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## Expectation-based Efficiency and Quality Improvements in Research Administration: Multi-Institutional Case Studies
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EDITOR’S PREFACE

As we end one year and begin another, we once again find ourselves taking stock and making plans. In our Fall/Winter 2011 edition of the Research Management Review you will find some information that I believe will be quite useful to you as you engage in that process. Metrics, quality improvement, large project management, and grantsmanship comprise the major topics of this issue.

In the ever-changing world of research administration we are always striving to improve processes and further develop the proficiency of ourselves and others in the research community. Questions we may ask are: How do we motivate for improvement? How do we know if we are making progress? Dhanonjoy Saha and Shailaja Hanumandla present a very interesting model for improving the quality of research administration through expectation and measurement. This model is a commonsense tool that can be adapted to your own research environment as you consider making improvements to your research service infrastructure.

Two case studies are offered which outline how quality improvement efforts were implemented at the Mayo Clinic and at the Medical University of South Carolina (MUSC). Steven Smith and Darren Gronseth describe the key action steps taken to improve the quality of broad research management systems at the Mayo Clinic. Julia Glenn, a recent Master of Research Administration graduate from MUSC, and Royce Sampson report on an NIH-funded initiative to develop an institution-wide web-based research budgeting and billing compliance tool. Their article outlines the steps taken to bring this electronic system from concept to reality. These articles inform the research administration community about the unique efforts of these two institutions while giving an overview of what should be considered, whether implementing wide-scale change or focusing on a single process improvement.

The importance of quality management of large-scale research projects is addressed by Sharlissa Moore and R. F. Shangraw. As we see more large projects with budgets of over $5 million in tandem with an environment of greater scrutiny and concern about the return on investment of federal dollars, it is more important than ever that the scope of work of these high-profile projects be accomplished on time and within budget. This article addresses the role played by high-quality research managers. Important considerations for any institution with or planning to apply for large project funding are discussed.

Grantsmanship is an ongoing topic in research administration. How can we improve our own grantsmanship skills or those of the investigators we serve? We have two articles that I encourage everyone to read and share with your investigators. Robert Porter gives some great ideas for creating a proposal that will create a
positive first impression with grant reviewers. This article is followed by Jeremy Miner’s treatment of important considerations for that second impression—responding to the grant reviewer. Our final offering on grantsmanship and peer review comes from Nancy Bell, who has written a short media review on the new NIH Peer Review video. This video can be used as a training tool for investigators or research administration colleagues who want to know more about the review process.

Some of us may have resolved that during the New Year we will facilitate improvement by creating a structured research administration training program for those with whom we work, or just do some professional development reading on our own. Managing Research, Development, and Innovation: Managing the Unmanageable is reviewed by Jo Ann Smith. After reading her review, you can better decide if this should be on your reading list in 2012.

As editor, it is my hope that you find the contents of every issue of Research Management Review to be useful to you in your own quest for professional excellence and self-improvement. Reading these articles has expanded my own research administration knowledge base, so I am confident you will find the time you invest in reading these articles to be well spent.

Finally, for their tireless efforts in expanding the body of knowledge for the profession of research administration, I thank the contributing authors, members of the RMR Editorial Board, and NCURA.

May 2012 bring blessings to you all!

Sincerely,

Jennifer Shambrook, Ph.D.
Editor, Research Management Review

April 5, 2012
LETTORS TO THE EDITOR

MAY BE INEXPENSIVE BUT WITH A BIG RETURN!

Reading Robert Porter’s article, “More Paper Out the Door: Ten Inexpensive Ways to Stimulate Proposal Development” (RMR 19: 64–73 [2011], I was impressed with his eloquent argument for working with investigators in what has been called “pre-pre award” or proposal development. His ten inexpensive ways, neatly summarized in a table, can (and should) be carried out in any type of institution that wants to increase its grant productivity and awards. Too often, however, universities do not offer such services or offer only a few, citing lack of staff, lack of faculty interest or participation, or a belief that such activity should be conducted at the departmental level. I would argue that this support not only should become part of the central grants function but should be expanded, in ways I will address below.

Those of us who have been working in proposal development long before the recent interest that he cites can document the success of such initiatives. For example, he writes that home-grown grant workshops have the advantage of being tailored to “the specialized needs of academic researchers” and consequently are “likely to yield positive returns at a much lower cost” than external grant writing workshops or those offered by consultants.

Let me offer a few examples from my own experience to reinforce that idea. For the last five years I have presented a workshop on preparing NSF CAREER grant applications, a program that is targeted at junior faculty on the tenure track. These are very prestigious but highly competitive grants that essentially support a faculty member through tenure. Our STEM faculty members have enthusiastically embraced the workshops, resulting in a marked increase in the number, quality, and success rate of these proposals. However, we reinforce the strategies offered in the workshop with individualized follow-up, including telephone calls, e-mails, appointments, and multiple readings of drafts.

At a previous university I developed a workshop on “Strategies for Effective
Fellowship Applications,” targeted to faculty in the humanities, education, and social sciences, who typically apply for fellowships to supplement sabbaticals or to conduct research leading to books or monographs. For these disciplines there are few large-scale research opportunities; fellowships provide necessary time away from teaching, research travel, and sometimes a research assistant.

However, fellowships are very competitive and usually are awarded directly to the individual. Consequently, many universities do not count fellowships in their research awards and provide little or no support for developing strong applications since the university does not submit the proposal and does not directly benefit from the award.

In these workshops, faculty members were encouraged and motivated to apply for very prestigious fellowships; again, these efforts met with great success. Our grants office also provided the same services for these individual grants that we did for those submitted by the institution, including advice, editing, and, in some cases, copying and mailing the applications. I maintain that these actions should be included in proposal development and research support if an institution really wants to grow its grant activity and support faculty research across all disciplines, not just those that yield large grant awards that provide indirect costs.

Another inexpensive but highly effective service is to help new faculty develop individual strategic funding plans. Many new faculty members, especially in STEM disciplines, spend the first year building a lab—a very time-consuming and unfamiliar experience. As graduate students they may have participated in their advisor’s grant proposals, but few of them are prepared to write their own research applications. They also may not realize that they need to begin with small grants before a funding agency is willing to invest in them for three to five years.

An individual strategic plan, laid out for their first three years, helps them think through a succession of grants, beginning small and working toward the National Institutes of Health (NIH) R01 or the National Science Foundation (NSF) three- or four-year project. All it takes is one meeting, using a prepared template and a well-informed research administrator who knows the grants and deadlines in that academic field. Regular follow-up communication from a research administrator also reinforces the timeline and the available support services. A status meeting at the end of the second academic year offers a good opportunity to review progress, make adjustments to the plan, and
motivate the faculty member to continue to develop research proposals.

Yes, such efforts are labor-intensive, but as Dr. Porter notes in the section on Coaching and Editing, “the need for assistance tails off rapidly once the researcher catches on.” Time and labor invested in young faculty will pay off for years to come, building an early set of best practices and, even more important, confidence in their ability to apply successfully for grants throughout their academic career.

Marjorie Piechowski
University of Wisconsin-Milwaukee
Expectation-based Efficiency and Quality Improvements in Research Administration: Multi-institutional Case Studies

Dhanonjoy C. Saha, Abrar Ahmed, and Shailaja Hanumandla
Cannon Research Center, Carolinas HealthCare System, and the University of North Carolina

ABSTRACT

Conventional wisdom may support the presumed notion that higher expectations increase efficiency and improve quality. However, this claim may only be validated when workers are equipped with appropriate tools, training, and a conducive work environment. This study implements various interventions, observes outcomes, and analyzes data collected in three different institutions between 2003 and 2010. To increase efficiency and improve quality in research administration, an “open-expectation,” outcome-based efficiency (application review turn-around, operating costs), and quality (compliance error rate) improvement initiative was taken and data collected. Before initiation and during the observation and data collection, the stakeholders were consulted, tools generated, employees trained, conducive work environments created, and expectations clearly communicated to employees. Analyses of the data showed that implementation of the initiative with an expectation of improvement resulted in improved employee efficiency and quality of their work, resulting in improved financial performance of the operating units studied.
INTRODUCTION

Research and development are essential factors in maintaining U.S. leadership in providing high-quality education, healthcare, and quality-of-life. Research and development aid the country in maintaining its economic strength and technological global leadership and are critical to expanding its knowledge base. They play an important role in driving improvements to advance social and economic power (Green & Langley, 2009). In addition to education, research has become a core mission of many academic health centers and universities—research is now considered a major pillar of their excellence.

Every year, the U.S. spends around 2.6% of its total Gross Domestic Product (GDP) on research and development. In 2010, the total research and development expenditure reached approximately $147.5 billion (National Science Foundation, 2011). Due to this sizable investment in research, understanding the system as well as managing and improving research activities became essential (Kirby, 1996). In recent years, the federal government has imposed stringent accountability standards in order to monitor appropriate utilization of research grant funds, both domestically and internationally. Therefore, it is important that institutions and universities alike conduct research activities with adherence to compliance, economic, and financial guidelines and regulations, if they wish to operate their research enterprise successfully both locally and internationally.

During the past two decades, significant changes have occurred in research and its operations in most western countries. As interest in research has grown among politicians and citizens, more emphasis has been placed on the practical value of research and effective utilization of limited funds. As research and development further expand in the competitive global market, an even greater emphasis is placed on the effective use of limited resources and resultant outcomes (Decker et al., 2007; Orszag & Holdren, 2010; Rockwell, 2009). Therefore, a new approach to research administration and management has become necessary in order to successfully navigate a rapidly changing research climate (Erno-Kjolhede, 2001).

Research administration is a dynamic discipline involving a variety of processes in the delivery of research excellence. The discipline operates as a complex vehicle in carrying out research strategy formation, grant application preparation, awards negotiation and management, compliance implementation, research publication, knowledge transfer, and research product commercialization. However, the activities imposed upon or expected from research administrators and managers are growing
and seem to be endless (Green & Langley, 2009). Therefore, research administrators must seek new and fresh approaches to managing the multidisciplinary system, which services employees and organizes the delivery of new research knowledge, services, and products. Concurrently, the system must also interface with state, federal, and private sponsors, the academic community, and research personnel, and aid the local and national environments in the delivery of the research product (Kirby, 1996).

“As research and development further expand in the competitive global market, an even greater emphasis is placed on the effective use of limited resources and resultant outcomes . . . .”

