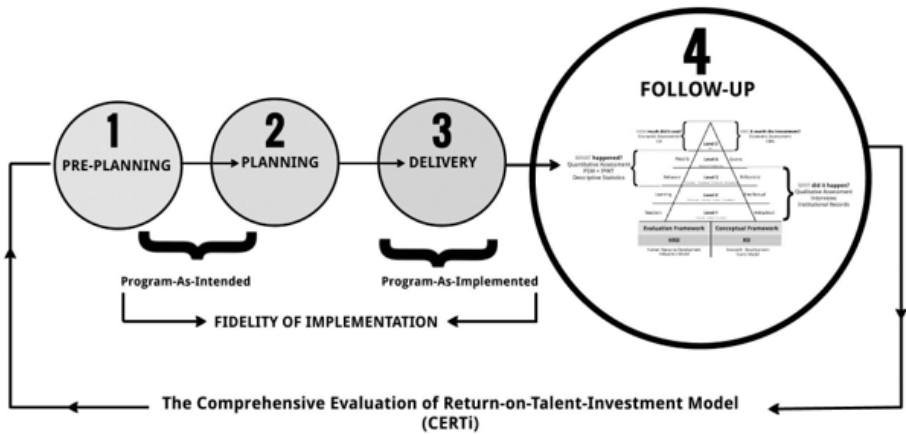


Figure 6. Logic Model

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Read from left to right, LM describes the program as it should work; inputs feed into activities yielding individual outputs resulting in specific outcomes and producing desired impacts. Read from right to left, they describe the program's theory; creating individual impacts necessitates accomplishing particular outcomes resulting from specific outputs, emanating from critical activities, and requiring unique inputs. Understanding the FRD program theory of change is essential because it explains linkages between activities and outcomes and how and why the desired change is expected, based on past research or experiences. LM are essentially a graphic representation of change theory illustrating the linkages among resources, activities, outputs, audiences, and short-, intermediate- and long-term outcomes. Figure 7 illustrates the *CERTi* comprehensive macro-micro approach.



CERTi - The Comprehensive Evaluation of Return-on-Talent Investment Model

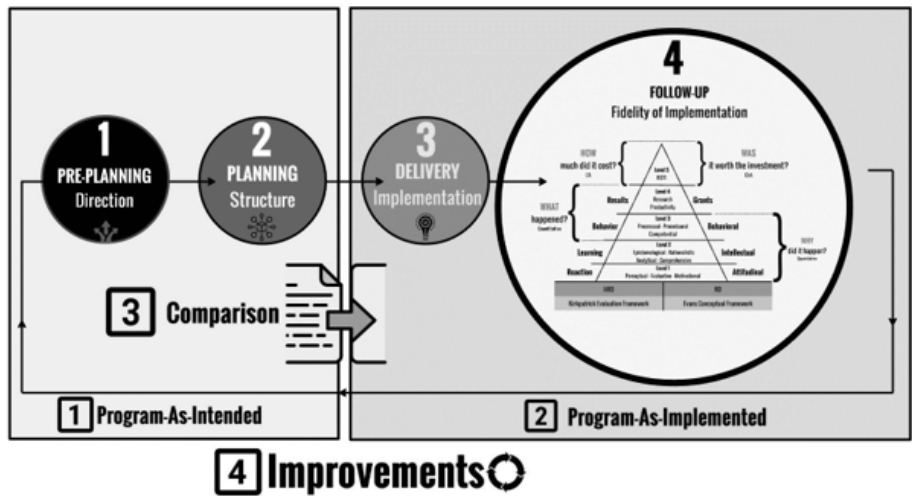


Figure 7. The CERTi Model

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CERTi Model Application

To demonstrate *CERTi's* applicability, we present a hypothetical case study of an FRD program. Facing governmental divestment in HEI and a recent decline in grant acquisitions, HEI leadership at the College of Public Health at an R1 research-intensive university implemented an FRD program to increase its faculty's grant acquisition skills. The College faces a leveling off of federal

grant funding due to a leveling of grant submissions and a decline in funded grant proposals. The program relies on senior level (i.e., Professor rank) faculty with a demonstrable record of grant acquisition to mentor a cohort of their junior level (i.e., Assistant rank) counterparts. The program was one year in length and coincided with federal agency proposal submission deadlines to culminate in grant proposal submissions to that agency.

Macro-Level

A *CERTi* evaluator begins by creating a program-as-intended LM representing the program's macro-level (i.e., pre-planning and planning) stages by documenting inputs, activities, outputs, outcomes, and desired impact as envisioned by its designers. Program artifacts (e.g., a timeline of events) and interviews with its designers (i.e., leadership team) represent these data points. Next, key program indicator measures are developed, facilitating comparison between program-as-intended and program-as-implemented LM to ascertain program FOI. The evaluator documents the program's inputs (e.g., faculty time and effort, facilities, supply costs), activities (e.g., group sessions and mentor/mentee meetings), outputs (e.g., grant proposals submissions), outcomes (e.g., mentee attitudinal, intellectual, behavioral) data, and impact (e.g., ROI data) utilizing the three-pronged qualitative, quantitative, and economic micro-level approach that take place during the delivery and follow-up stages.

Micro-Level

Quantitative Assessment—Researchers often aim to determine the effects of non-randomized factors, such as race, gender, and experience, to determine an unbiased estimate of the causal relationship between a sample's outcome and these nonrandomly assigned factors. They do this because non-randomized interventions create potential biases where the effect of treatment on outcome may be subject to treatment selection bias wherein receiving treatment based on shared covariates differs. A simple comparison between these groups' outcomes becomes an insufficient method of estimating treatment effect (Rosenbaum & Rubin, 1984). Lack of randomization can lead to an unbalanced probability of receiving treatment, conditional on baseline covariates, which opens the door for oversampling in either direction. Hence, we strongly encourage using causal estimation methodologies to estimate the causal effect of FRD programs in randomization's absence.

Randomized control trials (RCTs) are admittedly expensive to administer, consume researchers' valuable time and are often impractical to implement, explaining observational study prevalence in the educational field. However, researchers are increasingly employing statistical methods to mimic RCTs to increase their studies' rigor in the absence of randomization (Austin & Stuart, 2015). One such method increasingly used for addressing confounding and moving towards more causal estimates is using propensity scores to balance observable baseline covariates between treatment and control groups. A propensity score is the probability of treatment assignment conditional on measured baseline covariates, which allows for reducing or eliminating the confounding effects when using observational data (Rosenbaum & Rubin, 1983).

Pan and Bai (2015) outlined four steps to estimating the causal effect of programs:

1. Estimate propensity score
2. Match
3. Evaluate match quality
4. Evaluate outcomes

The first step entails estimating the likelihood of an individual data unit experiencing treatment given a set of characteristics (i.e., covariates). The second step involves matching scores of treated individual units within the data set to non-treated ones outside of the data set (i.e., control group) with a similar propensity score (i.e., probability of receiving the treatment given the same set of covariates) to have a more convincing comparison group. The third step involves evaluating match quality (i.e., the balance of covariates). The fourth and final step entails evaluating outcomes and estimating causal effects.

The statistical literature describes four methods of using propensity scores to address selection bias: stratification, adjustment, matching, and, more recently, inverse probability of treatment weighting (IPTW). Among all these methods, both matching and IPTW have demonstrated the greatest efficiency in reducing imbalance in baseline covariates (Pirracchio, Resche-Rigon, & Chevret, 2012). Austin and Stuart (2015) observed that the "use of IPTW has increased rapidly in recent years" (p. 3664) because this method creates non-confounded pseudo-populations. In such cases, there is oversampling of treated or control groups based on specific covariates. Countering this oversampling by weighting facilitates achieving balance. Figure 8 illustrates such a situation; there is oversampling in the treated group compared to the control group. Nine out of ten subjects, in this example, are treated, which creates an imbalance. This oversampling must be adjusted by up-weighting the control group by the inverse probability of being in the control group and down-weighting the treatment group by the inverse probability of being in the treatment group, which creates balance.

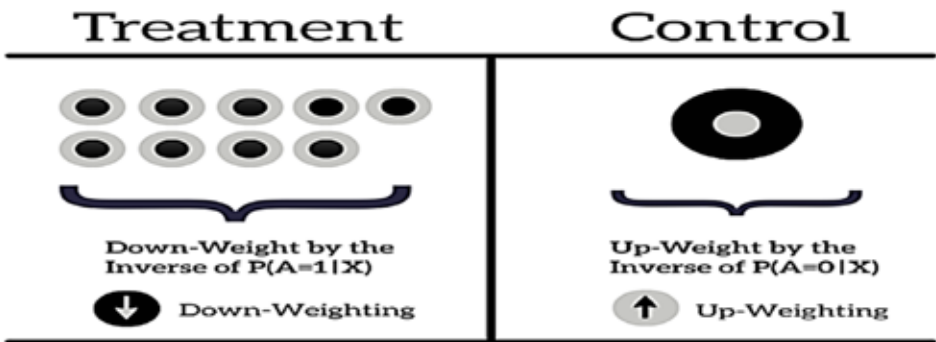


Figure 8. IPTW

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Achieving this balance results in a balanced pseudo-population based on observable baseline covariates, ensuring that, on average, treated subjects do not differ systematically from their control counterparts based on those characteristics, allowing for direct comparison between the groups to estimate treatment effect as illustrated by Figure 9. Each treated subject counts as nine-tenths of a subject (i.e., down-weighted) while the control subject counts as ten subjects (i.e., up-weighted), achieving balance. As a consequence of this weighting, what is absent in this new population is the oversampling present in the original one. In the original group, subjects had a higher probability of receiving treatment based on shared baseline covariates, while in the new one, that probability is equal. Although this does not rise to the rigor of randomization, it essentially mimics the desired characteristics of randomization present in RCTs.

