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From the Editor’s Desk

Timothy L. Linker
High Point University

The Journal of Research Administration is dedicated to stimulating critical thought and creating a space for dialogue to answer questions posed to us by our evolving field. As the new Editor of the Journal, I want to thank Dr. Jeffrey N. Joyce, the previous Editor, for his untiring efforts to expand the Journal’s breadth and depth of expertise, while working to ensure that it reflects the global community that it serves.

As an outgrowth of those efforts, in October of 2015, the SRA board approved the Journal’s transition to an open access and electronic delivery model. This change reflects the Society’s efforts to broaden the reach and impact of the Journal and to ensure that it remains the preeminent scholarly publication for research administration. This change also reflects the way in which we engage and consume information.

The Journal’s cover art is a reflection of the Society of Research Administrators International’s (SRA) 2015 annual conference theme of Learn.Connect.Grow. In this edition of the Journal, you will find articles that speak to a number of pressing concerns in research administration. I encourage you to take a moment and explore the articles and see how they can impact your research endeavors. Canary and authors, in their paper entitled “Disciplinary Difference in Conflict of Interest Policy Communication, Attitudes, and Knowledge,” investigate how conflict of interest policies are communicated across different disciplines. Dejean, in her article “Syncing the Law to Resolve the Disconnection between Awareness and Action in Legally Mandated Diversity Hiring Practices in Higher Education Institutions,” champions embedding legal compliance within a framework of organizational psychology and therapeutic paradigms. Ashley and Goodman provide valuable insights on running a biorepository by focusing on financial and administrative aspects in their article “Establishing and Marinating an Academic Biorepository.” Marina and co-authors in their paper “Evaluating Research Administration: Methods and Utility,” consider evaluation methods that offer a clearer and more revealing picture of the research enterprise.

In the paper “How Do I Review Thee: Let me Count the Ways: A Comparison of Research Grant Proposal Review Criteria Across US Federal Funding Agencies,” Falk-Krzesinski and Tobin evaluate the review criteria of ten US Federal funding agencies and demonstrate the similarity of those criteria. Godreau and co-authors, in their paper “Growing Faculty Research for Students’ Success: Best Practices of a Research Institute at a Minority-Serving Undergraduate Institution,” detail the step-by-step method used to build a culture of undergraduate research.

I want to thank those at the Journal who worked diligently behind the scenes to bring this edition to print. I also want to thank the Society and its members again for this opportunity to serve as your Editor. I look forward to working with you to grow the Journal and shape our shared experience.

Please send manuscripts to journal@srainternational.org
Establishing and Maintaining an Academic Biorepository

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Abstract: The significance of biorepositories has been known for many years but the latest advances in clinical and translational research and increased collaborations among investigators have made biorepositories even more prominent. Biorepositories collect and store human tissue and serum samples used in both the research and treatment of disease. In cancer, researchers are now able to take a tissue sample of a human tumor and implant it into a mouse to duplicate the human disease progression and response to treatment. Thus, new drugs are tested in animal model systems with human tumors before they reach the stage of human clinical trials. The deciphering of the human genome has also led to greater use of and dependence on biorepositories. Tumor tissue can now be analyzed to determine the genetic alterations that appear consistently in tumors. These aberrant and tumor related genes then become biomarkers for drugs; thus, the genetic profile of a tumor becomes a target for drug treatment unique to that patient. The implementation and administration of a biorepository core facility is very challenging and requires organized infrastructure that involves strong institutional support and commitment. More than ever, institutions face ethical and regulatory issues with regard to tissue procurement and research, confidentiality, consent procedures and the handling of research results. In addition, securing steady financial support could pose one of the biggest challenges during these economic times when funding is limited. Overcoming these challenges is essential to ensure the long-term sustainability of the core facility. The research administrator can provide valuable insights into the many aspects of running an effective biorepository by focusing on both the financial and the administrative aspects of a biorepository core facility, including establishment of a recharge account so that services can be billed, user fee rates that can sustain business fluctuations, financial monitoring so that the business does not go into deficit, business plans and performance review to ensure that the business stays viable.
Introduction

Biorepositories are essential to research in order to advance the treatment of many diseases. Their products can assist researchers in the areas of prevention and control and in providing personalized medicine to patients. Establishing the infrastructure for a biorepository requires significant efforts in strategic planning to effectively identify and request consent from participants as well as prepare for the proper collection, processing and storage of specimens while maintaining participant privacy rights (Ambrosone, Nesline, & Davis, 2006).

There are many aspects to a biorepository system. The operational aspects include the collection, processing, storage, retrieval and distribution of biospecimens; collection and management of clinical data; quality assurance and control; and biosafety and bioinformatics system. The legal and ethical aspects include custodianship; informed consent from human subjects; privacy protections for individuals who donate biospecimens; researcher’s access to biospecimens and intellectual property and resource sharing (National Cancer Institute, 2011). The business aspects involve the development of a business model that adequately incorporates building a recharge facility with proper rate user fee structure, procedures and tools to appropriately monitor funding, business plans and performance review to ensure effective management of the core facility. This article will highlight the role of biorepositories in cancer research and the practical steps taken at the Moores Cancer Center to administer and enhance the procurement, storage and distribution of human tissue samples as well as the business aspects including the rate setting, billing, financial monitoring, annual business plans and performance reviews.

Use of the Biorepository

It is now well known that biorepositories are a key resource for cancer research. It is therefore vital to have biorepositories in the Cancer Center as new therapies are developed and made available to patients to save and prolong lives. Their products can assist researchers in the areas of prevention and control and in providing personalized medicine to patients.

Scientists have developed many ways to identify genes and their functions and have learned a great deal about the role they play in the origin and progression of diseases. With the help of biorepositories, scientists are able to analyze vast amounts of clinical information about a patient’s health and diseases. Biorepositories can assist researchers to identify and validate ways to deliver drugs, identify how diseases progress and vary, and determine how different groups of patients respond to drugs. There are examples of how biospecimens can accelerate cancer research. Through the use of well-characterized and well-preserved tissue samples, a drug called trastuzumab (Herceptin®) was developed for the treatment of a genetically linked form of breast cancer. Another drug called Gleevec® was originally developed for the treatment of Chronic Lymphocytic Leukemia, a form of blood cancer, but researchers found through the analysis of biospecimens collected from different tumor types that it also can be used for treatment of gastrointestinal stromal tumors and is now FDA approved for that purpose (National Cancer Institute, 2015).

As the use of biorepositories increased, it created more collaboration among institutions and the establishment of large national databases. The existence of these large dispersed databases...
prompted the need for centralization at both the local institutional as well as the national level (Ginsburg, Burke, & Febbo, 2008). This led to the creation of the “next generation” biorepositories (Fullerton, Anderson, Guzauskas, Freeman, & Fryer-Edwards, 2010). The next generation biorepository will provide great scientific benefits to the medical community but there are many challenges associated with its implementation. The new initiatives and research governance can make the establishment and maintenance of biorepositories very difficult. Institutions have to deal with many ethical and regulatory issues in the areas of privacy, institutional review, informed consent and data stewardship. In the area of privacy, anonymization (personal information codification but with the secured retention of information linking the data to the subject) is no longer sufficient to protect the privacy of the participants. As such, institutions are required to provide extreme measures to control and retain coded identifiers with innovative approaches to data security and oversight of the research. Consistent approaches to institutional review across institutions are essential with regard to the cooperative understanding of the use and management of data. It is critical that alternative methods of obtaining consent for biorepository participation allow an on-going involvement of research subjects by developing ways of re-contacting the participants through the use of various communication tools. Stewardship of data should be carefully observed and institutions are mandated to adopt the defined research governance mechanisms. Applying standardized specimen and data collection procedures mitigates the process for obtaining and properly preserving high quality specimens (Hullseik, George, & Brown, 2011). In addition, a centralized Institutional Review Board approval is necessary to ensure consistency and expeditious access to the samples. Institutions have a moral obligation to protect trial participants and to establish a system in which samples that are donated are carefully maintained, monitored and used in the most efficient way.

**Major Challenges Facing Biorepositories**

Setting up a quality management program is one of the major challenges in creating and maintaining a successful biorepository. It has been shown that the most extensive impediment to the effective use of biorepositories is the lack of standardization in maintaining high-quality biospecimens. Institutions are faced with ethical, legal and policy issues on many different aspects involving quality assurance and control, informed consent and privacy protection, access and ownership of specimens. Providing administration and management structure that can address these major issues is difficult and challenging. The National Cancer Institute (NCI) established the Biorepository Coordinating Committee (BCC) and the Office of Biorepositories and Biospecimen Research (OBBR) which provided standardized procedures addressing the operational, ethical and legal aspects of establishing and maintaining biorepositories. They also provided best practices used by biorepositories around the country.

Some of the operational and research challenges that a biorepository faces are personnel, equipment and shipping of samples. The complex operations of the biorepository require that staff have specialized skills and experience. As such, personnel turnover is a major concern. The cost of losing trained employees is very high in terms of dollars and productivity. The biospecimens are stored under controlled temperature and any equipment breakdown such as a power failure will jeopardize the integrity of the samples. This is also true with the bioinformatics systems that
support the databases which maintain the sample records. There are cases when biospecimens are shipped and there are regulatory considerations when shipping biospecimens. A biorepository should follow domestic and international transport regulations imposed by the International Air Transport Association. All biorepository personnel are certified to receive, handle, package and distribute human infectious substances and biohazardous materials. Occupational Safety and Health Administration (OSHA) regulations on toxic and hazardous substances are consulted to determine whether a substance requires a hazardous label. Shipping breakdowns such as mislabeling of samples or improper packaging can cost large amounts of money and the loss of valuable research resources to the institution.

Biorepositories can also face difficulty in acquiring samples from participants. One of the common reasons why a person would want to participate in a study is the lack of generally accepted therapy or the partial effectiveness of the experimental therapy available to patients. Participating in a clinical study might offer the patient a new alternative to standard treatment before it will be available to the public. For example, Chronic Lymphoma Leukemia (CLL) is a type of cancer and although many patients suffer from this disease, patient participation in the study is limited. For some people with CLL the disease grows slowly and they don’t seek treatment until the disease is in its advanced stages. This contributes to the limited number of patients willing to participate in the study. Many patients do not know they have CLL. The progress of the research is dependent upon the number of samples collected and the frequency of donation. In addition, the collection of samples at different times is imperative to examine longitudinal changes at the various stages of the disease. Limited resources such as nurses/staffing and scheduling conflicts present difficulties and missed opportunities for patients to participate. Coordination of patient visits can be a challenge as some patients do not live locally and their availability is limited.

The last but not least of the major challenges is securing continued financial support to sustain the long term operations of the biorepository. Managing a biorepository requires infrastructure that usually involves different sources of support. It requires financial flexibility to meet emerging research needs. Institutions need to be creative in finding funding sources to continuously support the infrastructure of its biorepository not just for a limited time but also for the long-term commitment. The funds can come from grants, institutional support, philanthropic sources, and fees for service known as recharges or a combination of the sources. A recharge mechanism that allows recovery of costs becomes fundamental to sustain an effective biorepository. Other strategies such as seeking funding from grateful patients or from philanthropic resources can be a major source of funding. Many donors are willing to donate funds to research such as cancer due to personal experiences and many believe it is a great cause to support.

A financial analysis needs to be done to insure that at least initially the core facility will be adequately funded to conduct its business. Questions to ask are how long the apparent funding sources will be available, will the funding be sufficient to maintain a reasonable level and quality of service, what fees will be needed and how will they be charged, and are there hidden costs such as equipment maintenance, specialized instrumentation, webpage development.
Evaluation of the Success of the Biorepository

There are many ways to evaluate the success of individual biorepositories. It can be done by examining the number of users over time, number of publications citing the biorepository, dollar volume of business, users’ satisfaction surveys, and the overall results of operations. A biorepository can be considered successful if it can provide high-quality biospecimens while meeting the strict guidelines of the federal and institutional regulations involving the operational, legal and ethical aspects of running a biorepository. Biorepositories offer opportunities to researchers to expand the treatment of cancers through personalized medicine. It is changing how they think about cancer and how care should be delivered to the patients. Researchers are focusing more on not just getting the diagnosis right but also taking it further to characterize the tumor more specifically so treatments can be custom tailored to the patients. The true success of biorepositories can be measured by the advances made in scientific research as evidenced by reports citing biospecimens that led to greater treatment options available to patients.

MCC and the Regulatory Process

MCC is an Organized Research Unit (ORU) of the University of California and a major clinical department of UCSD Health Sciences, where interdisciplinary research is conducted to translate scientific discoveries from the laboratory to the cancer patient. The mission of the MCC is to translate promising scientific discoveries into new and better options for the prevention, diagnosis and treatment of cancer and for the amelioration of pain. Its mission is pursued by supporting principal investigators to conduct clinical trials and other primary research to find the most advanced treatments for cancer. The MCC is structured into six formal research programs focusing on different areas of cancers. It provides comprehensive care to cancer patients in a way where multidisciplinary teams work together to decide the best course of treatment. The MCC Biorepository resource plays a vital role in supporting this mission. It is used by many Cancer Center members who collaborate on various types of cancer research. The MCC Biorepository relies on Treating Teams which consist of physicians, case managers, and medical assistants who recruit patients that are willing to donate samples. The patient identification can start as early as when a cancer patient schedules an appointment. A patient who showed interest in donating samples can be sent a consent form electronically or by mail. The patient can then fill out the form at home and would be ready to participate at the time of appointment. In most cases, personal contact and communication with the Treating Team can prompt study participation of the patient.

The consent process varies from patient to patient. It could take between 15 to 40 minutes to complete. The consent form is lengthy; it consists of five pages with the addition of five more pages of HIPAA form and the Experimental Subject Bill of Rights.

There are different types of samples collected (blood in the form of serum, plasma or buffy coat; urine, saliva and tumor tissue) and depending on the type of sample, the collection, preparation and distribution of samples varies. The collection for blood, urine and saliva takes place in OSHA approved space. The tumor collection is performed during surgery and done in operating rooms. Once pathologists have processed the tissue collected samples are stored in -180°C
liquid nitrogen tanks. The samples are made available to MCC principal investigators or outside research collaborators.

At MCC, the Clinical Trials Office oversees hundreds of trials across all types of cancers and all phases of drug development. Patients who agree to participate in any clinical trial are educated about the study and go through the informed consent process. Once tissue donors are identified, samples are collected from consented patients and the clinical information on the subject is declassified and coded to protect privacy. The informed consent document addresses the following:

- The patient’s right to refuse biospecimen donation. Their refusal to donate should not in any way influence their treatment or eligibility to participate in the clinical trials.
- Explanation of why particular biospecimens are being sought and why human research participants are being asked to participate.
- The source of the biospecimens that will be collected for research.
- The custodian of the biospecimens and the role of the custodian.
- Documentation to support how the biospecimens will be used and whether they will be used in research other than the initial intended purpose.
- Statements about whether biospecimens will continue to be stored and shared as long as they are potentially useful for research.
- Assurance that biospecimens are respectfully destroyed when no longer useful for research, or transferred to another established resource in accordance with the terms of the informed consent.

The consent form represents agreement to donate blood and urine samples, access to medical record and potential to participate in future cancer studies. The informed consent form specifies that the samples are to be used for the conduct of research to better understand cancer diseases. Early diagnosis is momentous in the treatment of cancer. Patients are given the option to withdraw from participation at any time.

MCC has a Protocol Review and Monitoring Committee (PRMC) which provides oversight in monitoring the data integrity and safety of clinical trials conducted at the Cancer Center. The Committee reviews the data and safety monitoring plan of clinical trials that addresses the participant’s safety, data validity, risks and complexity of the clinical trial and proposed compliance with confidential and adverse event reporting requirements. In addition to the PRMC, the Clinical Trials Office, the Data and Safety Monitoring Board and the Cancer Center Quality Assurance Manager provide complementary review, monitoring and auditing functions during the various stages of the clinical trial. This is done to ensure that maximum protection and ethical treatment of human participants are in place.

Another regulatory component is the Institutional Review Board which is under the UCSD Human Research Protection Program (HRPP). The Program oversees ethical and regulatory policies and procedures involving research on human subjects. The policies and procedures were written in accordance with federal policy on the Protection of Human Subjects (DHHS Policy 45 CFR Part 46, FDA Policy 21 CFR Parts 50 and 56). The main function of the HRPP is to
review research protocols and determine to approve or disapprove, require modifications, propose amendments based on assessment of the risks and potential benefits of the research and whether or not the rights and welfare of human subjects are adequately protected. The HRPP also has the authority to suspend or terminate a study already activated. The IRB process adds another layer of protection to cancer studies to ensure that investigators securing the use of human samples have full institutional approval.

Creation of the MCC Biorepository and Tissue Technology Resource

One of the most important steps in creating a biorepository is determining funding sources to support the facility. There are also many other challenges related to managing a biorepository system that services all stages of research. There are a vast number of samples that have been collected from cancer prevention studies and many early detection trials and observational studies. As the grants supporting these trials end, funding for maintaining the biorepositories is not available (Goodman, Thornquist, Edelstein, & Omenn, 2006). Funding for a biorepository can come from different sources. The National Cancer Act officially established the Cancer Center Programs in 1971. The Act implemented a standard funding mechanism known as the P30 Cancer Center Support Grant or CCSG. The CCSG is awarded to institutions for successfully meeting a spectrum of rigorous standards associated with scientific and organizational merit; the highest and most difficult designation to achieve is comprehensive cancer center. The Moores Cancer Center is one of 41 designated comprehensive cancer centers in the country. As an NCI-designated Comprehensive Cancer Center, it conducts research activities in basic laboratory, clinical, prevention, control and population based research into a broad-spectrum transdisciplinary cancer research enterprise. It receives funding from NCI to support its research infrastructure including senior and program leaders, staff investigators, planning and evaluation, administration, shared resources and clinical trials.

The biorepository is one of the shared resources at MCC. It was established as a developing shared resource within the NCI funded Cancer Center Support Grant (CCSG) in 2006. For the 2013 core grant renewal, histology services were combined with tissue collection and storage to create the Biorepository and Tissue Technology Resource (BTTR). The BTTR provides different types of samples including plasma, serum, RNA stabilized buffy coat, urine, viably frozen tumor samples and paraffin embedded tumor slides with associated clinical information to investigators with Institutional Review Board (IRB) and Cancer Center Banking Committee approved protocols. Samples are collected over time from consenting subjects and clinical information is de-identified to protect privacy. The blood and urine samples are collected and frozen and coded with a unique study number for data storing. The data consist of time of collection, diagnosis of the tumor stage and site, clinical outcome and other demographical information. Patient information is de-identified as much as possible and the data are safeguarded with multiple levels and layers of security. Encryption is required for all health related personal data. Access to clinical annotation is determined based on need as outlined in each investigator’s protocol.

The priority of the BTTR is pure banking so it tries to maximize collection of samples from nine clinics at MCC involving Gastrointestinal, Genitourinary, Lung, Head and Neck, Melanoma,
Gynecology and clinical trials. Pure banking is between 85-90% versus 10-15% for investigator initiated procurement. The Shared Resource Leader evaluates the biospecimen requirements for PRMC, the Physician Assistant develops the protocol, and then it gets submitted to IRB. The BTTR has a general biobanking IRB protocol to cover most applications with delinked data. Faculty members need an IRB protocol only when they need delink data.

The MCC BTTR is partially funded by the NCI Cancer Center Support Grant, institutional support and also by a recharge mechanism. The University of California, San Diego (UCSD) allows a research unit such as the Cancer Center to develop a recharge mechanism to recover costs incurred by charging a fee to investigators seeking tissue but it must follow strict policies and procedures. There must be a need for the good or services to be provided by the activity. The benefits, including relative prices and quality of the proposed activity must be weighed against the benefits of obtaining similar goods or services from commercial sources or other University sources. Goods or services should not be sold to the general public unless the goods or services are unique or sales will not compete with commercial sources. Both the recharge mechanism and institutional support are essential in sustaining the operations of the BTTR. Without them, the Shared Resource cannot exist because the CCSG covers only a portion of the costs of operation. There are cases that some Shared Resources can function with only the CCSG and the recharge but the BTTR requires institutional support at this time in its development. It is very expensive to operate and the revenue from the recharge is limited. The early volume of business is not enough to support the operations and increasing the prices of the services is not a viable solution.

Collaborative Efforts of the BTTR

Collaboration plays an important role in research. It helps researchers from different disciplines share knowledge and resources. The federal government has created grants specifically to incentivize researchers. There are many benefits to collaborations and many discoveries have risen from the collaborative work of researchers. Collaboration can also help achieve greater economies of scale, improve productivity and increase competitive advantage.

In 2012 the Moores Cancer Center, Sanford-Burnham Medical Research Institute and Salk Institute joined together to form the NCI Cancer Center Council (C3) in the San Diego area to increase collaboration, leverage their collective talents and resources as well as garner more use of the Shared Resources, particularly the BTTR. C3 focuses on enhancing inter-institutional sharing of a unique core facility at each center. The MCC Biorepository and Tissue Technology Core is being used by C3 members and facilitates collaboration of research in cancer.

Role of the Finance Administrator in Establishing and Managing the Biorepository

Finance Administrators play a key role in establishing and managing the biorepository. The Finance Administrators understand the business operations and processes involving accounting, finance, marketing, economics, statistics and human resources. They can affect the effectiveness of the recharge facility because they specialize in a specific area in which they have knowledge and experience. The Finance Administrators are responsible for establishing a viable rate structure, managing the billing and payment, financial tracking, utilization reports and annual
business plans. In addition, their role is to effectively communicate business status and activities to Shared Resource leaders and those that are tasked with decision making. Because recharges need to break even, finance administrators can assist and influence the Shared Resource leaders in making important decisions that can maximize the effectiveness of their operations and integrate practices that can sustain the business.

Establishing the Rate Structure

Core facilities may or may not have recharges. If the core facility is a component of a multi-project program grant and services only the investigators of the grant, then there is no need for a recharge. However, if the facility is larger than the grant or institutionally based, it will need a recharge both to control utilization as well as to meet budgetary needs. Establishing a recharge involves performing market analysis. The benefits including relative prices and quality must be compared to the benefits of obtaining the services or goods from commercial sources or other university sources. There must be significant current and continuing demand and the services to be provided must be unique and specialized. It is critical to insure that all fixed and variable costs are covered and that there are no hidden or uncovered costs. Costs assigned to the activity must be essential to the purpose for which the activity was established. Personnel costs should be carefully analyzed to ensure that appropriate percent efforts are included in the rate calculation. For the BTTR rate calculation, we made sure that personnel performing the duties such as physicians and lab technicians involved in consenting and sample collection are factored in the fee structure. The fund balance will be operated on a break even basis although some activities are allowed to accumulate a surplus or deficit within the amount as determined by the institution. At UCSD the recharge facility is allowed to carry a surplus or deficit equivalent to two-month expenses. When calculating the opening rate, consideration should be given to adjusting the rate later to reflect the actual current volume of business.

Determining the Rates

There are a number of factors to consider in calculating the initial fee schedule. These include the level of anticipated business, any funding gap, availability of a subsidy from a grant or the institution, and source of users, including internal and external, which may lead to a tiered rate schedule. Tiered rates are implemented to reflect the type of users of the facility: Cancer Center member, non-Cancer Center member or non-UCSD member. Cancer Center participating members are eligible to use the Cancer Center Shared Resources at subsidized rates relative to other users due to the funding provided by the Cancer Center Support Grant. The criteria for participating membership are below:

- Have a salaried or non-salaried faculty appointment at UCSD, and
- Hold an NIH RO1 cancer-related grant or equivalent peer-reviewed grant, or
- Have recent publications that are relevant to cancer, or
- Have a Cancer Center leadership role to organize an essential activity or service, as appointed by the Center Director, or
• Have an extensive collaboration with other peer-reviewed Cancer Center members, or
• Be leading investigator-initiated Cancer Center clinical trials or accruing considerable numbers of patients (at least 5 per year) to such trials, or
• Systematically assisting in the procurement of clinical specimens for cancer-related research

Once a rate is established it should be used for at least one year to gauge if it meets the budget needs. Users resist constant changes in rates since they need to be budgeted in grants and other funding mechanisms. However, the initial rate is seldom the long-term rate because the first rate is projected, not actual business. An analysis of the rate should be conducted after one year to see if the rate is sustainable or needs to be modified based on the facility’s output.

The MCC Biorepository receives a minimal amount of grant funding and its operations are mainly funded through a recharge mechanism that involves charging fees for providing services to both university and non-university users. The process of establishing a recharge system at UCSD requires different layers of institutional approval. It starts with the development of a rate structure. UCSD employs strict costing principles and the development of the rate structure must adhere to policies and procedures. A viable rate structure is crucial in sustaining the business operations of the MCC Biorepository.

Below is a step-by-step process in establishing the rate structure.

1. Develop a faculty survey to assess the need for the biorepository core
2. Perform a market analysis to ensure that the price and quality is competitive
3. Identify potential Core Leader(s)
4. Explore financial options for supporting the service
5. Determine if a recharge is needed
6. If the recharge is needed, determine if a subsidy is available and how much
7. Restructure the tiered rates based on the subsidy
8. Analyze options to determine optimal approach

Calculate the recharge rates:

1. Determine the specific services that will be offered
2. Determine the percentage use of each service
3. Decide if the recharge is an hourly rate or a service unit rate
4. Project the billable units for members, non-members, and non-university

Calculate the personnel expenses

1. Determine staffing and the level of support required
2. Calculate the salaries and benefits based on projected effort and fringe benefit rates
3. Project the member usage based on faculty survey and biorepository leader estimates
4. Multiply the salaries and benefits by the member usage percentage
5. Deduct the subsidy to arrive at the net member expense
Calculate the non-personnel expenses:

1. Determine all essential costs required to provide the service (i.e., laboratory supplies, equipment depreciation, equipment service agreements, staff training)
2. Calculate the non-personnel expenses by multiplying each cost with the member usage percentage
3. Deduct the subsidy to arrive at the net member expense

The total personnel and non-personnel expenses are summed to arrive at the total projected expense to be recovered both with and without subsidy.

Calculate the tiered rates:

- The member rate, also known as the subsidized rate, is calculated by dividing the Total Net Member Expense by the member projected billable hours/units
- The non-member rate, also known as the base rate, is calculated by dividing the Total Recharge Expense by the non-member projected billable hours/units
- The non-university rate is calculated by adding the overhead rate to the non-member rate

In Tables 1A and 1B, the rate is constructed for a serum sample, one of the many services provided by the biorepository. The rate is calculated by accounting for the personnel, consumables, service agreements and equipment depreciation costs that allow the biorepository to perform the serum sample service unit. The facility receives a subsidy from the Cancer Center Support Grant, thus the rate structure is tiered, with a Cancer Center member rate, a non-member rate and for external users, a non-UCSD user rate. The same methodology can be used to calculate an hourly rate for a specific type of service using billable hours instead of units.