Traversing the heavily regulated landscape is not an easy task for research institutions and universities. The government is increasingly scrutinizing universities, expecting measurable returns on its investment and demanding greater transparency. As research regulations and compliance requirements increase and local, state, and federal funding decreases, research institutions and universities are faced with greater challenges as they seek to compensate for negative effects on their overall environments and increased operating costs. Therefore, it is imperative that research administrators assess the efficiency and quality of the research programs they administer. In the current economic climate, without new strategies and effective management tools, it will be challenging to continue with current programs, to grow new ones, or to gain further financial support. Furthermore, it has been suggested that a system be established that is both efficient and flexible in meeting the changing demands of a competitive academic and global-research environment. A vision to improve the quality and efficiency of research has been a high priority for many universities as administrators emphasize research strategy development and set strategic objectives within their respective institutions (Green & Langley, 2009).

A variety of approaches have been implemented at various institutions to improve the efficiency and quality of research. These include institution-wide reviews, management restructuring, business process re-engineering, and process and technology improvements (Fowler et al., 2011; Frolick & Ariyachandra, 2006). Anecdotal evidence suggests that several universities have utilized other methods, such as the Lean Method, Six-sigma, and Business Process Management. However, there is scant evidence in the literature on the impact of efficiency and quality improvement initiatives utilizing these methods in research administration.
(Green & Langley, 2009; Stapleton et al., 2009). Nonetheless, in several national surveys, performance variables such as financial and organizational policies, procedures, and operational efficiency outcomes on a higher level, based on full-time equivalents (FTEs), were reported (Kirby & Waugaman, 2001, 2005). The results of a recent study on some performance and compliance metrics have been reported, implying the need for efficiency and quality improvement initiatives and their impact on research administration (Smith & Chen, 2011). Therefore, we undertook this project to gather information and provide interventions with expectations to improve efficiency and quality in research administration. It has been reported that higher expectations increase scholarly productivity (Anema & Byrd, 1991; Whorley & Addis, 2007) and that implementation of personal developmental strategies may increase efficiency in workplaces (Saha, 2004). We wished to examine whether these approaches would be applicable to research administration. Therefore, the purpose of this study was to examine expectation-based efficiency and quality improvement in research administration and to determine whether these processes affect the financial performance of units adapting this method.

MATERIAL AND METHODS

The main goal of the case study was to measure the efficiency and quality of work in research administration. The case studies were conducted in three major U.S. institutions between 2003 and 2010 in which a combination of the Lean Method and Business Process Management were used (Frolick & Ariyachandra, 2006; Toyota Motor Corporation, 2009) with one exception: specific targets were not set (“open-expectation”). In addition, individuals were inspired to improve themselves with an expectation that this would improve efficiency in the workplace (Saha, 2004). Employees were inspired through formal and informal individual and group sessions. Also, opportunities were provided for the employees to reflect on their strengths and weaknesses, business processes were reviewed, a strategic plan was devised, stakeholders were consulted, institutional support was obtained, key performance indicators (KPIs) were selected, the plan was implemented, and data were collected. The plan was revised as necessary, or re-implemented. It was expected that the exercise would uncover opportunities for improvement and improve efficiency and quality, i.e., improve performance as measured by the KPIs. The institutions included: (1) a very large research-oriented metropolitan health department; (2) a mid-size research-
intensive academic medical center, which included a medical school and a dental school; and (3) a very large healthcare system in which a moderate amount of research is conducted.

Efficiency is typically defined as the ratio of a program’s input (such as costs or time spent) measured against its output or outcome (amount of products or services delivered). For the purpose of these studies, efficiency was measured in terms of the turn-around time for the completion of a specific task, i.e., the amount of time taken by the respective offices to complete a task, such as reviewing and approving a grant application. In other words, the time difference from the date on which the task/application was received/accepted by the research administration (or a comparable office), to the date on which the task/application was completed/approved and the PI notified of its completion, was considered turnaround time and expressed in calendar days. Five KPIs were used; Institutional Review Board (IRB) review turnaround time (full-board), IRB review turnaround time (expedited), research and training grant application turn-around time, agreements and contracts turn-around time, and clinical trial application review turn-around time. All KPIs used in the studies are listed in Table 1. Performance is defined by the efficiency of a task or unit adjusted in terms of total employees or total expenditures.

Measuring quality is more complicated as quality in many cases is subjective and defined differently by quality experts. A variety of perspectives was considered when defining quality, such as a customer’s perspective or a “specification-based” perspective. Quality in healthcare may be more precisely described as striving for and reaching excellence in standards of care (i.e., correct diagnosis, minimum wait time, lower cost, and private health information security). Quality in university research may be measured by the number of articles published in high-impact journals, number or dollar amount of grants received, number of patents issued, or number of products launched (i.e., technology commercialization). However, efficiency and quality measurements in research administration are complicated largely due to the lack of available data and inconsistencies in input variables. In our studies, quality was described as the number of applications with errors—two key quality indicators were measured (i.e., applications with errors) (as described in Table 1), and the number of errors in applications reviewed by institutional program officers who considered the application completed and ready for submission.
Table 1. Key Performance Indicators (KPIs) Used, Duration of Study, and Data Collection Methods

<table>
<thead>
<tr>
<th>Inst No.</th>
<th>Key Performance Indicators Used</th>
<th>Total Duration (Months)</th>
<th>Pre-implementation (Months)</th>
<th>Post-implementation (Months)</th>
<th>Data Collection Methods, Items Reviewed*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>**IRB review/approval turnaround time (full-board), days</td>
<td>8</td>
<td>2</td>
<td>6</td>
<td>R, P, eDR</td>
</tr>
<tr>
<td>1</td>
<td>**IRB review/approval turnaround time (expedited), days</td>
<td>8</td>
<td>2</td>
<td>6</td>
<td>R, P, eDR</td>
</tr>
<tr>
<td>2</td>
<td>Research and training grant application review/approval turnaround, days</td>
<td>36</td>
<td>6</td>
<td>30</td>
<td>R, P, eDR</td>
</tr>
<tr>
<td>2</td>
<td>‡Agreements and contracts/Other (A&amp;C/Other) review/approval turnaround time, days</td>
<td>36</td>
<td>6</td>
<td>30</td>
<td>R, P, eDR</td>
</tr>
<tr>
<td>2</td>
<td>Clinical trial agreements/contracts review/approval turnaround time, days</td>
<td>36</td>
<td>6</td>
<td>30</td>
<td>R, P, eDR</td>
</tr>
<tr>
<td>2</td>
<td>Applications with error (financial, regulatory and compliance errors), %</td>
<td>18</td>
<td>6</td>
<td>12</td>
<td>R, P, FR, eDR</td>
</tr>
<tr>
<td>2</td>
<td>Number of errors per application</td>
<td>18</td>
<td>6</td>
<td>12</td>
<td>R, P; FR</td>
</tr>
<tr>
<td>2</td>
<td>ORSP employee performance with respect to workload†</td>
<td>60</td>
<td>24</td>
<td>36</td>
<td>R, P, FR</td>
</tr>
<tr>
<td>3</td>
<td>‡‡Agreements and contracts (AC) review/approval turnaround time, days</td>
<td>36</td>
<td>12</td>
<td>24</td>
<td>R, P, eDR</td>
</tr>
<tr>
<td>3</td>
<td>Employee performance with respect to workload of a core unit</td>
<td>48</td>
<td>24</td>
<td>24</td>
<td>R, P, FR</td>
</tr>
<tr>
<td>3</td>
<td>Financial performance of a core unit, %</td>
<td>48</td>
<td>24</td>
<td>24</td>
<td>R, P, eDR, FR</td>
</tr>
</tbody>
</table>

* R, retrospective; P, prospective; eDR, electronic database records; FR, file records.
** Total turnaround time (turnaround), time taken by the Principal Investigator (PI) to respond and/or revise an application (PI time), and time taken by the IRB to review and approve a protocol (IRB time).
† Research agreements and contract, sub-contract—including and outgoing, federally-funded clinical trials, intellectual property agreements.
‡ Research agreements, sub-contracts—including and outgoing, collaboration agreements.
“...efficiency and quality measurements in research administration are complicated largely due to the lack of available data and the inconsistencies in input variables.”

An Excel spreadsheet was maintained to track the following variables: reviewer name; type of review; date of initial receipt of the application/document; date on which the document was reviewed; date of initial response to Principal Investigator (PI); total number of days taken to receive revision; number of applications with errors; number of errors per application; and date on which the completion notification sent to the PI. Date and time were tracked from the application or from the electronic records. The application review errors were independently identified by a third person, verified with the employee who reviewed the application, and confirmed.

It was expected that efficiency and quality would improve; the improvements would decrease workloads and, essentially, require fewer employees to complete specific tasks. It was further envisioned that the result would improve the financial performance of the unit studied.

Employee performance was calculated by dividing the workload² by the number of FTEs. Workload was converted to weight-adjusted units and expressed as arbitrary unit of work (AUW). Lastly, financial performance was calculated from the difference in budgeted amounts and the actual expended amounts and expressed as a percentage.

In institution #1 the hierarchy was concerned that an IRB application review and approval process was taking longer than expected. The IRB office was asked to determine the average time taken to review and approve different types of IRB applications—full-board and expedited reviews. It was also communicated that the results would be shared with the highest institutional officials and be posted on the institutional website. While no targets were set, an expectation of faster turnaround for the reviews and approvals was implied. Following the communication policies and procedures of the entire IRB, processes were reviewed and historical turnaround data were collected. The exercise identified redundant or inefficient processes and steps, need for education and training of staff and PIs, and need for policy changes. Prospective data were collected and analyzed—this included data on the PIs and their staff’s response time to the IRB’s questions or concerns, its impact on IRB review, and approval turnaround time. In institution #2, concerns were raised that clinical trial agreements and contracts review took longer than necessary and resulted in lost opportunities. It was expected that turnaround time would
decrease and improve efficiency. Based on these concerns, senior managers asked the Office of Research and Sponsored Programs (ORSP) to look into the situation and to improve efficiency—no specific target was proposed. In addition, during the exercise, a number of other areas were reviewed and data collected as presented in Table 1. Further, error rates on regulatory and financial compliance-related concerns were measured in which ORSP decision makers expected review and application quality improvements.

Similar issues were presented on grants and contracts review and approval turnaround time in one sub-unit and operational efficiency of a core unit in institution #3. Review and approval turnaround time for various grants and contracts were measured and the management and operational structures of the core unit were reviewed in which the same expectations were communicated.

Before initiating efficiency and quality measurements, a holistic efficiency and quality improvement approach was applied, which included a thorough review and revision of the following: (1) existing policies and procedures; (2) job descriptions and reporting structures; (3) roles and responsibilities of employees; (4) workflow; (5) personnel skills, expertise, education and training; (6) forms, checklists, and other tools; (7) interpersonal dynamics; and (8) total work environment. However, not all methods were implemented in all institutions—the methods and processes used were determined by needs as uncovered during the discovery phase and analysis. The process also included development and implementation of forms, checklists, matrices, seminars, presentations, and other staff development activities, such as developing career advancement strategies. In addition to attending in-house staff developmental activities, the employees were encouraged or required to attend regional and national meetings and conferences. Because of the initiatives, redundant processes were recognized, gaps were identified, and opportunities for improvement were revealed, strategic goals were created and specific goals and KPIs were developed (Frolick & Ariyachandra, 2006; Toyota Motor Corporation, 2009). Collectively, these activities and the “change management” strategies were considered interventions. These informal initiatives and interventions did not impose additional resources from the administration but they received the approval, support, and cooperation from the stakeholders and the upper management.