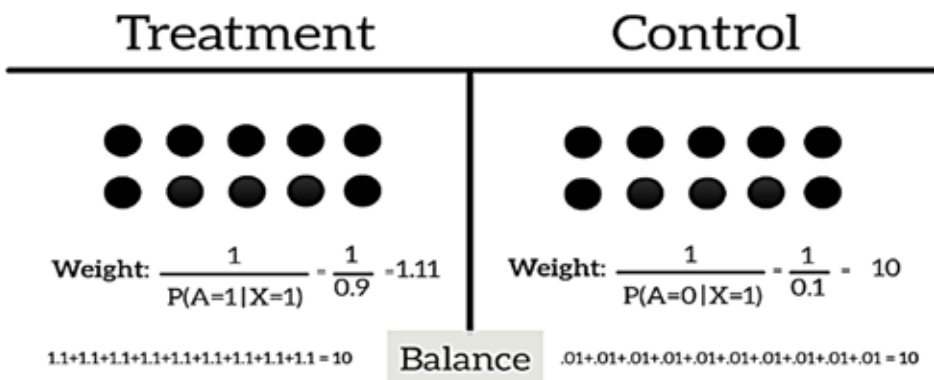


Figure 9. Balanced Pseudo Populations

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In summary, for researchers aiming to use IPTW to link an FRD program to its' outcome, good practice includes identifying an appropriate data set, defining the treatment, control, and outcome, selecting appropriate covariates, estimating the propensity score to 'match' the groups, assessing the 'matching' using balance techniques, and conducting an analysis of the outcome on the propensity score-adjusted sample. A *CERTi* evaluator can utilize the process shown in Figure 10 to create a pseudo-control group from non-participating faculty within the College based on shared baseline covariates (e.g., Race, Gender, Rank). Compared to FRD program participants, the outcomes of the pseudo-control group isolate treatment effect. They can accomplish this by identifying an appropriate data set, defining treatment, control, and outcome, selecting relevant covariates, estimating propensity scores to match groups, assessing match quality, and estimating program causal effect.

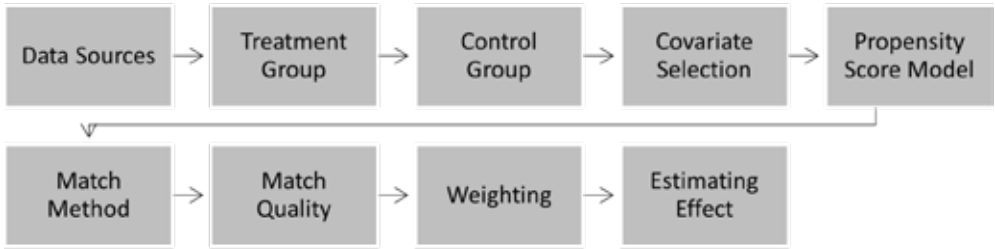


Figure 10. Estimating causal effects process

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Qualitative Assessment—Supplementing the quantitative assessment by conducting interviews with all stakeholders (e.g., leaders, mentors, and mentees) facilitates mapping out the "missing middle" between the program's activities and its' potential impact. Qualitative data provides an in-depth appraisal of "Why" things happened, which is essential to explaining program effectiveness and understanding the theory of change undergirding the program. Reviewing program records and artifacts (e.g., program timeline, the outline of events, session handouts, communications), along with university institutional records, facilitate developing the program-as-intended LM and identifying key program indicators. Semi-structured interviews with program developers (i.e., Leadership team) provides data on program pre-planning and planning activities.

Program records and artifacts (e.g., attendance records, communications, and presentations), university institutional records, and semi-structured interviews with participants (i.e., mentees and mentors) provide data facilitating the development of the program-as-implemented LM. Interviews with mentees and their mentors provide feedback on their experiences and allow for triangulation and verification of their interactions, providing a more holistic examination. These data elucidate the minutia of the mentoring process. Mentor perceptions regarding their interactions with mentees and between-mentee comparisons add rich context to mentees' attitudinal, intellectual, and behavioral data, providing a comprehensive picture of the development process.

Economic Assessment— Economic evaluations combine economics, a field concerned with allocating scarce resources, with evaluations. This data-informed field helps decision-makers choose among alternative policies or decision-making programs (Levin et al., 2017). Enhancing FRD program evaluations' robustness by supplementing the combined quantitative and qualitative approaches with a sound economic evaluation based on opportunity cost is essential to achieving a comprehensive evaluation methodology. Opportunity cost is "the value of what is sacrificed by using a specific resource in one way rather than in its best alternative use" (Levin & Belfield, 2015, p. 403). The assumption among decision-makers and evaluators is that cost information is readily available from budgets and business personnel. However, these methods are unreliable as a source for cost estimation because they fail to systematically account for all costs associated with the provision of programs and neglect to account for opportunity cost.

In contrast, the ingredients method of cost estimation is based on the economic principle of opportunity cost and provides more accurate cost estimations. It assumes that all the ingredients (e.g., personnel, training, facilities, equipment, materials, other outputs) associated with programs have cost implications. Operating under this assumption, the method documents all resources utilized in the program, regardless of whether each resource has a budgetary cost or not, to fully capture its actual cost. Next, it involves matching each ingredient with its respective costs. Monetizing ingredients' most common method is market prices because competition produces an equilibrium price representing the good's value. The simplicity and availability of market pricing have contributed to their everyday use in the educational field. Several things must be taken into consideration when valuing ingredients, such as geographic location. National average pricing is good for generalizability, but sometimes local average pricing is advantageous, especially when addressing local constituents such as policymakers. The critical consideration in choosing between national and local average pricing is transparency in detailing how ingredients were valued. Shadow pricing, "societal willingness to pay for a specific impact" (Levin & McEwan, 2000, pp. 60-61), is utilized in the absence of market prices. Various methods can calculate shadow pricing. One can use the market analogy method (i.e., using the market prices for comparable goods) or the defensive expenditure method (i.e., using estimates of society's willingness to pay to avoid adverse outcomes). Additionally, economists have made use of the hedonic method (i.e., use estimates of how much people are willing to pay for personal gains) and the trade-off method, and the contingent method (i.e., surveying people about how much they would be willing to pay). The ingredients method concludes with calculating total program costs, which provides evaluators with a proper accounting of the cost of each program to conduct their economic evaluation of choice; Cost-Effectiveness Analysis (CEA), Cost-Feasibility Analysis (CFA), Cost-Utility Analysis (CUA), Cost-benefit Analysis (CBA).

CBA's are analytical tools that compare alternatives based on the differences between their costs and a monetized measure of their effect. Essentially, this type of analysis monetizes program benefits and compares them to its' cost to determine program ROI, which makes it the most appropriate for calculating an FRD program's ROI. CBA evaluates all potential costs, including opportunity costs. This method produces the necessary information to gauge whether the program examined is worth university investment. It compares the program's benefit (i.e., total grant dollars) to its' total cost of provision to determine its ROI. Two central economic metrics used in benefit-cost analyses are Net Present Value (NPV) and Benefit-Cost Ratio (BCR), which bring program benefits and cost together to obtain an economic metric that informs as to the efficiency of educational investments (Levin et al., 2017).

Net Present Value (NPV) represents the discounted value of the benefit minus the costs' discounted value. Discounting is a process of determining money's present value since money is worth more today than tomorrow according to the time value of money (TVM) principle (Lokken, 1986). One method is the consumer saving options (i.e., returns sacrificed by consumers in order to consume resources now instead of saving them), and another is the average ROI made by entrepreneurs in the private sector (i.e., sacrificing resources in one project instead of using them in another) (Levin et al., 2017). There are many methods for choosing a discount rate. "The disagreement in the literature suggests evaluators should choose an initial discount rate of 3%

to 5% as a baseline discount rate and then test for uncertainty by conducting sensitivity analyses that vary discount rates between 0% and 10% to check the robustness of the findings." Levin et al. (2017, p. 99) This process allows for the adjustment of the TVM (Levin et al., 2017), as represented by the equations below. B_i and C_i are benefit and cost, t is the year in a series ranging from 1 to n , and i is the discount rate.

$$B_{PV} = \sum_{t=1}^n \frac{B_i}{(1+i)^{t-1}} \quad C_{PV} = \sum_{t=1}^n \frac{C_i}{(1+i)^{t-1}}$$

The equation calculates the NPV, where NPV=net present value, B=benefit, C=cost, and PV=present value.

$$NPV = B_{PV} - C_{PV}$$

According to Levin et al. (2017), "The NPV metric has the advantage of being the most straightforward to report and interpret" (p. 222). Programs with higher NPVs are always preferred, while programs with an NPV amount of less than zero are assumed inefficient and rejected.