Table 1A. Rate Calculation by Unit of Service: Serum Sample

<table>
<thead>
<tr>
<th>Personnel</th>
<th>% Effort</th>
<th>Salary &amp; Benefits</th>
<th>Total Recharge Expense</th>
<th>Percent Usage by Members</th>
<th>Member Expense</th>
<th>Less Subsidy</th>
<th>Net Member Expense</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shared Resource Leader</td>
<td>1%</td>
<td>$200,000</td>
<td>$2,000</td>
<td>96%</td>
<td>$1,923</td>
<td>$962</td>
<td>$962</td>
</tr>
<tr>
<td>Staff Research Associate IV</td>
<td>10%</td>
<td>$85,000</td>
<td>$8,500</td>
<td>95%</td>
<td>$8,173</td>
<td>$4,087</td>
<td>$4,087</td>
</tr>
<tr>
<td>Staff Research Associate III</td>
<td>5%</td>
<td>$65,000</td>
<td>$3,250</td>
<td>96%</td>
<td>$3,125</td>
<td>$1,563</td>
<td>$1,563</td>
</tr>
<tr>
<td>Staff Research Associate II</td>
<td>5%</td>
<td>$50,000</td>
<td>$2,500</td>
<td>96%</td>
<td>$2,404</td>
<td>$1,202</td>
<td>$1,202</td>
</tr>
<tr>
<td>Total Personnel</td>
<td></td>
<td></td>
<td>$16,250</td>
<td></td>
<td>$15,625</td>
<td>$7,813</td>
<td>$7,813</td>
</tr>
<tr>
<td>Lab Supplies</td>
<td></td>
<td></td>
<td>$1,350</td>
<td>95%</td>
<td>$1,298</td>
<td>-</td>
<td>$1,298</td>
</tr>
<tr>
<td>Equipment Depreciation</td>
<td></td>
<td></td>
<td>$1,500</td>
<td>95%</td>
<td>$1,442</td>
<td>-</td>
<td>$1,442</td>
</tr>
<tr>
<td>Total Non-Personnel</td>
<td></td>
<td></td>
<td>$2,850</td>
<td></td>
<td>$2,740</td>
<td>-</td>
<td>$2,740</td>
</tr>
<tr>
<td>Total projected expenses to be recovered</td>
<td></td>
<td></td>
<td>$19,100</td>
<td></td>
<td>$18,365</td>
<td>$7,813</td>
<td>$10,553</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Billable Units</th>
<th>Percent Usage</th>
<th>Projected Billable Units</th>
<th>Proposed Rate</th>
<th>Membership</th>
</tr>
</thead>
<tbody>
<tr>
<td>Members</td>
<td>96%</td>
<td>500</td>
<td>$21</td>
<td>$10,553 divided by 500 units</td>
</tr>
<tr>
<td>Non-members</td>
<td>4%</td>
<td>20</td>
<td>$37</td>
<td>$19,100 divided by 520 units</td>
</tr>
<tr>
<td>Non UCSD users</td>
<td>0%</td>
<td>0</td>
<td>$53</td>
<td>$37 plus the 45% overhead rate</td>
</tr>
<tr>
<td></td>
<td>100%</td>
<td>520 Units (Samples)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The MCC Biorepository provides a wide range of services and each type of service requires a separate rate calculation. Using the methodologies described above, the following catalog of services is provided to investigators:

### Table 1B. Rate Calculation Summary: Serum Sample

<table>
<thead>
<tr>
<th>Revenue:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Revenue-Member</td>
<td>$10,553</td>
</tr>
<tr>
<td>Revenue-Non-member</td>
<td>$734</td>
</tr>
<tr>
<td>Revenue- Non-UC User</td>
<td>$0</td>
</tr>
<tr>
<td>Total Revenue</td>
<td>$11,287</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expenses:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Salaries &amp; Benefits</td>
<td>$16,250</td>
</tr>
<tr>
<td>Supplies &amp; Other Expenses</td>
<td>$2,850</td>
</tr>
<tr>
<td>Total Expenses</td>
<td>$19,100</td>
</tr>
<tr>
<td>Less: CCSG Subsidy</td>
<td>$7,813</td>
</tr>
<tr>
<td>Plus: Differential Income Transfer</td>
<td>$0</td>
</tr>
<tr>
<td>Total Net Expenses</td>
<td>$11,287</td>
</tr>
<tr>
<td>Net Profit (Loss)</td>
<td>$0</td>
</tr>
</tbody>
</table>

### Table 2. Biorepository Catalog of Services

<table>
<thead>
<tr>
<th>Item Code</th>
<th>Item Description</th>
<th>Unit Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>BR0001A1</td>
<td>Serum per sample (250 nL) - Member</td>
<td>$21.00</td>
</tr>
<tr>
<td>BR0001B</td>
<td>Serum per sample (250 nL) - Non-Member</td>
<td>$37.00</td>
</tr>
<tr>
<td>BR0001C1</td>
<td>Serum per sample (250 nL) - Non-University</td>
<td>$53.00</td>
</tr>
<tr>
<td>BR0003A1</td>
<td>Plasma per sample (250 uL) - Member</td>
<td>$21.00</td>
</tr>
<tr>
<td>BR0003B</td>
<td>Plasma per sample (250 uL) - Non-Member</td>
<td>$37.00</td>
</tr>
<tr>
<td>BR0003C1</td>
<td>Plasma per sample (250 uL) - Non-University</td>
<td>$53.00</td>
</tr>
<tr>
<td>BR0004A1</td>
<td>Buffy Coat per sample (150 uL) - Member</td>
<td>$23.00</td>
</tr>
<tr>
<td>BR0004A2</td>
<td>Buffy Coat per sample (150 uL) - Non-Member</td>
<td>$40.00</td>
</tr>
<tr>
<td>BR0004C1</td>
<td>Buffy Coat per sample (150 uL) - Non-University</td>
<td>$58.00</td>
</tr>
<tr>
<td>BR0005A1</td>
<td>Urine per sample (500 uL) - Member</td>
<td>$21.00</td>
</tr>
<tr>
<td>BR0005B</td>
<td>Urine per sample (500 uL) - Non-Member</td>
<td>$37.00</td>
</tr>
<tr>
<td>BR0005C1</td>
<td>Urine per sample (500 uL) - Non-University</td>
<td>$53.00</td>
</tr>
<tr>
<td>BR0010A1</td>
<td>Saliva - Member</td>
<td>$40.00</td>
</tr>
<tr>
<td>BR0010B</td>
<td>Saliva - Non-Member</td>
<td>$72.00</td>
</tr>
<tr>
<td>BR0010C1</td>
<td>Saliva - Non-University</td>
<td>$105.00</td>
</tr>
<tr>
<td>BR0011A1</td>
<td>Solid Viable Fresh Tissue Per Subject - Member</td>
<td>$120.00</td>
</tr>
<tr>
<td>BR0011B</td>
<td>Solid Viable Fresh Tissue Per Subject - Non-Member</td>
<td>$170.00</td>
</tr>
<tr>
<td>BR0011C1</td>
<td>Solid Viable Fresh Tissue Per Subject - Non-University</td>
<td>$247.00</td>
</tr>
<tr>
<td>BR0015A1</td>
<td>Solid Fresh Frozen Tissue Per Vial (50 mg) Member</td>
<td>$24.00</td>
</tr>
<tr>
<td>BR0015B</td>
<td>Solid Fresh Frozen Tissue Per Vial (50 mg) -Non-Member</td>
<td>$36.00</td>
</tr>
<tr>
<td>BR0015C1</td>
<td>Solid Fresh Frozen Tissue Per Vial (50 mg) - Non-University</td>
<td>$52.00</td>
</tr>
<tr>
<td>BR0018A1</td>
<td>Xenografted Viable Freeze Tumor Per Vial - Member</td>
<td>$103.00</td>
</tr>
<tr>
<td>BR0018B</td>
<td>Xenografted Viable Freeze Tumor Per Vial - Non-Member</td>
<td>$140.00</td>
</tr>
<tr>
<td>BR0018C1</td>
<td>Xenografted Viable Freeze Tumor Per Vial - Non-University</td>
<td>$202.00</td>
</tr>
</tbody>
</table>
Implementing the Recharge Account

In order to implement a recharge account, a flexible automated database system is strongly recommended. It should be capable of handling the internal and external billing, recording of revenue and expenditures and utilization of members, non-members and non-university users and offer other advanced features such as online registration. At MCC, an in-house Microsoft Access database was developed to provide the financial infrastructure needed for the recharge account. When using the facility for the first time, the Principal Investigator has to register online. The online registration is the first step in gathering information from the user. It asks specific questions that will determine which rate to apply based on established criteria for different users. The system keeps the entire record by creating a profile and an account number for each customer. Once the registration has been approved, the user can submit their request to the respective facility. The laboratory personnel will generate a requisition form which requires the internal user to provide an account number to be charged for the service. The account is validated in the system first before the work can be started. For an external user, a Purchase Order has to be placed.

Billing the Services

Having an automated billing system is necessary in operating a recharge system. The core facility can generate hundreds of transactions in a month and this can only be handled effectively and efficiently using an automated billing system. There are two types of billings generated from the system; one is used for internal users and the other for external users. For billing the internal users, the system generates a file that has all the accounting information that can be downloaded into the university information financial system. This process is simple and fast and it can be done with a click of button. All calculations are done by the system including data merging and copying from the sources and application of different formulas to get the desired results. For the external billing, the invoice generated contains all data provided to the customer such as the bill amount and date, terms of payment, description of items and other related account information. Two copies of invoices are generated; one is sent to the customers and the other is sent to the UCSD Accounting Office for recording.

Payment Processing

Payments are processed for internal billing when the transactions are downloaded to the financial system which then post to the ledgers on a monthly basis. For external billing, payments are recorded by the UCSD Accounting Office when checks are received. The system generates an Aging Report so that accounts receivable are monitored and collected.

Financial Tracking

Managing the finances of the biorepository is very challenging. It should be viewed and managed as a small business with a varied funding and customer base. The revenue and expenditures need to be monitored monthly both at the level of the facility and centrally by a Research Administrator from the Cancer Center to ensure that the fund balance does not result in a surplus or deficit.
since the budget should be maintained at no gain/loss basis. There are a number of commercial products available to manage the utilization and finances of the facility; MCC has an in-house shared resource database to accomplish this. The system provides for internet registration for service, electronic internal billing, and electronic utilization tracking describing the service, user, fee and time of service.

In tracking the revenue and expenses of the biorepository, it is crucial to watch for seasonal or monthly perturbations such as an annual service contract, severance pay for a terminated employee, or the loss of a user’s grant. While any of these will have a negative impact on the monthly financials they may be one-time aberrations. It is also possible that more permanent revenue or expense changes will require modifying the service fee, either upwards or downwards. When changing the fee adequate notice should be sent to the research community so investigators can adjust their grant budgets accordingly. Six months is a fair lead time.

Table 3. Biorepository Fund Report

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Biorepository Recharge</td>
<td>$2,840</td>
<td>$26,566</td>
<td>$27,948</td>
<td>$1,258</td>
<td>$86,098</td>
<td>$83,844</td>
<td>$3,512</td>
</tr>
<tr>
<td>CCSG Subsidy</td>
<td>$1,200</td>
<td>$52,440</td>
<td>$53,410</td>
<td>$40,230</td>
<td>-</td>
<td>$40,230</td>
<td>-</td>
</tr>
<tr>
<td>Differential Income</td>
<td>$955</td>
<td>-</td>
<td>-</td>
<td>$955</td>
<td>$4,800</td>
<td>-</td>
<td>$5,755</td>
</tr>
<tr>
<td>Equipment Account</td>
<td>$30,000</td>
<td>-</td>
<td>-</td>
<td>$30,000</td>
<td>$1,500</td>
<td>-</td>
<td>$31,500</td>
</tr>
<tr>
<td><strong>GRAND TOTAL</strong></td>
<td><strong>$24,095</strong></td>
<td><strong>$78,906</strong></td>
<td><strong>$84,558</strong></td>
<td><strong>$72,443</strong></td>
<td><strong>$95,298</strong></td>
<td><strong>$124,074</strong></td>
<td><strong>$43,767</strong></td>
</tr>
</tbody>
</table>

Recharge is allowed to have a surplus/deficit if the amount is within 2 months of annualized expenses.
Differential Income generated from outside revenue recorded annually and can be used by the Department.
Equipment Account is recorded annually and used for replacement or purchase of new equipment.

In Table 3, the biorepository recharge account is projecting a balance of $3,512, which is within the policy since the amount is below the average 2 months of annualized expenses, which is $4,658. The differential income account has no limit and can be used as discretionary. The equipment account is restricted to new or replacement equipment.

Utilization Reports

Utilization reports are essential to the core facility especially if subsidies from grants are used to calculate the rates. At MCC, almost all of the core facilities including the Biorepository receive subsidies from the Cancer Center Support Grant. As such, it is necessary that we provide utilization to the National Cancer Institute to report how facilities are being used by the Cancer Center members. The MCC database can produce multiple types of utilization reports and graphs. It can generate reports at a specific time frame by Principal Investigator, Account or Index numbers, Item Codes or Service Types. Accurate reporting of utilization is a must because it can assist leaders and managers in evaluating the performance of the facility.
The MCC Shared Resource Database can produce different types of utilization reports:

**Utilization Report by Principal Investigator (PI)**

This report lists PI names, their membership status as of the end of reporting period, the number of samples used and the percent usage. For the calendar year 2014, there were a total of 20 PIs that used serum samples from the Biorepository. The projected utilization was overestimated during start up. Projected utilization used for the rate calculation was 520 samples; however, the actual utilization for the reported 12-month period was 360 distributed samples. This is not unusual in the early stages of a core facility’s development. It occurred due to multiple reasons. In this case, our faculty survey generated more prospective interest than the initial unitization. It happened because the faculty were expecting to conduct experiments that did not take place, the facility was not fully stocked with tissue samples because the requested samples were not yet acquired, the patient samples were more difficult to collect due to underestimating the staffing required to obtain consent and there was not a sufficient number of patients with the tumors being sought.

**Table 4. Biorepository Utilization by PI, 01/01/2014 – 12/31/2014 (Actual)**

<table>
<thead>
<tr>
<th>Full Name</th>
<th>Member as of Report End Date</th>
<th>Serum Samples</th>
<th>% Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>PI #1</td>
<td>Yes</td>
<td>30</td>
<td>8.33%</td>
</tr>
<tr>
<td>PI #2</td>
<td>Yes</td>
<td>28</td>
<td>7.78%</td>
</tr>
<tr>
<td>PI #3</td>
<td>Yes</td>
<td>7</td>
<td>1.94%</td>
</tr>
<tr>
<td>PI #4</td>
<td>Yes</td>
<td>20</td>
<td>5.56%</td>
</tr>
<tr>
<td>PI #5</td>
<td>Yes</td>
<td>13</td>
<td>3.61%</td>
</tr>
<tr>
<td>PI #6</td>
<td>Yes</td>
<td>17</td>
<td>4.72%</td>
</tr>
<tr>
<td>PI #7</td>
<td>Yes</td>
<td>15</td>
<td>4.17%</td>
</tr>
<tr>
<td>PI #8</td>
<td>Yes</td>
<td>22</td>
<td>6.11%</td>
</tr>
<tr>
<td>PI #9</td>
<td>Yes</td>
<td>30</td>
<td>8.33%</td>
</tr>
<tr>
<td>PI #10</td>
<td>Yes</td>
<td>12</td>
<td>3.33%</td>
</tr>
<tr>
<td>PI #11</td>
<td>Yes</td>
<td>18</td>
<td>5.00%</td>
</tr>
<tr>
<td>PI #12</td>
<td>Yes</td>
<td>43</td>
<td>11.94%</td>
</tr>
<tr>
<td>PI #13</td>
<td>Yes</td>
<td>22</td>
<td>6.11%</td>
</tr>
<tr>
<td>PI #14</td>
<td>Yes</td>
<td>10</td>
<td>2.78%</td>
</tr>
<tr>
<td>PI #15</td>
<td>Yes</td>
<td>26</td>
<td>7.22%</td>
</tr>
<tr>
<td>PI #16</td>
<td>Yes</td>
<td>12</td>
<td>3.33%</td>
</tr>
<tr>
<td>PI #17</td>
<td>Yes</td>
<td>11</td>
<td>3.06%</td>
</tr>
<tr>
<td>PI #18</td>
<td>No</td>
<td>6</td>
<td>1.67%</td>
</tr>
<tr>
<td>PI #19</td>
<td>No</td>
<td>8</td>
<td>2.22%</td>
</tr>
<tr>
<td>PI #20</td>
<td>No</td>
<td>10</td>
<td>2.78%</td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td></td>
<td><strong>360</strong></td>
<td><strong>100.00%</strong></td>
</tr>
</tbody>
</table>

Total Member Usage 93.33%
Total Non-Member Usage 6.67%
Grand Total 100.00%

**Notes:**
The projected utilization in the rate calculation was 520 but the actual utilization was 360.
The projected member usage in the rate calculation was 96% but the actual member usage was 93.33%.
Utilization by Membership

This report lists the member versus the non-member utilization per month for serum samples acquired by the 20 Principal Investigators for the calendar year 2014. Total number of serum samples acquired by members were 336 versus total number of serum samples acquired by non-members were 24. Total number of serum samples acquired by all members was 360.

Table 5. Serum Utilization by Membership

<table>
<thead>
<tr>
<th>Calendar Year 2014</th>
<th>Number of Samples Acquired by Members</th>
<th>Number of Samples Acquired by Non-Members</th>
<th>Total Number of Samples Acquired</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan</td>
<td>22</td>
<td>0</td>
<td>22</td>
</tr>
<tr>
<td>Feb</td>
<td>28</td>
<td>0</td>
<td>28</td>
</tr>
<tr>
<td>Mar</td>
<td>30</td>
<td>3</td>
<td>33</td>
</tr>
<tr>
<td>Apr</td>
<td>20</td>
<td>9</td>
<td>29</td>
</tr>
<tr>
<td>May</td>
<td>30</td>
<td>5</td>
<td>35</td>
</tr>
<tr>
<td>Jun</td>
<td>37</td>
<td>1</td>
<td>38</td>
</tr>
<tr>
<td>Jul</td>
<td>27</td>
<td>2</td>
<td>29</td>
</tr>
<tr>
<td>Aug</td>
<td>35</td>
<td>0</td>
<td>35</td>
</tr>
<tr>
<td>Sep</td>
<td>27</td>
<td>3</td>
<td>30</td>
</tr>
<tr>
<td>Oct</td>
<td>34</td>
<td>1</td>
<td>35</td>
</tr>
<tr>
<td>Nov</td>
<td>30</td>
<td>0</td>
<td>30</td>
</tr>
<tr>
<td>Dec</td>
<td>16</td>
<td>0</td>
<td>16</td>
</tr>
<tr>
<td>Total Serum Samples</td>
<td>336</td>
<td>24</td>
<td>360</td>
</tr>
</tbody>
</table>

![Graph showing serum utilization by membership]
Utilization by Service Type

This report lists the utilization of all the services offered by the Biorepository Shared Resource.

Table 6. Serum Utilization by Service

<table>
<thead>
<tr>
<th>Service</th>
<th>Samples</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serum Sample</td>
<td>360</td>
<td>16%</td>
</tr>
<tr>
<td>Plasma Sample</td>
<td>850</td>
<td>37%</td>
</tr>
<tr>
<td>Buffy Coat Sample</td>
<td>596</td>
<td>26%</td>
</tr>
<tr>
<td>Urine Sample</td>
<td>110</td>
<td>5%</td>
</tr>
<tr>
<td>Saliva Sample</td>
<td>100</td>
<td>4%</td>
</tr>
<tr>
<td>Solid Viable Fresh Tissue</td>
<td>48</td>
<td>2%</td>
</tr>
<tr>
<td>Solid Frozen Tissue</td>
<td>219</td>
<td>10%</td>
</tr>
<tr>
<td>Xenograph Viable Freeze Tumor</td>
<td>10</td>
<td>0%</td>
</tr>
<tr>
<td>Total</td>
<td>2293</td>
<td>100%</td>
</tr>
</tbody>
</table>

Surveys

Conducting surveys is one of the most meaningful areas of measurement in research. A good survey can identify issues that can be addressed by the BTTR to improve its services. It can be used as a benchmark to help establish a baseline from which the BTTR can gather information as to whether target population needs are met. Surveys can pave the way to a successful marketing program that can enhance the business.
Marketing

Marketing is a critical aspect of running a biorepository. Without marketing, the business may offer the best products or services but none of the potential customers may be aware and the business may not be given an opportunity to grow and succeed. For the BTTR to succeed, the product or services it offers must be known to potential users. A good marketing program that gives BTTR the best chance is a healthy mix of different forms of marketing such as website development, public relations, print advertising, and showings at special events like scientific retreats and seminars.

Annual Business Plan

An annual business plan is vital in order to consistently grow the business. It creates a road map for where the business is going. It does not necessarily guarantee success, but crafting the annual plan and course of action improves the odds in favor of the business. A good business plan should set goals that are achievable. Preparing a business plan can reveal business strengths and weaknesses and it can also paint realistic action or steps to be taken for achieving the desired outcomes. It is good business practice for the BTTR to have an annual business plan that includes a description of the services provided including any changes forecasted for the coming year, the current staffing and any changes, and the next year’s budget including a breakdown of each revenue source, the projected utilization, and plans for the next year. This report is prepared at the start of the academic fiscal year by the Shared Resources Manager and the BTTR Director. It is then approved by the Associate Director for Shared Resources. The Business Plan may include projected changes in technology requiring new instrumentation or personnel with specific skills. It may include the termination of services that are either no longer sought or those that can be better provided elsewhere (see Appendix 1 for the BTTR Business Plan).

Performance Review

Performance review is probably one of the most disliked tasks but it is also one of the most important steps in maintaining a core facility. Performance reviews provide a look at how the facility is doing based on performance measures or indicators. It allows the facility to focus on improving the different aspects of their operation and how it can progress toward its business goals. Without these indicators and guidance, it would be very difficult to attain its full potential.

It is necessary to have an annual performance review of the biorepository and this can be performed at a number of levels. The research administrator is primarily concerned with managing the administrative and financial aspects of the facility including service fees and budget. Client satisfaction based on timely delivery of service, up-to-date technology and quality output are monitored by a peer group—the Shared Resources Oversight Committee (SROC) at the Moores Cancer Center—that is chaired by the Cancer Center Associate Director for Shared Resources. The SROC is composed of research division leaders of the Cancer Center. It meets quarterly to review the performance of cores and discuss the need for new cores. Each core is required to present its performance to the SROC annually. The presentation is both a projection...
of future use and a progress report on the past year. There is a discussion period following each presentation. The SROC is also responsible for developing core facility governing polices that are crafted and carried out by research administrators. The success or failure of a shared resource program depends on the choice of appropriate institutional policies and requires an effective institutional governance regarding decisions on staffing, existence and composition of advisory committees, policies and of defined mechanisms of reporting, budgeting and financial support of each resource (De Paoli, 2009).

**Lesson Learned**

We know that the need for readily accessible, quality controlled human tissue is vital to cancer research and we believe that we can establish and maintain a flexible and dynamic Biorepository and Tissue Technology system. The establishment and maintenance of the BTTR posed many challenges. It was a complex undertaking and we learned many valuable lessons in the process. There were lessons learned involving personnel and hiring the right skilled staff but the most significant experience was gained in the process of establishing the rates. We overstated the projected usage for many of the different types of services. The early usage has been lower than expected and as a result the recharge did not generate enough revenue to cover the cost of operations. While the lower volume affected the anticipated revenue, the higher projected utilization had the offsetting benefit of creating a lower initial fee based on the rate setting methodology described herein.

This caused us to rely more on institutional support. We chose not to increase the rate at this time because we want to offer low prices as an incentive to increase usage. We also learned that we do not have enough staffing to obtain consent from participants and we are not capturing all prospective donors. We are hiring additional staff to mitigate this issue. We discovered that we do not have the samples that researchers want and we believe that this will be addressed with the increased staffing. We need to improve collaboration of the Finance Administrator and educate the laboratory researchers about the business aspects of operating the recharge system. We now know that operating the BTTR will require continued institutional support, at least temporarily. Finally, MCC is committed to support the BTTR because it considers this as an investment that will pay off in the long run. We are looking at more proactive steps to increase business by advertising, conducting faculty surveys and performing market analyses to meet the competition.

**Summary**

The significance of biorepositories in the biomedical research field has been established and proven to enhance and advance the future treatment of many diseases, but the creation and maintenance of a biorepository involve risks. One of the major risks is that there may be a limited number of patients that are willing to participate in the tissue collection. The success of the facility will highly depend on the number of samples collected, the quantity of tissue donation as well as the utilization by researchers to whom a fee will be charged. Moreover, there are many challenges in maintaining the different aspects of the biorepository system. The operational aspects which involve the collection, processing, storage, retrieval and distribution of specimens, management of clinical data, quality assurance and control can be handled by providing a system.
capable of complying with standard operating procedures to ensure that the integrity of samples are safeguarded at all times. The development of the informatics infrastructure is essential in this endeavor. Likewise, the legal and ethical aspects including custodianship, informed consent, and privacy protections for individuals who donate biospecimens can be addressed by having an effective Protocol Review and Monitoring System and Institutional Review Board.

Establishing and maintaining a biorepository is expensive and it requires not only commitment and support from the institution but also a strong administrator that can manage the business aspects of it. One of the major challenges remains adequate funding to support the resource. The best way to address this is to develop a recharge system so it can be operated as a business. Developing a good rate structure, continuously monitoring the financials, preparing an annual business plan and reviewing performance will contribute to a successful biorepository.

Authors’ Information

Sonia Ashley has over 30 years of accounting and managerial experience both in public and private sectors. She is the Director of Business Operations for the Moores Cancer Center and has been for over 15 years. She has experience managing core facilities and setting up rate structures for all of the core facilities at the Center. As the Director, she manages contract and grants exceeding over 90 million and in-charge of Human Resources responsible for over 500 employees. She made both short and workshop presentations with SRA on the management of core facilities.

Ira Goodman has over 40 years of contract and grant administration experience. He is currently the Associate Director for Administration for the Moores Cancer Center. He manages the administrative services that facilitate research, patient care and clinical research. He participates in the design and strategic planning for the Center, financial and human resources management, oversight of information systems development, program planning, space and facilities. He is an expert in setting up and managing core facilities and has presented workshops and presentations at SRA.

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scashley@ucsd.edu
References


Appendix 1

MOORES UCSD CANCER CENTER
Biorepository and Tissue Technology Shared Resource (BTTSR)
Business Plan FY 2013-14

| Director: Scott Vandenberg, MD PhD | Co-Director: Richard Schwab, MD | Co-Director: Nissi Varki |

Service Profile
The BTTSR provides for the acquisition, multi-modality processing, and archiving of well-annotated human biospecimens that is seamlessly integrated with histology and tissue analysis services. Three major activities are provided by this shared resource: 1) the biorepository for human tumor specimens that are acquired during diagnostic and therapeutic procedures from consented subjects with associated blood, urine (when applicable), and CSF (when applicable), and that are linkable to clinical and diagnostic and made available to MCC investigators; 2) tissue histology and technology for state-of-the-art molecular morphology/biomarker applications, and 3) histopathologic expertise for validation of diagnostic parameters on biorepository specimens, and assistance in the interpretation of human and mouse tissue pathology. Each major activity is coordinated by an expert faculty co-director. Dr. Vandenberg (STT), an experienced pathologist, is overall Director of the BTTSR, Dr. Schwab (STT) oversees the biorepository clinical affairs and sample collection and distribution, and Dr. Varki (STT) oversees the histology and tissue technology applications in human samples and animal models. The BTTSR assists in the formulation of targeted prospective collections for clinical trials or for translational research projects directed at biospecimens that need specific parameters, in addition to routine tissue collection during diagnostic or therapeutic procedures. Tissue technology includes multi-label immunohistochemistry, multiplexing immunofluorescence, and in situ hybridization in addition to analytical microscopy for molecular morphology, including spectral imaging. The state-of-the-art laser-capture microscopy in the tissue technology resource provides an important resource for performing genomic/expression profiling and proteomics on tissue sections with complex tumor cell heterogeneity and complements the biomarker discovery capabilities performed in this facility.

Integrated Services of the BTTSR
Biospecimen Oversight
- Acquisition of human biospecimens – solid tissue, blood, plasma/serum
- Processing, storage and custodial archiving
- Tissue quality assurances/specimen identification
- Database system integrated with Velos via e-sample module
- Management of biospecimen use & distribution via NCI best practices
Biospecimen Processing
- Whole blood processing for cells/serum/plasma
- Viable tissue processing/short term culture
- Freezing tissue (Liquid N2)
- Tissue fixing-processing with multiple modalities
- Microtomy of frozen and embedded tissue
- Optimization/standardization of existing biomarker assays
- Development of new biomarker assays/analytical molecular morphology
Interpretation of Tissue Parameters
- Expert histopathologic analyses/diagnostic conformation for human and mouse tissues
- Immunohistochemical/immunofluorescent assay validation and evaluation
Collaboration
- Consultations related to tissue preservation/histology
- Experimental design in projects for tissue histology
- Development of robust database elements using e-sample
- Core for tissue banking and specimen tracking, extraction of de-identified data related to distributed specimens for research data warehousing

A Professional Society, Educating and Supporting Research Administrators Around the World
Staffing:
Sharmeela Kaushal – Biorepository Lab Manager
MaryAnn Lawrence – Histology Research Associate
Jimmy Salinas – Biorepository Research Associate
Amanda Gifford – Histology Research Associate

Financial Plan:

<table>
<thead>
<tr>
<th>Income Source</th>
<th>Budget 2013-14</th>
<th>2013-14 Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCSG</td>
<td>$217,409</td>
<td>20%</td>
</tr>
<tr>
<td>Charge Backs</td>
<td>$380,000</td>
<td>36%</td>
</tr>
<tr>
<td>Institutional Support</td>
<td>$464,090</td>
<td>44%</td>
</tr>
<tr>
<td>Other (From Grants)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total Operating Budget</strong></td>
<td><strong>$1,061,499</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

Projected Utilization:

<table>
<thead>
<tr>
<th>Histology Service</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assay Handling</td>
<td>1,254</td>
</tr>
<tr>
<td>Tech Time</td>
<td>1,517</td>
</tr>
<tr>
<td>Pathology Consultation</td>
<td>51</td>
</tr>
<tr>
<td>Special Stain</td>
<td>2,918</td>
</tr>
<tr>
<td>Paraffin Section</td>
<td>43,959</td>
</tr>
<tr>
<td>Paraffin Block</td>
<td>15,444</td>
</tr>
<tr>
<td>Frozen Section</td>
<td>14,620</td>
</tr>
<tr>
<td>Other Consultation</td>
<td>2,168</td>
</tr>
<tr>
<td>Serial Sections more than 25</td>
<td>72</td>
</tr>
<tr>
<td>Routine Stain</td>
<td>9,440</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Biorepository Service</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serum</td>
<td>320</td>
</tr>
<tr>
<td>Plasma</td>
<td>350</td>
</tr>
<tr>
<td>Buffy Coat</td>
<td>300</td>
</tr>
<tr>
<td>Urine</td>
<td>225</td>
</tr>
<tr>
<td>Tumor Tissue</td>
<td>64</td>
</tr>
<tr>
<td>Normal Tissue</td>
<td>5</td>
</tr>
</tbody>
</table>

Plans for the Year:
The BTITSR is targeting these 3 areas for continuing and future development of services.

1) Innovative application of dual ISH/IHC labeling using the ACD RNAscope® technology which preserves optimal histologic detail. The ACD technology is especially valuable when a biomarker has no available antibody probes or when expression levels are especially low. The capability to perform dual ISH/IHC labeling on the same tissue section is a significant enhancement of localizing complex biomarker phenotypes.

2) The capacity for routine viable cell processing/short-term culturing of tumor cells to include tumorospheres cultures, 3D matrix cultures, transwell and tissue slice cultures under standard CO2/room-O2 conditions. In addition culture conditions with lower O2 conditions (1-6%) will be available for the various culture modalities. The Biorepository will minimize time between human tissue acquisition from the OR/day surgery suites and placement of viable cells in lower oxygen environments. Real-time videography (with bright-field interferential contrast or fluorescent illumination of monolayer cultures for ≤72 hours under normoxic 1-6% O2) is also being developed as a resource within the facility.

3) Optimization of LCM technology with respect to isolating analytes from subpopulations of tumor cells that represent small percentages of overall tumor populations but may exert profound biological effects on tumor growth, therapeutic responses, recurrence or invasive progression, of from subpopulations of viable cells in heterogeneous tumor cell cultures grown under variable O2 concentrations.

Unit Director Signature
Cancer Center Director Signature
Synching the Law to Resolve the Disconnection between Awareness and Action in Legally Mandated Diversity Hiring Practices in Higher Education Institutions

Jacqueline Sylvia Dejean, Doctorate of Law & Policy (DLP)
Tufts University

Abstract: Conflicting regulatory demands on higher education institutions (HEIs) contribute to an environment of increasing legal risk for HEIs. In addition, the increasing cost of non-compliance jeopardizes institutional viability as HEIs struggle to adjust to the pressure created by these legally-mandated changes. The legal risk to HEIs can be attributed to the breakdown that employees experience between their awareness of policies and their follow through in carrying out those legal actions. HEIs would benefit from implementing legally-mandated change in a way that maximizes compliance and therefore minimizes risks. This study investigates the relationship between the elements (legal rule, legal procedure and legal agents) of a new model, Synching the Law, that synchronizes the law with organizational characteristics allowing the organization to understand itself in the context of the legal rule and adapt successfully to the legal mandate. While this paper is primarily focused on making institutional legal change, the study used diverse hiring practices of research administration hiring managers to reveal the role of legal agent self-identity in the legal change decision-making process. This study reinforces the need for guidance in making legally-mandated changes that embed effectively within organizations using principles from organizational psychology and therapeutic paradigms. The study confirms that psychological decision making cannot solely be affected by an awareness of the rule of law and legal procedures. In fact, setting the law as a priority is insufficient to motivate compliance to the law by those who must carry out these legal rules.

Keywords: Organizational psychology, change management, action research, research administration, legal rule, legal procedure, legal agent, compliance, risk management, therapeutic jurisprudence, legal awareness, legal action, disconnection, synching the law
Introduction

Institutional change scholars rely on social psychology constructs, principles or models for designing organizational change strategies. Focusing on an understanding of the psychological basis for changing an individual mindset or managing the dynamics of a group, change scholars often develop tools that equip change agents to effectively engage institutions and steward the change process (Eisold, 2005; Gardner, 2006; Morgan, 1997). Both internal and external challenges can drive the institutional necessity for change. For institutions of higher education a legal mandate, such as, legislation, statutes, other policies and court decisions, serve as major external drivers of change bearing serious institutional risks including fines, non-fiscal punitive measures, loss of prestige and privilege, and public criticism.

Despite the high liability for higher education institutions, change scholars have yet to create a tool for implementing legally mandated change. Ideally, a tool that facilitates institutional compliance while minimizing legal liability would remedy this omission. Currently, institutions facing a changing legislative landscape must respond on a policy-by-policy basis to develop adequate plans. Each institution runs the risk of making changes that may not embed in institutional practices and result in non-compliance. Institutional non-compliance can manifest in several ways: by misinterpreting the law, by ineffectively implementing the law, or by failing to guide institutional enforcers of the law (Kern, 2014; Lipsky, 2010). Creating a remedy requires a solution that addresses each of these risks and removes barriers to effective change from a human behavior perspective.