The data collected include historical and prospective data from the period of two months to two years prior to initiating the study (pre-implementation data), and prospective data from the period of six months to three years after review and
intervention (post-implementation data), depending on the program and specific item/task involved. Available data were collected from paper-folder records and/or computer databases and were aggregated to monthly or yearly data means (see Table 1).

The “mean of the means” of the data was calculated and analyzed by one-way analysis of variance (ANOVA), which compared the pre-implementation period data to the post-implementation period data. The consolidated data were then presented as the means in calendar days or percentages and standard deviations (SDs). Values of $p<0.05$ were considered significant.

**RESULTS**

**IRB Review and Approval Turnaround Time**

The data presented in Figure 1A and 1B represent the IRB turnaround time in institution #1. Analyses of the data showed that turnaround time for full-board review and approval total turnaround time decreased from an average of 55.3 days ± 35.0 days to 35.4 days ± 7.2 days. Although the overall improvement from pre- to post-implementation period was 35.9%, it was not statistically significant (Figure 1A). However, the IRB office itself decreased the turnaround time from 30.5 days ± 11.7 days to 21.1 days ± 5.9 days, which was statistically significant ($p<0.05$), representing an efficiency improvement of 30.8%.

The expedited reviews and approval turnaround time decreased from an average of 31.4 days ± 16.4 days to 25.9 days ± 8.8 days (Figure 1B). Similarly, the overall improvement from pre- to post-implementation period was found to be 17.6%, but it did not reach statistical significance.

**Figure 1.** IRB Turnaround Time for Review and Approval of Full-board (A) and Expedited (B) Applications
Research and Training Grant Application Turn-around Time

Figure 2 shows that the average time taken for research and training grant applications review and approval significantly decreased from an average of 3.8 days ± 1.5 days to 1.9 days ± 0.37 days from pre-implementation to post-implementation period (p<0.001). Analysis of the data further showed that the time taken to complete this task decreased 50.0%, which was sustained throughout the duration of the study.

Agreements and Contracts Turn-around Time in Institution #2

Analysis of the data for turnaround time for review and approval of agreements and contracts at institution #2 showed a decrease from an average of 6.3 days ± 3.6 days in the pre-implementation period to 2.6 days ± 0.9 days in the post-implementation period. The overall improvement from pre- to post-implementation was 58.7%, which was statistically significant (p<0.003).

Figure 2. Turnaround Time for Review and Approval of Research and Training Grant Applications
Clinical Trial Applications Review and Approval Turnaround Time

The turnaround time for review and approval of clinical trial applications in institution #2 is shown in Figure 4. Analysis of the data showed that turnaround time decreased from an average of 23.0 days ± 13.6 days to 4.1 days ± 0.9 days in the pre- and post-implementation period, respectively (p<0.001), which represents an 82.2% efficiency improvement.

Figure 3. Turnaround Time for Review and Approval of Agreements and Contracts in Institution #2
Figure 4. Turnaround Time for Review and Approval of Clinical Trials Applications

Percentage of Application with Errors and Number of Errors per Application

Figure 5A shows the percentage of applications with errors. The overall percentage of applications with errors was reduced from an average of 40.4% ± 12.4% in the pre-implementation period to 28.1% ± 6.8% in the post-implementation period, a 30.4% decrease in error rate, which is a significant improvement in the quality of the applications reviewed (p<0.03). The data presented in Figure 5B showed that the number of errors per application decreased from an average of 0.7 errors ± 0.3 errors per application to 0.4 errors ± 0.1 errors per application. The number of errors per application decreased 42.9% in the post-implementation period compared to the pre-implementation period (p<0.05).
ORSP Employee Performance
Analyses of the data presented in Figure 6 indicated that each employee completed increased amounts of work (AUW), reflecting improved performance. The workload per FTE increased from 22.3 AUW ± 1.5 AUW in the pre-implementation period to 25.8 AUW ± 5.3 AUW in the post-implementation period, resulting in 15.7% performance improvement (p<0.05).

Figure 5. Percentage of Applications with Errors and Number of Errors per Application

Figure 6. Workload, Number of FTEs, and Arbitrary Unit of Work (AUW) per FTE
Agreements and Contracts Review and Approval Turnaround Time in institution #3

Data presented in Figure 7 indicated that average turnaround time significantly decreased from 34.3 days ± 27.0 days to 19.3 ± 10.3 days in the pre- and post-implementation periods, respectively, resulting in a 43.9% decrease in turnaround time in the post-implementation period (p<0.05).

![Figure 7](attachment:image.png)

**Figure 7.** Agreements and Contracts Review and Approval Turn-around Time in Institution #3

Employee Performance in a Core Unit

Employee performance data from a core unit in institution #3 are presented in Figure 8. Analyses of the data showed that the workload per FTE increased from an average of 13.3 AUW ± 1.0 AUW to 25.1 AUW ± 6.4 AUW, representing a 47.0% increase in efficiency in the post-implementation period compared to the pre-implementation period (p<0.01).
Financial Performance of a Core Unit

Data presented in Figure 9 demonstrates that financial performance of a core unit in institution #3 increased significantly (p<0.01) in the post-implementation period compared to pre-implementation period, 5.8% ± 24.5% (overspending) vs. -26.6 ± 9.6% (saving), respectively in relation to budgeted amounts, resulting in 32.4% performance improvement.
DISCUSSION

Efficiency and quality of work are key factors that directly determine an organization’s success; research administration is not unique. However, research administration offices are challenged with certain key issues unique to academic institutions, such as diversity of the faculty, input variations, and time pressures, where efficiency and quality play a major role in the effective management of the total business process. Faculty, staff, and administrators collaborate and work to achieve similar goals, but from different perspectives, and are likely to have different interests in the process. Additionally, research administrators are at times left without a foundation or reference point, since this is a relatively new discipline and data on efficiency and quality are substantially scant. Therefore, these studies were undertaken to generate data in this domain and to see if higher expectations would improve efficiency and quality in research administration. Here we document that higher expectations from superiors are associated with increased productivity of employees. The improvement measures were based on turnaround times and error rates from a plethora of documents and research agreements. In addition, data on associated financial benefits of these improvements were also documented. In our studies, target points for document review, approval turnaround time, error rates, and financial performance have not
been established. However, the results indicate that almost all KPIs were improved across all three institutions. We did not attempt to determine the exact cause and effect of the results, as this was beyond the scope of these studies. Nonetheless, implementing new policies and procedures, reengineering processes, creating databases, providing employee training, and communicating clearly with the expectation that KPIs would improve, seem likely to underlie these improvements (Anema & Byrd, 1991). These authors reported that expectations improved productivity. However, higher expectations may divert people from other important endeavors (Whorley & Addis, 2007). We did not observe any such deviations, presumably because we did not set target points in order to avoid the perception of having set our expectations too high.

“...higher expectations from superiors are associated with increased productivity of employees.”

In institution #1, three fundamental changes were made to improve the IRB application review and approval turnaround time. (1) An agency-wide educational program was instituted in which key stakeholders were invited to attend and educational seminars were presented; (2) applications were reviewed by the IRB office, recommended changes were communicated to the PIs, and the revisions were made before the applications were presented to the IRB for review; and (3) checklists were prepared and office staff members were re-trained to quickly identify administratively-incomplete applications. The incomplete applications were immediately returned to the submitters for corrections.

One additional procedural change contributed significantly to the faster turnaround time for the IRB application review and approval. In each full board meeting, a subcommittee of three was instituted where appropriate to determine whether recommended changes were made and approval granted if the changes were found to be satisfactory, without waiting for the next month’s convened IRB meeting. The procedural changes were workable because the office received institutional support and the committee members were committed to the additional work. However, the decrease in IRB review and approval turnaround time did not reach statistical significance. The shorter duration of the study period, small sample size, and high input variables may have contributed to the observed statistical insignificance. Nevertheless, IRB office turnaround time showed significant improvement, implying the effectiveness of the program. Our pre-implementation data were comparable to the data recently released by the
Association for the Accreditation of Human Research Protection Program (AAHRPP, 2011). Full-board approval was shown to take an average of 45.7 days while expedited review took an average of 27.9 days. Our post-implementation turnaround time was 35.9 days and 17.6 days, respectively—considerably lower than the national averages.

In institution #2, similar IRB procedural changes were made and marked improvements were reported to have been made (personal communication—data not shown here). A similar initiative implemented at Rockefeller University also revealed improvements in IRB turnaround times (Rhonda Kost & associates, unpublished data, www.ctsaweb.org). The data indicated that pre- and post-implementation turnaround times decreased from 59 days to 32 days (full-board review) and 16 days to 10 days (expedited review). Furthermore, similar results were found at the University of Texas Health Sciences Center at Houston (Sujatha Sridhar & associates, unpublished data. www.ctsaweb.org), suggesting the effectiveness of these interventions in improving IRB review and approval turnaround time.

The data from institution #2 showed significant improvements in turnaround time for all applications, agreements and contracts, and clinical trial applications reviews and approvals (Figures 2, 3, and 4). However, no significant improvement was found for material transfer agreements (data not shown). In addition, we found that personnel service agreement negotiation and execution (a separate process from grants and contracts negotiation and execution) turnaround time did not decrease (data not shown). The reason for these findings is uncertain. However, the role of employee entitlement and political influence in preventing contributions from involved employees (Atkinson & Gilleland, 2007) or employees’ over-emphasis on meeting other expectations, thereby distracting them (Atkinson & Gilleland, 2007; Harvey & Harris, 2010) and resulting in this outcome, cannot be ruled out. A similar phenomenon was shown in the examination of institution #3, in a unit not included in this study.