Although NPV is a simple and straightforward method for ascertaining program ROI, it does come with a trade-off. The method's simplicity makes it difficult to compare programs because a program's scale makes such a difference to the total number. A simple adaptation to the NPV metric of dividing benefit present value by cost present value is one way of overcoming this shortcoming, as illustrated by this equation.

$$BCR = \frac{B_{PV}}{C_{PV}}$$

A BCR above 1 represents benefits exceeding costs, and contrarywise, a BCR lower than 1 represents costs exceeding benefits, allowing for a better ROI comparison between programs. In this case study example, the FRD program aimed to attain NIH large-scale R-level grants. A *CERTi* evaluator would then utilize program benefit data (i.e., total grant dollars) from the quantitative assessment to compare the cumulative costs resulting from applying the ingredients method to assess the program's ROI via either the NPV or BCR metrics. They can also conduct a sensitivity analysis for cost estimates to test for their robustness.

Combined Approach

The data and ensuing analyses from this comprehensive (i.e., Macro-Micro) approach provide an estimate of program effectiveness, a realistic depiction of what transpired during the program's implementation, and a measure of ROI, allowing comparison between program intent and implementation in actuality to uncover incongruities. Findings resulting from LM comparison

may lead to one of these conclusions: 1) The program was implemented as intended and was successful; good planning, proper implementation, positive result, 2) The program was implemented as intended and was not successful; poor planning, proper implementation, a negative result, 3) The program was not implemented-as-intended and was not successful; good planning, poor implementation, a negative result, 4) The program plan was not clear, poorly implemented, and was not successful; poor planning, poor implementation, negative result Stolovitch and Keeps (2006). Any LM comparison data resulting in a negative outcome requires utilizing the macro/macro data to redesign the original program for continuous improvement. The comparison data would undergird the development of a new and improved program addressing the first's shortcomings. Figure 11 illustrates *CERTi*'s cyclical approach with LM outcomes.

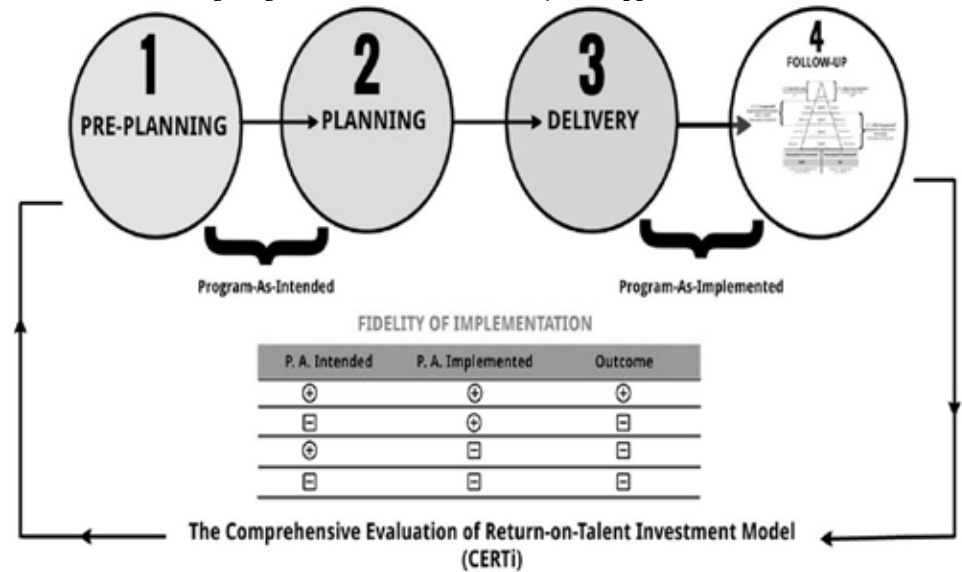


Figure 11. Cyclical approach
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Conclusion and Implications

As the world grapples with the financial implications of the COVID-19 global pandemic, HEI, who are already under fiscal strain, are sure to reduce funding for faculty PD and potentially eliminate FRD programs. Comprehensively assessing the efficacy and ROI of such programs is ever more crucial. Although past research evaluated FRD programs in terms of their effectiveness, implementation practices, and ROI independently, no model suggested addressing all three concurrently and simultaneously to assess these programs' worth comprehensively. *CERTi* provides an innovative, comprehensive, and interdependent approach that combines quantitative, qualitative, and economic methodologies to advance adult PD theory in a higher education setting. Future work should empirically examine the viability of the model in the field setting and expand the model to include a talent-centered focus (Tran, 2020), which emphasizes the needs of employees (e.g., support, growth, satisfaction, engagement) and assesses the degree to which FRD programs meet those needs.

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References

- AAAS. (2019). R&D at Colleges and Universities. Retrieved from <https://www.aaas.org/programs/r-d-budget-and-policy/rd-colleges-and-universities>
- Astin, A. W. (2012). *Assessment for excellence: The philosophy and practice of assessment and evaluation in higher education*. Rowman & Littlefield Publishers.
- Austin, P. C., & Stuart, E. A. (2015). Moving towards best practice when using inverse probability of treatment weighting (IPTW) using the propensity score to estimate causal treatment effects in observational studies. *Statistics in medicine*, 34(28), 3661-3679.
- Cronan, M. (2012). Grant strategies in a difficult funding climate. *Research Development & Grant Writing News*, 2(9).
- Evans, L. (2011). What Research Administrators Need to Know about Researcher Development: Towards a New Conceptual Model. *Journal of Research Administration*, 42(1), 15-37.
- Feldman, M. D., Steinauer, J. E., Khalili, M., Huang, L., Kahn, J. S., Lee, K. A., . . . Brown, J. S. (2012). A mentor development program for clinical translational science faculty leads to sustained, improved confidence in mentoring skills. *Clinical and translational science*, 5(4), 362-367.

- Fox, G. J., Benedetti, A., Mitnick, C. D., Pai, M., Menzies, D., & MDR-TB, C. G. f. M.-A. o. I. P. D. i. (2016). Propensity score-based approaches to confounding by indication in individual patient data meta-analysis: non-standardized treatment for multidrug resistant tuberculosis. *PloS one*, 11(3), e0151724.
- Freel, S. A., Smith, P. C., Burns, E. N., Downer, J. B., Brown, A. J., & Dewhirst, M. W. (2017). Multidisciplinary Mentoring Programs to Enhance Junior Faculty Research Grant Success. *Academic medicine: journal of the Association of American Medical Colleges*, 92(10), 1410-1415. Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5589470/pdf/nihms-845093.pdf>
- Gardiner, M., Tiggemann, M., Kearns, H., & Marshall, K. (2007). Show me the money! An empirical analysis of mentoring outcomes for women in academia. *Higher Education Research & Development*, 26(4), 425-442.
- Haras, C., Taylor, S. C., Sorcinelli, M. D., & von Hoene, L. (2017). INSTITUTIONAL COMMITMENT TO TEACHING EXCELLENCE: Assessing the Impacts.
- Jagsi, R., Griffith, K. A., Jones, R. D., Stewart, A., & Ubel, P. A. (2017). Factors associated with success of clinician-researchers receiving career development awards from the National Institutes of Health: a longitudinal cohort study. *Academic medicine: journal of the Association of American Medical Colleges*, 92(10), 1429.
- Kena, G., Hussar, W., McFarland, J., de Brey, C., Musu-Gillette, L., Wang, X., . . . Dunlop Velez, E. (2016). *The Condition of Education 2016*. Retrieved from The Condition of Education:
- Kirkpatrick, D. (1994). *Evaluating Training Programs: The Four Levels*. 1994 San Francisco. Calif Berrett-Koehler.
- Kulage, K. M., & Larson, E. L. (2017). Intramural Pilot Funding and Internal Grant Reviews Increase Research Capacity at a School of Nursing. *Nursing Outlook*.
- Lawler, P. A., & King, K. P. (2000). Refocusing faculty development: The view from an adult learning perspective.
- Levin, H. M., & Belfield, C. (2015). Guiding the development and use of cost-effectiveness analysis in education. *Journal of Research on Educational Effectiveness*, 8(3), 400-418.
- Levin, H. M., & McEwan, P. J. (2000). *Cost-effectiveness analysis: Methods and applications* (Vol. 4): Sage.

- Levin, H. M., McEwan, P. J., Belfield, C., Bowden, A. B., & Shand, R. (2017). *Economic evaluation in education: Cost-effectiveness and benefit-cost analysis*: SAGE publications.
- Lokken, L. (1986). The Time Value of Money Rules. *Tax L. Rev.*, 42, 1.
- Longo, D. R., Katerndahl, D. A., Turban, D. B., Griswold, K., Ge, B., Hewett, J. E., . . . Schubert, S. (2011). The research mentoring relationship in family medicine: findings from the grant generating project. *Family Medicine-Kansas City*, 43(4), 240.
- Lunsford, L. G., Baker, V., Griffin, K. A., & Johnson, W. B. (2013). Mentoring: A typology of costs for higher education faculty. *Mentoring & Tutoring: Partnership in Learning*, 21(2), 126-149.
- McLaughlin, J. A., & Jordan, G. B. (2004). Using logic models. *Handbook of practical program evaluation*, 2, 7-32.
- Morrison, L. J., Lorens, E., Bandiera, G., Liles, W. C., Lee, L., Hyland, R., . . . Heathcote, E. J. (2014). Impact of a formal mentoring program on academic promotion of Department of Medicine faculty: a comparative study. *Medical teacher*, 36(7), 608-614.
- Musambira, G., Collins, S., Brown, T., & Voss, K. (2012). From “Publish or Perish” to “Grant or Perish” Examining Grantsmanship in Communication and the Pressures on Communication Faculty to Procure External Funding for Research. *Journalism & Mass Communication Educator*, 67(3), 234-251.
- Newgard, C. D., Morris, C. D., Smith, L., Cook, J. N., Yealy, D. M., Collins, S., . . . Kimmel, S. (2018). The first national institutes of health institutional training program in emergency care research: productivity and outcomes. *Annals of emergency medicine*, 72(6), 679-690.
- NORDP. (2019). What is Research Development? Retrieved from <https://www.nordp.org/what-is-research-development->
- O'Donnell, C. L. (2008). Defining, conceptualizing, and measuring fidelity of implementation and its relationship to outcomes in K–12 curriculum intervention research. *Review of educational research*, 78(1), 33-84.
- Pan, W., & Bai, H. (2015). *Propensity score analysis: Fundamentals and developments*: Guilford Publications.
- Paul, S., Stein, F., Ottenbacher, K. J., & Liu, Y. (2002). The role of mentoring on research productivity among occupational therapy faculty. *Occupational Therapy International*, 9(1), 24-40.