Synching the Law: A Model for Legally Mandated Change

Framework of the Model

The Synching the Law model, created as part of this research, draws from organizational theory and legal therapeutic paradigms. Combining the generally accepted action research model (Cummings & Worley, 2008) with an understanding of organizational behavior and an existing legal intervention called therapeutic jurisprudence (Wexler, 1991), the model recommends overcoming institutional resistance to legally mandated changes by optimizing the role of the legal agent in the legal change process. In so doing, the model encourages a focus on organizational well-being and controls the stress often associated with change failures. This focus is a departure from the current practice of responding to the law with a punitive design to deter non-compliance. The legal agent includes those who must carry out the legal rule and are not the legal, subject, or content matter experts of the legal rule.

The model nods to the conventional wisdom of the necessity of institutional policies, but also equips organizations to incorporate changes that overcome the intergroup dynamics that disconnects awareness of rules and procedures from actions evidenced in the research findings. This results in departures from expected behaviors as required by law, i.e. non-compliance. The model encourages the use of legal agents in conjunction with legal experts at every point of potential legal failure which includes understanding the rule of the law, developing the
implementation process and providing guidance needed by the legal agents to overcome their embedded beliefs which contribute to non-compliance.

Summary of the Synching the Law Model

Figure 1 summarizes the model’s four elements: 1) interpreting the law, 2) synching the interpretation, 3) tailoring the procedures, and 4) sensitizing the implementation, and Table 1 outlines the model’s process flow.

---

**Table 1. Synching the Law Process Flow**

<table>
<thead>
<tr>
<th>Stage</th>
<th>Interpreting the Law</th>
<th>Synching the Interpretation</th>
<th>Tailoring the Procedures</th>
<th>Sensitizing the Implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Action</td>
<td>External legal interpretation enters organization, i.e. regulations, statues, court rulings, industry standards, best practices, etc.</td>
<td>What are the benefits and challenges of the law to the under- or over-bounded organization? Who benefits from the law? Who is challenged by it?</td>
<td>Empowered legal agents refine earlier determinations Gather data about past organizational changes Use legal benefits, challenges, and neutral areas to craft policy</td>
<td>Use of disequilibrium or safety approach in roll out of policy to targeted areas</td>
</tr>
<tr>
<td>Outcome</td>
<td>Formation of stakeholder group comprised of legal, content, or subject matter experts Determine potential benefits, challenges, and neutral aspect of the law.</td>
<td>Addition of legal agents to the stakeholder group Determination of organizational boundedness as related to the law</td>
<td>Addition of more legal agents based on refinements, as needed Identification of target organizational units Development of targeted procedural approaches rooted in psychological approaches</td>
<td>Embedded policies Monitor compliance by legal agents in targeted areas Evaluate efficacy of targeted procedures</td>
</tr>
</tbody>
</table>

---

*Figure 1. Synching the Law: A Model for Making Legally Mandated Changes in HEIs*
This project investigated the elements of the Synching the Law, a model designed to facilitate legally mandated change in U.S. higher education institutions (HEIs). In an environment of increasing legislative burden on HEIs, this model positions HEIs to comply with the law while reducing legal liability. The model makes a significant contribution to managing change and ensuring legal compliance.

**Literature Review**

*Making the Case with Diversity Law in the Higher Education Institution Context*

The first and most crucial part of the research involved selection of a legally mandated change. The criteria for this selection included a legal change that has historically resulted in challenges for institutional implementation. Laws that produced psychological stress in the internal stakeholders of the institution provided the best context for this project. The combination of these two criteria, i.e. institutional challenge and stakeholder psychological stress, led to the selection of diversity law and its implementation as the legal context of the project. The long history of diversity efforts in higher education institutions provided substantial information with regard to institutional compliance.

Decades ago, when HEIs described their responsibility to develop a culturally competent workforce, they meant effecting changes in core areas involving student admissions, enrollment, and retention as the primary focus, with employees and faculty as stakeholders (Worthington, 2012). The approach attempted to develop a culturally competent workforce through the admissions and the retention of diverse students to achieve a student body comprised of a mixture of people with diverse characteristics. US Supreme Court decisions shifted HEI diversity methods from structural diversity achieved through student quotas to interactional diversity rooted in student to student engagement achieved through holistic admissions criteria (Gurin, Dey, Hurtado, & Gurin, 2002; *Educational Benefits Realized*, 2010).

The preponderance of the literature around HEI diversity strongly favored student-focused diversity initiatives (Worthington, 2012). However, recognition of the role and importance of the institutional environments of HEIs, also known as campus climate, has emerged in more recent years (Smith, 2011; Worthington, 2012). An emphasis on campus climate integrated the role of diverse faculty in enabling a more comprehensive approach to developing culturally competent students (Igwebuike, 2006; Niemann & Maruyama, 2005). The campus climate focus on diversity initiatives provides an opportunity to include more than students and faculty, but also university administrators. Previous research shows a lack of gender, racial, and ethnic diversity among university leaders (Jackson & O’Callaghan, 2009; McHargh, 2010). This lack of diversity within the administration posed challenges for universities attempting to create culturally competent students as mandated by law (McHargh, 2010; Parker & Villalpando, 2007). Compliance to diversity law is not merely compliance with Title IX or Affirmative Action, but also compliance with the judicial interpretations of diversity mandates as described in Supreme Court decisions. Collectively, these represent what the study refers to as diversity law.
Making the Case with University Research Administration

The extensiveness of HEI organizational hierarchy and the complexity of diversity law applications in HEIs meant limiting the focus of the research to a segment of HEI stakeholders. This limitation created a reasonable and manageable research case. Research Administrators comprise one of many highly skilled university administrative groups. Similar to other university administrative areas, research administration evidences a high level of gender diversity among the general administrative staff, but lacks racial and ethnic diversity among staff. Both female and non-white populations are underrepresented at the executive level of the profession (Nash & Wright, 2013). As compliance officers, research administrators would be keenly aware of the importance of compliance and the adverse impact on the institution due non-compliance. Unlike other university administrative units that would not have the same awareness of the importance of compliance.

The profession of research administration in the United States became firmly established in the 1950s. According to the National Council of University Research Administrators (NCURA) prior to that time, the work of research administration was handled by part time university employees who held other primary duties (Wile, 2008). Federal funding for scholarly research activities grew, so too the regulations governing management both grant and contract processes and funds (Wile, 2008). The research endeavor has become an integral part of university business and identity, as reflected in HEI Carnegie classifications and the prestige associated with grant funding within the academia (Nash & Wright, 2013). The federal regulations governing research administration have also become more complex over time. The Research Administrators Certification Council (RACC) divides these administrators’ skill set into four categories: project development and administration, legal requirements and sponsor interface, financial management, and general management (RACC, 2014).

Since the launch of NCURA, there have emerged other organizations for the profession. The foremost of these organizations developed initially for non-university administrators is the Society of Research Administrators International (SRA). A review of the journal archives of both SRA and NCURA revealed a paucity of articles addressing diversity in research priorities despite the increasing federal focus on university development of a diverse future workforce, federal emphasis on increasing the diversity of those conducting research including post-doctoral scholars and graduate students, and the federal requirement to diversify research study participation in gender, race, and ethnicity, e.g. in the Public Health Service Act sec. 2492B, 42U.S.C. sec. 289a-2. Three studies investigated the profiles of research administrators. Roberts and House (2006) conducted a study of research administrators in the southeastern United States using 2005 demographic data describing gender and race as white or non-white. Shambrook and Roberts repeated the study in 2010 using national survey data and disaggregating the race/ethnicity category to include: African American, Asian, Hawaiian, Hispanic, Pacific Islander, and Native American. Both the 2006 and 2010 articles showed high representation of women (approximately 50% and 80% female, respectively) and low racial and ethnic diversity (less than 10% non-white). Neither study disaggregated diversity by professional level.
In 2013, Nash and Wright focused their research on the pathway to the highest position of the profession, i.e. chief research officers (CROs), and investigated the demographics of that group. Despite the dominance of women in the profession, less than 40% of CROs are women in doctorate conferring institutions. In research universities with the highest Carnegie classification, the percentage of women in the highest leadership positions was even lower: 15%. Nash and Wright aggregated the race and ethnicity classifications into white and non-white and found six percent of the CROs identified as minorities. Based on the minimal research conducted to date, one would conclude that the research administration profession is predominantly a white female workforce led principally by white men. The lack of diversity at the most competitive HEIs is not singular to offices of research administration, but, as reported by Jackson and O’Callaghan (2009) and McHargh (2010), is in fact indicative of the lack of diversity of university administration in general.

In the past, entrance into the profession has been through on the job training as exemplified by the short history of the one certification organization for the profession, the Research Administrators Certification Council (RACC) established in 1993 (RACC, 2014). In the last few years, universities have developed degree programs for the training of research administrators at the master’s level. This newest educational pathway does not change the fact that most current research administrators entered into the field without any prior knowledge of research administration and received training on-the-job.

Research Design

The foundation of this study stemmed from a broader interest, i.e. can legally mandated changes be implemented in organizations using a structured approach that incorporates organizational psychology principles? This study was premised on the idea that successful implementation of legal change required attention to the legal rule, legal procedures, and legal agents within the context of an individual organization’s characteristics.

The development of a structured model for embedding legally mandated change in organizations from the conceptual framework is depicted in Figure 1. The first three foundational elements of the model, i.e. legal rule, legal procedure, and legal agents, combined with the psychological approach to embedding change, i.e. either safety or disequilibrium, represent aspects of legal and psychological scholarship that had not been tested together. It was important to understand how these elements manifested in a particular legal context to confirm that the theoretical construct offered a useful framework. The focus here is observing and understanding the incorporation of diversity law considerations during the hiring process as practiced by research administration hiring officers.

Research Questions

In the context of diversity law and higher education, the specific research questions are:

1. Are research administrators aware of diversity laws and the diversity legal procedures of their institutions?
2. Are research administrators’ hiring decisions significantly related to their awareness of diversity law and diversity legal procedures, diversity priorities, training, or a demographic self-identification?

3. What is the preferred change approach of research administrators?

The study confirmed the relationship between the elements of the model in the context of diversity law as practiced by a type of administrative unit of higher education institutions. Specifically, the study revealed that strong correlations exist between awareness of diversity policy, i.e. defined as legal rule incorporated into legal procedures, and institutional priorities. Another strong correlation exists between hiring manager training and racial and gender diversity priorities. However, the only variable correlated to hiring decisions was the hiring managers’ gender and racial identity.

Methods

Data Sources and Collection

The Society of Research Administrators International (SRA) agreed to disseminate the web-based online survey to its membership. The 25-minute survey instrument, created by the author specifically for this study using SurveyMonkey, gathered data in the following categories: 1) hiring manager awareness of diversity policies and practices of their home institution, 2) hiring manager training in the hiring procedures affecting diverse workforce recruitment, and 3) perceptions of the role of diversity in their decision process. Currently, SRA’s membership included over 5000 members from over 50 countries. A statistically significant sample size (n=217) was achieved assuming that approximately 4000-4500 members were US based administrators, and, of that number, 10% were hiring managers or participated in the hiring process and exclusions described below in the methods section (Patten, 2012, p. 203).

Organized into six sections, SRA offered the opportunity to cluster data into four of the relevant geographic regions: Northeast, Western, Southern, and Midwest. The two other sections, Canadian and International, were excluded from the survey via a qualifying question. This exclusion was necessary because the diversity mandate applies only to US higher education institutions.

SRA membership included a variety of non-higher education institutions, such as teaching hospitals, research institutes, and other non-profit and for-profit organizations affiliated with HEIs. Information collected about the type of organization helped isolate the sample of interest. Participant demographics (gender, race) and the demographics of the office served by the hiring manager, rounded out the data collected.

De-identified data was stored in password protected cloud files using OneDrive for the duration of the research project. Identifying information deleted from the data set included IP addresses and home institution names. IP addresses were necessary initially to allow respondents to return to their unfinished survey. Home institution names allowed purging of non-higher education institutions included in the Type of Institution-Other category. In this way, the survey respondents’ identities remained confidential and did not affect data analysis or the interpretation of the
findings. All demographic information was aggregated by racial, ethnic, and gender categories. Data was kept and stored electronically in a password protected cloud and a password protected file on an external drive. The Institutional Review Board of Northeastern University approved this study.

Data collection provided the connection between the law and compliance to the law. The data collected helped to develop an understanding of how the three aspects of the framework (legal rule, legal procedure and legal agents) connected or failed to connect. Data collected provided insight into the preferences of higher education institution employees for one of two psychological approaches.

**Measures**

The study data involved variables designed to provide an understanding of the population and to investigate the relationship between the elements of the model from the legal agents’ perspective.

**Region.** This study used US regions defined by the Society of Research Administrators International. The SRA divided the US into four categories: Northeast, Southern, Midwest, and Western. The regions served to provide an independent demographic variable to define the study participants.

**Gender.** Gender serves as an independent variable in the study. The study defines gender as male, female, and other. There are two gender variables in this study. One variable captures the participants’ gender. The other variable measures the gender composition of the hiring managers’ organizational units.

**Race and Ethnicity.** The race/ethnicity independent variable allowed a selection of responses including: African American/Black, American Indian or Alaskan Native, Asian, Hispanic, White Non-Hispanic, Multi-racial/Multiethnic and Other. Due to the focus of this research on diversity law, this question was required; the survey did not allow participants to opt out of this question. However, participants who categorized all organizational unit personnel as “Other” and used the open comment box to write in “prefer not to answer” were deemed to be non-responsive and the data was treated as missing. Participant’s responses of “don’t know,” were coded as missing for the same reason. There are two race/ethnicity variables in this study. This variable captures participants’ race and ethnicity. The other variable measures the racial/ethnic composition of the hiring managers’ organizational units.

**Hiring Manager.** An independent variable in this study and the basis of the participant eligibility criteria, research administration hiring manager, included two categories: hiring manager, i.e. person with authority to both hire and fire, and hiring participant, i.e. person who assists in the hiring process in some manner.

**Type of Institution.** Because SRA membership included “colleges and universities, research hospitals and institutes, government agencies, non-profit funders of research, and industry,” the respondents’ identification included the categories: college, university, university affiliated foundation or other.
Total Personnel. Using a fillable grid allowed for the collection of disaggregated gender and racial information about each organizational unit. This variable provided the aggregated data with regard to number of people in each participant's unit. Total personnel was achieved by adding total males and total females together.

Total Male. This variable totaled all males listed in the fillable grid.

Total Female. This variable totaled all females listed in the fillable grid.

Total by Racial Group. This variable totaled all personnel into each racial category listed in the fillable grid. The categories included: African American/Black, American Indian or Alaskan Native, Asian, Hispanic, White Non-Hispanic, Multi-racial/Multiethnic and Other.

Racial Diversity Ratio. The racial index provided a means of analyzing the level of racial diversity of each office. This diversity index treated diversity as a ratio of white to non-white individuals. The non-white organizational unit totals, i.e. African American/Black, American Indian or Alaskan Native, Asian, Hispanic, Multi-racial/Multiethnic and Other, were combined for the purposes of this ratio. The ratio ranged from -1 to 1. Where -1 and 1 represented 1:1 ratios of non-white to white, or white to non-white, respectively. Zero indicated a non-diverse population that was either all white or all non-white. Otherwise, the ratio measured fractions of diversity by race. The formula for this variable was calculated as follows for each organizational unit:

\[ \text{If } w > nw, \text{ then } nw/w, \text{ but if } w < nw, \text{ then } -1 \times nw/w. \]

Gender Diversity Ratio. In order to measure level of gender diversity, a similar ratio with a range of -1 to 1 comprised of total males to total females and calculated as follows:

\[ \text{If } f > m, \text{ then } m/f, \text{ but if } f < m, \text{ then } -1 \times f/m. \]

Both the racial and diversity indices provided a measure of actual decision-making. The office compositions reflect the hiring norms of the managers collectively and reflect the intergroup practices of the managers.

Policy Awareness. The policy awareness variable served as an indication of level of knowledge of both the legal rule and the legal procedures. The independent variable, policy awareness, measured level of awareness by offering participants a list of typical racial and gender diversity policies at higher education institutions. The policies included in this variable were not meant to be comprehensive, but representative. Of the six policies listed, four were racially-based and two were gender-based policies. The racially-based choices included: affirmative action plan, equal employment opportunity policy, institutional diversity plan, and racial anti-harassment policy. The two gender-based references included: gender anti-harassment policy and Title IX coordinators. Thus, resulting in a policy awareness measure ranging from 0 to 6, where 0 equated to no awareness and 6 to total awareness.

Racial Priority Index. Three survey questions related to the prioritization of race and ethnicity in various institutional decisions, i.e. student enrollment, faculty recruitment, and hiring of
administrative staff form the basis of the racial priority index. Each of the three questions allowed for six responses ranging from unimportant to very important and scaled from 1 to 4, respectively. The other two responses, not applicable and don’t know, were assigned zero values in the racial priority. The index values ranged from 0 to 4 with 4 representing the highest priority. The formula for this variable was calculated as follows:

\[
\frac{\text{Sum of three race priority questions’ scale values}}{\text{Total number of race priority questions}}
\]

**Gender Priority Index.** The gender priority index used a similar rationale as the racial priority index. The formula for this variable was calculated as follows:

\[
\frac{\text{Sum of three gender priority questions’ scale values}}{\text{Total number of gender priority questions}}
\]

**Hiring Managers’ Racial Recruitment Priority.** This independent variable captured hiring managers’ racial hiring priority by assigning values of 1 to 4, unimportant to very important.

**Hiring Managers’ Gender Recruitment Priority.** This independent variable captured hiring managers’ gender hiring priority on a scale of 1-4, unimportant to very important.

**Hiring Managers’ Training Received.** This variable measured level of diversity hiring training received by the hiring manager on a six point scale from 1-6. The scale ranged from: “did not need training from my current institution” (0) to “yes, substantial, formal training received from my current institution” (6).

**Hiring Manager Training Needed.** This variable asked of all participants if training in diversity hiring would be beneficial. The two hiring manager training variables provided the opportunity to understand a likely reason for any observed associations between the variables that align with the various model elements.

**Psychological Approach.** The psychological approach measures practices and preferences for two approaches to organizational change: (1) disequilibrium and (2) psychological safety. Disequilibrium enables change by making people uncomfortable with the status quo, while avoiding stress levels so high as to create psychological dysfunction (Heifetz, Grashow, & Linsky, 2009). Psychological safety preserves individual identity, allowing the engagement of the individual without engendering fear of reprisal or marginalization (Singh, Winkel, & Selvarajan, 2013).

**Data Analysis**

Statistical analysis of data was accomplished using SPSS. Review of the survey data involved uncovering the occurrence of patterns attributable to each aspect of the model. The analytic process looked at the frequency of occurrences and determination of statistically significant correlations through analysis of variance (ANOVA).
Results

Participant Selection Criteria

Participant eligibility in this study required that the respondent hold a position that involved hiring of research administration personnel at their current institution. Of the 489 survey respondents, 319 participants identified as hiring managers with firing authority or as participants in the hiring process who reviewed resumes, triaged candidates, assisted with candidate interviews, recommended candidates for selection, or all of the above. All other survey respondents were excluded. Of the remaining 319 respondents, the study used the responses of the 217 participants who completed at least 87%-90% of the questions, i.e. 29 out of 33 questions. Respondents who abandoned the survey before completing the questions relevant to the study’s research questions

Table 2. Sample Population Demographic Data

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Status</td>
<td>Hiring Managers</td>
<td>137</td>
<td>63.1%</td>
</tr>
<tr>
<td></td>
<td>Hiring Participants</td>
<td>80</td>
<td>36.9%</td>
</tr>
<tr>
<td>Regions</td>
<td>Northeast</td>
<td>47</td>
<td>21.7%</td>
</tr>
<tr>
<td></td>
<td>Southern</td>
<td>80</td>
<td>36.9%</td>
</tr>
<tr>
<td></td>
<td>Midwest</td>
<td>46</td>
<td>21.2%</td>
</tr>
<tr>
<td></td>
<td>Western</td>
<td>44</td>
<td>20.3%</td>
</tr>
<tr>
<td>Type of Institution</td>
<td>University</td>
<td>204</td>
<td>94%</td>
</tr>
<tr>
<td></td>
<td>College</td>
<td>13</td>
<td>6%</td>
</tr>
<tr>
<td>Organizational Level</td>
<td>Central Administration</td>
<td>118</td>
<td>54.4%</td>
</tr>
<tr>
<td></td>
<td>Department</td>
<td>72</td>
<td>33.2%</td>
</tr>
<tr>
<td></td>
<td>Laboratory</td>
<td>2</td>
<td>0.9%</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>25</td>
<td>11.5%</td>
</tr>
<tr>
<td>Size of Research Funding</td>
<td>$1-$19,999,999</td>
<td>44</td>
<td>22%</td>
</tr>
<tr>
<td></td>
<td>$20,000,000-$39,999,999</td>
<td>19</td>
<td>9.5%</td>
</tr>
<tr>
<td></td>
<td>$40,000,000-$59,999,999</td>
<td>8</td>
<td>4%</td>
</tr>
<tr>
<td></td>
<td>$60,000,000-$79,999,999</td>
<td>12</td>
<td>6%</td>
</tr>
<tr>
<td></td>
<td>$80,000,000-$99,999,999</td>
<td>9</td>
<td>4.5%</td>
</tr>
<tr>
<td></td>
<td>Greater than $100,000,000</td>
<td>108</td>
<td>54%</td>
</tr>
<tr>
<td>Participants by Race and Ethnicity</td>
<td>African American or Black</td>
<td>16</td>
<td>7.5%</td>
</tr>
<tr>
<td></td>
<td>Asian</td>
<td>9</td>
<td>4.2%</td>
</tr>
<tr>
<td></td>
<td>Hispanic</td>
<td>13</td>
<td>6.1%</td>
</tr>
<tr>
<td></td>
<td>White, Non-Hispanic</td>
<td>169</td>
<td>79%</td>
</tr>
<tr>
<td></td>
<td>Multi-racial/Multi-ethnic</td>
<td>7</td>
<td>3.3%</td>
</tr>
<tr>
<td>Participants by Gender</td>
<td>Female</td>
<td>171</td>
<td>78.8%</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>46</td>
<td>21.2%</td>
</tr>
<tr>
<td>Participants by Year Experience</td>
<td>Less than 1 year</td>
<td>3</td>
<td>1.4%</td>
</tr>
<tr>
<td></td>
<td>1-3 years</td>
<td>14</td>
<td>6.5%</td>
</tr>
<tr>
<td></td>
<td>4-6 years</td>
<td>27</td>
<td>12.4%</td>
</tr>
<tr>
<td></td>
<td>7-9 years</td>
<td>27</td>
<td>12.4%</td>
</tr>
<tr>
<td></td>
<td>10 or more years</td>
<td>146</td>
<td>67.3%</td>
</tr>
</tbody>
</table>
were excluded. Of the 217 participants making up the research sample, 63.1% identified themselves as hiring managers and 36.9% self-identified as participants in the hiring process. Table 2 includes descriptive statistics of the sample population.

Descriptive Analysis of the Sample Population

Institutional demographics. Participants worked in all 4 geographic areas of the US: 21.7% from Northeast, 36.9% from Southern, 21.2% from Midwest and 20.3% from Western regions. Ninety-four percent of participants were employed by universities and the remaining 6% were employed by colleges. Over 50% of respondents identified as central administration, about one-third of participants worked in a department, and less than 1% worked in a laboratory. The remainder of participants worked in university affiliated research institutions. The participants’ institutions varied in the amount of research funding received. More than half maintained portfolios of $100 million per year or more in funding. The second largest group (22%) had an annual research funding portfolio under $20 million.

Diversity demographics. Participant diversity analysis by race and ethnicity revealed that the sample population broke down as follows: 79% White Non-Hispanic, 7.5% African American/Black, 6% Hispanic, 4.2% Asian, and 3.3% Multi-racial. The remaining respondents’ answers, 1.4%, were treated as missing. Gender demographics analysis of all 217 participants revealed 78.8% female and 21.2% male. Although an “other” category for gender was available, none of the hiring managers nor the hiring participants self-identified as “other”.

Other demographics. Participants’ number of years of experience shows that 67.3% of the participants have 10 or more years of experience in research administration.

Descriptive Analysis of Office Diversity Composition

Table 3 below shows the gender and race composition the research administrations offices served by the hiring managers and presents this data side by side with the hiring managers’ gender and race demographics.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
<th>Manager</th>
<th>Office</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Female</td>
<td>78.8%</td>
<td>70.4%</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>21.2%</td>
<td>29.6%</td>
</tr>
<tr>
<td>Race</td>
<td>Non-White</td>
<td>20.1%</td>
<td>35.3%</td>
</tr>
<tr>
<td></td>
<td>White</td>
<td>79.9%</td>
<td>64.7%</td>
</tr>
<tr>
<td>Gender/Race</td>
<td>Male/Non-White</td>
<td>2.3%</td>
<td>9.7%</td>
</tr>
<tr>
<td></td>
<td>Male/White</td>
<td>18.9%</td>
<td>18.5%</td>
</tr>
<tr>
<td></td>
<td>Female/Non-White</td>
<td>13.8%</td>
<td>25.6%</td>
</tr>
<tr>
<td></td>
<td>Female/White</td>
<td>65.6%</td>
<td>46.2%</td>
</tr>
</tbody>
</table>
Descriptive Analysis of Psychological Approaches to Change

Regardless of the circumstances, the data showed a stronger tendency for psychological safety than for disequilibrium as an approach to making change in an organization (Figure 2).

![Figure 2. Preference for Disequilibrium vs. Psychological Safety Approach to Making Institutional Changes](image)

Specifically, respondents reported that institutional change practices tend towards safety (69.9%) over disequilibrium (30.1%). At the office level, 77.6% use a safety approach. The hiring manager’s themselves reported a preference for psychological safety (70.9%) in making organizational change. Finally, the preference for legally mandated change represented the highest percentage, i.e. 83.2%, selecting psychological safety as the preferred approach to making legally mandated changes.

Regression Analysis

Table 4 summarizes the ANOVA results of the detailed description of the findings that follow.

**Finding 1.** Results of the ANOVA indicated an association between policy awareness and the prioritization of race and gender in hiring. There is a significant positive relationship between policy awareness and race/ethnicity prioritization in institutional practices (F1, 188 = 10.080; p<.01). The regression analysis also demonstrates a significant positive association of policy
awareness on gender prioritization in institutional practices (F1, 201 = 5.201, p<.05). A closer analysis reveals that awareness of race and ethnicity specific policies is significant positive association with hiring managers’ prioritization of racial recruitment (F1, 177= 6.857, p<.01). However, hiring managers’ gender prioritization is not significantly related to gender specific policy awareness (p=0.461).

**Finding 2.** When comparing hiring managers’ priorities to the hiring decisions made (as evidenced by the personnel race and gender ratios), the analysis shows that priorities have no significant relationship to hiring actions. The regression analysis shows no significant association between race/ethnicity hiring priorities and the racial/ethnic composition of their unit’s staff (p=0.644). Similarly, there is no significant association between hiring manager gender prioritization and the gender ratios (p=0.988).

The regression analysis identified a significant positive correlation between three variables: policy awareness, gender priority, and gender ratio (p=0.041). More specifically, when comparing gender policy awareness, gender priority, and gender ratio, a significant positive association emerged (p=0.059). However, when considering race and ethnicity, no significant correlation existed between policy awareness, racial priority, and race ratio (p=0.802). Neither was there a significant association between racial policy awareness, racial priority and race ratio (p=0.802).

**Finding 3.** The result of the analysis shows a significant positive relationship between training and hiring manager race/ethnicity priority (F1, 180= 12.222, p<.001). Training also has a

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**Table 4. ANOVA Results of Research Administrators Hiring Practices Survey**

<table>
<thead>
<tr>
<th>Description of Variable Correlations</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Policy awareness vs. Racial priority</td>
<td>10.080</td>
<td>.002</td>
</tr>
<tr>
<td>Policy awareness vs. Gender priority</td>
<td>5.201</td>
<td>.024</td>
</tr>
<tr>
<td>Racial policy awareness vs. Manager recruitment priority</td>
<td>6.857</td>
<td>.010</td>
</tr>
<tr>
<td>Gender policy awareness vs. Manager recruitment gender priority</td>
<td>.547</td>
<td>.461</td>
</tr>
<tr>
<td>Manager recruitment race/ethnicity priority vs. Racial diversity ratio</td>
<td>.214</td>
<td>.644</td>
</tr>
<tr>
<td>Manager recruitment gender priority vs. Gender diversity ratio</td>
<td>.000</td>
<td>.988</td>
</tr>
<tr>
<td>Policy awareness, Racial priority, vs. Racial diversity ratio</td>
<td>.220</td>
<td>.802</td>
</tr>
<tr>
<td>Policy awareness, Gender priority, vs. Racial diversity ratio</td>
<td>3.244</td>
<td>.041</td>
</tr>
<tr>
<td>Racial policy awareness, Racial priority, vs. Racial diversity ratio</td>
<td>.220</td>
<td>.802</td>
</tr>
<tr>
<td>Gender policy awareness, Gender priority, vs. Gender diversity ratio</td>
<td>2.888</td>
<td>.059</td>
</tr>
<tr>
<td>Training vs. Manager recruitment race/ethnicity priority</td>
<td>12.222</td>
<td>.001</td>
</tr>
<tr>
<td>Training vs. Manager recruitment gender priority</td>
<td>7.781</td>
<td>.006</td>
</tr>
<tr>
<td>Training vs. Racial diversity ratio</td>
<td>1.639</td>
<td>.202</td>
</tr>
<tr>
<td>Training vs. Gender diversity ratio</td>
<td>.018</td>
<td>.893</td>
</tr>
<tr>
<td>Race/ethnicity vs. Manager recruitment race/ethnicity priority</td>
<td>4.829</td>
<td>.029</td>
</tr>
<tr>
<td>Racial/ethnicity vs. Gender priority</td>
<td>3.772</td>
<td>.054</td>
</tr>
<tr>
<td>Gender vs. Race priority</td>
<td>5.365</td>
<td>.022</td>
</tr>
<tr>
<td>Race/ethnicity vs. Manager recruitment gender priority</td>
<td>5.312</td>
<td>.022</td>
</tr>
<tr>
<td>Manager gender vs. Gender diversity ratio</td>
<td>5.972</td>
<td>.015</td>
</tr>
</tbody>
</table>

---

**The Journal of Research Administration, (46)2**
significant positive association with hiring managers’ gender priority (F1, 181= 7.781, p<.01). However, there is no significant association between training and the racial/ethnic diversity ratio (p=0.202). There is no correlation between training and the gender diversity ratio (p=0.893).

**Finding 4.** There is a strong positive correlation between hiring managers’ prioritization of race and ethnicity and hiring managers’ racial demographics (p = 0.029). Gender prioritization and hiring managers’ race and ethnicity are significantly correlated (p=0.054). Institutional racial priority and hiring managers’ gender are significantly correlated (p=0.022). There is a strong, positive association between hiring managers’ gender prioritization and hiring managers’ race and ethnicity (p=0.022). Gender diversity ratio and hiring manager gender show a significant positive association (p=0.015).