A few of the steps toward process reengineering, which presumably contributed to improvements in these KPIs, are indicated in the Materials and Methods Section. Additionally, other important issues were revealed and have been brought to the administration’s through staff meetings, individual performance meetings, brainstorming meetings, small-group meetings, super-user focus group meetings, and lunch meetings. A series of other team-building efforts were implemented prior to stakeholder support and cooperation at the onset of and during data collection. The data collection method was informal and
unstructured; nonetheless, the following were found to be some of the reasons associated with a lack of motivation, resulting in poor employee performance: (1) lack of knowledge, tools and resources needed for job performance; (2) personal issues; (3) interpersonal dynamics within and outside the office; (4) health-related stress; (5) lack of clear policies and procedures; (6) ambiguous job descriptions and reporting relationships; and (7) unclear or lack of accountability and expectations. The exercises also revealed that employees who were viewed as not being able to deliver on time or produced poor-quality work and offered the most resistance to change, were those who worked under ill-defined circumstances and performance expectations and fell under the “entitled employee” category (Atkinson & Gilleland, 2007; Harvey & Harris, 2010). In addition, the process flow review revealed that all applications and protocols were routed to the Dean’s Office prior to being sent to ORSP, which needed approximately three days to process these items. Traditional and customary procedures appeared not to have served any meaningful purpose. Eliminating the step not only expedited the review process, but also decreased the Dean’s workload. However, the authors recognize that this step may not apply to other institutions, which may be bound by culture or internal policies and procedures.

Studies showed that de-emphasis on written accounting positively correlated with employees’ spontaneity, and innovation. Also, high (unrealistic) expectations from supervisors negatively correlated with employees’ frustration and anger (Eisikovits et al., 1985). Nonetheless, improvements were seen in this study where employees were asked to document the time spent on completion of a specific task. Employees were encouraged, not directed, or penalized in their efficiency evaluations. The tone of the supervisor communication may have contributed to this improvement (Harvey & Harris, 2010) in which “informative communication,” as opposed to “evaluative communication,” was used. Adaptation of these strategies may have contributed to the overall improved efficiency seen in these studies. However, resistance mediated through the “culture of resistance,” employee-entitlement and political influence (Atkinson & Gilleland, 2007; Harvey & Harris, 2010) and the frustration generated against the provision for written accountability, have been mitigated in part by the perception of supervisor competency, management style, and communication (Eisikovits et al., 1985; Harvey & Harris, 2010), and also through institutional support, which is an integral part of business process management (Frolick & Aryiachandra, 2006).
We found that the contract negotiation and execution process in institutions #2 and #3 varied; turnaround time for a comparable process in institution #2 significantly decreased from 114 days to 73 days (data not shown). An additional process change was implemented in which employees were instructed to send email reminders to constituents every two weeks followed by a phone call in the event of nonresponse. In an effort to develop matrices and improve efficiency, a similar approach was taken at another institution—extrapolation of data revealed that turnaround time for grants and contract negotiations was about 80 days (Smith & Citerne, 2010). In institution #3, it took much less time in both the pre- and post-implementation period (36.8 to 25.8 days, respectively) when utilizing a similar process (Figure 7). Different organizational structures, numbers of grants and contracts, complexity of contacts or organization, available FTEs, and management philosophy and expectations are considered the reasons for these differences.

Our studies have demonstrated decreased error rates in applications submitted and number of errors per application (Figure 5A & 5B). We assumed that low error rates in applications reflected one of the following scenarios: (1) reviewers were able to identify errors better and corrected them before they were marked “completed”, or (2) application preparers generated better applications during the post-implementation period. The contribution of the latter is thought to be the major contributing factor, which may be supported by the following observations. During the discovery and strategy phase, it was clear that substantial training and staff development were needed (also, supported by external consultants) and thought to be an integral part of the efficiency improvement process. Subsequently, individual and group trainings were developed and made available to the ORSP staff, PIs, and other institutional staff. The training may have provided staff with the necessary tools to prepare better-quality applications, i.e., with decreased number of errors. Further, our data revealed that the project officers (reviewers) took a slightly longer time to review and approve applications (data not shown) and other documents. The data suggested that the reviewers might have paid closer attention to the details in their document review, which in turn improved quality. Monahan and Fortune (1995) demonstrated that providing training on the internal proposal development process significantly improved external awards, reflecting application quality improvement. Our data agreed with this report.

In our studies, we observed two interesting, but not surprising, phenomena—sudden spikes in error rates prior to or after short times off, and
increased error rates in applications reviewed with unusual alacrity. After discussing these with employees, we understood that the performance problem affecting work error rates might involve factors such as employee wellness or personal problems. Of course, the employees sought to meet expectations, while compromising quality (Whorley & Addis, 2007). Our investigation found that errors spiked following minor physical or non-work-related stressors (Figure 5; May–June 2004 & February–March 2005) of certain employees (data not shown). Although no attempts were made to perform statistical analyses of these observations (outside the scope of this study), alleviating these concerns appears to have resolved inadvertent oversight by affected employees identifying regulatory, financial, or other compliance issues.

The studies also provide invaluable insight into the benefits of improved turnaround time and work quality. Some of the benefits included time saving, encouragement of new study submissions, increased customer satisfaction, and decreased complaints against ORSP. In addition to implementing the open-ended expectation model, the best results were generated through informative communication and via holding regular office staff meetings, soliciting feedback from faculty and staff, and identifying the causes for the delays and errors.

We recognize the limitations of these studies—the pre- and post-implementation periods were arbitrarily determined since efficiency and quality improvements are continuous processes. Also, the data were obtained from only three institutions. The lack of detailed, structured, uniform tracking processes, observers’ bias, and limited analyses of the data may have caused a slight overestimation of the above, we found that increased expediency increased error rates, just as increased expediency error rates have been linked to stress-related issues. When the causes were assessed, corrections were made and immediate improvement ensued. Improved efficiency was found to be directly correlated with the work unit’s improved financial performance. Efficiency improvement decreased FTE needs and contributed to overall financial performance improvement (Figures 8 and 9).

“In addition to implementing the open-ended expectation model, the best results were generated through informative communication and via implementing regular office staff meetings, soliciting feedback from the faculty and staff, and identifying the causes for the delays and errors.”
association between expectations and efficiency and work quality. However, our data and analyses exhibit several important strengths—they capture three different types of institutions with differing administrative and management structures, and differing expectations. These data may not be generalized; however, we are confident the results are comparable to those for other institutions and universities. Our findings revealed that implementation of similar processes will improve efficiency and quality, which in turn will improve the financial performance of research administration and sponsored programs as a whole. Again, the evidence provided by Monahan and Fortune (1995) clearly showed that improving the research administration process and providing services to faculty and staff, increase institutions’ external funding.

Our data also highlight the importance of achieving a base-level working performance system prior to implementing specifically focused initiatives. However, benchmarking data from a wider and more diverse group of institutions may further inform this analysis. In order to develop benchmarking data in research administration, we conceptualized a user-friendly data-capturing and data sharing system. Such a system may also assist institutions in planning or developing programs and in distributing resources more effectively. Currently, we are working to establish and validate the process and the system model. Furthermore, after reviewing data generated by other organizations, we have found data on efficiency improvement measures, but we were unable to find comprehensive information on the implementation process for a full quality improvement initiative. Our experiences with this form of observation and these analyses have led us to rethink and make adaptations to our management style in research administration. We hope these findings will stimulate ideas and encourage further research on the theoretical and methodological foundations for improving research administration and management.
ENDNOTES

1. Wrong or inappropriate IRB or IACUC approval date; wrong F&A cost rate or cognizant agency approval date; over or under budget; undocumented or unjustified waiver of or reduced F&A; inconsistent or inappropriate time and effort estimation or report; unallowable items in the budget; allowable items not budgeted; undocumented cost-share; over-committed effort; wrong or missing other support; inappropriate cost base; undocumented use of biohazard materials; use of undocumented or non-reviewed export control items; undocumented or unapproved use of animals or human subjects, or use of these subjects where the approval expired; missing or expired training of investigators using human and animal subjects; undocumented or non-reviewed conflicts of interest; use of uncertified or unapproved facilities; inappropriate use of funds; transfer of materials without material transfer agreements; shipping and receiving items from foreign countries without license or institutional review; binding institution (signing agreements/contracts) without appropriate signatory authority; use of foreign students and investigators from prohibited countries in studies involving export control issues; unauthorized use of select agents or use of these without institutional oversight, inappropriate or undocumented cost transfer; inappropriate or unreported reduction of efforts; unreported absentee PI; change of scope; and data entry errors. Applications include new and continuation applications, or final reports.

2. Employee workload was indicated as arbitrary unit of work (AUW). AUW is calculated by considering the total amount of funding, number of applications submitted, number of awards received, number of grants and contracts processed, and number of other applications or documents reviewed by the office. An arbitrary weighted-average value was assigned to each task or value, and the total value was considered as the entire workload, or AUW.
## Supplemental Data/Consolidated Data Summary

<table>
<thead>
<tr>
<th>Inst No.</th>
<th>Key Performance Indicators Used</th>
<th>Pre-implementation</th>
<th>Post-implementation</th>
<th>Improvement</th>
<th>Significance</th>
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<tr>
<td>1</td>
<td>IRB review/approval turnaround time (full-board), days</td>
<td>55.3 ± 35.0</td>
<td>35.4 ± 7.2</td>
<td>35.9%</td>
<td>NS*</td>
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<td>1</td>
<td>IRB review/approval turnaround time (expedited), days</td>
<td>31.4 ± 16.4</td>
<td>25.9 ± 8.8</td>
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<td>2</td>
<td>Research and training grant Application review/approval turnaround, days</td>
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<td>2</td>
<td>Agreements and contracts review/approval turnaround time, days</td>
<td>6.3 ± 3.6</td>
<td>2.6 ± 0.9</td>
<td>58.7%</td>
<td>p&lt;0.003</td>
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<td>2</td>
<td>Clinical trial agreements/contracts review/approval turnaround time, days</td>
<td>23.0 ± 13.6</td>
<td>4.1 ± 0.9</td>
<td>82.2%</td>
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<td>2</td>
<td>Applications with error,%</td>
<td>40.4 ± 12.4</td>
<td>28.1 ± 6.8</td>
<td>30.4%</td>
<td>p&lt;0.03</td>
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<td>2</td>
<td>Number of errors per application</td>
<td>0.7 ± 0.3</td>
<td>0.4 ± 0.1</td>
<td>42.9%</td>
<td>p&lt;0.05</td>
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<td>2</td>
<td>ORSP employee performance with respect to workload, AUW</td>
<td>22.3 ± 1.5</td>
<td>25.8 ± 5.3</td>
<td>15.7%</td>
<td>p&lt;0.05</td>
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<td>3</td>
<td>Agreements and contracts (AC) review/approval turnaround time, days</td>
<td>34.3 ± 27.0</td>
<td>19.3 ± 10.3</td>
<td>43.9%</td>
<td>p&lt;0.05</td>
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<td>3</td>
<td>Employee performance with respect to workload of a core unit, AUW</td>
<td>13.3 ± 1.0</td>
<td>25.1 ± 6.4</td>
<td>47.0%</td>
<td>p&lt;0.01</td>
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<td>3</td>
<td>Financial performance of a core unit, %</td>
<td>5.8 ± 24.5</td>
<td>-26.6 ± 9.6</td>
<td>32.4%</td>
<td>p&lt;0.01</td>
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*NS, not significant
AUTHORS’ NOTE

We thank Herbert L. Bonkovsky, MD, for his leadership, and Paul Hudobenko, Debra Kieft, Marcus Santodonato, and Cliff Williams for their commitments to the initiative that contributed, in part, to efficiency and quality improvements. We also thank Debra Kieft for her critical reviewing and editing of the manuscript.