- Pirracchio, R., Resche-Rigon, M., & Chevret, S. (2012). Evaluation of the propensity score methods for estimating marginal odds ratios in case of small sample size. *BMC Medical research methodology*, 12(1), 70.
- Rosenbaum, P. R., & Rubin, D. B. (1983). The central role of the propensity score in observational studies for causal effects. *Biometrika*, 70(1), 41-55.
- Rosenbaum, P. R., & Rubin, D. B. (1984). Reducing bias in observational studies using subclassification on the propensity score. *Journal of the American statistical Association*, 79(387), 516-524.
- Steiner, J. F., Curtis, P., Lanphear, B. P., Vu, K. O., & Main, D. S. (2004). Assessing the role of influential mentors in the research development of primary care fellows. *Academic Medicine*, 79(9), 865-872.
- Stolovitch, H. D., & Keeps, E. J. (2006). *Handbook of human performance technology: Principles, practices, and potential*: John Wiley & Sons.
- Tran, H. (2020). Revolutionizing school HR strategies and practices to reflect talent centered education leadership. *Leadership and Policy in Schools*, 1-15.
- Tsen, L. C., Borus, J. F., Nadelson, C. C., Seely, E. W., Haas, M. A., & Fuhlbrigge, A. L. (2012). The development, implementation, and assessment of an innovative faculty mentoring leadership program. *Academic medicine: journal of the Association of American Medical Colleges*, 87(12), 1757.
- Van der Weijden, I., Belder, R., Van Arensbergen, P., & Van Den Besselaar, P. (2015). How do young tenured professors benefit from a mentor? Effects on management, motivation and performance. *Higher Education*, 69(2), 275-287.
- Villar, A., & Strong, M. (2007). Is mentoring worth the money? A benefit-cost analysis and fiveyear rate of return of a comprehensive mentoring program for beginning teachers. *ERS Spectrum*, 25(3), 1-17.
- Wingard, D. L., Garman, K. A., & Reznik, V. (2004). Facilitating faculty success: outcomes and cost benefit of the UCSD National Center of Leadership in Academic Medicine. *Academic Medicine*, 79(10), S9-S11.
- Yoon, K. S., Duncan, T., Lee, S. W.-Y., Scarloss, B., & Shapley, K. L. (2007). Reviewing the Evidence on How Teacher Professional Development Affects Student Achievement. Issues & Answers. REL 2007-No. 033. *Regional Educational Laboratory Southwest (NJ1)*.

Encouraging Innovation: Should Internal Funding Programs Favor Faculty Who Are Already Productive?

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Abstract: *While it has been established that participation in interdisciplinary teams is likely to have a positive impact on researchers' careers, it has been questioned whether these researchers were already destined for success. If high-achieving faculty members are simply taking advantage of the availability of internal funds to boost their already high rates of productivity, internal programs designed to support the formation of novel teams and to enhance the impact of an institution's research portfolio may not be advancing their objectives. In this study, we examine whether applicants to an interdisciplinary funding program are already more productive than other faculty members, including those who apply for traditional (non-interdisciplinary) internal funding support. Data were drawn from several sources: Academic Analytics, which provides productivity data that allows for comparisons of faculty members within fields; the Office of the Vice Provost for Research's data on internal funding program applications; the Office of Research Administration's data on external grant proposal submissions; data from an internal survey on perceptions of the university's research climate; and Scopus, which provides individual faculty members' h-indices and lists of publications and citations. Results indicate that faculty members who join interdisciplinary research teams and are awarded internal funding are not more or less likely to be "superstars." This not only provides support for assertions that interdisciplinary programs can lead to team innovation and professional growth of individual faculty members, but also provides a blueprint for the establishment of baseline measures that can be used to help evaluate the impact of internal funding programs.*

Keywords: *Science of Team Science, Interdisciplinary Teams, Productivity*

Introduction

Academic institutions are economic engines in most regions in the U.S. and a significant source of scientific discovery and innovation (Association of Public and Land-Grant Universities, 2014), but more than this, they are seen as a powerful force for social change (Klein, 2008). Major funding agencies including the National Institute of Health (NIH) and National Science Foundation (NSF) recognize that the type of innovations required to make an impact on societal challenges require collaborations among researchers across disciplines (Stipelman et al., 2014). One set of criteria used by funding agencies for evaluating the viability of funding proposals focuses on the history of collaborations of an interdisciplinary team (Bennett et al., 2010). Thus, creating the conditions required for successful interdisciplinary collaboration is an imperative for research-intensive universities. One method for encouraging individuals to collaborate is the provision of pilot funding for teams that aim to address grand societal challenges. While there is no shortage of applicants for these opportunities for internal funding, universities face the difficulty of determining which teams are the most likely to succeed.

While the characteristics of successful teams are fairly well established, the attributes of faculty who are willing to engage with opportunities to collaborate across disciplines are still unclear. Hall and colleagues (2018) have identified this as a priority area for researchers who study processes and outcomes of scientific teams. Specifically, we are interested in whether funding should be directed toward faculty teams comprising members who are already highly productive and impactful in their own respective fields. The “productivity” question is often couched in language directing review committees to evaluate the “qualifications” or “accomplishments” of applicants. However, whether or not past productivity of team members is a predictor of a team’s success has not been well established.

Facilitating Factors for Productive Collaboration: Features of Organizations

The conditions required to motivate researchers to collaborate with each other is a long-standing question. These can be divided into organizational structural characteristics and individual attributes. Structural features of organizations that incentivize collaborations include the availability of pilot funding (Baldwin & Chang, 2007; Iglíč et al., 2017; Lotrecchiano et al., 2016); recognition and reward of researchers who engage in collaborations (Boardman & Corley, 2008; Lotrecchiano et al., 2016; Welch & Jha, 2016); and institutional norms that favor collaborations (Boardman & Corley, 2008). Other structural factors likely help motivate and support collaborations, including the availability of designated collaborative spaces, specific types of financial support provided to teams, and clear tenure and promotion policies that support interdisciplinary collaborations, but the real-world impact of these factors requires additional empirical investigation (Falk-Krzesinski et al., 2011).

Personal Characteristics of Productive Team Scientists

While structural features of organizations provide necessary support for interdisciplinary collaborations, personality characteristics and other personal attributes of researchers are also

associated with a greater willingness to collaborate. For example, researchers with positive attitudes toward collaboration are (not surprisingly) more likely to collaborate, and their teams are likely to have more impressive scholarly outcomes (Stipelman et al., 2010). Termed “readiness to collaborate,” this constellation of attitudes includes the desire to build relationships with researchers outside of one’s field, wanting to learn new skills, excitement about the prospect of advancing science, and the enjoyment of learning new information (Lotrecchiano et al., 2016).

Another key characteristic of researchers who are more likely to collaborate is cognitive openness (Baldwin & Chang, 2007; Belkhoujaa & Yoon, 2018; Mo et al., 2015). Researchers who are curious about a topic of importance and who are open to learning about it from many different disciplinary perspectives are not only motivated to collaborate, but may also contribute to positive internal team processes by being more personally affirming of the knowledge resources contributed by each member of the team, a communication behavior that supports team success (Woolley et al., 2010). Openness is a cognitive trait that is likely to produce positive attitudes toward collaboration.

Researcher Productivity

The variety of skills, resources, and experiences that individual researchers bring to a team are also important to the eventual success of a team (Woolley et al., 2015). These often translate into an individual team member’s productivity. The question of whether highly productive faculty members make better collaborators has been explored in several lines of research. Highly productive faculty “superstars” more easily attract collaborators because of their prestige, their ability to attract financial support, and their access to cognitive resources through their personal and professional networks (Jeong & Choi, 2014). Superstars’ demonstrated successes in producing scientific and technical knowledge is also a motivating factor for would-be collaborators who want to enhance their own productivity (Frenken et al., 2005). Thus, productivity can be seen as generating even greater productivity among team members. Further, top faculty members are likely to attract other top faculty members as potential collaborators (Lungeanu et al., 2014).

Although it is an unintended consequence of these patterns of collaboration, those with the greatest productivity have access to greater resources. In addition to attracting greater funding support, productive researchers have larger networks of previous collaborators and greater access to outlets for dissemination of their work because they are more likely to serve on editorial boards than less productive researchers (Frenken et al., 2005; Lungeanu et al., 2014). However, rewarding productivity in the form of internal pilot funding can be a double-edged sword. A case study of Stanford (Biancani et al., 2018) suggests that interdisciplinary initiatives can exacerbate inequalities by further advantaging scholars who are already highly productive and well-resourced. Academic institutions whose initiatives tip the balance in favor of already-productive faculty members may be hindering progress toward important goals such as increasing the competitiveness of funding proposals or generating meaningful technological innovations that are readily adoptable by key stakeholders.