**Discussion**

*Aligning Findings to the Research Questions*

**Research Question 1: Hiring Priorities.** The connection between policy awareness and priority setting is very apparent from the results of the study. At the institutional level hiring managers are cognizant of the institution’s priorities in relation to diversity related legal rules and legal procedures. This is not a surprising finding as one would hope that a general awareness of the rules would positively correlate to the priorities developed by those within the organization. However, the relationship only holds for race and ethnicity. There is a positive correlation between the level of awareness of racial policies and the importance placed upon the practice of prioritizing racial diversity in the enrollment of students, hiring of faculty, and hiring of administrators as well as in individual manager’s hiring priorities. There is also a positive relationship between training in diversity hiring and both race and gender hiring prioritization.

**Research Question 2: Hiring Decisions.** While one can hope that the awareness of policy and the priority placed on that policy would affect hiring actions, the exact opposite occurs. The study findings indicate that despite the high percentage of women in this field (Roberts & House, 2006; Shambrook & House, 2010) and in this sample, neither gender policy awareness nor gender priority were considered significant factors. Yet, gender hiring was significantly linked to gender policy and gender priority together. Conversely, significant links emerged between racial policy and racial priority, but there was no link between the two with hiring actions. Therefore, while hiring managers perceived race-based policies and priorities as important and gender-based policies and priorities as unrelated, in a female-manager dominated environment, gender hiring was the norm.

The clearest and most consistent link to hiring actions emerged only when considering the race or gender of the hiring manager. In the white dominated managers group, those most likely hired were white. The gender connection proved to be similar, i.e. women hired women. Finally, white-women managers most likely hired white women. The key concern here is two-fold. First, if personal characteristics drive hiring decisions and hiring managers are unaware of this tendency, then it is unlikely that the hiring managers will change their behavior. Secondly, current practices need to take the managers’ readiness to change their thinking as part of implementing a successful
legal change process. Only then can awareness and actions become synchronized. Addressing the unconscious tendencies of the hiring managers who serve as the legal agents in this study are the key to compliance in diversity hiring practices.

**Research Question 3: Preferred Change Approach.** Research administration hiring managers indicated a tendency for taking a psychological safety approach to making change at every level (Figure 2). The majority of hiring managers agreed that psychological safety was more evident in the change processes they observe in their higher education context. At both the university level and office level, managers reported tendency for psychological safety approaches to change. However, hiring managers also largely agreed that psychological safety was better way to make both institutional and regulatory changes.

*Aligning the Findings with the Synching the Law Model*

The assumption of the model inherent in its depiction in Figure 1 is that connections between the model’s elements are strengthened by Synching the Law into the organizational psyche. In order to make that case, the research looked into existing legal change practices and preferences in the diversity context, which assumes an absence of a structured psychological approach.

**The Power of Identity in Compliance.** Prior research argues that the breakdown in legal compliance occurs in three possible ways: 1) misinterpretation of the law, 2) ineffective implementation, and 3) failing to guide institutional enforcers (Kern, 2014; Lipsky, 2010). This study not only revealed the breakdown of the legal change process as it relates to compliance in diversity law, but exposed a fourth way that the law fails to embed. The fourth way relates to the identity of the individual making the decision. The research shows that individual identity had a stronger relationship with hiring actions than knowledge of the law. Knowledge of both the law and procedures was measured in terms of awareness and recognition of institutional priority. The findings suggest that intergroup dynamics permeate institutional decision making with regard to race and gender hiring. This remained true in a sample drawn from various US geographic regions, types of higher education institution, and types of office. The identity findings of this empirical study are consistent with the findings of EU and US studies (Morgan & Vardy, 2009; Rivera, 2012) focused on manager tendency to hire individuals whose identities are most closely reflected by the applicants that they interview. However, neither study offers a targeted solution to overcome the power of hiring manager identity in the selection of applicants.

**Placement of Identity in Legal Policy Development.** Addressing hiring manager identity during the interpreting the law and synching the interpretation steps of the model would have recognized the strength of identity as a psychological construct and addressed it by discussing the nature of this construct and allowing the stakeholder group to create a new shared identity construct that would be embedded in the procedures and tailored for the most resistant organizational units.

The development of a procedure could be enhanced by recognizing that hiring manager identity trumps awareness and priorities. Despite the collective recognition of how important diversity practices are to the institution, the analysis revealed no significant connection between diversity priorities and hiring practices. Their acknowledgement of diversity’s importance had no significant relationship with how the hiring managers made their hiring decisions except in the
case of gender, more specifically, in the hiring of women. Therefore, incorporating identity into the targeting of procedures would have prevented development of procedures based solely on agreement with the legal principles and procedures and focused more on getting hiring managers past their strongly held identity decision paradigms to a newly constructed, psychological identity that more effectively embeds the legal mandate.

**Implementing Legal Mandate Training with Identity in Mind.** This study focused on the rule and procedures related to diversity hiring mandates. The findings show a high correlation between training and awareness, but no such correlation could be made between training and actions. Again, identity, as a psychological construct, connected with diverse hiring decisions in a way that neither awareness nor training connected with diverse hiring decisions. Sensitizing the implementation addresses this issue of considering the psychological approach needed to truly embed the change that would address identity and not just awareness.

**Organizational Environment Relevant to Crafting an Identity Response.** Finally, the preponderance of reliance on psychological safety as an approach for embedding legally mandated change at higher education institutions suggests an interesting connection. Under-bounded organizations with flexible boundaries benefit from a psychological safety approach as intergroup conflicts manifest as identity conflicts, while over-bounded organizations tend to exhibit task-oriented conflicts. In the context of diversity and despite their hierarchical structure, higher education institutions are characterized as under-bounded organizations. Within universities, intergroup conflicts will manifest as identity conflicts, including conflicts of racial and gender orientation.

The study findings support the idea of universities as under-bounded within the context of diversity law compliance. The tendency to accept the law and yet not comply with it does not indicate rigidity, but the lack of a structure that would effectively shape behavior. While a semblance of structure exists in higher education, when it comes to implementation design, the clarity and targeting necessary to effectively change unchecked practices does not exist.

**Conclusion**

**Summary**

This study addressed the relationship between the legal rule, legal procedure, legal agents and psychological approach to change, i.e. elements of the *Synching the Law* model. The data collected captured the relationships between different elements of this model from the legal agents’ perspective. The findings of the study helped to identify a disconnection in the flow of legal change between awareness and action. Although action, i.e. hiring decisions, failed to correlate to policy awareness, it was clear that action connected significantly to legal agents’ demographic identity. Simply stated, hiring managers tended to duplicate themselves in the hiring process with regard to gender and race.
In an industry that is disproportionately white and female (Roberts & House, 2006; Shambrook & Roberts, 2010), self-identification as the basis for decision making means that very little will change without a redefining of identity as part of the intervention. In the larger context of implementing legally mandated change, the research findings indicate that historical uses of psychological approaches provides data for understanding the characteristics of organizations and can be used effectively to make the right changes if developed in conjunction with and targeted at the appropriate legal agents. *Synching the Law* offers a way to begin addressing disconnections in the legal change process as it moves from awareness to action.

**Future Research**

This study investigated the relationship between the individual elements of the model. Further testing would be needed to both validate and refine the model. This would be accomplished by staging organizational interventions and observing the outcomes. It would also be beneficial to test this model using different legal mandates other than diversity law to investigate the usefulness of the model in varying contexts. Finally, testing the model within different organizational structures and industries would shed light on the organizational contexts of the model.

**Author’s Note**

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References


Growing Faculty Research for Students’ Success: Best Practices of a Research Institute at a Minority-Serving Undergraduate Institution

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Abstract: Broader diversity in the research workforce affords the inclusion of research agendas, methods, and perspectives that might otherwise be overlooked to address key social and scientific problems. However, promoting diversity in science is not a trivial matter. It entails mitigating some of the long-term social and institutional inequalities that have prevented the participation of underrepresented groups, such as Latinos, in scientific research. For instance, the Hispanic Association of Colleges and Universities (HACU) reports that Hispanic serving institutions receive (on average) only 69 cents for every federal dollar of funding that all other higher education institutions receive.

This article describes how an interdisciplinary research institute at an under-resourced Hispanic serving institution managed to build a culture of undergraduate research by promoting the research of local faculty and supporting their mentoring role in the face of economic and administrative challenges. In spite of dramatic budget cuts that fluctuated between 1.4% and 13.3% (2005-2013) and loss of 23% of its senior faculty due to retirement (2006-2014), during a 10-year period, the Institute of Interdisciplinary Research (IIR) at the University of Puerto Rico at Cayey was able to increase the number of faculty conducting research from 7 to 54 and the number of students engaged in research from 8 to 481. During the period, UPR-C faculty from the Sciences, Arts, and Business Administration engaged in
the applied, regional and interdisciplinary research mission of the IIR, published 81 peer-reviewed articles, offered 238 research presentations, and submitted 81 grants (57 to external funding agencies and 24 to UPR-C divisions). Grant approval for external funding was 45.6%. Students’ most important research products included oral and written presentations in epidemiology, psychology, anthropology, ecology, chemistry, microbiology, pedagogy, business administration, and humanities. Overall, during the period, 84% of students who applied to graduate programs were admitted. This article identifies the key approaches and outcomes of a strategic planning process that allowed the IIR to become a successful campus-wide research resource for interdisciplinary research at an undergraduate, Hispanic serving institution facing fiscal and administrative challenges.

Keywords: institute of interdisciplinary research, research management, Hispanic serving undergraduate institution, undergraduate research, undergraduate faculty, research and mentoring, Puerto Rico

Introduction

Puerto Rico was a colony of Spain for ~400 years until 1898, when the US occupied the Island. Transformations ushered in by World War II changed the overtly colonial relationship between the Island and the US to the current Commonwealth status as a non-incorporated US territory. Island-born Puerto Ricans are US citizens and most wish to maintain close political and economic ties to the US. However, most Puerto Ricans also view themselves as a distinct group with common history, culture, and heritage (Dávila, 1997; Duany, 2002; Morris, 1995). Both Spanish and English are official languages in Puerto Rico, but mainly Spanish is spoken. Because the Island’s economy is heavily dependent on US industry and federal funds transfers, mainland events such as the recent economic recession adversely affected this US territory. Currently, Puerto Rico’s per capita income is ~$15,200 (half that of Mississippi, the poorest state), and the unemployment rate is 15.4 percent (Alvarez, 2014). The resident population is estimated at 3.6 million (U.S. Census Bureau, 2013), while almost 5 million Puerto Ricans are now living in the US (U.S. Census Bureau, 2011).

Since 1903, the University of Puerto Rico (UPR) has been the sole public institution charged with the mission to “develop the latent intellectual and spiritual enrichment of our society fully,” so that “the intellectual and spiritual values of exceptional personalities that surge from all its social sectors, especially from those less favored in terms of economic resources, will be put to the service of the Puerto Rican community” (UPRRC EGCTI, 2015, our emphasis). With a total student population of 61,967 students, the UPR system has to implement this mission across its eleven campuses: three of which are graduate and eight of which are primarily undergraduate. The University of Puerto Rico at Cayey (UPR-C) is one of the UPR’s eight undergraduate campuses. It offers 27 bachelor’s degrees in Natural Science (Biology, Chemistry, Mathematics and the Natural Sciences General Program); Social Sciences (Psychology and Mental Health); Arts (English, Literature, Humanities, Foreign Languages, Literature and Linguistics) and Professional Schools (Education and Business Administration). Enrollment trends from 2005 to 2009 varied from 22% to 33% in Natural Sciences, including the Natural Sciences General Program, 24% to 27% in Business Administration and from 13% to 14% in Social Sciences. General fall enrollment
at UPR-C has increased 5.39% from 3,634 in 2005-06 to 3,830 in 2009-10. Practically all students (99%) are Puerto Rican (UPR-C Assessment Office, 2013a, 2013b; U.S. Department of Education, 2012) and the majority (67%) is female. Most UPR-C students come from the municipalities that surround the town of Cayey, located in the central mountainous area of Puerto Rico (see Figure 1).

Consistent with UPR’s overall mission, UPR-C offers quality educational opportunities to low-income students of its service region who meet the University’s admissions criteria. The majority of incoming UPR-C full-time undergraduate students (75%) received Pell Grants and more than half (56.9%) proceed from public schools. The average GPA for incoming freshmen is 2.87. Full-time attendance status in 2013 was 93%. The campus has 164 full-time faculty and 32 part-time professors, 90% of whom are Puerto Rican. One hundred twenty-nine are tenured or tenure-track, and 67 are faculty with non-tenure adjunct positions; approximately 79% of all tenure and tenure-track faculty have a Ph.D.

This faculty along with administrators and staff are charged with fulfilling three UPR-C missions, which together emphasize providing a quality education that integrates: 1) interdisciplinary approaches, 2) research, and 3) community engagement (UPR-C mission, 2006). The Institute of Interdisciplinary Research (IIR) (http://web1.oss.cayey.upr.edu/iii/) supports this mission.
Six overarching aims developed in 2004 guide the IIR initiatives: 1) to promote interdisciplinary research; 2) to produce knowledge that is relevant to Puerto Rico and to the UPR-C service region; 3) to facilitate research at UPR-C; 4) to promote research-informed curricular innovations; 5) to provide a supportive environment for researchers and students; and 6) to disseminate results of the research projects it sponsors. Unlike research centers at other colleges and universities that respond to particular faculties or academic divisions, the IIR operates under the general aegis of the Academic Deanship, supporting projects across all academic departments, programs and disciplines. Its six aims are broad enough to allow full participation from students and faculty from the natural and social sciences, business administration, education, and humanities, but not so broad that it loses focus on the applied, interdisciplinary and regional criteria of the research activities and projects it sponsors.

The IIR offers an array of research support services that respond to this broad mission. For example, it provides population statistics and census data support services to students, faculty and the surrounding community through its Census Information Center (CIC): an office supported via a memorandum of understanding between the UPR-C and the U.S. Census Bureau. Unlike other undergraduate research initiatives at UPR-C, the IIR offers these and other support services to students, while also promoting the academic and professional development for all interested faculty via workshops, the dissemination of local training opportunities, and the coordination of an interdisciplinary seminar series with invited speakers and local faculty. The IIR also offers pre- and post-award administrative support to faculty-led research projects in interdisciplinary areas of pertinence to the University’s service region. Faculty from any academic departments can become affiliated to the IIR and seek such support. In general, faculty affiliated to the IIR develops projects that share a thematic focus in health and health disparities, education, social inequality, race and racism, and the environment. Supported faculty, in turn, recruit students as research assistants into their projects and the IIR coordinates activities to support the student’s academic and professional development as well. Activities offered by the IIR to students include interdisciplinary courses, training on research methodologies and research ethics, workshops that prepare them for graduate school, among other academic enrichment activities. Furthermore, because the IIR offers administrative support to a variety of faculty-led research projects, undergraduate students come to the IIR headquarters seeking research opportunities and sometimes contact faculty directly when they learn about a project that aims to solve a specific, recognized problem of their interest. Finally, the IIR contributes to scholarship in various applied areas through the systematic dissemination of findings, via technical reports, peer review publications, and the coordination of a campus wide symposia where participating faculty and students are expected to present.

The IIR developed this ambitious undertaking as UPR-C was beginning a transformation from a predominantly teaching institution to an institution where scholarly research could also be valued. Like other undergraduate minority-serving institutions, faculty’s ability to do research at UPR-C was compromised by lack of research infrastructure, institutional research policies and high teaching and service loads (Pickens, 2010). The regular course load at UPR-C for example, is 4 courses per semester and some faculty offer additional courses (ranging from 5 to 7 courses per semester) to meet departmental needs. Faculty must also participate in committee
work and perform administrative duties that can become quite burdensome in the context of fiscal shortages and reduced administrative assistance. Furthermore, mentoring undergraduate students at institutions where there are no graduate programs adds additional challenges since mentors cannot rely on the help of post-docs or graduate research assistants. Since undergraduate students do not have the expertise for much of scholarly work, faculty must go out of their way to train and design projects suited for students’ participation. The development of the IIR thus required institutional transformations to ensure that faculty could have the time, incentives, institutional support and recognition necessary to develop their research and capacity to mentor undergraduate students.

To achieve such transformations, institutions must establish conditions (policies, incentive programs, facilities, administrative support, etc.) that promote those outcomes (Barthell, Chen, Endicot, Hughes, Radke, Simmons, & Wilson, 2013; CUR & Hensel, 2012; Pickens, 2010; Rabionet, Santiago, & Zorrilla, 2009; Tinto, 2012). Yet, these institutional changes take time and, at UPR-C, they were further complicated by extensive budget cuts, the drastic loss of tenured faculty and administrative turnover. In the course of 8 years (2005-2013), UPR-C experienced budget reductions that fluctuated between 1.4% and 13.3%, lost 23% of its regular faculty, and had five different Chancellors and six Academic Deans. There were also four different Directors overseeing developments at the IIR, with some administrations being more supportive of research than others. This article describes how the IIR was able to withstand these challenges and develop a culture of undergraduate research by promoting faculty participation in research and sustaining their research and mentoring practices at the UPR-C.

Best practices to support undergraduate research

Engaging faculty mentors as active stakeholders

While large research universities have, over time, developed the research infrastructure, policies, and administrative support necessary to run undergraduate research programs, undergraduate minority-serving institutions often do not have such infrastructure in place (Carpi & Lents, 2013, B30). Thus, before UPR-C could insure successful implementation of research mentoring practices, the IIR had to catalyze new policies, administrative procedures and institutional innovations that could promote research in the first place. For example, IIR staff had to develop administrative procedures not available before, such as: 1) fiscal procedures that allow students to receive compensation and insurance coverage during research field trips; 2) protocols to compensate research participants; 3) a shadow accounting system to support faculty in the monitoring and use of their project’s funds; 4) the establishment of six performance databases to assist in the metric monitoring and assessment of the IIR efforts in different areas (faculty publications, presentations and proposals, seminars, workshops, conferences, pre- and post-award training, and a Students Follow Up Survey database) and 5) staff evaluation procedures and instruments suitable to assess their implementation of the IIR activities and services. Other internal fiscal and administrative follow-up procedures such documentation and payments tracking systems between administrative units were also implemented.
Most importantly, IIR researchers actively participated in drafting by-laws at the Academic Senate for the recruitment of faculty with research potential at UPR-C that made the selection of new faculty a more rigorous process while also ensuring that UPR-C disseminates positions widely to attract the best talent (UPR-C, Cert. #36, 2012). In addition, since 2008 Chancellors and Academic Departments began to consistently introduce contract letters into the hiring process to establish research as a tenure requirement. Furthermore, Certification #34 (2014-2015) of the Administrative Board allows faculty to receive up to 65% of the equivalent salary cost of their devoted time in an external funded project, as a research incentive.

Another important innovation was the establishment of joint-tenure-track appointments between the IIR and two Academic Departments (Biology in 2008 and Business Administration in 2013). Faculty hired under these innovative appointments allocates 50% of time to research activities and 50% to teach the equivalent of 6 credit-hours, instead of having a 12 credits course load. These two joint positions were supported by academic leaders at UPR-C and by the Vice Presidency of Research at the University of Puerto Rico Central Administration as part of an overall effort to promote research at this undergraduate campus.

The development of these new policies and procedures at the IIR took place in the context of administrative turnover and great fiscal instability. Setting these transformations in motion, thus required an “effort from below” (not a top-down approach) which meant engaging faculty, not just as research mentors but also as stakeholders who must actively mobilize to create the supportive environment they need for developing their research. Such active engagement from stakeholders—what Barthell et al. (2013, p. 42) call “building support”—early on in strategic planning is key for the sustainability of undergraduate research programs (see also Pickens, 2010) and this was the case of the IIR. In fact, the IIR’s mission was conceived in 2003-2004 after five strategic planning sessions with more than 25 participating faculty representing all the academic departments at UPR-C discussing the strengths, weaknesses, opportunities, and threats of this institutional initiative (a planning technique known as SWOT analysis). This broad participatory process actively engaged faculty while also maintaining open channels of communication and firm commitment from middle management towards the interdisciplinary vision of the IIR.

Early developments at the IIR also benefitted from an institutional plan and leadership that had identified interdisciplinary education as a key area of interest at UPR-C since the nineties. The model developed for the implementation of General Education at the UPR-C shortly afterwards required that all first year students take an interdisciplinary course “that significantly relates two or more disciplines with the purpose of integrating or coordinating its concepts, methods, or conclusions” (UPR-C, Cert. #16, 1992). Similarly, the IIR’s programmatic agenda privileges approaches that significantly relate two or more disciplines with the purpose of integrating or complementing concepts, methods, and analyses to generate new knowledge. Researchers can explore hypotheses in the fields and test them experimentally or conduct systematic applied investigation within a specific context to solve an identified problem in that context. Because of UPR-C previous trajectory with interdisciplinary curricula, faculty felt encouraged to work beyond their departmental boundaries in research projects as well. The idea of establishing the IIR thus developed in 2000 by a group of professors in the Social Science Department, as part of this institutional dialogue on interdisciplinary studies in research and education.
Upper level administrators committed to this vision in 2004 opened a tenure-track appointment for Social Scientists with scholarly publications and grantsmanship expertise. The first author, a cultural anthropologist, was recruited and designated as a full-time researcher charged with overseeing the IIR strategic development as a campus-wide resource. Later, UPR-C administrators added a full-time administrative assistant to the IIR regular staff. However, administrative positions, while important, were not enough to grow an interdisciplinary culture or research from which undergraduates could benefit. The question of how to achieve this status was thus amply discussed in strategic planning sessions where faculty members from different disciplines participated over the course of the 2003-2004 academic year, until they reached a common vision. At the initial stage of the process, a few participants favored the idea of focusing the IIR resources on supporting undergraduate students’ research projects; while others believed more emphasis should first be placed on supporting and developing faculty research. After debate and deliberations based on the SWOT analysis, the majority of participants established an important consensus: before undergraduate research could flourish, the University and the IIR needed to support the research endeavors of faculty who could then effectively mentor students. This early understanding was fundamental for implementing most of the initiatives mentioned in the following sections.

Supporting local mentors

Mentors are critical for developing student talent and research competencies (MacLachlan, 2012; Serrano-García, 2006). However, efforts to support research and mentoring activities at undergraduate minority-serving institutions where faculty have a heavy course load and administrative commitments are multi-dimensional require a great deal of coordination and funding. Central strategies implemented by the IIR to promote faculty research were: 1) providing release time for faculty; 2) facilitating administrative support; 3) developing mentoring communities; and 4) combining accountability with recognition.

The first strategy—providing release time for faculty—is costly but critical for institutions such as UPR-C. Thanks to external funds provided by a Research Infrastructure for Minority Institutions (RIMI) grant from NIH in 2004, the IIR was able to provide four faculty members with 25% to 50% release time during a period of five years (2004-2009). The grant, which sought to build research capacity in predominantly minority-serving academic institutions, also had the goal of developing a biomedical and socio-behavioral interdisciplinary research program with an emphasis on health disparities. The research topics included race and racism, ethnopharmacology and pharmacognosy, gender and HIV, and nanomaterials for biomedicine. A group of five faculty members (three from the natural sciences and two from the social sciences) sought the grant and submitted the application for it with the assistance of the UPR-C External Resource Office. Three of the five faculty members who wrote the grant proposal actively participated in the IIR strategic planning process. With this 4.4 million dollar grant (the largest grant the University had ever received) faculty were able to teach two or three courses per semester (instead of four). This sustained effort enabled them to significantly strengthen their research agenda and mentor students effectively over the course of five years. The great majority (84%) of those students who participated and applied were accepted into and subsequently enrolled in 108 diverse graduate
programs in: clinical psychology, medical sciences, chemistry, mathematics, public health, pharmacy, professional schools, and biological and social sciences. With such positive results, UPR-C continued to provide release time and seed funding for other promising researchers with institutional funds. In 2006, UPR-C doubled the amount of seed funding allocated for the support of faculty research from $30,000 to $60,000.

Providing faculty with administrative support is also crucial, especially in heavily bureaucratic environments such as the public university. In 2010, the IIR won another five-year grant from NIH entitled “Building Research Infrastructure and Capacity” (BRIC Program, 2013). With this second NIH grant, the IIR was able to hire additional post-award personnel who could support faculty on the administrative front as well as train existing personnel in research administration and compliance. Without such support, faculty at under-resourced institutions can easily get discouraged from doing research and mentoring since they may end up dealing more with paper-work and the administrative hurdles of implementing a research project in a non-research institution and less with the research and mentoring as they ought. Recruiting and training excellent administrative and research support staff, who were often sought out by other units and departments for guidance, became a hallmark of the IIR that motivated faculty to pursue their research and mentoring activities.

Furthermore, to counteract burdensome workload of faculty, the IIR provided the support of mentoring communities. With this model, students who worked as research assistants with faculty had a variety of resources at the IIR that complemented and reinforced the guidance they received from their local mentors. Some of these include workshops and guidance for the development of an academic and research portfolio with their CV, personal statements, summer internship research applications, technical support for the design and development of poster presentations, graduate programs fairs, and meetings with peers to receive support, awareness and references about research strategies and commitment to pursue graduate studies, among other topics. This approach differs from the one-on-one mentoring model usually provided by research-intensive institutions. Rabionet et al. (2009) reported benefits of using such a multifaceted mentoring model based on multi-institutional collaborations at the UPR Graduate School of Public Health. Windham, Stevermer, & Anthes (2004) also reported that student interaction with a team of multiple mentors resulted in exposure to multiple perspectives and increased one-on-one interaction (p. 27). With NIH support, the IIR hired a training coordinator who worked in close collaboration with faculty mentors, a student development core leader, and other campus officials in the implementation of an Academic and Professional Development (APD) Program for undergraduates. The training coordinator provided one-on-one orientation to students who wished to learn more about research opportunities, internships and fellowships, helped them with their application and APD portfolio, organized a research speaker’s series and identified a variety of resources for graduate school. Other strategies used to complement faculty mentoring included providing workshops on topics such as ethics in research, how to write a statement of purpose, how to write a CV, creating electronic student profiles, how to apply to summer research internships, and how to write a research question. The training coordinator and the student development core leader also planned an undergraduate research symposium, the publication of a student newsletter on research topics, facilitated students’ access to international
and local virtual mentors from diverse research fields, and developed guides and workshops with the collaboration of the IIR staff to help faculty and research assistants improve their mentoring experience. All of these resources were published on the IIR webpage and updated bi-monthly for the benefit of students and mentors. These and other collaborative strategies implemented by the IIR with external and institutional funding distributed the responsibilities of mentoring among many individuals, allowing UPR-C overburdened faculty to concentrate on what they did best: providing students with the research experience, technical competencies and scientific guidance they need to enter graduate school.

Finally, the IIR combined faculty accountability with recognition. For many years (since the early 1990’s to 2008) the peer-review system by which faculty members at UPR-C were evaluated did not seriously consider research productivity as a key tenure and promotion criterion. Although this changed after 2008 for pre-tenured faculty, post-tenured faculty were still rewarded primarily for teaching effectiveness and committee work and were, thus, less likely to feel motivated to invest time in developing and carrying out a research project. To counteract this hurdle, the IIR promoted faculty accountability through individual assessment activities that also facilitated the institutional recognition of their achievements. Research faculty were asked to submit a personal development plan (PDP) describing future research activities, plans for publications and presentations, submitting grants and students to be mentored. Faculty accompanied their PDP with a request to the IIR for training support, for sponsorship of external guest speakers who could be potential research collaborators, for contracting professional services (editors, evaluators, etc.) and other requests in support of their scholarship. At the end of each academic year, faculty submitted the annual report showing their achievements in relationship to the PDP. This information was then included in annual reports to the Academic Dean, Chancellors, posted on the IIR website and published in the IIR newsletter, Encuentros. In addition, faculty were invited to present their research progress during the UPR-C Faculty Development Symposia, a one-day activity dedicated to faculty research at UPR-C which is held once a year when no classes are in session.

**Increasing and diversifying the pool of mentors**

The aforementioned initiatives, while important, only managed to benefit a handful of researchers during the first seven years of the IIR’s development (2004-2011). In order to mentor more students and provide more research experiences, the pool of local mentors had to be increased.

Two initiatives played a key role in achieving this goal. First of all, in 2011, the IIR created the interdisciplinary semester-long course for research assistants, Interdisciplinary Research Experience for Students (INTD 4116). The course allows any UPR-C full-time student, freshman through senior, to obtain credit for collaborating in the research project of a faculty member under his or her guidance. This course not only increased, but also significantly diversified the pool of mentors who could enroll students as research assistants, while also allowing students to receive credit for their participation, an opportunity not previously available to students from the Social Sciences, Education, Business or Humanities at UPR-C. The course is approved by the IIR’s interdisciplinary Advisory Board, is evaluated as a pass/fail course, has flexible credits and is open to faculty from all departments who have no course-overload and can present a detailed
research plan. Although similar courses were available in the Chemistry, Mathematics and Biology departments previously, the new IIR course significantly increased the amount of mentors and students from other departments who could benefit from this opportunity, especially those from the Social Sciences.

Although the INTD 4116 course allowed the IIR to diversify the pool of faculty who could mentor students, greater efforts were still needed to increase the total number of mentors with research credentials. Like many other institutions of higher education, UPR-C had been experiencing a drastic loss of regular faculty due to retirement (Dehn, 2012). Not all retired faculty could be replaced with tenure-track positions, and the number of adjunct faculty grew from 26.8% in 2005-06 to 34.1% in 2012-13. However, since most of the faculty who retired were not active researchers, UPR-C managed to increase its local capacity for mentoring students in research by promoting hiring practices that established peer-review publication, grant development and undergraduate mentoring as a tenure requirement for the open positions at UPR-C. In fact, UPR-C is the only undergraduate campus in the UPR system that has consistently promoted the recruitment of research-oriented faculty in all academic disciplines and programs, following procedures outlined in policies developed by the Academic Senate (2004, 2012 and 2015). As a result, all 11 tenure-track faculty positions filled between 2011 and 2013 were hired with contract letters that established research expectations for tenure at UPR-C were in the Biology (1), Chemistry (1), Mathematics (2), Business Administration (1), Social Sciences (2), Education (2), Humanities (1), and English (1) departments. Some of the areas of interdisciplinary research of these faculty include: biomathematics and epidemiology, material sciences, clinical psychology, cultural studies, and labor economics. Many of these faculty were also guaranteed favorable working conditions in their contract letters such as: a) no course overload (i.e. not exceeding 12 credits per semester); b) no more than two course preparations per semester; c) no committee work overload; d) favorable class time arrangements that provide uninterrupted time blocks for research; and e) 25% release time for one or two semesters, among other support mechanisms. The contract letters of these new hires emphasized excellence in teaching, research, and student mentoring as important criteria for obtaining tenure.

These strategies and transformations, spearheaded by the IIR and a broad base of research affiliates, allowed UPR-C to increase the availability, engagement, and support of faculty who could devote time to research and student mentoring.