LITERATURE CITED

Harvey, P., & Harris, K. J. (2010). Frustration-based outcomes of entitlement and the influence of supervisor communication. Human Relations, 63(11), 1639–1660.


Transforming Research Management Systems at Mayo Clinic

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ABSTRACT

In order for research programs at academic medical centers and universities to survive and thrive in the increasingly challenging economic, political and regulatory environment, successful transformation is extremely important. Transformation and quality management techniques are increasingly well established in medical practice organizations. In medical research organizations, the introduction of quality management systems is a more recent development. Mayo Clinic has now completed five years of implementing quality management systems in support of its national research organization. This article describes the quality management system under development within research at Mayo Clinic, key action steps taken in transforming the research management systems, results achieved to date in improving performance, and lessons learned.

INTRODUCTION

Mayo Clinic serves as an integrated, multispecialty group practice of medicine, with a mission to inspire hope and contribute to health and well-being by providing the best care to every patient through integrated clinical practice, education, and research. It operates a large and complex national research enterprise that is ranked in the top 20 of all National Institutes of Health (NIH)-funded academic medical centers in the United States, operating on campuses in Arizona, Florida, and Minnesota. One important aspect of the Mayo Clinic research enterprise is the management system designed to advance discovery and the translation of these discoveries to the broader benefit of society. The management systems supporting
research have the potential to be transformed through the disciplined application of quality management systems.

**Quality Management Systems in Research Organizations**

In advance of introducing a quality management system into the research organization at Mayo Clinic, the authors reviewed the experience in the field through discussions with experienced research leaders and through a review of the literature. Discussions with experienced research leaders suggested there have been some early adopters of quality management techniques in research organizations. A review of the literature reported the experience of some of these early adopters, highlighting the application of quality management techniques in research organizations, including: Lean and Six Sigma applied to clinical and translational research (Schweikhart, 2009); quality improvement used to strengthen informed consent in human subject research (Foglia, Salsa, & Dieksma, 2009); Six Sigma deployed to optimize data entry processes in clinical research (Liu, 2006); and Continuous Quality Improvement, Lean and Six Sigma applied in pharmaceutical and biotechnology research and development organizations (Carleysmith, Dufton, & Altria, 2009; Johnson, 2002; Sollecito & Kaluzny, 2000). This experience as reported in the literature highlights some of the benefits of applying quality management systems in research.

**BACKGROUND**

During the summer of 2005 Mayo Clinic launched a major initiative designed to create a world-class research management system to advance its research vision and strategic priorities. The initiative, called the Research Infrastructure Service Excellence (RISE) initiative, was designed to create a management system for research characterized by ‘best-in-class’ customer service, quality, performance, reliability, efficiency, and cost-effectiveness.

“The . . . Research Infrastructure Service Excellence (RISE) initiative . . . was designed to create a management system for research characterized by ‘best-in-class’ customer service, quality, performance, reliability, efficiency, and cost-effectiveness.”

The RISE initiative was organized into four phases: (1) Research Vision and Strategic Priorities, (2) Research Infrastructure Compliance, (3) Research Infrastructure Process Improvement, and (4) Research Infrastructure Service Excellence.

Research leadership recognized that to accomplish the goal of creating and implementing a world-class research
management system, simply improving current business practices was not going to bring about the transformational change that was essential. Leadership established as a high priority the creation of a new research management system built on proven quality management principles.

**KEY ACTION STEPS**

The key action steps were as follows: securing senior leadership support, establishing a clear research vision, securing resources, addressing infrastructure compliance requirements, achieving significant process improvement results, and pursuing service excellence.

**Securing Senior Leadership Support**

Early in the RISE initiative those involved realized that strong and unavering senior leadership support was needed to achieve the transformational change required to establish ‘best-in-class’ performance. Research leadership launched their sponsorship efforts early in 2006 with a clear, easy-to-understand plan that was called the Mayo Clinic RISE Roadmap to Excellence.

Figure 1 shows the four phases of the initiative.

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**Figure 1.** Mayo Clinic RISE Roadmap to Excellence
Research leadership used the Mayo Clinic RISE Roadmap to Excellence to articulate the vision of the RISE initiative, which was “to create a world-class research management system to support Mayo’s world-class scientists.” Of course, articulating the vision and creating the desire to make the transformational changes necessary to realize the vision are two different things.

“Research leadership used the Mayo Clinic RISE Roadmap to Excellence to articulate the vision of the RISE initiative, which was ‘to create a world-class research management system to support Mayo’s world-class scientists.’”

Phase 1—Establishing a Clear Research Vision

Research leadership first articulated a clear vision for research that set the direction for both scientific and administrative initiatives. The research vision at Mayo Clinic is “Understand, predict, prevent, diagnose, optimally treat, and ultimately cure disease.” This vision set the framework for the development of a research management system.

Phase 2—Addressing Infrastructure Compliance Requirements

Research leadership next addressed infrastructure compliance-related questions. The fundamental underpinning of a world-class research management system includes ensuring that the research enterprise is operating within a fully compliant environment. Managers took a series of proactive steps in concert with internal audit services to survey the research enterprise and ensure that all appropriate steps were taken to verify that the research infrastructure components were operating in accordance with federal, state, and institutional requirements.

Phase 3—Achieving Significant Process Improvement Results

Research leadership then achieved significant process improvement results to address substantial operational inefficiencies and to demonstrate in tangible terms the transformational capability of quality management within a research enterprise. This phase had three primary objectives:

1. Improve the fundamental business processes
2. Build acceptance and understanding of process improvement and quality management
3. Create momentum for implementing a quality management system in research

The quality management system was designed based on ISO9000 standards to create the infrastructure necessary for sustainable and effective quality management. The four business processes
chosen for Phase 3 of the RISE initiative were selected based on input received from institutional and research leadership. The processes chosen were known to have chronic performance issues, resulting in substantial customer dissatisfaction. The four processes chosen were as follows:

1. Clinical trial protocol development
2. Institutional Review Board (IRB) protocol review
3. Office of Sponsored Projects Administration (OSPA) proposal development and negotiation of price and payment terms
4. Legal Contract Administration (LCA) contract negotiation

The overarching goal for each of the four process improvement teams was to establish best-in-class service levels, thereby making service improvements obvious and tangible. For example, all four process improvement teams focused on reducing the cycle times, in addition to other deliverables. Phase 3 of the RISE initiative included understanding the current state, designing a desired future state, and implementing the desired improvements effectively.

**Current State**

Research leadership first needed to understand how the existing research management system came into being. The system had evolved over several decades through a series of separate efforts conducted in attempts to meet the evolving needs of the system’s customers. When leadership for the RISE initiative started to assess the current state of the research infrastructure, several characteristics of the system started to become apparent:

- Processes and procedures were dispersed, variable, difficult to interpret, and in some circumstances conflicted with one another.
- Significant process variation and operational inefficiency characterized daily operations.
- Many basic tools necessary for effective day-to-day operations were not available.
- Performance data were not accessible, which forced managers to make decisions with a lack of verified data.
- Performance expectations were not established, which resulted in a lack of accountability.
- Management personnel had little exposure to fundamental quality principles.

All of this presented a major opportunity for senior research leadership to establish a comprehensive research management system designed to be best in class to support the world-class scientists at Mayo Clinic.

**Future State**

Next, each of the four process improvement teams designed a future ‘ideal’ state for each of these critical
research business processes. Each team used a variety of quality management tools, including attending quality training, using value stream mapping techniques, conducting idealized design sessions, and ultimately creating new process flows, standard operating procedures and work instructions in conjunction with training tools for each of these essential research business processes.

**Change Management**

To make improvements and move the organization from the “current state” to a more desirable “future state” required a change management process. The natural human response to change is resistance—the larger the change, the more it is resisted. The redesigning of the core business processes represented significant change for the personnel in the business units. The business unit leaders and quality office personnel had a good idea that there would be skepticism that the redesigned business processes could achieve the cycle time reductions being purported based on reactions from the process redesign teams themselves.

Communication, education, and training were the three tools utilized by the business unit leaders to prepare their business units for implementation of the redesigned processes. The business unit leaders communicated the need for change to all business unit personnel, with the goal being defined as improving customer service. The business unit personnel were then educated at a high level concerning the quality tools and process improvement methodologies utilized to redesign their respective processes. After the need for change and credibility of the redesign processes had been established, the impacted personnel were trained on the redesigned processes so they could be effectively implemented.

**Effective Implementation**

Once the business units completed the implementation of the redesigned processes, each team demonstrated that it had achieved significant performance improvement results. Overall, the teams improved quality, service, and reliability. In addition, the teams standardized and removed variation from their processes, reduced waste, achieved cost savings, and improved cycle times dramatically. As illustrated in Figure 2:

- The **Protocol Development Team** succeeded in reducing its cycle time by 77%, from an average of 231 days to an average of 54 days, while at the same time reducing resources needed for the process by 2.5 full-time equivalents (FTEs).
- The **IRB Protocol Review Team** reduced its cycle time by 35%, from an average of 37 days to an average of 24 days, while at the same time reducing resources needed for the process by 4.0 FTEs.
The OSPA Team reduced its cycle time by 72%, from an average of 95 days to an average of 27 days. The LCA Team reduced its cycle time by 88%, from an average of 105 days to an average of 12 days. Overall, the four teams reduced cycle times by 75%, positioning our scientists to submit applications for funding up to 351 days faster than was previously possible at Mayo Clinic.

Mayo Clinic Case Study

![Process Improvement Cycle Time Reduction](image)

Figure 2. Mayo Clinic Research Cycle Time Reductions

The success of Phase 3 of the RISE initiative contributed to greater acceptance and understanding of the application of process improvement techniques and tools. It also created momentum for the initiative.

Phase 4—Pursuing Service Excellence

Finally, research leadership pursued service excellence through the disciplined application of quality management systems across the research infrastructure at Mayo Clinic. This phase of the RISE initiative was the result of Mayo’s research leaders’ understanding the critical difference between achieving process improvement and sustaining quality management systems.