There is evidence that individual research productivity is not a particularly good indicator of whether a diverse team will succeed in meeting its goals for productivity and innovation. Woolley and colleagues (2010, 2015) have studied the impact of a wide variety of factors including gender, disciplinary/professional background, and prior accomplishments on the outcomes of diverse teams. Their results indicate that individual team members do not need to be particularly accomplished in order to come together to generate innovation. A “satisficing” level of knowledge competence is necessary; top scholar status isn’t required. Other factors are considerably more important, especially team communication processes, which result in the creation of “collective intelligence” that can be successfully applied to complex problems (Woolley et al., 2010).

In fact, it appears that productivity is less important than positive attitudes toward and experiences with interdisciplinary collaboration. Stipelman and colleagues (2010) establish a clear empirical link between the number of publications/scholarly presentations and attitudes toward collaboration, rather than to previous productivity. It may well be that the personal chemistry of a group constitutes the sort of “magic” that generates team innovation and productivity, far beyond what could be predicted by the records of individual scholars (Hara et al., 2003). The more we know about who is engaged in interdisciplinary research efforts (relative to those who choose not to engage), the better we can understand the nature of the impact of interdisciplinary team science on individual faculty careers. The research question that guides this study is:

RQ1: Are the members of teams who receive competitive awards for interdisciplinary research more productive prior to receiving the award than other faculty ?

To answer this question, we have consulted a number of sources of data and indices of productivity and impact for faculty at the University of Miami. These include Elsevier’s Scopus (h-index), Academic Analytics (relative impact of a scholar within their own field), University of Miami’s Office of Research Administration (ORA, for number of grant applications and awards for each faculty member), and the Office of the Vice Provost for Research (OVPR), which maintains records on which faculty have received internal funding awards through the university’s primary funding mechanisms to support research and creative activity, including interdisciplinary team awards. This allowed us to compare faculty who (1) were members of interdisciplinary teams awarded funding through a highly competitive, rigorously evaluated process; (2) were members of interdisciplinary teams not awarded funding; (3) were not members of interdisciplinary teams applying through this mechanism but who did receive other internal (individual-level) awards; and (4) other faculty members who have not applied for (or did not receive) internal funding. Additionally, we report on data collected through the university’s Research Climate Survey, which allows us to compare the responses of faculty who have received interdisciplinary research funding support with faculty not participating in the program.

U-LINK

The internal funding mechanism supporting interdisciplinary team research, U-LINK (University of Miami Laboratory for Integrative Knowledge), was offered at the University of Miami between 2017–2020. (See Morgan, Ahn, et al., 2020; Morgan, Bixby, et al., 2020, and Morgan,

et al., 2019). The U-LINK program offered significant financial support and other resources for interdisciplinary teams across two phases of funding. Phase I teams received a total of \$40K that was explicitly designated to support “protected time” for team formation and collaboration processes; most faculty used these funds for summer salary. Phase I teams were also provided with meeting facilitation services (as needed) and designated meeting space in each campus’s library. Additionally, a matchmaking process integrated librarians as full members of each of the teams. Teams that received Phase I funding were eligible to compete for Phase II funding, which provided \$150K in funding, renewable for a second year, contingent on satisfactory progress. In addition to the forms of support awarded to teams in Phase I, Phase II teams received full funding for a full-time doctoral research assistant. Each year, 5-6 teams received Phase I funding and 2-3 teams received Phase II/Phase II renewal funding. (See <https://ulink.miami.edu> for additional program information and a list of projects for each phase of funding.)

Teams requesting U-LINK funding were evaluated on several criteria. These included interdisciplinary team composition (two or more departments/disciplines represented), whether the team was proposing to develop one or more implementable solutions (or feasible approaches) that could address a grand challenge to society, the innovativeness of the team’s approach, and the identification of appropriate stakeholder groups who agreed to engage in the collaboration process. U-LINK teams receiving funding had to meet a number of requirements: (1) actively engage key stakeholders in their collaborative work; (2) attend an annual full-day team science training program covering best practices and skills-based workshops; (3) submit progress reports and attend an annual Symposium presenting the outcomes of their work; and (4) apply for external funding in year two of Phase II funding. All teams that were renewed for Phase II funding met all requirements.

The award process was highly competitive in all three years. Table 1 presents the number of applications received and the number of applications that were funded. Members of an internal advisory board that included the Vice Provost for Research and Associate Provost for Research (co-directors of the U-LINK program), a development officer, and eight additional faculty from the arts, humanities, social sciences, and STEM fields evaluated each application. After a triaging process based on overall scores, an extensive discussion of the remaining applications resulted in consensus decisions about which teams would receive funding..

Table 1. Number of U-LINK Applications Received and Funded

Award Year	Phase I applications received	Phase I applications funded	Phase II applications received	Phase II applications funded
2018	42	5	--	--
2019	17	6	5*	3
2020	21	6	7	3

*Note: One team deferred their Phase II application until the following year due to team personnel changes.

Methods

Setting

The institution's factbook reported a total of 3,226 (2,697 full-time and 529 part-time) faculty members across three campuses. Of 3,226 faculty members in the institution, 1,891 (51%) identified as male and 1,335 (49%) identified as female. In addition, 1,757 (54%) identified as White, 817 (25%) identified as Hispanic or Latino, 135 (4%) identified as Black, 381 (12%) identified as Asian/Pacific Islander, and 136 (4%) identified as "other," including American Indian, 2 or more races, and unknown.

The institution is composed of regular ($n = 1,030$, 38%), educator ($n = 1,102$, 41%), research ($n = 184$, 7%), librarian ($n = 59$, 2%), and associated ($n = 322$, 12%) faculty members. According to the Higher Education Research and Development Survey Fiscal Year 2018 (National Center for Science and Engineering Statistics, National Science Foundation, 2019), the institution spent \$357,104,000 on research and development, including \$181,958,000 received from the federal government, \$18,374,000 from state and local government, and \$146,132,000 from other sources including institutional funds, business, and nonprofit organizations. This results in the institution ranking 72nd in the nation in terms of total research and development expenditures. In addition, the institution's medical school received \$133,469,892 from NIH in 2018, and it was ranked 40th among all US medical schools for research expenditures (Blue Ridge Institute for Medical Research, 2018). The institution's factbook in reported that 14% (\$510.1 million) of the institution's operational funding was derived from grants and contracts.

Data Collection

The data used in the current study were drawn from multiple sources. First, a list of faculty names who have received the institution's internal grants was obtained from the Office of the Vice Provost for Research (OVPR). Second, for all faculty members in the institution, a number of scholarly productivity measures were extracted from Academic Analytics (AA). From the AA database, we obtained faculty academic rank, discipline, and year of highest degree earned. Third, we extracted the h-index, the number of total publications and the number of citations per year for the last three years from Elsevier's Scopus database. Fourth, a dataset containing the number of extramural grant proposals all faculty members submitted as Principal Investigator (PI) or Co-PI from 2017 to 2019 was obtained from the institution's Office of Research Administration (ORA). All data were merged based on faculty members' last and first names. Lastly, we incorporated data from an institution-wide research climate survey administered in Fall 2019 (which asks whether respondents have applied for (or received) several types of internal funding, including U-LINK); the resulting data set from the OVPR allowed us to compute factor scores measuring attitudes toward interdisciplinary research and perceived support from institution for interdisciplinary research and to compare scores according to type of funding activity. (Please see Appendix A for survey items.)

Variables and Measures

Our research question was examined based on the following four sets of variables: (1) academic background; (2) scholarly productivity; (3) attitudes toward interdisciplinary research; and (4) perceived support from institution for interdisciplinary research.

Faculty Academic Background

Academic Analytics (AA) reports an individual faculty member's academic characteristics, including (1) academic rank as assistant, associate, or full professor, (2) broader field of study, which includes biological and biomedical sciences; business; education; engineering; family, consumer and human sciences; humanities; health professions sciences; natural resources and conservation; physical and mathematical sciences; and social and behavioral sciences, and (3) year of highest degree earned, from which we calculated years of experience in the field by subtracting from 2019.

Scholarly Productivity

Multiple quantitative metrics for individual faculty members' scholarly productivity were used. First, four scholarly productivity indicators—the number of books/book chapters and journal articles written by faculty in the previous 3 years, the number of citations of faculty members' scholarly publications, the number and dollar amount of grants received by faculty members, and the awards/honors received by the faculty members—were collected by AA from independent databases, web sources, and government agency reports. Second, AA's scholarly productivity metric, called the Faculty Scholarly Research Index (FSRI), was used to quantify scholars' relative impact in their respective disciplines. FSRI is a standardized score that is derived based on a set of statistical algorithms developed by AA, which assign differential weights on the four aforementioned indicators in one's respective field. Third, the h-index extracted from Scopus quantifies both productivity and impact of the published work of a scholar. Specifically, the h-index means that h documents from the author's set of published studies have been cited at least h times (i.e. 10 papers have been cited at least 10 times, resulting in an h-index of 10), but others have been cited fewer than h times. Lastly, the number of extramural grant proposals submitted by the faculty member as a principal investigator (PI) or a Co-PI was used to quantify the extent to which a faculty member is active in seeking extramural grants.