**Increasing research capacity at the home institution**

Although it is unlikely that any one strategy would have produced the successful results with undergraduates outlined herein, all the aforementioned actions have one key factor in common: they sought to promote the research capacity locally at UPR-C. In an environment like Puerto Rico, where students and faculty from underrepresented backgrounds are the majority, this strategy provides a critical mass of local mentors that—with adequate support—serve as excellent role models for undergraduates at their home institution.

This approach differs from traditional models of undergraduate training at predominantly teaching institutions, which often send students to conduct summer training with faculty at
research-intensive institutions, leaving the research infrastructure at the students’ local institution relatively untapped. Research on the impact of this strategy on health professions has shown that such interventions are less effective than interventions that are sustained throughout college (U.S. Department of Health and Human Services, 2009). For Puerto Rico this export model further implies that knowledge production is better carried out elsewhere, reinforcing the current population exodus from the Island and stereotypes that Latinos are less intelligent. In contrast, the IIR staff and researchers believed that the students’ home institution should develop its own research infrastructure by supporting and promoting the research of local UPR-C faculty in collaboration with research partners at other institutions of higher education in PR and in the US mainland. Such collaborations were fostered by inviting external speakers to the IIR interdisciplinary seminar series and by supporting faculty travel and presentations at international conferences with institutional and external funding. Supporting the participation of local faculty in summer trainings and internships abroad also encouraged collaborations between UPR-C faculty and faculty from other institutions. Through these strategies and by hiring and providing favorable working conditions for local Puerto Rican faculty invested in research, the IIR was able to expand the pool of mentors who could offer semester-long and sustained training to undergraduate students at UPR-C, thereby increasing their chances of acquiring the necessary skills to enter graduate school and continue research careers.

Building a campus-wide resource

Finally, a strategy that the IIR implemented to develop a culture of research at this undergraduate minority-serving institution was making sure the university community saw the IIR as a campus-wide resource. This was not easy to accomplish since most activities and personnel at the IIR were supported by external funds that respond to specific programmatic and disciplinary interests, with the NIH being a key funding source. As Carpi and Lents (2013) argue, since underfinanced, public and minority-serving institutions have fewer resources for planning and post-award administrative capacity, external funding is crucial for sustaining a minority-serving institution’s undergraduate research efforts. The UPR-C is no exception. Yet, since externally funded projects often require extra resources to run effectively, they also have the tendency to function as isolated units with their own administrative structures and mechanisms (Golenko, Pager, & Holden, 2012). This can prevent their integration into the institutional fabric. In a tightly-knit institution, it can also deter participation from a number of faculty members who do not feel directly benefitted by the externally funded program, alienating potential mentors from engaging in research (Pickens, 2010).

With NIH support, the IIR lessened this effect by offering training on topics such as grantsmanship, workshops on research methodologies, IRB and post-award management, that were open to all interested faculty, students and administrative staff, benefiting a wide array of stakeholders across the institution. Other externally sponsored activities such as seminars, workshops, and symposia were also widely advertised for the benefit of the whole UPR-C academic community to promote research, support an academic and research culture and infrastructure among researchers, and facilitate interdisciplinary dialogs. IIR affiliates and research staff also spearheaded the development of institutional policies and procedures that promoted research beyond the IIR.
such as: developing mechanisms to provide an allowance to research assistants (RAs) during field-research; creating protocols for compensating research participants; developing procedures to sponsor international speakers; establishing procedures for expedited acquisition of research equipment; hiring graduate-students from other UPR units as research assistants and other institutional innovations.

Most importantly, the UPR-C agree to re-invest 50% of the facilities and administrative costs recovered from IIR’s research grants allocated to an IIR revolving account, allowing the IIR director to carry-over funds across fiscal years and assign them to where they are most needed. In turn, the IIR made strategic use of those funds investing them as seed money to support promising projects. This institutional commitment enabled the IIR to fulfill its broader mission “to foster applied, interdisciplinary projects that are relevant to the UPR-C service region” while contributing to strengthening the institutional research culture. For example, it enabled the IIR to provide additional support and seed-money grants to faculty and students from other disciplines, expanding the scope of impact to other applied projects of pertinence to the service area and to the NIH biomedical research agenda. Carpi and Lents (2013) argue that such institutional outcomes at minority-serving institutions are often undocumented. They state that while externally funded undergraduate research programs have been lauded as a transformative experience for students, the institutional effects of such programs at minority-serving, under-resourced institutions is often underappreciated and less well known. Similarly, the institutional impact of NIH externally funded programs at UPR-C went beyond the specific expected outcomes of the NIH biomedical agenda to encompass other unanticipated institutional transformations, such as developing new administrative procedures, changing hiring practices for all UPR-C faculty and creating interdisciplinary courses for students and faculty of all areas thereby diversifying the pool of mentors and the pool of students who could participate as research assistants.

Enlisting the collaboration of other externally funded programs in biomedical research training such as the NIH-NIGMS Research Initiative for Scientific Enhancement (RISE), the Howard Hughes Medical Institute, the Science Education Alliance, and the Genomics Education Partnership to enhance the students understanding of the scientific method, experimental design, and presentation of results was another important strategy for strengthening the IIR research infrastructure as these programs also provide supplemental support to faculty who are able to mentor additional students, some of whom participated in IIR projects and initiatives as well. An example of this type of collaboration is the UPR-Cayey Week of Interdisciplinary Studies and Undergraduate Research. With the leadership of the IIR and support from the Academic Dean in 2013, the activity showcased the work of more than 240 undergraduate students from RISE, Howard Hughes, the UPR-C Honor’s Program, UPR-C General Education Program Capstone course, and the IIR. Students presented their work in oral or poster format. The event was widely advertised and sent a strong message regarding UPR-C’s transformation from an exclusively teaching college to a university that also values research and research mentorship. Following this event, the Academic Dean designated a full day in May of 2015 when no classes were held to host an undergraduate symposium where more than 245 students presented their research, creative and community service projects.
Other innovations such as having double codification for courses sponsored by the IIR and academic departments or the Honors Program fostered the IIR’s integration into the institutional fabric, encouraging more faculty and students to join its research program. The hiring of two tenure-track joint faculty appointments (with 50% time assigned to the IIR and 50% to an academic department) also encouraged greater integration among academic departments, their students, and the IIR. By gradually implementing these strategies, the IIR avoided operating as an island dedicated to the exclusive mission of securing externally funded programs, developing instead into a campus-wide resource for faculty mentors and their students.

**Faculty and undergraduates research outcomes**

By attracting and engaging local faculty as stakeholders, supporting their research and mentoring role across disciplinary lines, increasing the pool of mentors, and using external funds strategically to support the development of the IIR as a campus-wide resource, the IIR strengthened its capacity for promoting undergraduate research at a minority-serving institution in the face of economic and administrative challenges. The following outcomes evidence this achievement.

*Increased faculty engagement and productivity in research*

During a 10-year period, the number of faculty conducting research at the IIR consistently increased yearly, going from 7 in 2003 to 20 in 2013 (see Figure 2). Overall, in a 10-year period,
the IIR supported a total of 54 faculty who published 81 peer-reviewed articles, submitted 57 grants, and made approximately 238 presentations at conferences. More importantly, they mentored more than 481 undergraduate students. Although UPR-C experienced a drastic loss of faculty, the aforementioned strategies, particularly the research-focused recruitment strategies, increased the number of faculty who could mentor students and, thus, the overall number of students who could engage in research activities.

In an institution that 10 years ago only considered teaching excellence as the primary criteria for tenure promotion, the research faculty has brought a great deal of prestige to UPR-C. One junior faculty, Dr. Javier Arce received the Presidential Early Career Award for outstanding investigators in 2013 (NSF, 2013). He holds a joint appointment between the IIR and the Biology Department (with 50% dedicated to each unit) and was the only researcher based in Puerto Rico who received this prestigious award. He has mentored 30 undergraduate students, many of whom have presented their research at international conferences and participated in national summer internship programs. Similarly, Dr. Patricia Noboa, another recent hire, won an international award from the United Nations’ organization UNAIDS for her work with HIV (Noboa-Ortega, Ortega-Guzmán, & Feldman, 2014); she has mentored more than 25 students.

Increased research assistants in multidisciplinary areas

The above named strategies laid the groundwork for enabling one of the single, most important conditions that needed to take place for the development of an undergraduate research culture at UPR-C: providing undergraduate students with the opportunity to work under the supervision of local mentors at their home institution. Students could enroll in the aforementioned INTD 4116 course or any equivalent course in the Biology, Mathematics or Chemistry departments to work for one semester or more under the mentorship of the faculty member supported by the IIR. The IIR required that students write a research report and present at the UPR-C local student symposia (student travel off-Island was supported when funding was available). Undergraduates could also work on a voluntary basis or receive a stipend if the faculty had external or institutional funds to hire him or her. When needed, the IIR helped faculty recruit students into their projects by publishing the research title (along with the necessary RA requirements) so students can contact the faculty researcher directly. The IIR also developed other venues to provide students with research experiences, such as research-intensive semester and summer courses offered by local and invited faculty. Accordingly, the number of undergraduate students participating as RAs or enrolled in research-focused courses sponsored by the IIR increased from 7 in 2003 to 130 in 2013 (see Figure 2).

Students working as RAs emphasized, among other aspects, the important role that their mentors and those who belong to their mentoring communities at the IIR, played in their academic development (including the support of student peers). In a survey (administered from 2011 to 2014), students affiliated to the IIR and its NIH sponsored program BRIC wrote that the most valuable aspect of the experience was:

“Teamwork with peers with equal interests; obtaining and nurturing with knowledge and techniques that were unknown; receiving full support and professional assistance from the mentor and BRIC staff.”
“The strong ties with mentors and the friendships that provided support; in addition, the tools that will help me continue graduate studies.”

“The most valuable part of the experience was the communication between mentors UPR Cayey and members of BRIC program. They definitely guide students towards success. After doing research during the semester, we have the opportunity to present our research orally at the symposium of the Institute for Interdisciplinary Research, which reinforces our oral techniques.”

Students working on interdisciplinary teams also mentioned “having access to different research disciplines and having the advice of a professional in the area who guided us through each step” as a most valuable experience. The interdisciplinary research program sponsored by the IIR and the INTD 4116 course facilitated this increased involvement of faculty and undergraduate students from a wide variety of disciplines. As Figure 3 shows, from 2003 to 2010, approximately two thirds of the undergraduate students participating as RAs were from the natural sciences departments (Chemistry, Biology and General Sciences). There were few opportunities for students from other disciplines to engage in research. After the INTD 4116 course was created (between 2011 and 2013), the involvement of students from other areas in research projects sponsored by the IIR (especially from the social sciences, Education and Business Administration) gradually increased exponentially, to the point where their participation was almost equal to that of students from the natural sciences. This transformation made the IIR’s student profile more representative of the UPR-C classification by the Carnegie Foundation as a Baccalaureate College of Diverse Fields with a Balanced Arts and Sciences/Professions Undergraduate Instructional Program.

Figure 3. Areas of study of research assistants at the IIR: a) 2003-2004 to 2009-2010 (n=116), b) 2010-2011 to 2012-13 (n=196) and c) 2013-2014 (n=132)

Increased graduation and admissions to graduate school

A key outcome of providing students with the opportunity of working under the research mentorship of local faculty is their enhanced engagement with their studies, leading to their successful completion of their BA. A significant difference is observed when we compare the six-year graduation rate of those students who had research experiences at the IIR with the graduation rate of the total number of students who enrolled at UPR-C. While the average UPR-
C graduation rate for the period of 2002-2007 was 43.2% ± 2.5%, IIR students had an average graduation rate of 61.2% ± 9.9% for the same period (t(5) = -5.167, p=0.004). The experience of participating in research also enhances a student’s preparedness for applying and entering graduate programs. As Table 1 shows, 84% of the students who graduated after acquiring research experience at the IIR were accepted into graduate programs in Puerto Rico or in the states. In fact, students who participated in the IIR programs were 3.7 times more likely than students from the regular enrollment to apply and be accepted into graduate school. Without adjusting for academic or socioeconomic variables, students who acquired research experience at the IIR represent more than 56% (76/135) of students admitted into biomedical or health science graduate programs, even though they only represent 11% (156/1,381 students) of the overall graduate population between 2007 and 2013 (see Table 1; application and admission institutional data is not available prior to 2007).

Table 1. Comparison of Number of Applications and Admissions to Graduate Schools and Biomedical Graduate Programs of UPR-C/IIR and UPR-C Students.

<table>
<thead>
<tr>
<th>Graduate School Status</th>
<th>IIR Students 2007-2013 (n=156)</th>
<th>UPR-C Students 2007-2013 (n=1,381)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number (% of all graduates applying to graduate school)</td>
<td>129 (83%) (n=129/156)</td>
<td>445 (32%) (n=445/1,381)</td>
</tr>
<tr>
<td>Number (% of all graduates admitted to graduate school)</td>
<td>108 (64%) (n=108/129)</td>
<td>257 (58%) (n=257/445)</td>
</tr>
<tr>
<td>Number (% of all graduates admitted to biomedical graduate programs)</td>
<td>76 (70%) (n=76/108)</td>
<td>135 (53%) (n=135/257)</td>
</tr>
</tbody>
</table>

Providing undergraduate students the opportunity to work as RAs under the supervision of a mentor at their home institution played a crucial role in the IIR’s success in increasing undergraduate participation in research and their success in being admitted to graduate school, more so than participating in research-oriented interdisciplinary courses. For example, when we compare the experiences of those students who only gained research experiences through course work, as opposed to those students who participated as RAs with local faculty, we notice that the second experience yields more positive results in terms of the students’ acceptance to graduate programs. Overall, students who were RAs were 15% more likely to apply and be accepted to graduate schools than those who only took research-focused courses (see Table 2). As one RA stated: “For me, this experience as a research assistant has been one of the most if not the most enriching experiences I’ve had in college. I think this experience has impacted both my educational as well as my personal life.”
Table 2. Comparison of Graduate Schools Status of IIR Research Assistants and IIR Students Enrolled in Research-courses only.

<table>
<thead>
<tr>
<th>Graduate School Status</th>
<th>IIR Students Research Assistants 2004-2013 (n=106)</th>
<th>IIR Students Course Work 2004-2013 (n=40)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number (%) of all graduates applying to graduate school</td>
<td>93 (88%) (n=93/106)</td>
<td>29 (73%) (n=29/40)</td>
</tr>
<tr>
<td>Number (%) of all graduates admitted to graduate school</td>
<td>81 (87%) (n=81/93)</td>
<td>21 (72%) (n=21/29)</td>
</tr>
<tr>
<td>Number (%) of all graduates admitted to biomedical graduate programs</td>
<td>59 (73%) (n=59/81)</td>
<td>12 (57%) (n=12/21)</td>
</tr>
</tbody>
</table>

**Forming empowered, confident and committed students**

To assess the experience of students who worked at research assistants under the mentorship of UPR-C faculty, questionnaires were self-administered at the end of each semester during the student symposium. This instrument included two sections with quantitative items and one section with qualitative items divided as follows: Part I, collected general demographic information; Part II, inquired about RA’s research experience and their attitudes towards research in areas such as: interest in health-related research, familiarity with research methods and techniques, development of research skills, ethical aspects of research, presentation of written or oral reports with research findings, and interest in continuing graduate studies; and Part III, collected students’ qualitative assessment by asking about the most valuable part of their research experience. In summary, results from this open-ended question display a diverse set of personal, academic, and social rewards, particularly in areas of personal development, including self-confidence, leadership, discipline, emotional growth and facing life challenges. One student, for example, stated: “Aside from the opportunity to present your research in different scenarios, (this experience) transforms you into a person who is a fighter, with goals to achieve.” Another said: “[the experience] helps you trust your abilities.”

Active participation in research also played a key role in maintaining students’ motivation throughout college and the feeling that they belonged at the University. For instance, a student said: “The most valuable part is when you begin to do research, you are in a lab, start reading data in English, begin to engage into a new unknown world and this new world becomes part of you… you begin to love what you do…” Other students stated: “This experience opened my knowledge and desire for research and helped me define my graduate studies goals,” and: “The experience of belonging to the Research Institute has given me the motivation to get adapted to the University because I feel that I am part of it.”
Commitment to social change and creative leadership were also pointed out as rewards of the RA experience. Some students commented that the most valuable part was “Being part of the development of a research project that arises from my concerns as a human being, and seeing how it can be a model in order to create change in society,” “To help improve the social situation of PR by providing new knowledge on violence in young Puerto Ricans,” and that “The best part was joining the program and interacting with the community to know about their concerns.” Finally, one student mentioned that “[I had] the satisfaction of being part of a project that leaves footprints in society.”

Most frequently, students described how the experience as research assistants enhanced their professional skills and academic coursework by giving them the opportunity to integrate and apply what they had learned. In their words:

“This (research experience) creates in us a different view on how to apply all the knowledge acquired through undergraduate studies,”

“It is a rewarding and great learning experience. It contributes to our academic performance and expands our vision about society,”

“I would recommend this [RA] experience, because it enriches you as a student and increases the analytical and critical abilities of the person. I was able to apply everything I have learned in the courses I have taken,”

“I developed research and technical skills;”

“I got to learn dynamics and skills that are not offered in the courses I have taken so far;”

“I could recommend this experience because it changes your life in a positive way... it develops a real life application and encourages teamwork,” and

“This was my best experience in my four years of undergraduate studies.”

Conclusions

Scholars agree that engaging undergraduate students in research is a highly effective strategy for retaining them and sustaining them in a research career path (Brown, Daly, & Leong, 2009; Boyer Commission, 1998; Cox & Andriot, 2009; González, 2006; Lopatto, 2003; MacLachlan, 2012). The Boyer Commission clearly established that mentored research experiences can inspire undergraduate students to be more adaptive, resourceful and better able to meet the challenges of specialized training and professional life (1998, p. 18). The effects of these experiences are particularly strong with Latinos and other students from underrepresented groups (Lopatto, 2007; Russell, Hancock, & McCullough, 2007). However, Latinos are particularly underrepresented among students attaining college degrees in general (Vernez & Mizell, 2002). Hispanic serving institutions (HSIs), on average, receive only 69 cents for every federal dollar of funding that all other higher education institutions receive (Hispanic Association of Colleges and Universities, 2015). Institutional approaches, thus, need to be rethought to mitigate long-term inequalities in order to uncover and engage the best talent for research.
UPR-C has pioneered important transformations leading to this goal, developing a successful model for training students from underrepresented low-income backgrounds at a HSI through its IIR. This article examined the strategies and approaches leading to this successful outcome facilitated by the IIR at this 99% Hispanic serving institution. It described the IIR success of supporting undergraduate research by supporting faculty over the span of ten years (2003-2013) and identified the most significant strategies leading to it. Of foremost importance was the strategic planning effort “from below” that addressed the need to create a supportive institutional environment for faculty to develop their research and mentor students. With this vision in mind, the IIR at UPR-C engaged faculty as stakeholders, supported their research initiatives, increased the number of local research mentors, and operated as a campus-wide resource. By providing pre- and post-award administrative support, interdisciplinary seminars and symposia, training workshops for faculty and students and continuing hosting the Census Information Center, the IIR provided a culturally responsive context for mentoring in which the research endeavors of local faculty and students could flourish and have continuity. This strategic vision encompassed, in fact promoted, supporting faculty research at this undergraduate institution through system-wide transformations launched by stakeholders and collaborators that gradually made significant transformations in the institutional culture and administrative environment.

Currently, UPR-C has an exceptional record in training underrepresented students for research careers. With only 3,800 students in 2013, UPR-C ranks 18th in the US as source institutions for Hispanic PhDs in natural and social sciences (2008-2012; NSF, 2015). The results of the strategic vision and approaches described in this article are tangible and have significantly impacted interdisciplinary undergraduate research at this undergraduate under sourced minority institution, transforming student lives with research opportunities not available before. In the words of a student: “I think the experience of being a Research Assistant changed my life... through this, I found my road to the future and my goal is to attend graduate school, [and obtain] a PhD.”
Authors’ Note

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How Do I Review Thee? Let Me Count the Ways:
A Comparison of Research Grant Proposal Review Criteria
Across US Federal Funding Agencies

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Abstract: While Elizabeth Barrett Browning counted 25 ways in which she loves her husband in her poem, “How Do I Love Thee? Let me Count the Ways,” we identified only eight ways to evaluate the potential for success of a federal research grant proposal. This may be surprising, as it seems upon initial glance of the review criteria used by various federal funding agencies that each has its own distinct set of “rules” regarding the review of grant proposals for research and scholarship. Much of the grantsmanship process is dependent upon the review criteria, which represent the funders’ desired impact of the research. But since most funders that offer research grants share the overarching goals of supporting research that (1) fits within its mission and (2) will bring a strong return on its financial investment, the review criteria used to evaluate research grant proposals are based on a similar set of fundamental questions. In this article, we compare the review criteria of 10 US federal agencies that support research through grant programs, and demonstrate that there are actually only a small and finite number of ways that a grant proposal can be evaluated. Though each funding agency may use slightly different wording, we found that the majority of the agencies’ criteria address eight key questions. Within the highly competitive landscape of research grant funding, new researchers must find support for their research agendas and established investigators and research development offices must consider ways to diversify their funding portfolios, yet all may be discouraged by the apparent myriad of differences in review criteria used by various funding agencies. Guided by research administrators and research development professionals, recognizing that grant proposal review criteria are similar across funding agencies may help lower the barrier to applying for federal funding for new and early career researchers, or facilitate funding portfolio diversification for experienced researchers. Grantmakers are furthermore provided valuable guidance to develop and refine their own proposal review criteria.

Keywords: Funding portfolio, research grants, proposal review criteria, peer review, federal funding, grantsmanship, proposal development, research development, research administration
Introduction

The research funding landscape in the United States is highly competitive, with flat or shrinking budgets for investigator-initiated research programs at most federal agencies (American Association for the Advancement of Science (AAAS), 2014). Taking biomedical research as an example, in 2014, the National Institutes of Health (NIH) budgeted $15 billion to fund research project grants, an amount that has essentially remained the same since 2003 (AAAS, 2014; Federation of American Societies for Experimental Biology, 2014). At the same time, the number of research grant applications has steadily increased, from close to 35,000 in 2003 to 51,000 in 2014. The result has been a stunning 30% drop in funding success rates, from 30.2% in 2003 to 18.8% in 2014. Other federal agencies that fund research, including the National Science Foundation (NSF), Office of Veterans Affairs (VA), and Department of Defense (DoD), are feeling the similar sting of budget restrictions.

Within this tenuous funding environment, it has become essential that investigators and research development offices sustain their research programs by continuing to encourage new researchers to apply for grant support and encouraging established researchers to diversify their funding portfolios. New researchers benefit from clear information about the federal grant process, and experienced researchers benefit from considering funding opportunities from federal funding agencies, national organizations and advocacy groups, state agencies, private philanthropic organizations, regional or local special interest groups, corporations, and internal institutional grant competitions that may not be their typical targets for support. With increasing competition for grant funding, investigators who might be accustomed to one set of rules for preparing grant proposals may become quickly overwhelmed by the prospect of learning entirely new sets of rules for different funding agencies.

Yet this process is not as daunting if we start from the perspective that any funder that offers research grants has essentially the same goal: to support research that fits within its mission and will bring a strong return on its financial investment (Russell & Morrison, 2015). The review criteria used to evaluate research grant proposals reflect the funder’s approach to identifying the most relevant and impactful research to support (Geever, 2012; Gerin & Kapelewski, 2010; Kiritz, 2007). Thus, planning and preparing a successful grant proposal depends on a clear understanding of the review criteria that will be used. These criteria directly inform how the proposal content should be presented and how much space should be afforded to each section of the proposal, as well as which keywords should be highlighted. It may seem that each funder—federal, state, local, private—has its own distinct set of rules regarding the preparation and review of grant proposals, and that each funder uses specific jargon in its review process. However, because all funders aim to support research that is relevant and impactful, we suggest that the mandatory review criteria used to evaluate research grant proposals are based on a set of fundamental questions, such as: Does this research fit within the funder’s mission? Will the results of this research fill a gap in knowledge or meet an unmet need? Do the investigators have the skills and resources necessary to carry out the research?

In this article, we examine the research grant proposal review criteria used by 10 US federal agencies to demonstrate that there exist only a small and finite number of ways that federal research grant proposals are actually evaluated. Our goal is to help research administrators and research development professionals empower investigators to more confidently navigate funder review.
criteria, thereby lowering the barrier to first-time applicants or to grant portfolio diversification for more established researchers. Recognizing that research proposal review criteria are aligned across federal funding agencies can also help proposal writers who might be faced with other funding opportunities in which the review criteria are not clearly defined. On the flip side of that equation, understanding that review criteria are based on the same core goals can help grantmakers as they develop and refine review criteria for their funding opportunities.

Observations

We performed an online search of 10 US federal agencies’ (NIH, NSF, VA, Department of Education [ED], DoD, National Aeronautics and Space Administration [NASA], Department of Energy [DOE], United States Department of Agriculture [USDA], National Endowment for the Humanities [NEH], and National Endowment for the Arts [NEA]) websites to identify policies and procedures related to their research grant proposal review process. The NIH Office of Extramural research (OER) website provided the greatest detail and transparency with regard to the review criteria and review process used for evaluating research grant proposals (National Institutes of Health, 2008a; 2008b; 2015a), and served as a starting point for our analysis of the review criteria for the other nine agencies. We developed key questions corresponding to each of the NIH review criteria, and then aligned the review criteria of the remaining nine agencies with these key questions.

Federal grant program guidance and policy changes occur frequently; the links to online resources for research grant proposal policies for each of the various funding agencies included in our analysis were current as of August 10, 2015. Note that our analysis includes information from the National Institute on Disability and Rehabilitation Research (NIDRR) program as administered by ED. On June 1, 2015, the NIDRR was transferred from ED to the Administration for Community Living (ACL) in the US Department of Health and Human Services (DHHS), and is now called the National Institute on Disability, Independent Living, and Rehabilitation Research (NIDILRR) Field-Initiated Program. Our analysis of NIDRR was current as of May 4, 2015.

Also note that there is variability between different research grant programs within each federal agency. We included in our analysis review criteria from the DoD Congressionally Directed Medical Research Programs (CDMRP), the USDA National Institute of Food and Agriculture, the NEH Digital Humanities Start-up program, and the NEA ART WORKS program. Criteria for NASA research programs were compiled from numerous NASA Research Announcements.

The NIH review criteria

The NIH criteria emphasize clinical, interdisciplinary, and translational biomedical research (National Institutes of Health, 2008a). Reviewers are instructed to evaluate research grant proposals based on how well five core review criteria are met: Significance, Innovation, Approach, Investigator(s), and Environment (Table 1) (National Institutes of Health, 2015a; 2015b). Assigned reviewers consider each of the five core review criteria and assign a separate score for each using a 9-point scale. These ratings are included in a summary statement that is provided to the researcher, whether or not the entire study section ultimately discusses the proposal.
Each of the five core review criteria can be simplified into a general question. The Significance criterion asks reviewers to consider “Why does the research matter?” Reviewers look for whether the proposed project will address an important problem or critical barrier to progress in the field, and whether the knowledge gained from the proposed research will advance scientific knowledge, technical capacity, or clinical practice to drive the field forward. Innovation translates into “How is the research new?” Reviewers consider how the proposed research challenges current thinking with novel concepts, approaches, tools, or treatments. Approach asks, “How will the research be done?” Reviewers assess the proposed research strategy, methodology, and analyses and determine whether they are appropriate to achieve the aims of the project, and how riskier aspects of the proposal might be handled with alternative approaches. The remaining two core criteria evaluate the context in which the research will be done—defined as the collective set of resources, equipment, institutional support, and facilities available (Environment)—and what is special about the people doing the research (Investigator). For the Environment criterion, reviewers evaluate whether the resources and institutional support available to the investigators are sufficient to ensure successful completion of the research aims, including any unique features such as access to specific subject populations or collaborative arrangements. For the Investigator criterion, reviewers determine whether the primary investigator (PI), other researchers, and any collaborators have the experience and training needed to complete the proposed research, as well as how collaborators will combine their skills and work together.

Table 1. The NIH core review criteria for research project grant proposals

<table>
<thead>
<tr>
<th>Review Criterion</th>
<th>Key Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>Significance</td>
<td>Why does the research matter?</td>
</tr>
<tr>
<td>Innovation</td>
<td>How is the research new?</td>
</tr>
<tr>
<td>Approach</td>
<td>How will the research be done?</td>
</tr>
<tr>
<td>Environment</td>
<td>In what context will the research be done (e.g., facilities, resources,</td>
</tr>
<tr>
<td></td>
<td>equipment, and institutional support)?</td>
</tr>
<tr>
<td>Investigator</td>
<td>What is special about the people doing the research?</td>
</tr>
<tr>
<td>Overall Impact</td>
<td>What is the return on investment?</td>
</tr>
</tbody>
</table>

a See National Institutes of Health, 2015a; 2015b.

b While Overall Impact is not considered as a core review criterion, it asks reviewers to take into consideration the five core review criteria as they assess the likelihood of the project to have a strong and sustained influence on the research field.

NIH, National Institutes of Health.

The five core review criteria ratings, in addition to other proposal-specific criteria, are then used to determine an Overall Impact/Priority Score (National Institutes of Health, 2015a; 2015b). This score reflects the reviewers’ assessment of the “likelihood for the project to exert a sustained, powerful influence on the research field(s) involved.” An application does not need to have exemplary scores in all criteria in order to be judged as likely to have a high overall impact. For example, a project that by its nature is not highly innovative may nevertheless be deemed essential to advance knowledge within a field. A 2011 study by the National Institutes of General Medicine Science (NIGMS) examined the correlation between the core review criteria scores and the
Overall Impact score and found that reviewers weighted certain criteria more heavily than others, in the following order: Approach > Significance > Innovation > Investigator > Environment (Rockey, 2011). Thus, the quality of ideas appeared to matter more than investigator reputation, a particularly good finding for new investigators (Berg, 2010a; 2010b; 2010c). These findings of relative importance of the core review criteria by reviewers also suggest that, in terms of space, it makes sense for proposers to utilize more pages of the proposal narrative to address aspects of their approach and the research project’s significance than on the environment supporting the project.

Other agencies have formalized systems for weighting grant proposal review criteria. For example, the ED NIDRR standard selection criteria are weighted using a points designation (US Department of Education, 2014): Design of Research Activities (50 pts); Importance of the Problem (15 pts); Project Staff (15 pts); Plan of Evaluation (10 pts); and Adequacy and Accessibility of Resources (10 pts). Similar to NIH reviewers, ED weights research design and the importance of the problem more heavily than staff or resources when evaluating grant proposals (Committee on the External Evaluation of NIDRR and Its Grantees, National Research Council, Rivard, O’Connell, & Wegman, 2011).

**How do the NIH review criteria compare to those of other federal agencies?**

The most straightforward comparison of research grant review criteria is between the NIH and NSF, which together make up 25% of the research and development budget in the US (AAAS, 2014). The NSF criteria emphasize transformative and interdisciplinary research (National Science Foundation, 2007), and involve three (3) guiding principles, two (2) review criteria, and five (5) review elements (National Science Foundation, 2014). The two review criteria used by the NSF are Intellectual Merit, which encompasses the potential to advance the field, and Broader Impacts, which encompasses the potential to benefit society and contribute to the achievement of specific, desired societal outcomes. Within each of these two review criteria are five review elements (Figure 1). These five review elements line up remarkably well with the NIH core review criteria (Table 2), with both agencies’ criteria addressing a similar set of concepts but using distinct language to describe each criterion.