Creating a Research Quality Management System

There are eight fundamental elements of the quality management system in research at Mayo Clinic, as outlined in Figure 3. These eight elements are based on commonly accepted quality management principles, ISO9000 standards, a quality manual template from 9000World.com, and quality management concepts originating

![Figure 3. Mayo Clinic Research Quality Management System Model](https://www.9000world.com)

The logic behind the quality management system was simple. To bring about the desired transformational changes, quality management would have to be implemented in the work units that comprised Mayo’s research management system. To improve quality management in a meaningful way, the personnel providing the services must be empowered to manage and improve the quality of their work and the services they provide. A quality management system coupled with an understanding and practical application of the fundamental quality principles provide the means for proactive quality management and continuous improvement.

**Creating an Office of Research Quality Management Services**

In order to facilitate ongoing support for quality management, research leadership established an Office of Research Quality Management Services (ORQMS). This office...
received requests from several work units volunteering to participate in the creation of quality management systems. Having work units volunteer meant that research leadership and the ORQMS had been successful in creating a “pull” (as opposed to “push”) environment for quality management, the former having a good chance for success and the latter being almost certainly destined for failure.

“The logic behind the quality management system was simple. To bring about the transformational changes that were desired, quality management would have to be implemented in the work units that comprised Mayo’s research management system.”

Creating a Process for Implementing Quality Management Systems

The ORQMS created a process and sequence of events to help work units implement a quality management system. After the quality improvement advisors make certain that work unit leadership and management personnel are committed to improving quality and that a culture open to change and new ideas exists in the work unit, office personnel conduct training sessions for the work units to help them understand: (a) the nature of a quality management system, and (b) the benefits of using a quality management system to manage quality for operational performance. Once this training is accomplished, the quality improvement advisor provides more detailed training on each element of the quality management system prior to implementation.

Obtaining the knowledge necessary to implement a quality management system does not necessarily mean work unit personnel buy into the concept that proactive management of quality will result in improvements in operational efficiency and increased capacity. As a result, some employees were hesitant to allocate the resources necessary to realize the benefits of their quality management system. Thankfully, a quality management system starts to sell itself even before it is fully implemented. Our experience has been that the act of documenting and standardizing the business unit’s processes alone creates significant efficiencies that result in newfound capacity within the work unit. The documentation and standardization of a process normally mean there will be less variation in the process, thereby allowing the process to be performed more efficiently. Often the opportunities for improvement become so evident during the business process documentation exercise that the improvements are simply worked into the new standardized process.
Creating Research Quality Coordinators at the Work Unit Level

In all circumstances the actions of standardizing processes and implementing each work unit’s quality management system created new capacity in each work unit to redeploy existing resources. The new capacity represents an opportunity for the work unit to invest in personnel (quality coordinators) who are responsible for coordinating the work unit’s quality management, planning, and reporting activities. The work units that have fully functional quality management systems have either hired quality coordinators from outside their work unit or assigned these responsibilities to existing personnel. Both scenarios are working well. The act of a business unit investing in personnel who have a defined responsibility for quality management coordination signifies to leadership that they understand that the benefits of managing quality proactively outweigh the modest investment in personnel necessary to ensure that their quality management efforts are effective. Quality coordinator positions may be full- or part-time depending on the size of the business unit. Responsibilities may also be shared among employees.

Sustaining Service Excellence

The RISE initiative designed to transform Mayo’s research management system will never be complete. As progress is made, actions must be taken to protect and sustain the gains that have been achieved by the initiative. To effectively sustain the gains and be able to utilize these gains to solidify the desire for change (nothing creates desire more than demonstrable success), the vision of the RISE initiative and the new concepts and methodologies for quality management and process improvement had to be reinforced. Reinforcement can, and in this case did, take multiple forms. The strategies and methodologies Mayo is using to sustain the gains already achieved by the initiative and to position the initiative for further sustainable transformation include the following:

- Leadership continues to clearly articulate the vision and provide visible support.
- Leadership reinforces the commitment to quality by supporting the ORQMS.
- Leadership expects work units to achieve best-in-class performance levels.
“The act of a business unit investing in personnel who have a defined responsibility for quality management coordination signifies to leadership that they understand that the benefits of managing quality proactively outweigh the modest investment in personnel necessary to ensure that their quality management efforts are effective.”

A further example of research leadership’s commitment to quality is their support for the formation of a new program for Quality and Customer Service Oversight. The oversight group for this program has been charged with providing direction for quality and customer service activities, interacting with Mayo’s research community to “hear their voice” and to prioritize continuous improvement projects resulting from these interactions. A Quality Customer Service and Satisfaction Work Group is currently being implemented.

All of these actions have one thing in common: they were taken to ensure that all of the efforts by all of the people who have contributed to the RISE initiative and who are committed to its vision “to create a world-class research management system to support Mayo’s world-class scientists” result in this vision becoming a sustainable reality.

LESSONS LEARNED

At various points during the RISE Initiative, those most directly involved began to understand that these efforts do not have an end point, just as the pursuit of quality and excellence does not have an end point. Those involved also quickly came to the realization that transforming Mayo’s research management system would require a tremendous amount of work performed by dedicated and talented people, and that the work had to be conducted using well-thought-out strategies with a single, easily understandable vision in mind. Research and Office of Research Quality Leadership realized that in order to transform Mayo’s research management system, the fundamental quality principles had to become something more than abstract concepts to the work units supporting Mayo’s research enterprise. They had to become a real and meaningful component of their management philosophy. The most powerful lesson learned is that fundamental quality management principles may be effectively applied to a complex research enterprise and achieve transformational results within a relatively short timeframe.
LITERATURE CITED


Developing an Institution-wide Web-based Research Request and Preliminary Budget Development System

Julia L. Glenn and Royce R. Sampson
Medical University of South Carolina

ABSTRACT

While medical research may often be regarded by academics and the general population in terms of the remarkable science being conducted or the study participants willing to volunteer their time for the advancement of medical innovation, many in the research administration field recognize the tremendous amount of effort that goes on behind the scenes (Shambrook & Roberts, 2011). Accurate budgeting and compliant billing are two of the critical pieces of an evolving research administration puzzle. These activities are vital to the overall success of any research project and to the integrity of the research institution. In today’s technology-driven world wherein the term “process improvement” is widespread in academic research, electronic tools to reduce burden and increase efficiency have become a common goal at many research institutions. Along these very lines, the South Carolina Clinical and Translational Research Institute at the Medical University of South Carolina (MUSC), the “academic home” of the National Institutes of Health Clinical and Translational Science Award (UL1RR029882), partnered with the institution’s Office of the Associate Provost for Research to develop a streamlined, centralized infrastructure for accurate research budgeting and compliant billing. The purpose of this paper is to describe the conceptual model of an institution-wide secure, web-based research service request and preliminary budget development tool currently under development at the Medical University of South Carolina.
BACKGROUND AND INTRODUCTION

The Medical University of South Carolina (MUSC) was founded in 1824 and today remains the only comprehensive academic health sciences center in the state of South Carolina. The institution strives not only to provide an outstanding educational atmosphere for its students and deliver patient care of the highest quality, but also seeks to be an international leader in the development of new medical knowledge and cutting-edge innovation. To that end, MUSC has a robust portfolio of basic, clinical, and translational research. In FY2010, the institution was awarded more than 1,200 research awards totaling over $234 million and representing over 500 investigators and countless research staff (Office of Research and Sponsored Programs, 2010).

In recent years, MUSC administration and leadership have continuously emphasized the importance of using available technological advances to create streamlined and effective systems for the management, review, and administration of the institution’s abundant research. In the last decade, MUSC has implemented electronic tools for the submission and review of Institutional Review Board and Institutional Biosafety Committee applications, grant proposals to the Office of Research and Sponsored Programs, as well as the submission of applications to Grants.gov utilizing a system-to-system interface (Medical University of South Carolina, 2006). While such processes have undergone a technology overhaul, the critical processes of budget development and review as well as compliant research billing have remained static and have been deemed challenging by many research faculty, staff, and administrators. These processes rely almost exclusively on manual paper transactions and constant, repetitive email and face-to-face communications between various contributors to the study, such as the investigator, study coordinators, service providers, and billing specialists. Research study team members must begin to construct their preliminary research budgets by contacting individual service providers separately to obtain pricing for research procedures. For example, price quotes for a myriad of laboratory tests are requested from the individual laboratories performing the tests; quotes for radiological procedures must come from the university’s Imaging Center or the Department of Radiology; estimated costs for an entire menu of investigational pharmacological services originate from Investigational Drug Services; quotes for specific research nursing services might be secured from the Clinical and Translational Research Center; and so on. Quotes may be obtained via email, paper applications, or phone calls, depending on the individual service provider. In addition, providers of research-related services often operate in silos. They provide pricing for their specific services,
when in fact protocol procedures are often interrelated. A radiological scan, for example, may require contrast media, the cost for which must be obtained from a different source than the scan itself. The current system requires that the individual requesting research services is: 1) aware of this complicating detail, and 2) obtaining the fee for the scan from the Department of Radiology and the technical (or facility) fee for the administration of the contrast from the Hospital Compliance Billing Office.

Once study teams obtain an “accurate” budget through this current method, the equally complicated coverage analysis process begins. This process also relies heavily on constant communication between research study team members and very specific (and sparse) service providers with valuable but individualized knowledge. Research staff must construct a billing grid complete with every research-related service that may incur a cost and subsequently be billed. The billing grid must indicate whether each identified service will be billed to the study sponsor, is a routine care procedure to be billed to a third party payer (such as the research subject’s insurance carrier), or is to be covered by study personnel’s effort. Often these grids must be built from scratch.

Sponsors of investigator-initiated protocols frequently do not provide a general template complete with all billable study procedures. However, while sponsors of industry-initiated/industry-sponsored protocols often supply such templates, they are extremely different from the way the institution actually bills for services (for example, the common line item of “chemistry” may be comprised of a variety of different billable services). In either case, the study team must generate an original grid. Once the billing grid is complete, a Medicare Coverage Analysis (MCA—a thorough review required for all clinical research studies to ensure that any tests, procedures, and/or interventions performed on study participants and being billed to any third party remain in compliance with legal mandates) must be requested from the University Compliance Office to ensure compliant billing throughout the subsequent study. This review entails manually entering information from the billing grid into a large Excel database so that historical decisions regarding coverage can be accessible at a later date. Coverage decisions are communicated to the study team via email and/or phone. Billing grids and budgets are manually updated as a result of the billing review as needed.
This current labor-intensive system of research budgeting and billing compliance review is time-consuming, outdated, and prone to human error. As such, and with a large and growing portfolio of medical research, the South Carolina Clinical and Translational Research Institute (SCTR) and the Office of the Associate Provost for Research sought to develop an electronic system that would accomplish three critical tasks: 1) streamline and centralize the process of requesting research-related services across campus; 2) assist in the timely creation of an accurate preliminary budget and billing grid to ensure research billing compliance for individual research studies; and 3) allow MUSC to be competitive with academic medical centers of similar stature (Stanford University, 2010; Whitney & Wolff, 2011) with regard to electronic research administration and clinical trials management systems. What follows is a discussion of the conceptual model used to develop a comprehensive electronic system for research service requests and budget development at MUSC.