Attitudes Toward Interdisciplinary Research

Attitudes toward interdisciplinary research were measured using 10 researcher-developed survey items. Examples of survey items measuring attitudes toward interdisciplinary research include "Interdisciplinary research imposes a significant time burden", and "I rarely interact with researchers from other departments". Responses were measured on the 5-point Likert scale, ranging from 1 for Strongly Disagree to 5 for Strongly Agree. A factor score was computed after performing exploratory factor analysis of 10 survey items using the principal axis factoring method, with a higher score indicating more positive attitudes toward interdisciplinary research. Cronbach's alpha for the current sample ($n = 161$) was 0.75.

Perceived Support for Interdisciplinary Research

Perceived support from the institution for interdisciplinary research was measured using 4 survey researcher-developed items. Examples of items include “institution provides incentives for interdisciplinary research”, and “institution recognizes and rewards interdisciplinary researchers”. Responses were measured on the 5-point Likert scale, ranging from 1 for Strongly Disagree to 5 for Strongly Agree. A factor score was computed after performing exploratory factor analysis of four items using the principal axis factoring method, with a higher score indicating more perceived support from the institution toward interdisciplinary research. Cronbach’s alpha for the current sample ($n = 171$) was 0.87.

Analytic Strategies

We first summarized and compared the academic backgrounds of awardees of an interdisciplinary pilot research funding program, faculty who have received other forms of internal funding, and faculty who have not received either of these internal grants. Then, propensity score matching (PSM, Guo & Fraser, 2014) were performed to evaluate whether awardees of an interdisciplinary pilot research funding program have demonstrated different levels of scholarly productivity, when compared to faculty who have received other forms of internal funding, and faculty who have not received any internal funding. The MatchIt package (Ho et al., 2007a; 2007b) available in R (R Development Core Team, 2008) was used to perform PSM in order to examine whether interdisciplinary pilot research funding awardees were more likely to submit grants, be awarded external funding, publish more books or scholarly articles, or have publications with higher impact. Specifically, PSM is used to create matched subgroups that adjust for faculty academic ranks, years of experience post terminal degree, and faculty members’ disciplines, and then to compare scholarly productivity measures between balanced subgroups (i.e., interdisciplinary pilot research funding awardees; institution’s internal funding recipients; other faculty members who have received neither). The major advantage of this approach is that the potential selection bias that would threaten the validity of statistical results using the observational data (without random assignment) would be reduced by equating comparison groups based on the potential confounding covariates, when estimating the effectiveness of a program.

Results

Interdisciplinary Pilot Research Funding Awardees

Of a total of 63 interdisciplinary pilot research funding awardees, 49% are tenured or tenure-track faculty members. These include 3 Assistant (4.8%), 15 Associate (23.8%), and 13 Full (20.6%) professors. Those interdisciplinary pilot research funding awardees have a mean of 20.1 years since highest degree earned ($SD = 9.1$, $min = 3$, $max = 45$) from diverse fields of study: awardees in the 2019 funding cycle were affiliated with physical and life sciences (19%), engineering (15%), computer science (12%), education (12%), social and behavioral sciences (11%), medical and health sciences (11%), business (4%), arts and humanities (8%), communication (4%), and law (4%).

Interdisciplinary pilot research funding awardees had a mean of 17.9 h-index ($SD = 16.7$, $min = 0$, $max = 85$); a mean of 204.9 citations compiled by Scopus in 2017 ($SD = 363.7$, $min = 0$, $max = 1763$); a mean of 215.3 citations compiled by Scopus in 2018 ($SD = 360.8$, $min = 0$, $max = 1941$); a mean of 41.0 citations compiled by Scopus in 2019 ($SD = 360.8$, $min = 0$, $max = 1941$); and a mean of .28 of the Faculty Scholarly Research Index reported by Academic Analytics ($SD = 71.1$, $min = 0$, $max = 665$). On average, interdisciplinary pilot research funding awardees submitted approximately 2.5 external grant proposals through the institution's ORA from FY15 to FY18. Total grant proposals being submitted through the institution's ORA between FY15 and FY18 by these awardees ranged from 1 to 34 ($M = 9.7$, $SD = 8.4$). According to AA, which provides a four-year snapshot of grant awards, interdisciplinary pilot research funding awardees have received a mean amount of \$286,016 ($SD = \$350,107$, $min = 0$, $max = \$1,435,118$) from their extramural grant agents.

Academic Characteristics of Interdisciplinary Pilot Research Funding Awardees

When compared to other internal funding recipients, interdisciplinary pilot research funding awardees tend to be: (1) higher-ranked professors in the institution, indicating that assistant professors were less likely to join interdisciplinary pilot research teams, and (2) more experienced (i.e., 22.1 years since terminal degree award for interdisciplinary pilot research funding awardees vs. 12.1 for other internal funding recipients, $t(62.42) = 4.8$, $p < .05$). In addition, interdisciplinary pilot research funding awardees were less likely to be from humanities, engineering, and business, while they were more likely to be from biological sciences, natural resources and conservation, or health-related disciplines. When compared to all other faculty members in the institution, interdisciplinary pilot research funding awardees tend to be less experienced (21.8 years for interdisciplinary pilot research funding awardees vs. 26.1 years for other faculty members; $t(131.83) = -3.29$, $p = .001$).

Scholarly Productivity of Interdisciplinary Pilot Research Funding Awardees

Grant Submissions

After adjusting for faculty academic rank, years of experience in the field and broader discipline, results from propensity score analysis (PSA) indicate that there was a significant difference in the average number of external grant proposals submitted through ORA between interdisciplinary pilot research funding awardees and other internal funding recipients. As shown in Figure 1, interdisciplinary pilot research funding awardees submitted significantly more grant proposals ($n = 11.6$) through ORA than other internal funding recipients ($n = 5.2$), $t(37.84) = -3.42$, $p = .002$, 95% CI: -10.09 to -2.58. This suggests that interdisciplinary pilot research funding awardees are more experienced with the process of applying for extramural grant funding when they enter the pilot interdisciplinary research funding program.

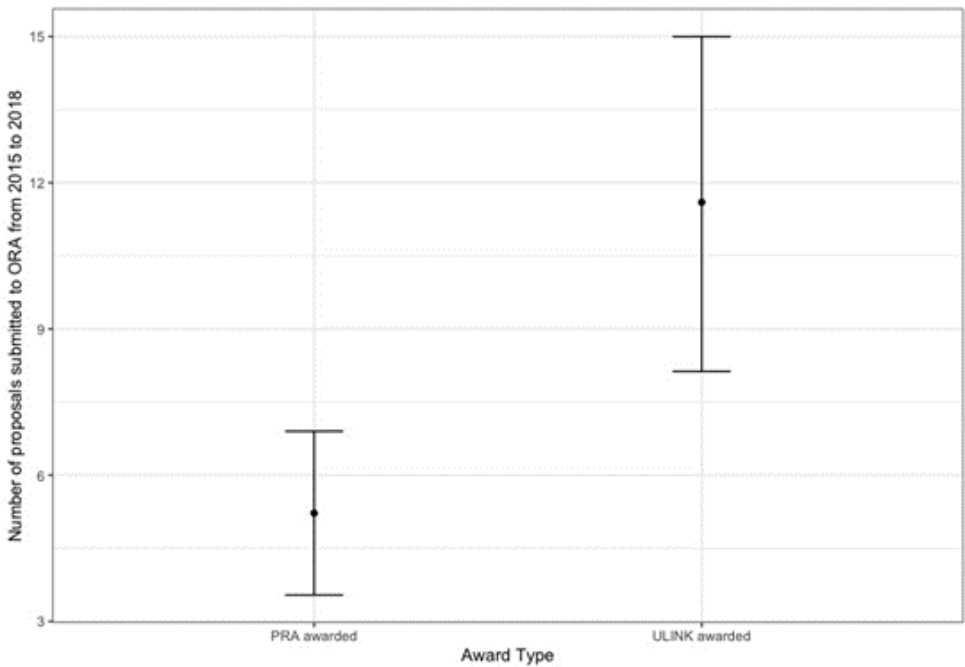


Figure 1. Comparison of External Grant Proposals Submitted by Internal Award Type

[Click here for larger image](#)

Scholarly Productivity

After adjusting for faculty rank, years of experience and discipline, results from propensity score analysis suggest that no significant difference exists between interdisciplinary pilot research funding awardees and other internal funding recipients on any other indicators of faculty scholarly productivity. The indicators of faculty productivity that we examined include faculty h-index (compiled by Scopus), number of scholarly citations (compiled by Scopus) in 2017, 2018, and 2019, overall Faculty Scholarly Research Index (compiled by Academic Analytics), as well as numbers of published books, articles, and citations (as compiled by Academic Analytics), number and dollar amount of grants (Academic Analytics), and faculty members' rankings within their own disciplines (Academic Analytics). Similarly, after controlling for all pre-existing confounding variables including faculty rank, experience, and disciplines, we found no statistically significant differences in any indicators of faculty productivity between interdisciplinary pilot research funding awardees and other faculty members in the institution.

Attitudes Toward Interdisciplinary Research

We were interested in whether attitudes toward interdisciplinary research among faculty based on their award status. Results from Analysis of Variance (ANOVA) indicated that no significant differences were found in faculty members' overall willingness to collaborate between faculty

who had applied to a pilot interdisciplinary funding opportunity ($M = 4.16$, $SD = .46$, $n = 34$) and those who had not applied ($M = 3.99$, $SD = .50$, $n = 95$) or those who did not know about it ($M = 3.97$, $SD = .60$, $n = 32$), $F(2, 158) = 1.57$, $p = .21$. (Please see Figure 2.)