- What is the potential for the proposed activity to (a) advance knowledge and understanding within its own field or across different fields (Intellectual Merit); and (b) benefit society or advance desired societal outcomes (Broader Impact)?
- To what extent do the proposed activities suggest and explore creative, original, or potentially transformative concepts?
- Is the plan for carrying out the proposed activities well-reasoned, well-organized, and based on a sound rationale? Does the plan incorporate a mechanism to assess success?
- How well qualified is the individual, team, or institution to conduct the proposed activities?
- Are there adequate resources available to the PI (either at the home institution or through collaborations) to carry out the proposed activities?
Table 2. Comparison of the NIH and NSF research grant proposal review criteria

<table>
<thead>
<tr>
<th>Key Question</th>
<th>NIH Core Review Criteria&lt;sup&gt;a&lt;/sup&gt;</th>
<th>NSF Review Elements&lt;sup&gt;b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Why does the research matter?</td>
<td>Significance – project addresses an important problem or a critical barrier to progress in the field</td>
<td>Intellectual Merit - Potential of the activity to advance knowledge and understanding</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Broader Impact – Potential of the activity to benefit society</td>
</tr>
<tr>
<td>How is the research new?</td>
<td>Innovation – project challenges current paradigms by utilizing novel theoretical concepts, approaches or methodologies, instrumentation, or interventions</td>
<td>Creative, original, and transformative concepts and activities</td>
</tr>
<tr>
<td>How will the research be done?</td>
<td>Approach - overall strategy, methodology, and analyses well-reasoned and appropriate to accomplish the specific aims of the project</td>
<td>Well-reasoned, well-organized, rational plan for carrying out proposed activities and mechanism to assess success</td>
</tr>
<tr>
<td>In what context will the research be done?</td>
<td>Environment - scientific environment in which the work will be done contribute to the probability of success</td>
<td>Adequate resources available to carry out the proposed activities</td>
</tr>
<tr>
<td>What is special about the people doing the research?</td>
<td>Investigators - PD/PIs, collaborators, and other researchers are well suited to the project</td>
<td>Qualified individual, team, or institution conducting the proposed activities</td>
</tr>
<tr>
<td>What is the return on investment?</td>
<td>Overall Impact&lt;sup&gt;c&lt;/sup&gt; - likelihood for the project to exert a sustained, powerful influence on the research field(s) involved</td>
<td>The potential to benefit society and contribute to the achievement of specific, desired societal outcomes</td>
</tr>
</tbody>
</table>

<sup>a</sup> See National Institutes of Health, 2015a; 2015b.
<sup>b</sup> See National Science Foundation, 2014.
<sup>c</sup> While Overall Impact is not considered as a core review criterion, it asks reviewers to take into consideration the five core review criteria as they assess the likelihood of the project to have a strong and sustained influence on the research field.

NIH, National Institutes of Health; NSF, National Science Foundation; PD, program director; PI, principal investigator.
Table 3. Comparison of research grant proposal review criteria used by the NIH, NSF, and NEH

<table>
<thead>
<tr>
<th>Key Question</th>
<th>NIH Core Criteria&lt;sup&gt;a&lt;/sup&gt;</th>
<th>NSF Merit Review Elements&lt;sup&gt;b&lt;/sup&gt;</th>
<th>NEH Application Review Criteria&lt;sup&gt;c&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Why does the research matter?</td>
<td>Significance</td>
<td>Intellectual Merit - Potential of the activity to advance knowledge and understanding</td>
<td>Humanities Significance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Broader Impact – Potential of the activity to benefit society</td>
<td></td>
</tr>
<tr>
<td>How is the research new?</td>
<td>Innovation</td>
<td>Creative, original, and transformative concepts and activities</td>
<td>Quality of Innovation</td>
</tr>
<tr>
<td>How will the research be done?</td>
<td>Approach</td>
<td>Well-reasoned, well-organized, rational plan for carrying out proposed activities and mechanism to assess success</td>
<td>Project Feasibility and Work Plan</td>
</tr>
<tr>
<td>In what context will the research be done?</td>
<td>Environment</td>
<td>Adequate resources available to carry out the proposed activities</td>
<td>Project Feasibility and Work Plan</td>
</tr>
<tr>
<td>What is special about the people doing the research?</td>
<td>Investigators</td>
<td>Qualified individual, team, or institution conducting the proposed activities</td>
<td>Project Staff Qualifications</td>
</tr>
<tr>
<td>What is the return on investment?</td>
<td>Overall Impact&lt;sup&gt;d&lt;/sup&gt;</td>
<td>The potential to benefit society and contribute to the achievement of specific, desired societal outcomes</td>
<td>Overall Value to Humanities Scholarship</td>
</tr>
</tbody>
</table>

<sup>a</sup> See National Institutes of Health, 2015a; 2015b.
<sup>b</sup> See National Science Foundation, 2014.
<sup>c</sup> See National Endowment for the Humanities, 2014; 2015.
<sup>d</sup> While Overall Impact is not considered as a core review criterion, it asks reviewers to take into consideration the five core review criteria as they assess the likelihood of the project to have a strong and sustained influence on the research field.

NIH, National Institutes of Health; NSF, National Science Foundation; NEH, National Endowment for the Humanities.
What about a non-science funding agency like the NEH? While there is some variability between individual NEH grant programs, the NEH application review criteria are: Humanities Significance, Project Feasibility and Work Plan, Quality of Innovation, Project Staff Qualifications, and Overall Value to Humanities Scholarship (National Endowment for the Humanities, 2015a; 2015b). The significance of the project includes its potential to enhance research, teaching, and learning in the humanities. The quality of innovation is evaluated in terms of the idea, approach, method, or digital technology (and the appropriateness of the technology) that will be used in the project. Reviewers also examine the qualifications, expertise, and levels of commitment of the project director and key project staff or contributors. The quality of the conception, definition, organization, and description of the project and the applicant’s clarity of expression, as well as the feasibility of the plan of work are also assessed. Finally, reviewers consider the likelihood that the project will stimulate or facilitate new research of value to scholars and general audiences in the humanities. Table 3 shows the NEH review criteria compared with those used by the NIH and NSF. Though there is not an exact match for the key question “In what context will the research be done?” (i.e., the research environment and available resources), this is evaluated in NEH proposals as part of the Project Feasibility and Work Plan.

Comparing review criteria across federal agencies: Eight key questions

In addition to the core review criteria mentioned above, funding agencies also typically ask reviewers to consider the project budget and the approach that will be used to evaluate project success. When we expanded the comparison of research grant proposal review criteria across 10 US federal agencies, and included the budget and evaluation criteria, we revealed that all of the agencies’ review criteria aligned with a consistent set of eight key questions that reviewers consider when evaluating any type of research proposal (Table 4).

The research grant proposal review criteria used by the 10 federal funding agencies are associated with these eight key questions (Table 5). We have already demonstrated that the question, “Why does it matter?”—which addresses the importance or significance of the proposed project—applies to similar review criteria from the NIH (Significance), NSF (Intellectual Merit), and the NEH (Humanities Significance) (National Endowment for the Humanities, 2015a; 2015b; National Institutes of Health, 2015a, 2015b; National Science Foundation, 2014). Likewise, ED evaluates the “Importance of the Problem” (US Department of Education, 2014); the DoD application review criteria includes “Importance” (Department of Defense, 2015); the VA and NASA each evaluate “Significance” (National Aeronautics and Space Administration, 2015; US Department of Veterans Affairs, 2015); the DOE looks at “Scientific and Technological Merit” (US Department of Energy, 2015); the USDA evaluates “Project Relevance” (United States Department of Agriculture, 2015); and the NEA assesses “Artistic Excellence” (National Endowment for the Arts, 2015). There are also parallels in the language used by each of the funders as they ask reviewers to assess proposed research project innovation or novelty, the approach or methodology to be used, the investigators or personnel involved, the environment and resources available, and the overall impact or value of the project (Table 5).
Table 4. Eight key questions considered by reviewers of research grant proposals and the associated review criteria terms used by 10 US federal funding agencies

<table>
<thead>
<tr>
<th>Key Question</th>
<th>Review Criteria Terms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Why does it matter?</td>
<td>Significance</td>
</tr>
<tr>
<td></td>
<td>Importance</td>
</tr>
<tr>
<td>How is it new?</td>
<td>Innovation</td>
</tr>
<tr>
<td></td>
<td>Novelty</td>
</tr>
<tr>
<td></td>
<td>Creativity</td>
</tr>
<tr>
<td>How will it be done?</td>
<td>Approach</td>
</tr>
<tr>
<td></td>
<td>Plan</td>
</tr>
<tr>
<td></td>
<td>Methodology</td>
</tr>
<tr>
<td></td>
<td>Objectives</td>
</tr>
<tr>
<td></td>
<td>Aims</td>
</tr>
<tr>
<td>In what context will it be done?</td>
<td>Environment</td>
</tr>
<tr>
<td></td>
<td>Resources</td>
</tr>
<tr>
<td></td>
<td>Populations</td>
</tr>
<tr>
<td></td>
<td>Facilities</td>
</tr>
<tr>
<td>What is special about the people involved?</td>
<td>Investigators</td>
</tr>
<tr>
<td></td>
<td>Organization</td>
</tr>
<tr>
<td></td>
<td>People</td>
</tr>
<tr>
<td></td>
<td>Researchers</td>
</tr>
<tr>
<td></td>
<td>Personnel</td>
</tr>
<tr>
<td></td>
<td>Partners</td>
</tr>
<tr>
<td></td>
<td>Collaborators</td>
</tr>
<tr>
<td></td>
<td>Staff</td>
</tr>
<tr>
<td>What is the return on investment?</td>
<td>Impact</td>
</tr>
<tr>
<td></td>
<td>Value</td>
</tr>
<tr>
<td></td>
<td>Relevance</td>
</tr>
<tr>
<td>How effectively will the financial resources be managed?</td>
<td>Budget</td>
</tr>
<tr>
<td>How will success be determined?</td>
<td>Evaluation</td>
</tr>
<tr>
<td></td>
<td>Assessment</td>
</tr>
<tr>
<td>Key Question</td>
<td>NIH</td>
</tr>
<tr>
<td>------------------------------------</td>
<td>------------------------------------------</td>
</tr>
<tr>
<td>Broader Impact: potential of the activity to benefit society</td>
<td>Intellectual Merit: potential of the activity to advance knowledge and understanding</td>
</tr>
<tr>
<td>How is it new?</td>
<td>Creative, original, and transformative concepts and activities</td>
</tr>
<tr>
<td>How will it be done?</td>
<td>Well reasoned, well-organized, rational plan</td>
</tr>
<tr>
<td>Environment</td>
<td>Adequate resources available to carry out the proposed activities</td>
</tr>
<tr>
<td>What is special about the people involved?</td>
<td>Investigator</td>
</tr>
</tbody>
</table>
### Key Question

<table>
<thead>
<tr>
<th>What is the return on investment?</th>
<th>Overall Impact a</th>
<th>Broader Impact: potential to benefit society and contribute to the achievement of specific, desired societal outcomes</th>
<th>Relevance to the healthcare of veterans</th>
<th>Design of Dissemination Activities</th>
<th>Impact</th>
<th>Relevance</th>
<th>N/A</th>
<th>Relevance and Importance to US agriculture</th>
<th>Likelihood of stimulating or facilitating new research in the humanities</th>
<th>Artistic Merit: potential impact on artists, the artistic field, and the organization's community</th>
</tr>
</thead>
<tbody>
<tr>
<td>How effectively will the financial resources be managed?</td>
<td>Budget</td>
<td>N/A</td>
<td>N/A</td>
<td>Adequacy and Reasonableness of the Budget</td>
<td>Budget</td>
<td>Evaluation of cost</td>
<td>Reasonableness and appropriateness of the proposed budget</td>
<td>N/A</td>
<td>Project’s feasibility, design, cost, and work plan</td>
<td>Artistic Merit: appropriateness of the budget</td>
</tr>
<tr>
<td>How will success be determined?</td>
<td>N/A</td>
<td>Mechanism to assess success</td>
<td>N/A</td>
<td>Plan of Evaluation</td>
<td>N/A</td>
<td>Evaluation against the state-of-the-art</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>Artistic Merit: appropriateness of the proposed performance measurements</td>
</tr>
</tbody>
</table>

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a Evaluation criteria are from the 2014 ED National Institute on Disability and Rehabilitation Research (NIDRR), now called the National Institute on Disability, Independent Living, and Rehabilitation Research (NIDILRR) Field-Initiated Program. As of June 1, 2015, the NIDILRR was transferred to the Administration for Community Living (ACL) in the US Department of Health and Human Services (DHHS). Information on ACL can be found at www.acl.gov.

b There is variability between DoD grant programs. The review criteria here are representative of the DoD Congressionally Directed Medical Research Programs (CDMRP).

c There is variability between NASA grant programs. The merit score criteria here are compiled from numerous NASA Research Announcements.

d Evaluation criteria will vary among USDA programs. Criteria specific for the National Institute of Food and Agriculture (NIFA) are noted in the resource file.

e The review criteria may vary from program to program. The Application Review criteria here are from the Digital Humanities Start-up program.

f The review criteria vary between programs. The Application Review Criteria here are from the ART WORKS program.

g While Overall Impact is not considered as a core review criterion, it asks reviewers to take into consideration the five core review criteria as they assess the likelihood of the project to have a strong and sustained influence on the research field.

NIH, National Institutes of Health; NSF, National Science Foundation; VA, Department of Veterans Affairs; ED, Department of Education; DoD, Department of Defense; NASA, National Aeronautics and Space Administration; DOE, Department of Education; USDA, US Department of Agriculture; NEH, National Endowment for the Humanities; NEA, National Endowment for the Arts; N/A, not applicable.
While all the agencies’ collective review criteria fall within the eight key questions, there is some variability across agencies. For example, the DOE does not have a clear review criterion for evaluating the overall impact or value of a project, equivalent to the key question “What is the return on investment?” Some agencies to do not explicitly include the budget as part of their review criteria, such as the NSF, VA, and USDA, while other agencies do not specifically ask for a plan to evaluate success of the project, including the NIH, VA, DoD, DOE, USDA, or NEH. Funders may also have unique review criteria. Unlike the other nine agencies evaluated, the DoD uses the review criterion “Application Presentation,” which assesses the writing, clarity, and presentation of the application components. Agencies may also have mission- or program-specific review criteria; for example, for certain applications, the NEA may evaluate the potential to reach underserved populations as part of “Artistic Merit.” Despite these differences, it is clear that for the 10 federal funding agencies examined, the review criteria used to evaluate research grant proposals are extraordinarily aligned.

If we remember that all funding agencies are trying to evaluate research grant proposals to reach the same goals—to determine which projects fit within their mission and will provide a return on their financial investment—it is perhaps not all that surprising that the review criteria that federal funding agencies use are aligned. We further propose that funding announcements from any funder, including state agencies, local groups, and private philanthropic organizations, similarly ask for research grant proposals to answer some, if not all, of the eight key questions that emerged from our analysis of US federal funding agencies. Keeping these key questions in mind can help research administrators and research development offices, as well as proposal writers, decipher research grant proposal review criteria from almost any funding agency, thereby facilitating proposal development.

For this article, we limited our analysis to the review criteria used across different US federal funders to evaluate research grant proposals, and did not include criteria used for other federal funding mechanisms, such as training grants or contract proposals. NIH has compared the review criteria used across their various funding mechanisms, including research grants, grants for conferences and scientific meetings, small business innovation or technology transfer grants, fellowship and career development grants, and training grants, among others (National Institutes of Health, 2014). Again, while there are differences in the language used to describe each core review criterion across the various grant mechanisms, the concepts being reviewed—what is being done, why it is being done, how it is new, who is doing the work, and where it will be done—are essentially the same across each mechanism.
Conclusion

We have demonstrated that research grant proposal review criteria are remarkably aligned across 10 US federal funding agencies, despite the differences in their missions and the terminology each uses for its own review process (Table 5). Moreover, a set of only eight key questions summarizes the collective research grant proposal review criteria across all these federal agencies. While the sheer number of non-federal funding opportunities makes a similar comparative analysis of their review criteria impractical, we suggest that the eight key questions emerging from our analysis provide a starting point for researchers, research administrators, and funders to assess the review criteria used by most, if not all, other research funding opportunities. This is reasonable given that each funder is trying to achieve the same goal during the grant review process: find those research projects that fit the funder’s mission and are worth its investment. Through this lens, the review criteria used for research proposals across agencies are easier to understand and address, which may encourage new investigators to apply for funding, and seasoned investigators and research development offices to consider a diversified set of funding sources for their research portfolios. We also hope that this analysis provides guidance to other grantmakers as they develop review criteria for their own funding opportunities. For the 10 US federal agencies included here, we hope that the analysis serves as a starting point to develop even greater consistency across the review criteria—perhaps even a single canonic, cross-agency set of review criteria—used to evaluate federal research grant proposals.

Author’s Note

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Evaluating Research Administration: Methods and Utility

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Abstract: Three studies were jointly conducted by the Office of Research Administration and Office of Proposal Development at Tufts University to evaluate the services within each respective office. The studies featured assessments that used, respectively, (1) quantitative metrics; (2) a quantitative satisfaction survey with limited qualitative questions; and (3) a mixed-methods survey that evaluated both satisfaction and learning using quantitative metrics and equally weighted qualitative responses. These studies are used as case studies, and are described congruently to demonstrate that varying assessment methods have utility, separately and together, in evaluating the research administration enterprise. Findings illustrate that several factors influence which method should be used, including the goals of the evaluation itself. Additionally, findings indicate that judicial use of quantitative metrics supplemented with qualitative measures in mixed methods approaches allows the user to paint a more comprehensive and detailed picture. Finally, methods and inferences from such studies can be leveraged to gain or sustain competitive advantage among peer institutions and position the research administration enterprise for future success.

Introduction

Metrics are “a means of representing a quantitative or qualitative measurable [emphasis in original] aspect of an issue in a condensed form” (Horvath, 2003, as cited in Kreimeyer & Lindemann, 2001, p. 75). Consequently, performance metrics represent “[m]easures used to evaluate and improve the efficiency and effectiveness of business process” (Cole, 2010, p. 14). Examples of quantitative metrics used in the field of research administration include success rate (number of submitted proposals accepted for funding), dollar amount of funding applied for and received, and number of applications submitted. Customer feedback on research administration services is an example of qualitative metrics. The benefits of developing and implementing metrics for research administration offices include defining and monitoring business processes and their impact, defining responsibilities, managing expectations, improving decision making and prioritization, motivating teams and evaluating staff performance (Haines, 2012). These benefits can be condensed to three areas: changing behavior, driving performance, and supporting investments in research administration (Taylor, Lee, & Smith, 2014, slide 5).
Current use of metrics in evaluating research administration

Analyzing metrics in relation to sponsored funding and measuring research productivity is a well-established business practice among academic institutions with a research mission or focus. The University of Minnesota, for example, tracks data related to expenditures; publications and indicators of faculty reputations; proposals and grant awards; invitations and collaborations; indirect cost recovery; student engagement in research; space allocations; and other “common research metrics” (University of Minnesota, 2008, p. 10). Some institutions have incorporated metrics into their daily operations. The University of Iowa posts weekly “Homepage Metrics” on its Division of Sponsored Programs’ website (http://dsp.research.uiowa.edu). These metrics consist of the numbers of routing forms that were received; submitted proposals; completed contracts; non-monetary agreements and subawards; and processed awards, and are calculated weekly and during the fiscal year to-date.

Those institutions that do not already use metrics to guide and evaluate their work are now outside the norm. A recent informal survey of research administrators for the Society of Research Administrators (SRA) International’s electronic newsletter, Catalyst, found that most research administration offices (78% of those who responded) conduct some kind of evaluation of their services (Davis-Hamilton, 2014). The most commonly used evaluation methods reported include collection of informal feedback from customers, examination of existing management reports and data, and comparison of current internal operational data to those from prior periods.

Pitfalls of current metrics used to evaluate research administration

While the metrics discussed above can be useful and informative assessment tools, some scholars feel that metrics based on financial or other quantitative measures “do not sufficiently capture the quality of the level of service demands” placed on research administration (Cole, 2010, p. viii). By “reducing the complexity of the representation of an issue” quantitative metrics “tend to oversimplify or omit dependencies of an issue, thus making the representation incomplete” (Kaplan & Norton, 1992, as cited in Kreimeyer & Lindemann, 2001, p. 87).

Furthermore, the external environment influences traditional quantitative metrics, like success rates, making it difficult to evaluate the merit of the activities internal to the institution. This can be illustrated by looking at success rates from the perspective of the PESTEL framework, a tool used to identify the external opportunities and threats that may impact an institution’s operation. The PESTEL framework organizes these external “forces” into six major categories: Political, Economic, Socio-cultural, Technological, Ecological, and Legal (Rothenberg, 2013, pp. 56-57). These forces can drive funds available to support research, which then influences success rates in the public and private sectors.

Research programs outside of a sponsoring agency’s priority areas face increased challenges in securing funds. An example is the recent emphasis placed on obesity research by the United States Department of Agriculture and the National Institutes of Health, linked to the obesity epidemic in the US and the current administration’s personal interest in tackling this public health challenge (socio-cultural and political forces). This presents an opportunity and competitive advantage for organizations with active obesity research programs, increasing their success rate. Conversely, it
serves as a threat, and competitive disadvantage, to other health sciences organizations, lowering their success rate. Similarly, the more recent decline in economic growth has culminated in sequestration and fewer research dollars, lowering success rates nation-wide and threatening the breadth and longevity of many research programs (an economic force). The influence of these external “forces” must, therefore, also be considered when using quantitative metrics to evaluate an institution’s research administration enterprise. While many research administration offices currently use metrics in evaluating their work, the need for an effective, evidence-based metric standard that captures the complexity of the field remains unmet. Adoption of a mixed methods approach, utilizing both quantitative and qualitative measures, may allow research administrators to garner more comprehensive evaluations of their services, either individually or collectively as representative of the research administration enterprise.

The search for effective metrics to evaluate research administration: complexity metrics & satisfaction

The current lack of standard performance metrics for research administration services has far-reaching consequences. According to a recent SRA Catalyst survey (Davis-Hamilton, 2014), 15% of those who conduct evaluations of their offices have doubts about their validity. As noted in the same Catalyst article, some common platforms for evaluation were utilized but no clear standards emerged from the results of their informal survey. This lack of standard metrics not only creates validity concerns, but also makes comparisons across offices more difficult.

The ability to assess the quality of a research administration enterprise is extremely important. It is critical to ensure that available research administration resources adequately support investigators. As well, such assessment can inform decisions on allocation of additional resources that meet the changing needs of faculty and drive competitive advantage. To quote Janice Besch, Managing Director of the National Institute of Complementary Medicine at the University of Western Sydney, “[r]esearchers require robust management systems to support their activities in a funding environment that is highly competitive and carrying a significant compliance burden. If they are not well supported, they are likely to scale down, or fail in, their grant seeking activities; funding will diminish; and there is a risk that whole research programs could be shut down due to compliance breaches” (Besch, 2014, p. 1). Management systems to support research activities can include the various software and other technological tools research administrators use, but more fundamentally can be viewed as the research administrators themselves and research administration as a whole. Proper assessment of the quality of such instrumental systems, as part of a comprehensive effort to optimize them, is part of the effort to diminish those threats to which research activities are vulnerable, according to Besch’s observations. Another study (Cole, 2010) further posits that the success of research administration offices should be measured by performance metrics grounded in needs and preferences of both faculty and department administrators. Below, we assess two solutions to meet this requirement: complexity metrics and satisfaction surveys.

Complexity metrics. In the quest to develop meaningful metrics of research administration, one must take into consideration the complexities of the tasks performed by research administrators. In this context, the judgment of complexity is in relation to the “more complex grant awards,
which require more time and resources to manage due to the nature of sponsor requirements and/or collaborative activities with multiple researchers and institutions” (Taylor, Lee & Lee, 2014, slide 30). One means of measuring complexity was compiled by Chris Thomson of Moderas (moderas.org). His Proposal Complexity Scoring Matrix aims to judge the complexity of a proposal by the workload that goes into its review, which includes factors related to staffing, budget, human or animal subjects, subcontracts, international collaborations, and others.

Duke University offers another approach to measuring complexity, where management measures the complexity of a department’s sponsored research portfolio and ties it to the compensation of research administrators. The information on complexity and types of grants is supplemented “with information about the department’s practices with training, hiring, and procurement. Each assessment received a score, and the overall score is averaged” (Melin-Rogovin, 2012). A lower score is better, as it indicates that the department manages its portfolio well, has appropriate skills and training, is hiring adequately, and uses existing systems to maintain compliance.

Despite painting a more comprehensive picture of the research administration enterprise, complexity metrics take significant time and effort to develop and may be cumbersome and time-consuming for end-users. Additionally, it is highly subjective how much weight should be assigned to various components of such metrics in evaluations of research administration. Thus, while complexity metrics are the most nuanced quantitative metrics and often present a more accurate account of productivity and performance, they alone may not always be sufficient for a comprehensive assessment.

Satisfaction surveys. In a departure from quantitative and objective complexity metrics, satisfaction metrics focus on how satisfied faculty and staff are with the services provided to them by offices of research administration and development. This information can be assessed using both quantitative and qualitative measures. Giese and Cote (2002) define the concept of customer satisfaction as “a summary affective response of varying intensity” with a “time-specific point of determination and limited duration, that is directed toward focal aspects of product-related experience” (p. ii). In the research administration context, customers are faculty and their support staff that use services of research administration offices. Along these lines, product-related experience is the research administration service itself and the value provided to the customer through the use of said service.

There exist few scholarly studies on faculty’s own perceptions of the administrative resources available to them in the conduct of research (Mullen, Murthy, & Teague, 2008). This leaves a large gap in any attempt to assess the success of research administration offices. As Dr. Sharon Cole notes in the context of describing changes in the research administration system to bring about growth and collaboration, “[r]esearch faculty are the generators of the grants administration workload and recipient of services; therefore, their opinions and participation are deemed important to the improvements of the system of research administration” (Cole, 2007, p. 19). Besch (2014) continues this line of argument, writing, “[a]n effective barometer for excellent research management will undoubtedly be how it is perceived by those who rely on it” (p. 1).
Despite this dearth of formalized scholarship, satisfaction surveys—surveys that include a faculty opinion component—have been used at a variety of institutions to evaluate institutional research resources. These include Cole’s study of faculty at several research universities, which used a non-statistically significant informal online survey distributed via email asking faculty what services they found lacking in existing research administration structures, and what changes were needed in the working relationship between administrators and investigators (Cole, 2007). Besch (2014) moved beyond a customer satisfaction survey to introduce a short, clearly written mixed methods study that she reports, “never failed to produce a rich set of responses and a real sense of how the office was performing” (p. 4). Overall those who use qualitative measures asking for client feedback about and satisfaction with research administration services report high-quality, useful data.

Limits of this largely qualitative and subjective method include a relatively low return rate for surveys among faculty. One survey reported a 20.6% response rate (Mullen et. al., 2008), another only 11% (Cole, 2007), while a third survey of both faculty and administrators rose from 20% to 35% over several administrations (Besch, 2014). However, as qualitative data involves rich and detailed responses, high quality and analytically valuable information can be gathered from a small response group despite the potential lack of statistical power.

Methods and Results

We present below three case studies, the first and second conducted by the Office of Research Administration, and the third conducted by the Office of Proposal Development at Tufts University. Each presents the methods and results of a unique metric analysis and/or a customer satisfaction survey designed to assess key metrics to analyze the success of services within each respective office. While each of these studies was a standalone effort with its own objectives, our goal in describing them together is to analyze the utility of varying methods in evaluating research administration of (1) quantitative metrics; (2) a quantitative satisfaction survey with limited qualitative questions; and (3) a mixed-method survey that evaluated satisfaction and learning using quantitative questions and equally weighted qualitative responses. In our discussion, we will assess this utility, as well as the limitations of each method, followed by examples of how inferences drawn from each can be used to gain or sustain competitive advantage.

Case Study 1: Office of Research Administration (ORA) Metrics Study

Background. The Office of Research Administration (ORA) provides pre-award and non-financial post-award services to Tufts University faculty and department administrators. ORA is representative of two distinct offices: one that serves the Boston Campus (Health Sciences) and the Grafton Campus (Veterinary Medicine), and one that serves the Medford Campus (Arts & Sciences, Engineering, The Fletcher School of Law and Diplomacy, and several Centers).

Methods. In order to assess the performance of the office on a variety of factors, a metrics study took place on the Tufts University Boston Campus during a three-month period of the 2013 calendar year (June through August), representing a quarter-cycle of annual pre-award activity.
The study tracked metrics relating to the four core ORA services: (1) review and submission of proposals; (2) processing of requests to change the award’s budget (referred to as “re-budgets” below); (3) processing of requests to extend the award end date without additional costs (referred to as “no-cost extension requests” below); and (4) issuing sub-award agreements to other institutions where Tufts is the prime entity.

In order to quantitatively assess the delivery of these services, each of the four ORA-Boston staff members recorded twice a day all their actions relevant to each of the designated activities (see Table 1). Dates of actions were recorded in an Excel spreadsheet located on a shared drive, and each staff member was scheduled for unhindered daily access during two one-hour intervals, one in the morning and one in the afternoon. Once recorded, the data was used to map and analyze the processes as they progressed over time. It was hypothesized that analysis of metrics relating to documentation flow and length of time for each action would allow for the identification of bottlenecks and opportunities for streamlining as well as improving service delivery.

**Results.** Results of the study supported the hypothesis, as the metrics tracked uncovered addressable points of delay in each of the areas examined. For example, it was found that 33% of proposals during the study period arrived to ORA for review on the day of the submission deadline. This prevented the full review of these proposals and was correlated with an average resubmission rate of 1.27 (in this example, a resubmitted proposal is one which must be sent to a given funding agency more than once due to errors, warnings, or other deficiencies discovered shortly after the initial submission). It was concluded that additional time for review could reduce or eliminate the resubmission rate.

Results also indicated that 35% of re-budget requests made during the study period required revisions or additional information from the department before they were ready for processing by ORA. Further analysis revealed that only 11.5% of re-budgets processed during the study period required ORA involvement, as agency approval was unnecessary in the majority of the cases. Similarly, results captured that nearly half (44%) of no cost extension requests required additional information that had to be subsequently collected, increasing the time needed to complete the process. Finally, metrics concerning the sub-award process revealed that the largest bottlenecks were centered on the processes of gathering necessary information from a department and waiting for countersignature from the other party.