METHODS

Groundwork for the proposed model first began by identifying major stakeholders in the research budgeting and billing process at the MUSC. Key participants, in addition to SCTR and the Office of the Associate Provost for Research, were initially identified as: the Department of Radiology, the Investigational Drug Pharmacy (IDS), University Medical Associates (UMA) and Medical University Hospital Authority (MUHA) Compliance...
Billing Offices, the MUHA Clinical Chemistry Laboratory (MUHA Lab), and the Department of Medicine. These stakeholders were approached with the basic concept of a centralized electronic research request and preliminary budgeting infrastructure and asked to lend support to the project by endorsing the pilot-testing of the proposed system for day-to-day research service requests and approvals. Early meetings with the stakeholders centered on functionality of the proposed system and changes to current workflow. After their endorsement, key project personnel were identified (see Table 1).

These personnel set three goals at the outset of the conceptual model development. With the help and expertise of identified stakeholders, SCTR research specialists, SCTR biomedical informatics programmers and analysts, and departmental research administration professionals who can offer proficient piloting and recommendations, project personnel sought to:

- develop a dynamic and intuitive user interface prototype wherein faculty and staff can request research services from multiple service providers simultaneously and concurrently develop associated research service-related budgets and billing grids with ease;
- develop a streamlined administrative portal model wherein service providers can electronically manage, review, and approve requests for research services and prices as well as provide a thorough billing compliance review; and
- keep all identified stakeholders engaged and informed throughout development to encourage their ongoing recommendations and continued support for the project.

RESULTS

Goal 1. Develop a User Interface Prototype

Project personnel identified three basic objectives for the original user interface model: a) allow users to request research services and associated pricing from various service providers simultaneously via an electronic system; b) allow users to construct a preliminary billing grid and subsequent draft research budget using the requested research services and prices electronically; and c) allow users to electronically indicate how requested research services will be billed/funded for billing compliance review.

To achieve the first objective, project personnel, in collaboration with the service providers whose research services would ultimately be displayed in the system, developed the service catalog interface displayed in Figure 2.
Table 1. Key Project Personnel and Project Roles

<table>
<thead>
<tr>
<th>Project Title</th>
<th>Project Personnel &amp; Affiliations</th>
<th>Project Role</th>
</tr>
</thead>
</table>
| Project Owner        | Royce Sampson, MSN, RN, CRA SCTR SUCCESS Center                       | • Overall concept development  
• Map out system functionality  
• Strategic planning for phased system rollout  
• Review and approve all system content and design  
• Obtain project funding and SCTR Leadership approval |
| Project Leader (2)   | Lane Glenn, BS, MRA SCTR SUCCESS Center  
Amanda Zimmerman, BA SCTR SUCCESS Center | • Assist Project Owner with overall concept development  
• Assist Project Owner with outlining system functionality  
• Develop system content and design (user interface and administrative portal) for Project Owner approval  
• Work with stakeholders to identify system need and requirements  
• Collaborated with SCTR Office of Biomedical Informatics during system development on problems encountered to offer solutions and additional system options |
| Lead Developer       | Mark Gunnels, BA SCTR Office of Biomedical Informatics                | • Analyzes the Project Owner’s/Leaders’ scope of work regarding system functionality and design and creates appropriate system programming solutions  
• Responsible for the overall architectural design of the system from a programming and software perspective |
| Infrastructure Lead  | John Clark SCTR Office of Biomedical Informatics                      | • Responsible for the implementation of the system from a hardware and networking perspective |
| Lead Collaborator    | Loretta Lynch-Reichert, MS Office of the Associate Provost for Research | • Works with key institutional stakeholders to achieve buy-in on and support for the proposed system |
| Project Manager      | Maynard Cain, BS, MBA, PMP SCTR Office of Biomedical Informatics      | • Maps out SCTR biomedical informatics staff tasks and timelines in accordance with Project Owner’s/Leaders’ plan to ensure timely completion of the project |
| Project Programmer (4) | Andrew Cates (Lead), BS SCTR Office of Biomedical Informatics  
Jed Schneider, BS, MA SCTR Office of Biomedical Informatics  
Gary Fredericks, BS, MBA SCTR Office of Biomedical Informatics  
Matthew Scott, BA SCTR Office of Biomedical Informatics | • Manages biomedical informatics development process  
• Implements actual system content and design from a programming perspective  
• Responsible for performing daily/weekly development tasks in support of system release  
• Provides general system maintenance |
Using online shopping as a model, project personnel created a prototype wherein users can easily search for research services under logical groupings. Much like shoppers can search for genres of books at online bookstores, users can search for groupings of various services, such as Laboratory, Radiology, Investigational Drug, etc., or perform a simple search for one particular service. Users can browse services under any of the listed service providers. As users find the service they are looking for, they simply click “ADD” to include the service in “My Services,” which is analogous with an online shopping cart. Rather than requesting services from each service provider separately, users can now select services from multiple providers concurrently.

The system allows each request to be associated with one research project. Users may associate the newly submitted service request to a project that already exists in the system or enter a new project (Figure 3) by providing some basic project information such as title, involvement of human subjects.
and/or research animals, and funding source, as well as authorize project personnel for system access and specific rights. Next, users are asked to provide the estimated total number of subjects and estimated total number of visits to begin constructing their preliminary budget (Figure 4).

With this initial information, the system generates an electronic billing grid template. To achieve their second and third objectives, project personnel created a billing grid with multifunctional views—allowing users to accomplish two tasks: 1) generate an initial budget based on the research services requested, the quantity of selected services at each visit, and the current fees from each of the appropriate service providers, and 2) indicate how each requested service will be billed throughout the course of the study for a thorough billing compliance review. As illustrated in Figure 5, users first enter the number of times per visit that each service is to be completed (1st grid), followed by the funding source (2nd grid). A preliminary research budget (3rd grid) is then produced. Fees that are to be billed to a third party or are to be covered by study personnel’s effort are not included in this original budget.
**Figure 3.** New Research Project Prototype

Below is a prototype of a page from a research management system that allows users to enter a new research project. The form includes fields for short title, funding status, funding source, sponsor name, NIH grant number, and protocol title. There are also sections for federal grant title, federal grant code, federal grant sponsor, and federal grant sponsor name. The form also includes a section for human subjects with options for approval type and approval date.

**Assigned Authorized Users**

<table>
<thead>
<tr>
<th>User Information</th>
<th>Proxy Rights</th>
</tr>
</thead>
<tbody>
<tr>
<td>Role</td>
<td>Access</td>
</tr>
<tr>
<td>Co-Investigator</td>
<td></td>
</tr>
<tr>
<td>Principal Investigator</td>
<td></td>
</tr>
<tr>
<td>Coordinator</td>
<td></td>
</tr>
</tbody>
</table>

**Figure 4.** Preliminary Budget Information Prototype

Next, please enter the following information specific to your research project. This information will help us generate applicable service fees for your review.

<table>
<thead>
<tr>
<th>Estimated Total Number of Subjects</th>
<th>Estimated Total Number of Visits</th>
<th>Estimated Study Start Date</th>
<th>Estimated Study End Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>5</td>
<td>1/31/11</td>
<td>5/31/11</td>
</tr>
</tbody>
</table>
With this initial information, the system generates an electronic billing grid template. To achieve their second and third objectives, project personnel created a billing grid with multifunctional views—allowing users to accomplish two tasks: 1) generate an initial budget based on the research services requested, the quantity of selected services at each visit, and the current fees from each of the appropriate service providers, and 2) indicate how each requested service will be billed throughout the course of the study for a thorough billing compliance review. As illustrated in Figure 5, users first enter the number of times per visit that each service is to be completed (1st grid), followed by the funding source (2nd grid). A preliminary research budget (3rd grid) is then produced. Fees that are to be billed to a third party or are to be covered by study personnel’s effort are not included in this original budget.

![Figure 5. Preliminary Billing Grid/Research Budget Prototype](image-url)
Goal 2. Develop an Administrative Portal Prototype

A robust and intuitive administrative portal is as important as the user interface to ensure success of the system as well as stakeholder buy-in. The administrative portal allows system administrators to manage, review, and approve users’ service requests within a centralized electronic portal. Project personnel identified three key objectives for the proposed administrative prototype: a) allow administrators to receive service requests electronically and quickly view all service requests for their program by status; b) allow administrators to review services of individual requests for approval and tracking purposes; and c) allow administrators to view services requested from other programs to help identify additional required services (for example, contrast media for a particular radiological exam) as needed.

To achieve the first objective a familiar, email-type interface was adopted, wherein administrators can view all service requests for their program sorted by status (Figure 6).

Similar to any modern email client, administrators have an “Inbox” (“Submitted Requests”) where newly submitted requests that need to be addressed reside until the Administrator changes the status from “Submitted” to “In Process.” Once logged in, the administrative portal automatically defaults to this “Inbox” view. The folders indicating status (“Submitted,” “In Process,” “Completed”)
denote the phase of service request review. Administrators can quickly move back and forth between each status to gauge workflow and any outstanding issues at a glance. Administrators can likewise place requests “On Hold” (for example, if the sponsor of a study has put the study on clinical hold for further FDA review), which removes the request from the standard service request status folders and places it in the “On Hold” folder until manually changed by the administrator.

Administrators can likewise send requests out for additional “PI Review” prior to approval (if the contents of the request have changed dramatically from initial submission, for example). Changing a request to “PI Review” status generates an automatic email from the system to the principal investigator summarizing request changes that require his/her approval. Similarly, when any request has been reviewed and approved (described below), the system places the request in the “Completed” tab. This folder (status) view provides a global, multiple-project perspective that facilitates efficient administrative management of the service requests for the program. Within each folder, each request also includes an abbreviated view of pertinent request information: the names of the principal investigator and requester as well as an overview of services being requested (available in a drop-down menu).

Additional features of the administrative portal include the ability to assign any request to a particular staff member for management, review, and approval and to access individual service request details by clicking on the hyperlinked Service Request Identification Number, SRID.

Administrators have a variety of tools available to them in the Service Request Details module (Figure 7).
To accomplish the second and third objectives for the Administrative Portal, project personnel designed a multipurpose Service Request Details module wherein administrators can view both in-depth details about the protocol itself (funding source, sponsor, IRB and IACUC numbers, etc.) as well as the individual services being requested. Within this module, administrators can review, edit, and/or complete data required for service request processing, tracking, and reporting. Examples include ensuring that users have requested the correct services, entered the correct quantity, and received the appropriate service pricing (the system accommodates multiple-tiered pricing dependent upon funding source). Administrators can add and/or delete services to the request as indicated through review of project and/or after discussing the request with the requester and investigator. Since many institutional service providers have policies that require requesters to be

Figure 7. Administrative Portal—Service Request Details Prototype
contacted within 24 hours of the initial request, the system also tracks the date and time of status change for comparison with established program metrics for evaluation and reporting as well as for continued process improvement activities.