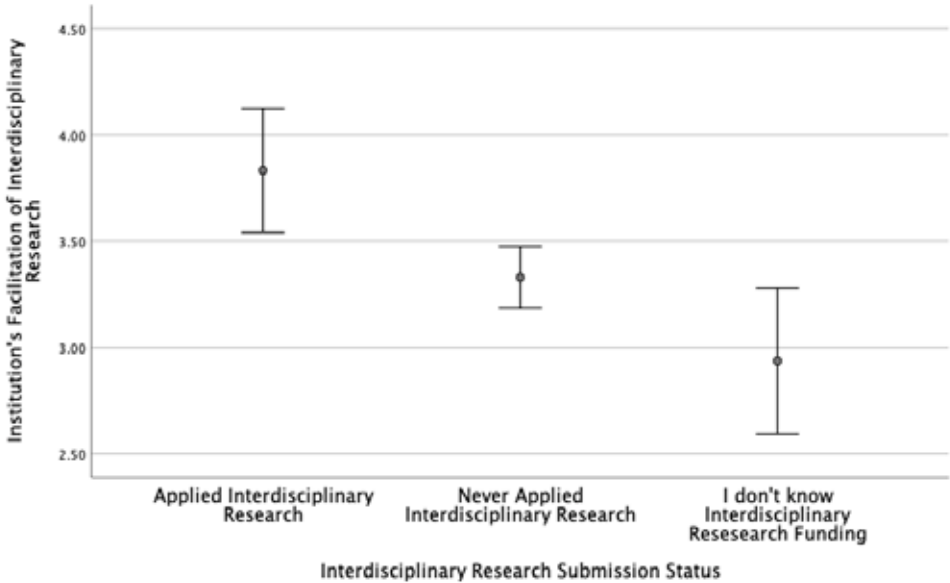


Figure 2. Perceived Support for Interdisciplinary Research by Faculty Members by Internal Grant Application Status

[Click here for larger image](#)

There were also no significant differences in willingness to collaborate between faculty who had been awarded a pilot interdisciplinary funding grant ($M = 4.10$, $SD = .44$, $n = 26$) and those who had not ($M = 4.35$, $SD = .51$, $n = 8$), $F(1, 32) = 1.76$, $p = .19$; this is presented in Figure 3. This indicates that faculty members who are not currently involved with a pilot interdisciplinary funding grant are nonetheless willing to engage in interdisciplinary collaborations.

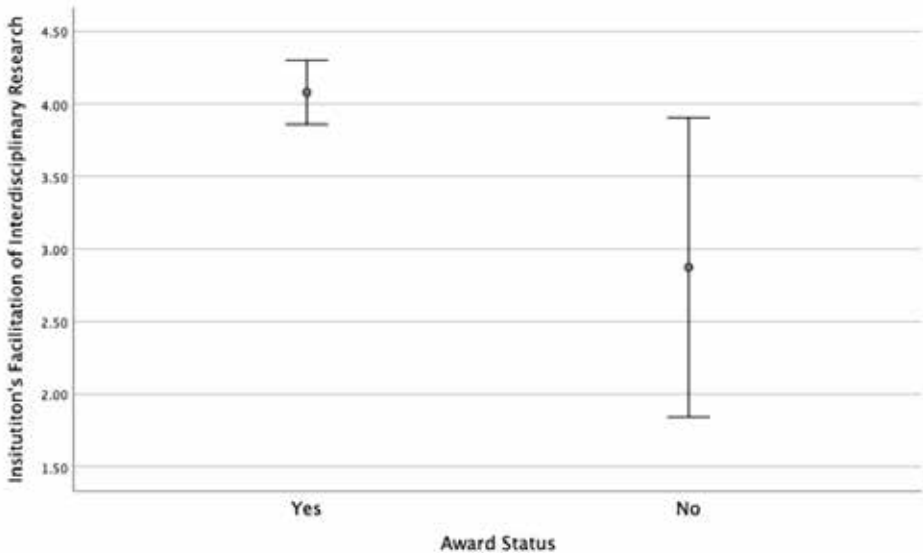


Figure 3. Perceived Support for Interdisciplinary Research by U-LINK Award Status

[Click here for larger image](#)

Discussion

A common criteria for evaluating applications for internal or external funding is the level of prior accomplishment of applicants. Additionally, funding programs designed to foster interdisciplinary team research through pilot funding involve the evaluation of proposals based on the likelihood that a team will succeed, which is often thought to be linked to the productivity of individual team members. Further, it stands to reason that any empirical evaluation of the effectiveness of an interdisciplinary funding program in producing greater research productivity should account for the possibility that the researchers who decide to join scientific teams are fundamentally different in some ways from other faculty members, i.e. that they are already more productive. Faculty “pushback” to internal funding programs sometimes takes the form of sentiments that such programs favor individuals who are less in need of scarce internal resources because they would be successful in applying for external funding without it.

To address these questions, we examined whether members of interdisciplinary teams are similar to faculty who were on teams that applied but were not awarded funding, or alternatively, faculty who have successfully competed for other internal funding without a specific interdisciplinary focus. In essence, these analyses are designed not only to provide insights into the attributes of faculty willing to engage in interdisciplinary collaborations, but also to investigate whether the future success of a pilot funding program might owe more to the characteristics of participating faculty members than to the features of the program itself.

Our analyses of multiple quantitative measures of faculty productivity indicate that with one exception, the faculty involved in a pilot interdisciplinary research program are no more (nor less)

likely to be highly productive. However, we found that faculty submitting applications for internal funding (both for the support of individual research and for interdisciplinary team projects) were more likely to have submitted external grant proposals, though they were not more likely to have been awarded external grant funding. These findings are important because in order to assert that faculty involvement in interdisciplinary research activities leads to greater faculty productivity and success, it is critical to establish a clear baseline for researcher activities and outcomes. While our analyses of items on a Research Climate Survey regarding attitudes toward interdisciplinary work indicate that most faculty are willing to engage in interdisciplinary research, it is also worth noting that open-ended responses indicate that some faculty have misgivings about the effects of such work on tenure and promotion decisions. If institutions are committed to interdisciplinary collaboration, such misgivings must be addressed by administrators and by faculty governing bodies (such as the Faculty Senate).

Our results are consistent with the work of researchers who have discovered that high levels of individual productivity are not predictive of interdisciplinary team success (Hara et al., 2003; Lungeanu et al., 2014; Pentland, 2012; Woolley et al., 2010, 2015). This finding indicates that interdisciplinary pilot funding programs can serve as a means to motivate mid- and late-career faculty members who may be searching for new sources of inspiration. A focus on broad challenges to society virtually demands the participation of faculty from diverse disciplinary backgrounds, including those in the humanities and social sciences, where insights into the human condition and human behaviors can lead to outcomes that are more easily translatable and implementable by key stakeholders. Similarly, faculty at smaller or mid-sized universities may find that they have fewer potential collaborators within their own disciplines. A well-run interdisciplinary research program that incentivizes the formation of new collaborations (without regard to current levels of research productivity) may be the spark needed to create innovative, fundable work.

There are, of course, limitations to this study. First and foremost, it provides insights into the patterns of productivity at just one university; unfortunately, the use of diverse sources of confidential data makes it difficult to perform these analyses across multiple universities. At the same time, this study provides a useful blueprint for conducting similar analyses at other institutions. Second, measures of productivity are controversial at best; it is difficult to distinguish between quality and quantity of research, for example. We have tried to mitigate the impact of this issue by incorporating multiple indicators of productivity and both internal and external sources of data.

There are several areas that warrant further exploration by researchers. First, because this study focuses on just one university, we would suggest that a consortium of research administrators across multiple universities follow the data collection procedures detailed here to create an expanded data set that can yield more generalizable findings. Second, we believe that universities interested in research productivity look to new and less traditional metrics (such as Altmetrics) to assess the impact of pilot research funding on private industry practice or public discourse about issues of importance via the media (Biancani et al., 2018).

Our findings have, of course, practical implications for research administrators. Perhaps most obviously, we believe that while measures of productivity and impact are important to consider

as accountability measures, they should be applied to individuals and teams who have already received funding rather than those who are applying for funding. Because past productivity appears not to be associated with long-term outcomes associated with the award of pilot funding, using an applicant's past scholarly productivity as a criteria is not only unwarranted, it may actually be counterproductive. Faculty who need the opportunity to pursue a more fruitful line of research or who need to restart a program of research after a period of inactivity would not be competitive for awards that could otherwise support their ability to join the ranks of productive and innovative researchers whose work advances the strategic objectives of the institution. This is particularly true for less-productive faculty who seek to engage in interdisciplinary team research, which offers unique opportunities to generate novel discoveries and successfully compete for external funding support (Lungeanu et al., 2014).

Conclusion

This study provides good news for universities that seek to promote interdisciplinary research and who hope for a significant return on investment. Although “superstar” faculty members may find it easy to hand-pick teams that include other highly productive faculty members, this is not a prerequisite for success. Our well-triangulated analyses demonstrate that interdisciplinary teams that secure funding in a highly competitive process have individual members who are no more or less productive than the average faculty member. This suggests that application review criteria should focus on the innovation represented in the proposal more than the prior achievements of faculty members on the team.