**Case Study 2: ORA Customer Satisfaction Survey**

**Background.** See background for Case Study 1.

**Methods.** In a separate effort following the case study described above, both Boston/Grafton and Medford ORA locations distributed an IRB-approved satisfaction survey during the three weeks in September–October 2013 to all three of Tufts’ campuses. As ORA is a central pre-award office, customers for the purposes of this study were defined as: (1) faculty that either applied for or received at least one grant or other extramural award in the preceding 12 months; (2) department administrators that assist faculty with proposals; and (3) central post-award office staff. A total of 532 individuals were invited to participate, including 463 faculty, 53 department administrators, and 16 staff of the central post-award office. This study was not designed with a hypothesis, but...
rather to gather information about current levels of satisfaction with ORA that could later be used as a benchmark for evaluations and an opportunity for improvement.

The satisfaction survey (see Appendix A) was sent electronically using the Qualtrics online survey tool. It consisted of nine questions grouped as follows: two demographic questions (campus location, faculty or staff); three main questions designed to gather information about the volume

Table 1. Office of Research Administration (ORA) Metrics Tracked

<table>
<thead>
<tr>
<th>Core Service</th>
<th>Metrics Tracked</th>
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| Proposal Submission           | ORA is first contacted about proposal  
                                 | ORA conducts initial review of proposal (if applicable)  
                                 | Number of revisions  
                                 | Internal forms received by ORA  
                                 | Full proposal received by ORA  
                                 | Proposal submitted to the agency  
                                 | Number of submissions (if applicable) |
| Re-budget Requests            | ORA receives re-budget request  
                                 | ORA contacts department for revisions (if applicable)  
                                 | Department sends revisions (if applicable)  
                                 | ORA contacts agency for approval (if applicable)  
                                 | Number of contacts with the agency  
                                 | Agency returns determination (if applicable)  
                                 | ORA routes re-budget to post-award office |
| No Cost Extensions            | ORA receives no cost extension request  
                                 | ORA contacts department for additional information (if applicable)  
                                 | Department sends additional information (if applicable)  
                                 | ORA contacts agency for approval (if applicable)  
                                 | Number of contacts with agency (if applicable)  
                                 | Agency returns determination (if applicable)  
                                 | ORA finalizes no cost extension and routes internally |
| Subawards (Tufts as prime)    | ORA receives notification that sub-award is needed  
                                 | ORA contacts department for additional information (if applicable)  
                                 | ORA has complete information for sub-award  
                                 | ORA sends draft to department for review (if applicable)  
                                 | Department returns draft to ORA (if applicable)  
                                 | ORA sends sub-award to other party  
                                 | ORA follows up with other party (if applicable)  
                                 | Number of follow ups with other party  
                                 | ORA receives request for changes from other party (if applicable)  
                                 | ORA responds to other party (if applicable)  
                                 | Number of drafts exchanged (if applicable)  
                                 | Sub-award is executed by the other party  
                                 | ORA signs sub-award  
                                 | Fully executed sub-award distributed internally |
of grant activity and frequency of the individual’s interactions with ORA; a general question about overall satisfaction with ORA services, followed by a detailed question about the respondents’ satisfaction; and two open-ended questions asking respondents to explain their other answers.

The detailed satisfaction question presented a list of ten service metrics and asked respondents to rank satisfaction with each using a five-point Likert scale ranging from very satisfied to very unsatisfied. The service metrics listed for evaluation were: turnaround time; status updates; communication skills; attention to details; knowledge/expertise; professionalism; collegiality; responsiveness to customers’ needs; help in managing the proposal time frame well; and quality and usefulness of information on ORA website. These metrics were selected for inclusion in the survey after conducting a thorough literature review of the performance measures used by other research administration offices in their self-evaluations, as well as the analysis of several existing survey instruments used by other universities in evaluations of their sponsored programs services (Utah State University Survey of the Division of Sponsored Programs; Barry University Office of Grants and Sponsored Programs Evaluation Survey).

The first of the two open-ended questions asked respondents to explain the reasoning behind any or all of the qualitative satisfaction scores they had assigned to the service metrics listed in the survey. The second gave them an opportunity to express any ideas and opinions about what ORA could do to further improve pre-award research administration at Tufts.

Of 117 participants that clicked on the survey link, 83 people (71%) completed the survey, translating to an overall completion rate of 15.6%. Faculty comprised 63% of respondents, while staff comprised the remaining 37%. Overall, 52 faculty members and 31 staff completed the survey. Of note, the survey received 82 responses to one or more of the open ended questions: 46 participants (55% of all responses) commented on what impacted their rating(s), and 36 participants (43% of all responses) commented on what ORA could do to better assist them with their pre-award needs.

Results. The short format required only a brief time and effort investment from the participants, potentially increasing the number of responses. While almost half of administrators (45%) who were invited to participate in the survey completed it, faculty members participated in smaller numbers (11% of those who were invited completed the survey). In analyzing the data, we noted that many participating faculty held a stronger opinion, either positive or negative, regarding ORA services, while the administrators’ feedback was more evenly spread across the satisfaction spectrum. While this survey was not designed to explore in detail the services that were evaluated, results showed that it did provide a window for customers to express their satisfaction, both quantitatively and qualitatively.

The survey created a snapshot of faculty and staff satisfaction with ORA on various metrics, giving a baseline that can be used in future surveys, especially those following major change. In addition to quantitative information, insightful qualitative feedback on ORA services was also received. Overall, the majority (67%) of respondents were either very satisfied (28%) or satisfied (39%). An additional 24% of respondents were neutral (neither satisfied nor dissatisfied). A total of 9% (8 participants) were dissatisfied (7%) or very dissatisfied (2%), with all but one of the
dissatisfied respondents being faculty. In service metrics, collegiality and professionalism ranked highest in terms of satisfaction. Attention to detail solicited the most responses with some degree of dissatisfaction.

Case Study 3: Office of Proposal Development (OPD) Faculty Satisfaction Survey

Background. Founded in 2004, the Office of Proposal Development (OPD) at Tufts University is a central research development office that offers grant writing and proposal preparation assistance to faculty. Solely a pre-award office, services currently offered include grant writing; proposal editing and commenting for content; assistance with several other aspects of proposal submission, such as project management; funding opportunity searches and database training; and a variety of trainings and workshops focusing on aspects of proposal preparation.

Methods. For the purposes of this survey, faculty who had availed themselves of OPD services in the period between 2009 and 2014 and were still employed by Tufts were considered part of the target population, totaling 119 faculty. Faculty who met this definition were approached via email to ask for their participation. The survey remained open for a period of six weeks, with an initial request and three reminders sent via email. Faculty who consented to take the IRB-approved survey were directed to an online instrument built using the Qualtrics online survey tool.

The OPD provides skill-building training, as well as a ‘learn to fish’ model of proposal editing. In the ‘learn-to-fish’ model, the grant writer offers comments and edits to successive drafts of a proposal, engaging faculty in an iterative process that improves the current proposal while explaining and demonstrating best practices. The end goal of this process is to improve the faculty member’s proposal writing skills over successive interactions with the office. Given these services, constructs gathered from the literature (Campbell & Longo, 2002; Hoyt & Howard, 1978; Reif-Lehrer, 1992; Sridhar, 2009; Stein, Clair, Lebeau, Prochaska, Rossi, & Swift, 2012; Wasby, 2001) led to the inclusion of metrics relating to satisfaction with services provided, as well as to what extent faculty felt that their own proposal submission skills and confidence had improved after their experience working with the OPD. The survey used a combination of quantitative and qualitative questions to assess two major questions associated with these metrics, both having to do with the perceived benefits of using OPD programs: (1) To what extent, if at all, were you satisfied with the services you received from the OPD during your proposal preparation?; and (2) To what extent, if at all, do you perceive that your skills in grant writing and proposal submission have improved as a result of your work with the OPD?

This mixed-methods satisfaction survey (see Appendix B) asked a total of 23 questions, broken into four sections: (1) background information, which asked information about name (not required, as it removed anonymity) and rank, time at Tufts, number of grants applied to and received, and type of assistance received; (2) experience with the OPD, which asked both quantitative (on a five-point Likert scale from very satisfied to very dissatisfied) and qualitative questions relating to satisfaction with the OPD in general and with specific services; (3) grant submission post-OPD support, which asked quantitative (yes and no, as well as four- or five-point Likert scales tied to the construct of each question) and qualitative questions relating to the faculty’s perception of their grant application preparation abilities after their experience working with the OPD; and
(4), a conclusion section with an open-ended space to provide feedback. The survey was designed so that none of the questions required answers to advance to the next question or section. It was hypothesized that working with the OPD a) has a positive impact on confidence and skills related to pre-award proposal submission; b) increases faculty confidence in the preparation of grant applications, and c) is perceived as having a positive impact on faculty’s ability to prepare competitive grant proposals.

**Results.** A total of 41 faculty clicked on the survey link, with 33 (27.7% of those who were invited) completing the full survey. Controlling for responses inputted over multiple days or hours, indicating that the survey was not completed in one sitting, the mean response time was approximately 10 minutes, with a median response time of approximately 7 minutes. Six responses of 33 were removed from analysis for lack of validity. These responses fell into two categories. Some provided feedback about other pre- or post-award support offices in place of or in addition to the OPD, leading to a lack of clarity about which answers referred to OPD support. Other faculty indicated they did not recall that they had received OPD support. The 27 valid responses represented 22.7% of the target population.

Of services provided by the OPD, grant writing/editing assistance was the most commonly used service, with 92.6% of respondents reporting that they had received writing/editing help. Sixty three percent of respondents report receiving help with extra-narrative elements (such as biographical sketches, resources pages, and letters of support), while 37% received project management assistance. Overall, 92.6% of respondents were very satisfied (N = 17) or satisfied (N = 8). Of the services offered, respondents were most satisfied with editing (96.3% very satisfied or satisfied, out of 27) and extra-narrative support (90.5% very satisfied or satisfied, out of 21.) Further, 96.3% of respondents would recommend the OPD to a colleague, and 96.3% would also use OPD services again.

Results also showed an increase in confidence in respondents’ ability to prepare competitive grant submissions after their experience working with the OPD. Twenty-three of 27 respondents reported being very confident (N = 17) or confident (N = 6) in their ability to prepare competitive grant submissions; 77.8% of respondents reported that in their perception their experience working with the OPD had a high (N = 11) or moderate (N = 10) impact on their confidence level. An additional 6 respondents reported no impact. Additionally, 85.2% reported that their experience working with the OPD had a high (N = 14) or moderate (N = 9) impact on their ability to prepare competitive grant proposals. This indicates that the OPD’s intervention has a positive impact on proposals that are not prepared using the office, an important finding that helps to confirm the ‘learn to fish’ model used by the office does indeed create perceived effects on faculty. One third of respondents (N = 9) reported using an OPD tool to teach a colleague, which indicates that OPD has been able to assist not only the faculty they reach directly, but also those faculty’s colleagues. Thus, the study results provided confirmation of the office’s wider than anticipated impact on the pre-award research enterprise at Tufts.

Results of this study support the hypotheses for the sample population, in that a majority of faculty who responded found that working with the OPD increased their confidence in grant submission and had a high or moderate impact on their ability to prepare competitive grant submissions.
proposals. Further, as anticipated, the pairing of long answer qualitative answers with related quantitative questions assessing key metrics led to a more detailed set of responses and more specific answers to qualitative questions, adding nuance and depth to the data overall.

Discussion

Utility and limitations of assessments using qualitative, quantitative, and mixed methods

The case studies described herein featured assessments using (1) quantitative metrics; (2) a quantitative satisfaction survey with limited qualitative questions; and (3) a mixed-methods survey that evaluated both satisfaction and learning using quantitative metrics and equally weighted qualitative responses. The type of findings and inferences that were made possible by the methods used, or the lack thereof, are discussed below.

Case Study 1: ORA Metrics Study. Results of this quantitative study were found to be rich and immediately useful in adjusting operational elements to improve work processes. This utility demonstrates the value of using quantitative methods tied to performance metrics to assess research administration tasks relating to timing and rounds of review. Such assessments can be implemented internally within research administration offices without the involvement of customers. They are the least time consuming assessments of the three we evaluated in terms of time to conduct (low) and demands on faculty and departmental research administration staff (none). However, the sole focus on operational dynamics failed to represent/assess the cultural dynamics. In this study, the lack of customer involvement makes it impossible to explore the departmental difficulties associated with each of the tracked processes.

Case Study 2: ORA Customer Satisfaction Survey. Findings from this quantitative satisfaction survey with limited qualitative responses demonstrated that involving customers gave access to broader data about the customer experience, adding the element missing in an internally focused qualitative-metrics-only assessment. Limitations of this method include a lack of actionable knowledge if not paired with a quantitative metrics assessment such as that in the ORA Metrics Study, which enables more thorough assessment by providing context for customer’s answers.

Case Study 3: OPD Satisfaction Survey. Results of this mixed-methods survey with quantitative metrics and equally weighted qualitative responses demonstrated that when paired with quantitative outcomes that detail levels of satisfaction with specific services, the use of interspersed qualitative questions added richness and nuance to the analysis of what satisfies faculty. Narrative responses allowed faculty to explain why they were satisfied with OPD services. Responses such as, “[e]xtremely professional, courteous, competent and timely in terms of editing of research narrative, preparation of biosketches, and providing tactical and strategic advice on proposal structure” not only added depth of assessment, but were also useful to determine which OPD service provisions provide satisfaction. Limitations of this method include a larger time commitment for the OPD staff to review qualitative survey results, as well as the participants themselves to complete it. The amount of time necessary from participants, as well as the perception that a qualitative survey will be time consuming, may also depress responses.
Metrics and competitive advantage

Metrics such as those tracked in the three described studies have a dual function that is critical to the evaluation of an institution’s central and departmental research administration offices, either separately or collectively, the combination of which create the research administration enterprise. First, they allow the institution to assess its research administration resources from the perspective of how they aid in the development of unique core organizational competencies (Rothaermel, 2013, pp. 88-90). The institution can use this resource-based view to support future investments in those resources needed to gain or sustain competitive advantage against peer institutions, or justify investments in research administration resources that have previously been made. Second, they allow the institution to evaluate alignment between its research administration goals, tasks, and people–information to optimize performance. This dual approach equips the institution to better position its research administration enterprise for success because it combines an evaluation of resources with information on performance.

Resources are more likely to lead to competitive advantage when they are Valuable, costly to imitate, Rare, and Organized to capture value (the VIRO framework) (Rothaermel, 2013, p. 91). Valuable resources correlate with reduced administrative burden and/or increased satisfaction as both increase the customer’s perceived value of the service provided (Rothaermel, 2013, p. 92). Such resources can be uncovered using quantitative metrics such as those outlined in the ORA Metrics Study. An outcome of that study was to redirect effort from day-to-day activities to remapping some of the processes that were tracked to remove bottlenecks. While this required a significant time commitment in an office that was understaffed, it improved service delivery and reduced administrative burden, increasing the value gained from ORA’s resources. The value of resources can also be discovered through expressed satisfaction such as that qualitatively captured using the metrics outlined in the OPD Satisfaction Survey.

Resources that are rare are those that allow an institution to do better than its peers, or those that are used by an institution in a unique way compared to its peers. Costly to imitate resources are those that are expensive for peers to replicate in terms of procurement or time needed for implementation (Rothaermel, 2013, pp. 92-93). Satisfaction metrics like those outlined in the ORA and OPD Satisfaction Surveys can be used to benchmark an institution’s resources compared to peer institutions. The OPD Satisfaction Survey demonstrated that services offered by this office are rare because of the long-term value that faculty received as result of the ‘learn to fish’ model. Another key finding, each staff member’s contribution to faculty’s grant development experience, highlighted the diverse and specialized skills and training of each staff member. The latter also demonstrated that OPD’s resources are costly to imitate given the staff’s specialized skill sets and the time investment necessary to cultivate successful relationships with faculty. These findings justify prior investments, and provide support for future investments by demonstrating that OPD resources are a source of competitive strength for the University.

In order to capture the most value from resources, there must be organizational structures and systems in place that exploit their competitive potential (Rothaermel, 2013, p. 94). Quantitative metrics, such as those outlined in the ORA Metrics Study, can be used to understand how structures and systems are being used, highlight where processes can be linked and consequentially, how
prior investments can be maximized and better utilized. Findings from this study determined that
the no-cost extension review provides an opportunity for linking with the subaward process as it
can serve as a prompt for extensions of subcontracts issued under the award. It is also a checkpoint
for common areas of noncompliance, such as change in scope and personnel effort during the no
cost extension period. This led to the revision of ORA’s no-cost extension form to include these
additional data elements. The ORA Metrics Study also identified that more value could be gained
by utilizing the systems housed in other central offices at Tufts in the re-budget request process.
Re-budget requests are now routed to the post-award office first, and to ORA second and only in
instances where agency approval is necessary. This has exploited the competitive potential of these
resources while maximizing prior investments.

For a university research administration office, metrics such as those outlined in the ORA Metrics
Study and Customer Satisfaction Survey can be used to determine where there is misalignment
between tasks, goals, and/or people. According to the Organizational Alignment Model (Figure
1), organizations develop an overarching strategy and define their goals in response to the external
environment. To accomplish these goals, they create tasks and hire people to perform these tasks. In
order for the strategy to be successful there must be alignment between the defined goals, the created
tasks, and the hired people. It is from this alignment that the organization gains competitive strength
(Lane, Maznevski, DiStefano, & Dietz, 2009, pp. 179-185). Ideally, identified misalignments
will lead to changes that will help build the skills needed to perform the tasks required to meet
an organization’s goal(s), creating the alignment that is critical in driving future performance.
An example of this type of alignment, the ORA Metrics Study highlighted that a majority of the
bottlenecks in the existing processes for re-budget and no-cost extensions requests were attributable
to a disconnect at the department level. More specifically, the disconnect was present between the
associated tasks and the skill-set of the individuals performing these tasks. As an outcome of this
study, as well as other assessment initiatives, efforts are currently underway to create a standard
level of performance. This will be accomplished by re-defining and re-designing positions so that
they have a stronger research administration orientation and by providing more formalized
and institution-driven training.

Qualitative feedback is also useful in discovering misalignment between faculty’s perception of
the goals established by an organization for its research administration operation, and the
actual goals, tasks, and people assigned to the research administration enterprise. This issue is
typified by the results of the OPD Satisfaction Survey, as faculty respondents requested
services that did not align with university or office-set goals. Knowledge about this
disconnect allows for better communication of existing university and office goals and for
evaluation of the office tasks for alignment

Note. Lane et al., 2009

Figure 1. Organizational Alignment Model.
with faculty’s goals. Greater alignment between the two can alter the respective contribution of OPD and faculty to the task at hand, and ultimately drive performance.

Conclusion

These findings demonstrate that the types and combinations of methods most useful in evaluating an office of research administration are dependent on several factors, including the goal of evaluation, types of available baseline data, the amount of time and institutional support available to the investigator, and the amount of time and effort that can be asked of survey respondents. Used in combination based on the needs of a given office, the approaches employed in each case study offer examples of how to usefully assess the impact, strengths, and weaknesses of a research administration office, and can be used to gain or sustain competitive advantage and position the research administration enterprise for future success. While it is recognized that evaluation metrics can be influenced by external forces (i.e. the PESTEL framework), the methods used in the three described case studies were not designed to assess the potential impact of said factors. These forces were instead referenced to highlight the need to look internally at the institution’s resources when evaluating its research administration enterprise. Additional research on external factors is warranted to explore ways to assess the impact of such factors on research administration metrics.

Authors’ Note

This paper is the result of the analysis carried out by employees of Tufts University as part of their institutional duties. However, this paper is the authors’ sole responsibility and does not purport to represent the views of Tufts University.

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Appendix B

Tufts Office of Proposal Development Satisfaction Survey

Thank you for agreeing to participate in this survey! The Tufts Office of Proposal Development (OPD) is evaluating the satisfaction of faculty with the OPD and the services that we provide, as well as the perceived effects of our services. The survey should take between 15-20 minutes, and will include questions about your background in grant submission, your experience working with the Tufts OPD, and any new grant submissions since that interaction.

Background Information

The questions in this section will ask you for information about yourself and your position at the university. You will also be asked questions about your previous grant submission experience, and the types of assistance you have received from the Tufts OPD.

1. We will start with a few questions about your position at Tufts. If you would like anonymity, please skip these questions. If you choose to answer this question you are providing consent for the investigator to contact you with follow up questions based on your responses below, regarding clarifications of or expansions on your answers.

   - Name
   - Position
   - Date of Hire

2. Please select the number of grant applications on which you were listed as Principal Investigator (PI) (or equivalent) either at Tufts or at another institution, during the period between 2003 and 2014.

   - 0-1
   - 2-3
   - 4-6
   - 7-9
   - 10+

3. Of the grant applications above, approximately how many have been funded?

   - 0-1
   - 2-3
   - 4-6
   - 7-9
   - 10+
4. Please check all types of assistance you received from the OPD during your submission. If you received a type of assistance that is not listed, please write it in below.
   - Funding Search/Database Instruction
   - Commenting/Editing of Research Plan
   - Project Management
   - Extra-Narrative (e.g. Biosketch, Resources)
   - Seminar
   - Other

**Experience with the Office of Proposal Development**

In this section you will be asked to discuss your experience working with the OPD. Some questions will ask you to rate your satisfaction with experiences and services on a scale. Others will ask you to describe your thoughts on the services provided.

1a. Please rate your satisfaction with the overall services provided to you by the OPD, using the scale below.
   - Very Satisfied
   - Satisfied
   - Neutral
   - Dissatisfied
   - Very Dissatisfied

1b. Please explain your rating in the space below, citing specific examples where available.

2a. Please rate your satisfaction with the specific services listed below, with Very Satisfied indicating that the service provided was excellent, and Very Dissatisfied indicating that the service provided was poor. If you did not receive a service, please select ‘Not Applicable.” (Note, scale for all Very Satisfied, Satisfied, Neutral, Dissatisfied, Very Dissatisfied)
   - Funding Search
   - Project Management
   - Readings/Commenting
   - Extra-Narrative (e.g. Biosketch)
   - Seminar

2b. Please explain your ratings in the space below. What exchanges with members of the OPD team were either particularly satisfying or dissatisfying? Please provide specific examples if available.

3a. Please think back to the submission(s) with which you were assisted by the OPD. What elements of support would you describe as the most helpful to you during the proposal development process?
3b. What elements of OPD support would you describe as the least helpful in the completion of your proposal?

**Grant Submission Post-OPD Support**

This final section of the survey will concern your perception of your grant application preparation abilities after your experience working with the OPD. Some questions will ask you to rate your abilities on a scale; others will ask you to describe your thoughts.

1. Thinking about your experience working with the OPD, what changes, if any, do you perceive in your ability to prepare grant submissions?

2a. Please rate your current confidence level in your ability to prepare competitive grant submissions, using the scale below.

- Very Confident
- Confident
- Neutral
- Unconfident
- Very Unconfident

2b. Please rate your perception of how working with the OPD has affected your confidence level in your ability to prepare competitive grant submissions, if at all, using the scale below.

- High Impact
- Moderate Impact
- No Impact
- Moderate Negative Impact
- High Negative Impact

3. Please rate your likelihood of applying for future grant funding, using the scale below.

- Very Likely
- Likely
- Unlikely
- Very Unlikely

4. Please rate your perception of how your work with the OPD has affected your likelihood of applying for future grant funding, if at all, using the scale below.

- High Impact
- Moderate Impact
- No Impact
- Moderate Negative Impact
- High Negative Impact
4b. Please rate the impact that working with the OPD has had on your ability to prepare competitive grant submissions, if any.

- High Impact
- Moderate Impact
- No Impact
- Moderate Negative Impact
- High Negative Impact

5. Have you used a tool or strategy learned from the OPD to assist or instruct a colleague?

- Yes
- No

5b. If yes, please discuss below, using specific examples if possible.

6. Please rate your likelihood of suggesting that a colleague contact the OPD for support, using the scale below.

- Very Likely
- Likely
- Unlikely
- Very Unlikely

7. Please rate your likelihood of using OPD services again, using the scale below.

- Very Likely
- Likely
- Unlikely
- Very Unlikely

**Conclusion**

Please use this space to provide any feedback on the survey instrument, or other comments about your experience with the Office of Proposal Development.

Do you consent to the inclusion of text from your responses in reports, papers, or presentations? Any attributions made will remain anonymous.

- Yes
- No

This concludes the Tufts Office of Proposal Development New Faculty Satisfaction Survey. Thank you very much for your time and effort in answering our questions!
Disciplinary Differences in Conflict of Interest Policy Communication, Attitudes, and Knowledge

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Abstract: Research institutions are charged with developing and managing conflict of interest (COI) policies regarding the design, conduct, and reporting of research. Prior research indicates that university researchers may not understand the purpose of these policies and may resent the time taken to demonstrate compliance. Policy communication is not a simple issue, nor is it a process clearly defined in the COI context. Accordingly, this study investigates multiple aspects of policy communication across disciplines to shed light on policy communication practices as well as on how communication relates to policy knowledge and attitudes. Specifically, this study investigates COI policy communication, knowledge, and attitudes at a large university and compares differences across disciplines. Using the framework of structurating activity theory, the study also analyzes how norms for ethical conduct differ across disciplines and correlate with policy communication, knowledge, and attitudes. A total of 246 participants representing health sciences and non-health sciences disciplines participated in an online survey regarding the institution’s COI policies. Results indicate that attitudes toward the COI policies are positive across disciplines and that policy knowledge is higher than mid-range. However, policy communication is low across disciplines, with non-health sciences participants reporting lowest levels of communication about the policy. Implications and recommendations are offered for future research and research administration practice.

Keywords: conflict of interest, policy communication, policy attitudes, policy knowledge, structurating activity theory
Introduction

Financial conflicts of interest (COI) in research exist when an investigator potentially benefits financially from the research in which that individual is involved. One common conflict occurs when an investigator establishes a financial relationship with an industry partner through receipt of industry-sponsored research, gifts, or remuneration from consultation, speaking engagements, etc. Several studies suggest that industry partnerships can cause conscious or subconscious bias on study design, data collection and analysis, and reporting of results, no matter the nature of the relationship (Bekelman, Li, & Gross, 2003; Berger, 2015; Bes-Rastrollo, Schulze, Ruiz-Canela, & Martinez-Gonzalez, 2013; Lexchin, Bero, Djulbegovic, & Clark, 2003; Sah & Fugh-Berman, 2013). Another common conflict of interest occurs when an investigator generates intellectual property through research. Generating intellectual property alone does not cause a financial conflict of interest, but a conflict does arise if an existing industry partner or a university-funded start-up company commercializes the intellectual property. Although remarkably little research exists on conflicts of interest involving start-up companies, financial and commitment conflicts are an obvious concern, especially if the researcher also holds an equity interest in the company (Smith, 2011).

The volume of industry-physician relationships and number of start-up companies appears to be increasing. According to Ornstein, Weber, and Nguyen (2013), pharmaceutical and medical device companies made payments to physicians of $4 billion from 2009-2013. That figure was nearly matched ($3.53 billion) between August 2013 and December 2014 (Groeger, Ornstein, Tigas, & Jones, 2015). Similarly, the number of university start-up companies created per year increased from 330 in 2003 to 647 in 2012 (Valdivia, 2013). These data together demonstrate that as industry-physician relationships and university investments in start-ups and licensing of intellectual property increase, so do the number of potential conflicts of interest related to research.

The increasing likelihood of conflicts of interest and lack of transparency of physician’s industry relationships have received the attention of government regulators, leading to policy changes. In 2008, Senator Chuck Grassley (R-IA) called for policy revisions concerning industry payments to individual physicians. This led to the Physicians Payments Sunshine Act (2010) and the Department of Health and Human Services adopting new regulations to Public Health Services funding, which included changes to the National Institute for Health (NIH) conflict of interest policy in 2011. Some of the new NIH regulations set standards on investigators’ industry relationships and intellectual property. Because the NIH is the largest research funding agency outside of the Department of Defense (White House Office of Science and Technology Policy, 2014), changes to its COI policy have had a major impact on COI policies and procedures of the nation’s universities and colleges that seek NIH grant funding. The new NIH COI policy holds universities accountable for ensuring that researchers comply with federal regulations. As a result, many research universities made significant changes to their COI policies and procedures in 2012 based on NIH standards.

Implementation of a new university COI policy (COIP) is challenging. The policy must be robust enough to account for an array of possible conflicts of interest, including the aforementioned
examples, as well as accommodating a diverse population of researchers. Universities with closely associated medical schools face an extraordinary challenge if the university desires a unified and comprehensive COIP. Clinical researchers at medical schools may have more industry-related conflicts based on the large amounts of money pharmaceutical and medical device companies give to physicians. Furthermore, attitudes, objectives, motivations, and philosophies may differ between researchers in different fields. A comprehensive COIP must be communicated effectively to such a diverse audience. This may mean different communication strategies customized to unique audiences, or one strategy that transcends the differences between researchers across all fields with conflicts of interest (which may or may not be field-related). Clearly, much remains to be understood about how COIPs are perceived, interpreted, and communicated, and with what consequences. Prior research indicates that three key concerns for COIPs are communication, knowledge, and attitudes, which we discuss below.

**Communication**

Policy making, implementation, and compliance are communicative practices. Policy practice is not linear, but rather implies a circuit of communicative behaviors that might include attending to potential unintended consequences of policy provisions, addressing ambiguities in the policy text, and managing paradoxes inherent to the academic research context (LeGreco, 2012). Canary, Blevins, and Ghorbani (2015) found that the bulk of organizational communication research on policy communication represents an information transfer perspective to policy communication among practitioners. Lee and Garvin (2003) suggest that practitioners ought to move away from such notions of information transfer and toward methods of informational exchange, including reciprocity and valuing open, two-way communication channels.

Policy communication requires a high degree of openness, clearly explaining every phase of the process, and being open about expectations by developing relationships based on mutual trust (Janse & Konijnendijk, 2007). However, conflicting pressures from multiple parties may lead to reservations about the COI process, and result in secrecy rather than transparency. Frankel (1996) warns that secrecy will persist if researchers continue to view it as a necessary strategy for maintaining industry ties. Furthermore, concerns for proprietary gain can subvert traditional processes of openness and sharing among scientists. Industry partnerships and agreements place restrictions on researchers that in many cases lead to unwillingness or inability to share information, including data, findings, and methods. Marchington, Rubery, and Grimshaw (2011) advise that when implementers are faced with difficult undertakings across organizational boundaries, they should be keenly aware of issues of alignment, integration, and consistency. That is, when a governing body has not aligned meaning and goals with members, and members are poorly integrated into systems of knowledge sharing (or if the system does not support integration), problematic inconsistencies may ensue. To address this, Beachy, Berger, & Olson (2014) concluded from their Institute of Medicine roundtable on COI management that goals of communicating to the public about COI are to promote innovation, meet client needs, and increase and maintain public trust.

Clearly, policy communication is not a simple issue, nor is it a process that has been clearly defined in the COIP context. Accordingly, this study investigates multiple aspects of policy...
communication across disciplines to shed light on such practices as well as on how communication relates to policy knowledge and attitudes.