These findings also have significant implications for university recruitment of new faculty. Depending on university goals, investing in the hiring of a “big ticket” faculty superstar may not be as wise as investing funds in faculty development to teach faculty how to collaborate effectively across disciplinary boundaries in the quest to create meaningful and potentially transformative innovation. Such productive collaborations require that researchers know how to exhibit social sensitivity and to communicate effectively. These are skills that can and should be taught; greater collective productivity and innovation are likely to follow.

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References

- Association of Public and Land-Grant Universities. (2014). <https://www.aplu.org/>
- Baldwin, R., & Chang, D. (2007). Collaborating to learn, learning to collaborate. *Peer Review*, 9(4), 26–30. <https://www.aacu.org/publications-research/periodicals/collaborating-learn-learning-collaborate>
- Belkhouja, M., & Yoon, H. (2018). How does openness influence the impact of a scholar's research? An analysis of business scholars' citations over their careers. *Research Policy*, 47(10), 2037–2047. <https://doi.org/10.1016/j.respol.2018.07.012>
- Bennett, H., Gadlin, M., & Levine-Finley, S. (2010). Collaboration & team science: A field guide. National Institutes of Health. <http://teamscience.nih.gov>
- Biancani, S., Dahlander, L., McFarland, D. A., & Smith, S. (2018). Superstars in the making? The broad effects of interdisciplinary centers. *Research Policy*, 47(3), 543–557. <https://doi.org/10.1016/j.respol.2018.01.014>
- Blue Ridge Institute for Medical Research. (2018). Ranking tables of NIH funding to US medical schools in 2018. http://www.brimr.org/NIH_Awards/2018/NIH_Awards_2018.htm
- Boardman, P., & Corley, E. (2008). University research centers and the composition of research collaborators. *Research Policy*, 37(5), 900–913. <https://doi.org/10.1016/j.respol.2008.01.012>
- Falk-Krzesinski, H., Contractor, N., Fiore, S., Hall, K. L., Kane, C., Keyton, J., Klein, J. T., Spring, B., Stokols, D., & Trochim, W. (2011). Mapping a research agenda for the science of team science. *Research Evaluation*, 20(2), 145–158. <https://doi.org/10.3152/095820211X12941371876580>
- Frenken, K., Holz, W., & Vor, F. (2005). The citation impact of research collaborations: The case of European biotechnology and applied microbiology (1988–2002). *Journal of Engineering and Technology Management*, 22(1-2), 9–30. <https://doi.org/10.1016/j.jengtecman.2004.11.002>

- Guo, S., & Fraser, W. M. (2014). *Propensity score analysis: Statistical methods and applications* (2nd ed.). Sage Publications.
- Hall, K. L., Vogel, A. L., Huang, G. C., Serrano, K. J., Rice, E. L., Tsakraklides, S. P., & Fiore, S. M. (2018). The science of team science: A review of the empirical evidence and research gaps on collaboration in science. *American Psychologist*, 73(4), 532–548. <https://doi.org/10.1037/amp0000319>
- Hara, N., Solomon, S., Kim, S. L., & Sonnenwald, D. H. (2003). An emerging view of scientific collaboration: Scientists' perspectives on collaboration and factors that impact collaboration. *Journal of the American Society for Information Science and Technology*, 54(10), 952–965. <https://doi.org/10.1002/asi.10291>
- Ho, D., Imai, K., King, G., & Stuart, E. (2007a). Matching as nonparametric preprocessing for reducing model dependence in parametric causal inference. *Political Analysis*, 15(3), 199–236. <http://gking.harvard.edu/files/abs/matchp-abs.shtml>
- Ho, D., Imai, K., King, G., & Stuart, E. (2007b). Matchit: Nonparametric preprocessing for parametric causal inference. *Journal of Statistical Software*. <http://gking.harvard.edu/matchit/>
- Iglič, H., Doreian, P., Kronegger, L., & Ferligoj, A. (2017). With whom do researchers collaborate and why? *Scientometrics*, 112(1), 153–174. <https://doi.org/10.1007/s11192-017-2386-y>
- Jeong, S., & Choi, J. Y. (2014). Collaborative research for academic knowledge creation: How team characteristics, motivation, and processes influence research impact. *Science and Public Policy*, 42(4), 460–473. <https://doi.org/10.1093/scipol/scu067>
- Klein, J. T. (2008). Evaluation of interdisciplinary and transdisciplinary research: A literature review. *American Journal of Preventive Medicine*, 35(2 Suppl.), S116–S123. <https://doi.org/10.1016/j.amepre.2008.05.010>
- Lotrecchiano, G. R., Mallinson, T. R., Leblanc-Beaudoin, T., Schwartz, L. S., Lazar, D., & Falk-Krzesinski, H. J. (2016). Individual motivation and threat indicators of collaboration readiness in scientific knowledge producing teams: A scoping review and domain analysis. *Heliyon*, 2(5), e00105. <https://doi.org/10.1016/j.heliyon.2016.e00105>
- Lungeanu, A., Huang, Y., & Contractor, N. S. (2014). Understanding the assembly of interdisciplinary teams and its impact on performance. *Journal of Informetrics*, 8(1), 59–70. <https://doi.org/10.1016/j.joi.2013.10.006>

- Mo, G. Y., Hayat, Z., & Wellman, B. (2015). How far can scholarly networks go? Examining the relationships between distance, disciplines, motivations, and clusters. In *Communication and Information Technologies Annual* (pp. 107–133). *Studies in Media and Communications*: Vol. 9. Emerald Group Publishing Limited. <https://doi.org/10.1108/S2050-206020150000009005>
- Morgan, S. E., Ahn, S., Bixby, J. L., Mosser, A., Harrison, T., & Wang, J. (2020). *Measuring program and interdisciplinary team success: Metrics, measures, and impacts* [Conference presentation]. Annual meeting of the International Network for the Science of Team Science, Durham, NC (online conference). <https://www.youtube.com/watch?v=XJ4f9z8rjgc&list=PL66EPbm4ojiAFgVZBuNOtQct6orXWozab&index=5&t=0s>
- Morgan, S. E., Bixby, J. L., Mosser, A., de Velasco, J., Isom, D., Agarwal, A., Clement, A., Miller, K., Celik, N., Ferriss-Hill, J., Sawicki, A., & Timpano, K. (2020). *U-LINK: An innovative pilot funding program that operationalizes empirical findings in SciTS* [Conference presentation]. Annual meeting of the International Network for the Science of Team Science, Durham, NC (online conference). <https://www.youtube.com/watch?v=eWfej2H-Rs&list=PL66EPbm4ojiAFgVZBuNOtQct6orXWozab&index=3&t=0s>
- Morgan, S. E., Mosser, A., Ahn, S., Harrison, T. R., Wang, J., Reynolds, A., Huang, Q., Mao, B., & Bixby, J. L. (2019). *The University of Miami's Laboratory for INtegrative Knowledge: An evaluation of a team science workshop* [Conference presentation]. Annual Meeting on the Science of Team Science, Lansing, MI.
- National Center for Science and Engineering Statistics, National Science Foundation. (2018). Higher Education Research and Development Survey, fiscal year 2018. <https://ncesdata.nsf.gov/herd/>
- Pentland, A. S. (2012). The new science of building great teams. *Harvard Business Review*, 90(4), 61–70.
- R Core Team. (2020). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. <https://www.R-project.org/>
- Stipelman, B. A., Feng, A., Hall, K., Moser, R., Stokols, D., Nebeling, L., Berger, N., Goran, M., Jeffery, R., McTiernan, A., & Thornquist, M. (2010). The relationship between collaborative readiness and scientific productivity in the transdisciplinary research on energetics and cancer (TREC) centers. *Annals of Behavioral Medicine*, 39(1 Suppl.), S143.
- Stipelman, B. A., Huang, G., Hall, K. L., Wagner, R., Shuptrine, S. R., Pearson, K., et al. (2014, August 6–8). *An analysis of NIH funding of team-based research grant mechanisms* [Poster presentation]. Fifth Annual International Science of Team Science Conference, Austin, TX.

- Welch, E. W., & Jha, Y. (2016). Network and perceptual determinants of satisfaction among science and engineering faculty in US research universities. *Journal of Technology Transfer*, 41(2), 290–328. <http://dx.doi.org/10.1007/s10961-015-9393-z>
- Woolley, A. W., Aggarwal, I., & Malone, T. W. (2015). Collective intelligence and group performance. *Current Directions in Psychological Science*, 24(6), 420–424. <https://doi.org/10.1177%2F09637214155599543>
- Woolley, A. W., Chabris, C. F., Pentland, A., Hashmi, N., & Malone, T. W. (2010). Evidence for a collective intelligence factor in the performance of human groups. *Science*, 330, 686–688. <https://www.jstor.org/stable/40931726>

Appendix A

Attitudes Toward Interdisciplinary Research survey items

Interdisciplinary research imposes a significant time burden.

I rarely interact with researchers from other departments.

Interdisciplinary research improves research productivity.

Interdisciplinary research improves research quality.

Interdisciplinary research questions do not interest me.

Interdisciplinary collaboration is difficult because of differences in research methodology.

It is difficult to find a journal to publish interdisciplinary research.

Interdisciplinary research results in more publications than single-disciplinary research.

Interdisciplinary research threatens my autonomy as a researcher.

Interdisciplinary research increases the potential for scientific innovation.

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