**Knowledge**

If researchers are to be expected to comply with policy, they should be informed as to what a conflict is and what will be required if they are deemed to have a potentially conflictual relationship. As researchers are informed, their knowledge of COI processes increases. Gabler (2010) notes, “Social learning [is] the source of policy integration. Learning implies actors’ improved understanding of alternative ideas, reflected in changes to frames that underlie identities, interests, policies, and institutions” (p. 83). Lipton, Boyd, & Bero (2004) provide several useful pieces of advice. Implementers should know which gaps in knowledge exist to understand how to properly assess what information needs to be conveyed. Lipton et al. (2004) found that while researchers report a desire for self-regulation and personal integrity, they approach policy only to the extent that it applies to them. They likely underappreciate their responsibility to understand the scope and implications of conflicts of interest.

For the most part, researchers understand why COIPs exist, and understand appropriate procedures to ensure conflicts are managed (Lipton et al., 2004). However, many are not aware of the actual impact of financial incentives in research, and faculty researchers generally lack understanding of specific details regarding COIPs (Glaser & Bero, 2005; Lipton et al., 2004). This is may be due to COIPs lacking detail regarding what constitutes COI and how it should be managed, or simply not being readily accessible to organizational members (Ancker & Flanagin, 2007). When the policy is available, those who are affected by the policy may develop the requisite knowledge for using it effectively, increasing compliance rates (Zelisko, Baumann, Gamble, Laporte, & Deber, 2014). Gabler (2010) asserts that researchers become strongly integrated with policy mandates when stakeholder goals are congruent and the institution provides opportunities for complex and reciprocal learning. In a recent study, Sacco, Bruton, Hanjal, & Lustgraaf (2015) found that participants who had taken college-level ethics courses demonstrated more sensitivity to the importance of disclosing financial COIs than those without such education. Although participants in that study were students rather than researchers, results indicate the influence of knowledge development opportunities on responses to research ethics issues. Overall, prior research indicates that researchers may have cursory knowledge of COIPs but details that could influence compliance are often lacking. Studies have more often focused on attitudes toward policies rather than objective levels of knowledge. Accordingly, we discuss policy attitudes below.

**Attitudes**

Prior research reveals several themes in researcher attitudes about COI and related policies. For example, Mecca, Gibson, Giorgini, Medeiros, Mumford, & Connelly (2015) interviewed researchers across disciplines to gauge their attitudes about conflict of interest scenarios they were presented. Their analysis revealed five attitudinal themes: disclosure, self-removal, accommodation, denial, and recognition of complexity. By far the most prevalent attitude was that conflicts are adequately managed by disclosure. Although disclosure is important, the authors note that researchers do not seem to understand other aspects of COI that may not be
adequately managed by disclosures. Their findings comport with Glaser and Bero’s (2005) review of published research about COI attitudes. Glaser and Bero’s analysis indicates a high reliance on disclosure, which likely reveals “a lack of awareness of the actual impact of financial incentives on themselves and other researchers” (p. 553). Results of that review of research also indicate that researchers believe that financial obligations influence how other researchers report findings, but not themselves. Glaser and Bero warn that if bias is unexamined, disclosure may not be enough to manage conflicts. Yet, Glaser and Bero (2005) explained that researchers approve of industry ties when they are indirectly related to research. Their review of empirical studies assessed researcher attitudes toward industry-research ties, not COI policy specifically, which is the focus of our present study.

A strength of this prior work is that it represents researchers across disciplines. However, little has been done to compare attitudes across disciplines. It is entirely plausible that researchers in different disciplines will have varying attitudes about conflicts of interest, policy solutions, and oversight in the research arena. For example, physicians who engage in industry relationships have been shown to rationalize potential conflicts of interest based on “(1) a sense of entitlement to accept industry gifts, and (2) a sense of invulnerability to the biasing effects of conflicts of interest” (Sah, 2012, p. 482). Sah’s work indicates that the prevailing attitude among many physicians was that they felt as though they worked extremely hard in medical school; therefore, they deserved the gifts. Other studies have identified a “bias blind spot” in which individuals claim not to be biased by industry relationships, but they acknowledge those same relationships would bias their peers (Dana & Loewenstein, 2003; Pronin, Lin, & Ross, 2004; Sah & Fugh-Berman, 2013).

Viewing policy as a conglomeration of symbolic appeals, Frankel (1996) emphasizes how policy text “performs important symbolic functions” (p. 1302) in an effort to comfort anxious stakeholders. In reality, though, faculty often feel alienated through COI management processes (Lipton et al., 2004). For example, Lipton et al. found that many researchers believe that only researchers with active financial industry ties should be obligated to know the details of their institution’s COIP. In a survey of hundreds of faculty across multiple campuses of the University of California, Lipton et al. (2004) obtained results regarding attitudes toward COIP in 10 departments that reported more financial conflict disclosures than others. Findings show that faculty members have complex, contradictory feelings about university-industry relationships. Most view campus policies as irrelevant, and some expressed anger over the process of policy implementation. Although departmental comparisons were not part of the Lipton et al. (2004) analysis, it could be that such attitudes might differ across researchers from different disciplines. In the following section we discuss theoretical reasons for investigating disciplinary differences in the COIP process and offer our hypotheses and research question that guided the analysis.

**Theoretical Framework**

Structurating activity theory (SAT; Canary, 2010b) provides a robust theoretical framework for examining differences in policy perspectives and policy communication processes. SAT integrates broad social constructs from structuration theory (Giddens, 1984) with system-specific constructs of cultural-historical activity theory (Engeström, 1999). Developed to explain
cross-system policy processes at multiple levels, SAT proposes that organizational members, and non-members, function in inter-related activity systems throughout policy processes. These systems are collectivities of people, practices, and resources that orient toward an object over time, such as developing a particular type of technology or educating a particular set of students. Broad social structures of signification (involving meaning), legitimation (involving norms), and domination (involving authority over people and resources) both enable and constrain activity accomplishment. At the same time, system-specific elements of subjects (particular people), rules (norms), community (all members of the system), material and symbolic mediating resources (e.g., tools and language), and division of labor (authoritative and task-related) shape (or mediate, according to SAT) how activity is accomplished and, as a result, influence eventual outcomes.

Key propositions of SAT indicate its appropriateness for this study. In particular, proposition two of the theory states, “Elements of systems of ongoing activity mediate situated action and interaction, such that system elements shape how and what policy knowledge is constructed within and between activity systems” (Canary, 2010b, p. 34). This study both applies and tests proposition two by focusing on conflict of interest policy processes in different disciplinary activity systems. Because a university includes many intersecting activity systems, each with their unique blend of people, practices, and resources oriented around discipline-specific objects as well as institution-wide goals, proposition five also guides this study: “Policy knowledge constructed between systems is mediated by elements of intersecting activity systems” (Canary, 2010b, p. 37).

Previous research applying SAT in policy contexts has demonstrated ways in which communication is central to developing knowledge and attitudes about policies (e.g., Canary & McPhee, 2009; Canary, Riforgiate, & Montoya, 2013). SAT-based research has also indicated ways in which policy-related systems can differ in their policy communication processes, knowledge development, and accordingly in their policy-related outcomes (Canary, 2010a). Additionally, prior studies indicate that broad structures such as the legitimation of policy to structure practice and the authority of experts are reproduced through policy interpretation and implementation (Canary & McPhee, 2009). In the context of institutional conflict of interest policy, then, we would anticipate that different academic disciplinary activity systems would have different policy communication processes that might result in differing levels of policy knowledge and varying attitudes toward the conflict of interest policy. The explanatory mechanism for these differences would be different mediating elements that shape activity in different disciplinary activity systems.

Furthermore, different activity systems might have various logics for deciding what constitutes good or bad, right or wrong behavior, known as ethical climates (Victor & Cullen, 1988). These climates would shape activity accomplishment as part of the rules of activity systems, guiding what is viewed as normative for how to accomplish activity. Prior research has identified five primary ethical climates that exist to varying degrees in different organizations and professions (Martin & Cullen, 2006): (1) caring climate emphasizes considering what is best for others in the organization, what is best for the overall organization, and what is best for the customer or public; (2) law and code climate emphasizes obeying laws or following professional standards; (3) rules climate emphasizes organization-specific rules and procedures as guidelines for behavior and decisions; (4) instrumental climate emphasizes both protecting one’s own personal interests over others’ as well as protecting interests of the organization above other considerations; and
independence climate emphasizes members relying on their own personal morals and ethics to guide behavior and decisions (Victor & Cullen, 1988). Although prior SAT-based research has not investigated ethical climates as a type of system rule, this study extends SAT by examining how norms for ethical conduct might differ across different disciplinary activity systems and accordingly shape how members of different activity systems communicate about the conflict of interest policy as well as their policy knowledge and attitudes.

One way to operationalize activity systems in a research setting such as a university is to divide disciplines by those orienting around health sciences, such as oncology, and those orienting around non-health sciences, such as engineering. Although this is a broad conceptualization of activity systems, health sciences are focused on discovery and innovations involving patients or health outcomes whereas non-health sciences are focused on discovery and innovations not necessarily related specifically to people or to health. Accordingly, participants as well as other system elements may lead to different perceptions about and processes related to conflict of interest policies. The following hypotheses are posed to test SAT propositions about activity system differences. Due to the lack of prior research on ethical climates from an SAT perspective, we also pose a research question to examine the role of ethical climates in these different disciplinary activity systems.

Hypotheses and Research Question

H1: Disciplinary differences exist for COIP communication.
H2: Disciplinary differences exist for COIP knowledge.
H3: Disciplinary differences exist for COIP attitudes.
RQ1: How are ethical climates associated with policy communication, knowledge, and attitudes?

Method

The current quantitative study is part of an ongoing longitudinal program evaluation and process improvement project concerning COIP procedures at a large research university in the western region of the United States. The current study involved an online survey distributed through the university’s email system to researchers identified as belonging to departments with more than four individuals who disclosed external financial relationships as recorded in the university’s research administration system. The online survey was anonymous, with reminder emails sent twice to the entire sampling frame to improve response rates. As an incentive to participate, participants could enter a drawing for one of five $100 gift cards by going to a separate website, if they chose.

Participants

Recruitment emails were sent to faculty, graduate students, and post-doctoral researchers in 51 academic departments, with 3,016 researchers in the sampling frame. After the initial email invitation and two reminder emails sent at two-week intervals, 249 participants completed at least some portion of the online survey. After removing three cases that only included demographic responses, the final sample was 246 participants.

There were 142 participants from health sciences disciplines and 84 participants from non-health sciences disciplines (20 participants did not report departmental affiliation). Several positions
were represented in the sample, including professors \((n = 60)\), associate professors \((n = 26)\), assistant professor \((n = 36)\), physician \((n = 26)\), clinical professor \((n = 5)\), post-doctoral researcher \((n = 14)\), graduate assistant \((n = 48)\), adjunct associate professor \((n = 4)\), adjunct professor \((n = 1)\), and other \((n = 6)\). Participants reported various lengths of time at the university: 0-5 years, \(n = 92\); 6-10 years, \(n = 55\); 11-15 years, \(n = 29\); 16-20 years, \(n = 16\); more than 20 years, \(n = 46\); missing, \(n = 8\). A majority of participants indicated they had received COI training in the past \((n = 139)\), while 56 reported not having COI training and 41 participants did not know if they had COI training or not. Most participants reported working with the Office of Sponsored Projects \((n = 146)\). A total of 46.3% of participants reported conducting human subjects research \((n = 114)\) and 50% reported that they do not conduct human subjects research \((n = 123)\). A majority of participants \((n = 152)\) reported that they do not have a COI managed by the COI office, whereas 69 participants indicated they are currently managed for COI and 18 participants indicated they do not know. Most participants reported English is their native language \((n = 196)\) and most participants were male \((n = 169)\), with 62 female participants, 1 transgender, and 14 not responding.

**Measures**

**Policy communication.** The Policy Communication Index (PCI; Canary, Riforgiate, & Montoya, 2013) was used to measure five communication processes and an overall indicator of frequency of policy communication. At the request of the institution’s COI committee, one additional context-specific item was added concerning communication: “I get written instructions about the COI policy from other in-department staff.” The PCI includes 20 items with Likert-type response choices ranging from 1 (“never”) to 5 (“very often”). The PCI includes five subscales: meeting discussions (Cronbach’s \(\alpha = .91\)), human resources communication (Cronbach’s \(\alpha = .72\)), coworker interactions (Cronbach’s \(\alpha = .88\)), supervisor/coworker written instructions (Cronbach’s \(\alpha = .85\)), and personal expressions (Cronbach’s \(\alpha = .88\)). For this study, wording of items for the human resources communication sub-scale were changed to reflect research administration staff rather than human resources staff so results of this sub-scale are interpreted as “Research Administration Communication.” With the additional requested item, there were 21 items used to measure policy communication.

**Policy knowledge.** Policy knowledge was measured in three ways. An eight-item Likert-type measure of self-reported policy knowledge used in previous research (Canary et al., 2013) measured participants’ perceptions of their knowledge about the COIP. Participants rated statements on a 1-5 scale ranging from “strongly disagree” (1) to “strongly agree” (5). This measure demonstrated high reliability (Cronbach’s \(\alpha = .90\)). We also developed six study-specific items to measure participants’ knowledge about the purpose of the COIP, which consisted of participants discriminating between statements that do and do not apply to the COIP. This was a summed score of their correct answers. Six additional items were developed to measure participants’ knowledge of the scope of the COIP, also measured by summing participants’ correct answers.

**Policy attitudes.** Policy attitudes were measured with seven Likert-type items used in previous policy research (Canary et al., 2013). Responses range from 1 (“strongly disagree”) to 5 (“strongly agree”), with higher scores indicating more favorable attitudes toward the focal policy. This measure demonstrated acceptable reliability, Cronbach’s \(\alpha = .83\).
Ethical climate. The Ethical Climate Questionnaire (ECQ; Victor & Cullen, 1988) was used to measure perceptions of how decisions and actions are determined to be right or wrong, desirable or undesirable, good or bad, within the whole university. There are 26 Likert-type items in the ECQ that identify five distinct types of ethical climates: caring (Cronbach’s \( \alpha = .76 \)), law and code (Cronbach’s \( \alpha = .81 \)), rules (Cronbach’s \( \alpha = .76 \)), instrumental (Cronbach’s \( \alpha = .83 \)), and independence (Cronbach’s \( \alpha = .73 \)). Responses range from 1 (“completely false”) to 6 (“completely true”).

Data Analysis

Independent samples \( t \)-tests were used to test for group differences predicted in Hypotheses 1, 2, and 3. The Research Question was answered by first conducting an independent samples \( t \)-test to assess group differences in ethical climates. Then, a Pearson’s correlation analysis was used to analyze associations among variables.

Results

Policy Communication

Hypothesis 1 predicted that there would be disciplinary differences in conflict of interest policy communication. Hypothesis 1 was supported. Results are reported for the overall PCI scores as well as for the five constitutive sub-scales. Table 1 presents statistical results for tests of Hypotheses 1, 2, and 3.

Table 1. Group Means for Policy Communication, Knowledge, and Attitudes

<table>
<thead>
<tr>
<th>Variable</th>
<th>Health Sciences ((n = 142)) Mean (SD)</th>
<th>Non-Health Sciences ((n = 84)) Mean (SD)</th>
<th>( t ) statistic (significance)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCI</td>
<td>2.18 (.73)</td>
<td>1.86 (.59)</td>
<td>3.60 ((p &lt; .001))</td>
</tr>
<tr>
<td>MEET</td>
<td>1.94 (.74)</td>
<td>1.73 (.73)</td>
<td>2.00 ((p &lt; .05))</td>
</tr>
<tr>
<td>HRCOM (Research Admin)</td>
<td>2.51 (.81)</td>
<td>2.19 (.71)</td>
<td>2.98 ((p &lt; .01))</td>
</tr>
<tr>
<td>COWORKER</td>
<td>2.12 (.94)</td>
<td>1.79 (.74)</td>
<td>2.87 ((p &lt; .01))</td>
</tr>
<tr>
<td>WRITTEN INST</td>
<td>2.27 (.90)</td>
<td>1.95 (.85)</td>
<td>2.57 ((p &lt; .05))</td>
</tr>
<tr>
<td>PERS EXP</td>
<td>2.04 (.94)</td>
<td>1.62 (.81)</td>
<td>3.39 ((p &lt; .001))</td>
</tr>
<tr>
<td>SELF REPORT KNOW</td>
<td>3.61 (.72)</td>
<td>3.33 (.91)</td>
<td>2.44 ((p &lt; .05))</td>
</tr>
<tr>
<td>KNOW SCOPE</td>
<td>3.25 (.89)</td>
<td>3.25 (1.12)</td>
<td>.03 ((n. s.))</td>
</tr>
<tr>
<td>KNOW PURP</td>
<td>4.11 (1.02)</td>
<td>4.04 (1.06)</td>
<td>.54 ((n. s.))</td>
</tr>
<tr>
<td>ATTITUDE</td>
<td>3.70 (.63)</td>
<td>3.67 (.62)</td>
<td>.34 ((n. s.))</td>
</tr>
</tbody>
</table>
Policy Communication Index. Equality of variances was found to be violated for the PCI, $F(1, 218) = 4.14, p = .043$. Owing to this violated assumption, we used a $t$ statistic not assuming homogeneity of variance. The $t$-test revealed that health sciences participants ($n = 137$) reported higher levels of overall policy communication ($M = 2.18, SD = .73$) than non-health sciences participants ($n = 83; M = 1.86, SD = .59$), $t(218) = 3.60, p < .001$.

Meeting Communication. Health sciences participants reported significantly more meeting communication about the COIP ($M = 1.94, SD = .74$) than non-health sciences participants ($M = 1.73, SD = .73$), $t(218) = 2.00, p < .05$.

Research Administration Communication. Health sciences participants reported significantly more communication from research administration staff ($M = 2.51, SD = .81$) than non-health sciences participants ($M = 2.19, SD = .71$), $t(218) = 2.98, p < .01$.

Coworker Interactions. Equality of variances was found to be violated for this sub-scale, $F(1, 203) = 4.45, p = .036$. Owing to this violated assumption, a $t$ statistic not assuming homogeneity of variance was computed. The $t$-test revealed that health sciences participants reported more coworker interactions about the COIP ($M = 2.12, SD = .94$) than non-health sciences participants ($M = 1.79, SD = .74$), $t(203) = 2.87, p < .01$.

Written Instructions. Health sciences participants reported significantly higher levels of written instructions about the COIP ($M = 2.27, SD = .90$) than non-health sciences participants ($M = 1.95, SD = .85$), $t(218) = 2.57, p < .05$.

Personal Expressions. Health sciences participants reported significantly more personal expressions about the COIP ($M = 2.04, SD = .94$) than non-health sciences participants ($M = 1.62, SD = .81$), $t(217) = 3.39, p = .001$.

Policy Knowledge

Hypothesis 2 predicted that differences would exist between groups for COIP knowledge. Hypothesis 2 was partially supported. We report results for the three knowledge measures separately.

Self-Reported Knowledge. Equality of variances was found to be violated for self-reported knowledge, $F(1, 145) = 9.11, p = .003$. Owing to this violated assumption, a $t$ statistic not assuming homogeneity of variance was computed. The $t$-test revealed that health sciences participants reported higher levels of perceived policy knowledge ($M = 3.61, SD = .72$) than non-health sciences participants ($M = 3.33, SD = .91$), $t(145) = 2.44, p < .05$.

Knowledge of Policy Scope. There were no significant group differences for knowledge of the COIP scope (see Table 1).

Knowledge of Policy Purpose. There were no significant group differences for knowledge of the COIP purpose (see Table 1).
Policy Attitudes

Hypothesis 3 predicted that differences would exist between groups for COIP attitudes. No significant attitudinal difference was found between health sciences and non-health sciences researchers for attitudes toward the COIP (see Table 1). Hypothesis 3 was not supported.

Ethical Climates and Policy Variables

The research question asked about associations between ethical climates and policy communication, knowledge, and attitudes. First, group differences were explored to examine whether ethical climates differed across disciplines in similar ways to policy communication and knowledge. Two significant group differences emerged. Health sciences participants indicated stronger perceptions of the law and code climate ($M = 4.83$, $SD = 72$) than non-health sciences participants ($M = 4.51$, $SD = .83$), $t (214) = 3.01$, $p < .01$. This climate is characterized by decisions that are guided by laws and professional codes of conduct (Victor & Cullen, 1988). Health sciences participants also indicated stronger perceptions of the rules climate ($M = 4.40$, $SD = .77$) than non-health sciences participants ($M = 4.17$, $SD = .79$), $t (215) = 2.11$, $p < .05$. This climate is characterized by decisions that are guided by organization-specific rules and procedures.

Next, a Pearson correlational analysis was conducted to explore how the five ethical climates associate with policy communication, knowledge, and attitudes variables. Table 2 presents the correlation matrix for ethical climate and policy communication variables. Table 3 presents the correlation matrix for ethical climate, knowledge, and attitude variables.

Table 2. Correlations, Ethical Climates and Policy Communication

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Note: ** Correlation is significant at the .001 level (2-tailed); * Correlation is significant at the .01 level (2-tailed).
The overall index for policy communication, PCI, was positively and significantly correlated with all five ethical climates (Table 2). More specifically, meeting communication and coworker interactions were positively and significantly correlated with all five ethical climates (Table 2). The law and code as well as rules climates were the only two climates not positively correlated with personal expressions at a significant level. In a similar vein, the instrumental and independence climates were the only two climates not positively correlated with human resources (research administration) communication at a significant level. We discuss implications of this set of results in the Discussion section.

Measures of policy purpose and scope were not positively correlated with any ethical climate at a significant level (Table 3). However, both purpose and scope knowledge were negatively correlated with the caring climate \( (r = -.15 \text{ and } r = -.13, \text{ respectively}) \) and purpose knowledge was also negatively correlated with the instrumental climate \( (r = -.19) \). Perhaps predictably, the law and code as well as rules climates were positively correlated with the self-report measure of policy knowledge at a significant level \( (r = .14 \text{ and } r = .15, \text{ respectively}) \), although no other climates significantly correlated with that measure. Those two climates also positively correlated with policy attitudes at significant levels \( (r = .18 \text{ and } r = .19, \text{ respectively}) \). The instrumental climate (with an emphasis on protecting one’s own interests and those of the organization) negatively correlated with policy attitudes at a significant level \( (r = -.26) \).

**Discussion**

The goal of this study was to build on previous COIP research by theoretically investigating policy communication, knowledge, and attitudes across disciplines. Previous studies of researcher attitudes toward COIP have not examined the nuances of different ways the policy
is communicated nor different types of knowledge researchers have concerning the policy. By conceptualizing health sciences and non-health sciences as distinct activity systems, this investigation also considered how different ethical climates of researchers’ disciplinary systems might associate with their policy communication, knowledge, and attitudes. There are several important implications for COI policy research and research administration practices. These are discussed below, followed by a discussion of study limitations and suggestions for future research.

Although it was hypothesized that group differences exist for COI policy communication, knowledge, and attitudes, the most compelling differences clearly emerged for communication processes. Health sciences researchers indicated that they communicated more about the COIP in all five modes than non-health sciences researchers. One explanation for this may be that health sciences researchers as a whole tend to have more interaction with industry in the form of sponsored research and external relationships such as consulting and speaking engagements. Therefore, health sciences researchers are required to engage with the policy more often. Indeed, significantly more health sciences participants than non-health sciences participants reported having significant external financial relationships ($\chi^2 = 9.61, p < .05$) and significantly more health sciences participants than non-health sciences participants reported having COIs managed by the university ($\chi^2 = 7.70, p < .05$).

It is important to note, however, that the amount of communication for both groups was low, with health sciences participants only meeting the mid-point for research administration communication. All other methods for communicating policy were below the mid-point on the five-point scale. This could be due to the fact that the COIP is not something researchers deal with on a daily basis. This finding does comport with other research about organizational communication concerning national-level policies (Canary et al., 2013), indicating that policy communication by its very nature may simply be a low-frequency occurrence in organizations.

Another interesting finding regarding policy communication and attitudes emerged during correlational analyses. Although not hypothesized in this study, policy attitudes were negatively correlated with coworker interactions ($r = -.15, p < .05$). This finding is consistent with results of the Canary et al. (2013) study that used the federal Family and Medical Leave Act (FMLA) as the focal policy. Results of these two studies may be pointing to a characteristic of coworker interactions about policies in general, that such informal interactions may foster negativity toward policies that are implemented from upper administration or external authorities. It seems, however, that communication with administrators who are able to interpret and provide guidance on policies, such as human resources or research administration staff members, has the opposite effect. In the current study, policy attitudes positively correlated with research administration communication ($r = .14, p < .05$). This is similar to the Canary et al. (2013) study that found positive correlations between policy attitudes and human resources communication about the FMLA.

This study also contributes to understanding how different disciplines view guidelines for behavior and decision making within the same institution. Participants were asked to respond to the ethical climate questions based on their perceptions of the way things are at their institution, not their particular department or school. As such, it is not surprising that no group differences emerged for three of the five ethical climates. However, researchers associated with the health
sciences identified stronger climates characterized by following laws, professional codes, and institutional rules than non-health sciences researchers. This finding helps shed light on the higher communication scores for the health sciences participants. It could be that the higher frequency of communicating about the COI policy produces perceptions that actions and decisions within the broader organization are governed more by laws, policies, and procedures than by personal moral codes or concern for the greater good.

Results for how ethical climates associate with policy communication, knowledge, and attitudes also have implications for theory, research, and research administration practice. This is the first study to investigate associations between ethical climates and policy processes. We highlight here the more intriguing results that warrant further empirical attention. One such finding is the lack of significant correlation between personal expressions communication and the two climates most strongly associated with health sciences participants—law and code and rules climates. The other three climates (i.e., caring, instrumental, and independence) all positively correlated with participants sharing their personal expressions about the COI policy. This could point to a hesitancy for people to share personal opinions about policy that they perceive is out of their control or somehow a blanket mandate, which in turn might reflect a broader perception that their work activities are governed more by laws, codes, and procedures than by their individual agency. This conjecture is further supported by the lack of positive correlation between research administration communication and the instrumental and independence climates. With the strong association between this type of communication and policy attitudes, this result might point to a reproduction of a negative view of externally-mandated policies when people perceive that their work is more guided by their own morals and interests than those of other stakeholders or higher authorities. Indeed, the instrumental climate is the only climate to have a significant negative correlation with policy attitudes. Such negative attitudes might be counteracted with more active research administration communication to dispel misperceptions about the policy and its related procedures, discussing ways the COI policy has researchers’ best interests in mind as well as the interests of the institution, patients, and the public.

SAT was used to guide this study due to its practical focus as well as its explanatory utility. Particular interest was in applying and testing the two propositions asserting that policy knowledge processes are shaped by elements of intersecting activity systems. Results provide some support for these propositions, although the null findings regarding differences in certain types of policy knowledge and in policy attitudes temper our support for these assertions. Overall, however, it seems an SAT explanation for differences between health sciences and non-health sciences researchers increases our understanding of COIP processes in complex research organizations, such as universities, in several ways. One contribution of our SAT-based analysis is that disciplinary activity systems orienting toward different objects (i.e., patients and health versus other research foci) engage with the COIP at different rates and in different ways. Those involved in health sciences are much more likely to come into contact with compliance procedures of the COIP simply due to the higher rates with which such researchers engage with industry in the research process. Accordingly, their communication frequency about the policy and their level of perceived knowledge about the policy are much higher than those who do not come into contact with the ins-and-outs of the policy as often. This supports the view that system elements, such as
norms for doing research, the object of activity, their mediating resources for conducting research, and such shape policy communication and policy knowledge.

A second contribution of an SAT perspective on the COIP process is to consider the structurating aspect of policy communication. That is, SAT asserts that policy knowledge processes within and across activity systems are constrained and enabled by broader social structures, such as professional norms, societal expectations concerning authority, and meanings assigned to phrases such as “conflict of interest” (Canary, 2010b). At the same time, proposition six of SAT asserts that policy knowledge in turn “produces, reproduces, or transforms social structure” (Canary, 2010b, p. 37). Although the current study was cross-sectional, and therefore limited to analyzing a point in time, these findings may be a spring board for future studies of how communication, knowledge, and attitudes of COI policies serve to reproduce entrenched institutional or disciplinary structures or serve as opportunities to begin transforming structures that have constrained productive COI policy processes across intersecting activity systems. For example, policy attitudes were higher than expected for both groups, with a sample mean of 3.65 on a five-point scale. This information could be used to tailor COI communication to capitalize on the positive perceptions of the policy in general and focus communication efforts at ways researchers might perceive the policy procedures to be misaligned with their system norms and overall activities. In this way, policy communication could be a way to transform negative connotations of “conflict of interest” as well as a way to reconcile perceptions that authoritative structures of policy requirements contradict professional structures of research activities.

Another way an SAT-based interpretation of results contributes to COIP research and practices is by using activity systems as a way to explain the interplay of ethical climates and policy communication, knowledge, and attitudes. When planning how to communicate about the policy with researchers in various disciplinary systems, research administrators can use findings from this study to consider how to adjust their communication tactics to account for different ethical climates. For instance, when addressing researchers in non-health science disciplines who might be guided more by their own morals (“independence climate”) or by the common good (“caring climate”) rather than by an overall concern for laws and codes, research administrators might highlight that a COIP helps researchers demonstrate their integrity clearly and publicly and that COIP procedures are meant to protect all parties involved. Additionally, case studies and examples from researchers’ own disciplines would be excellent tools for increasing knowledge about COI as well as improving attitudes about engaging with policy procedures. Thus, researchers will be able to align their own system norms, resources, and purposes with those of research administration generally and with the COIP more specifically.

**Limitations and Suggestions for Future Research**

Although the findings discussed above shed light on nuances of COI policy process and perceptions, there are limitations to the current study. First, this study was conducted at one institution rather than several. Accordingly, group comparisons and measures of variables are limited in their generalizability. Future research can build upon these findings by replicating this study design across multiple institutions. Second, the sample was limited in size. We had hoped to compare group differences at the level of different departments but the response rate
was too low to enable such fine-grained analysis. A follow-up study is in the planning stages that will incorporate changes in the recruitment process to increase response rates. Future researchers interested in obtaining participation by busy researchers may consider creative alternatives to increase participation.

Future research will build upon this study by studying multiple institutions with larger sample sizes. It is important to continue finding ways to improve COI processes and perceptions. Qualitative inquiries might enrich results of this study by seeking open-ended answers to questions about COI policy procedures and perceptions. Such qualitative endeavors might identify ways research administrators can improve policy attitudes, increase policy knowledge, and leverage policy communication efforts to benefit their institutions and multiple stakeholders.

**Conclusion**

To conclude, this study presents a snapshot of how researchers in a large research university perceive, understand, and communicate about their institution’s conflict of interest policy. Furthermore, analyses shed light on how perceptions of ethical climates of the university associate with policy attitudes, knowledge, and communication in different disciplinary activity systems. This theoretically-grounded analysis provides a springboard for further empirical research about how researchers engage with conflict of interest policies. Research administrators can use this study as a template for assessments at their own institutions and research organizations as part of program evaluation and process improvement. Additionally, results of this study suggest ways research administrators can connect with researchers in meaningful ways to make COI training and procedures more effective overall.

**Endnotes**

1ProPublica’s data do not account for all industry payments, and the data sets include all physicians, not just university-affiliated physicians.

2The data are based only on those university technology transfer offices that report to the Association of University Technology Managers.
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