In addition, administrators not only have access to any pertinent documents users may have attached to the initial request under the “Uploads” tab but can also upload applicable documents related to the service request to facilitate the proposal pricing process, document work fulfillment, or share pertinent information directly with the investigative team (Figure 8). Often, review of a protocol and consent by the service provider helps to ensure that all necessary services have been requested and pricing is accurate. Likewise, this ability for users and administrators to share documents can facilitate effective service consults as needed in areas such as regulatory, ethics, and biostatistics. All service request documents are accessible to the requester, the Principal Investigator, and any other users given access. This feature allows service providers and users to “communicate” as needed through a versioned/auditable document repository.

Figure 8. Administrative Portal—Document Repository Prototype
Lastly, to view those services requested from other programs for any individual service request, administrators simply click on the “Related Service Requests” tab within the module (Figure 9). Like their Administrator Inbox, administrators have access to an abbreviated view of all other service providers involved in the protocol as well as individual services requested from each provider. This functionality ensures that service providers do not operate in silos but are able to provide integrated, collaborative, and comprehensive services in order to better promote the success and compliance of investigators’ requests.

![Figure 9. Administrative Portal—Associated Service Requests Prototype](image)

**Goal 3. Engaging and Informing Stakeholders**

Due to the trans-institutional nature of this project, as well as multiple and diverse service providers and potential system users, project personnel recognized the critical importance of keeping all stakeholders engaged, involved, and informed throughout conceptual model development. Encouraging input, suggestions, and pilot testing from stakeholders would be the key to the overall success and eventual institutional adoption of the model. To succeed, this system could not simply be the sole innovation of SCTR.

To achieve this crucial goal, project personnel employed a variety of methods, including bi-monthly meetings with all identified service providers. With all providers convened together in an open forum, suggestions for and concerns with the proposed system were elicited and
encouraged. Because providers had a long history of operating separately, this joint meeting proved extremely beneficial. Providers were able to discern how others operated and discuss centralized workflow through the new system. Project personnel were able to identify additional features that may allow the system to function even more efficiently. Project personnel also arranged separate meetings with individual service providers to ensure that no one provider perceived any major difficulties or issues with the system, as well as to encourage providers to voice ideas on how to enhance the system using their individualized knowledge.

To keep potential system users engaged and informed during conceptual model development, project personnel also participated in a number of bi-monthly campus outreach meetings (departmental meetings, clinical trials billing meetings, Lunch ‘n’ Learn presentations). During each meeting, project personnel gave a brief overview of the proposed system (functionality, use cases, proposed workflow) as well as an update on the conceptual model development and future implementation. User feedback, small user workgroup participation, and user pilot testers were solicited during each meeting.

To garner support from institutional leadership and administration, project personnel provided a number of brief presentations on the proposed system at the College of Medicine Dean’s Council meeting as well as various Departmental Administrators meetings. All presentations were received enthusiastically.

The success of these assorted techniques to keep stakeholders engaged and informed has been evaluated by several metrics. The number of service providers wishing to partake in the system has grown from the original six to more than 10, and the list continues to grow with the recent addition of numerous institutional Cores and Facilities. Project personnel have identified no fewer than 15 departments and divisions across campus requesting to utilize the system for requesting and budgeting for services, ranging from Transplant Surgery, to Pediatric Cardiology, to Radiology.

**CONCLUSION AND NEXT STEPS**

These results, which demonstrate the successful development of comprehensive prototypes that delineate a practical and efficient means of electronically managing, reviewing, and administering a variety of vital pre-award activities, while ensuring the continued interest and participation of current stakeholders and encouraging future participants, have clear implications for the proposed system.

Due to such sizeable interest in the proposal from not only the individual providers of research-related services but also from the research administration community at large, development of the system has begun in earnest. The SCTR Biomedical Informatics Program has
dedicated five full-time programmers and analysts to the project in hopes of releasing the first iteration of the system in late Fall 2011. In preparation for this release, project leaders and project managers continue to publicize the conceptual model of the system across campus—to individual departments and divisions, research administrators, and top institutional leaders—in order to garner further support and solicit additional feedback for future upgrades and enhancements. In addition, project personnel have begun to draft a training and education plan to coincide with the release. System training will focus on both broad institutional education (Tegrity sessions available to all users, SCTR Lunch ‘n’ Learn presentations, new faculty orientation, etc.) and individualized/one-on-one training sessions as requested.

Proposals for future system enhancements and upgrades already abound. Planning and designing activities have already begun to incorporate the first of many such system augmentations. After the release of the initial system this fall, SCTR and its collaborators will begin to develop a robust user dashboard (a prototype of which is displayed below) that will display an overview of pertinent study and investigator information, such as a list of all protocols and service requests within the system, a catalog of related grants and publications, system notifications, etc.

![User Dashboard](image-url)

**Figure 10.** User Dashboard
In addition, SCTR will begin to develop a strong study tracking and work fulfillment infrastructure that ties directly into the request and budget development system. This study tracking system (a small pilot of which has already been released for early feedback) is multifunctional and will enable study team members to track work performed on a discrete study (at the individual study participant and visit level) for sponsor invoicing purposes and service providers to track work performed within their individual service centers for PI billing.

Other proposed upgrades that will be explored include: an electronic subject enrollment log and visit scheduling calendar, a consent tracking and versioning system, and electronic source documentation abilities.

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LITERATURE CITED

http://research.musc.edu/orsp/Reports/FY10.pdf


Managing Risk and Uncertainty in Large-Scale University Research Projects

Sharlissa Moore and R. F. Shangraw, Jr.
Arizona State University

ABSTRACT

Both publicly and privately funded research projects managed by universities are growing in size and scope. Complex, large-scale projects (over $50 million) pose new management challenges and risks for universities. This paper explores the relationship between project success and a variety of factors in large-scale university projects. First, we characterize the challenge of large-scale university research project management, synthesize findings from the literature, and identify research gaps. Second, we offer a profile of large-scale U.S. university-run projects based on a survey conducted by us. The projects address a range of research from large-scale clinical trials to the construction of complex scientific instruments. While NIH is the largest overall government funder of university research, NASA is the largest funder of these large-scale university projects. Third, we share some preliminary results from our survey. While universities often meet their technical performance goals, cost and schedule overruns are common and can be significant. Qualitative data confirmed that research project managers face anti-management challenges in the university setting and challenges with project management techniques not tailored to the university.

INTRODUCTION

The number of large, complex research projects managed by universities is growing in size and scope. Additionally, industries are shifting more research projects to universities (Hall, Link, & Scott, 2003). At Arizona State University (ASU), for example, the amount of annual funding for sponsored projects over $5 million has risen from $10 million to $40 million over the past twenty years (Raudenbush, 2011). Large-scale research projects (over $50 million) pose management challenges and risks because they are often complex and unpredictable, involve new technologies,
involve a large number of stakeholders and institutions, and extend over a long time scale (Bonnal, Jonghe & Ferguson, 2006). The traditional project management (PM) literature offers a number of methodologies for managing risk and uncertainty in large-scale projects, with a focus on minimizing cost and schedule overruns. However, universities are not known for the implementation of sophisticated project management systems and the management methodologies may fall by the wayside of ‘getting the science right.’ The relatively new field of research project management (RPM) is still developing its professional identity and gaining legitimacy, and scientists have resisted managers’ attempts to engage in research project management (Sapienza, 2004; Schuetzenmeister, 2010).

As the scope and size of research projects expand, universities have become major players, and sometimes leaders, in multi-million dollar research and development (R&D) projects. For example, in 2009, the National Science Foundation (NSF) awarded over $200 million to the University of Wisconsin-Madison to construct a deep-ice neutrino detector, called IceCube, in Antarctica. In 2007, the National Institutes of Health (NIH) awarded over $63 million over three years to George Washington University to develop a Diabetes Prevention Program. Over the past decade, NASA has granted several dozen awards over $100 million to universities for first-of-a-kind spacecraft research and development, including Genesis, Deep Impact, and Galex. These research projects are often: (1) extremely complex; and (2) decentralized, with work occurring at multiple institutions and across disciplines; and (3) may change dramatically in scope. All of these risk factors contribute to cost and schedule overruns in large-scale projects.

“. . . large-scale research project management techniques should be improved in order to increase project success.”

This paper explores the current population of completed or nearly completed large-scale university-run research projects and then examines the relationship between university management techniques and project success. We demonstrate that a significant amount of funding is spent on university-led projects larger than $50 million and argue that large-scale research project management techniques should be improved in order to increase project success. We begin by discussing how large-scale projects are defined and characterized in the literature and how we apply these characteristics to large-scale university-run research projects. Next, we discuss a number of challenges facing university research project managers. We then offer an
overview of project outcome measures, primarily cost, schedule, and technical performance, and discuss how these apply specifically to R&D. Next, we describe our methodology for developing a sample of large-scale university-run projects, which we believe is the total population minus U.S. Department of Defense projects. We describe the attributes of this population, finding a median university total project cost expenditure of $93,586,025 and an average project timescale of seven years. Finally, we share some preliminary findings from our survey of managers of these projects. While many university projects meet their overall technical objectives, many do so by overrunning the original cost and by slipping the initial schedule.

WHAT IS A LARGE-SCALE RESEARCH PROJECT?

The large-scale project and its even larger counterpart, the megaproject, are often defined based on cost ranges, though these cost ranges vary throughout the literature. For example, Flyvbjerg (2007) defined large-scale projects as those that cost between $100 million and several billion dollars. He defined megaprojects as projects over $1 billion with a lifetime of 50 years or more (Flyvbjerg, 2005). Merrow (1988) defined large-scale projects as those over $500 million, and he defined projects over $1 billion as “very large projects.” Large-scale research projects, however, are generally lower in cost than the large-scale infrastructure projects on which much of the literature on large-scale projects focuses. Further, projects on which the university is the lead manager are typically on the lower end of the large-scale research project cost range.

For the purposes of this study, we used a cost threshold of over $50 million in total project costs to characterize large-scale research projects, of which there are roughly 58 U.S. university-led projects in the United States (as of 2010). This choice was empirically driven. If we had used the $100 million cut-off from the literature described above, the sample would have been limited to 21 projects and skewed toward National Aeronautics and Space Administration (NASA) and U.S. Department of Energy (DOE) projects led by California Institute of Technology (Caltech) and Stanford University. Types of scientific and technical research projects over $50 million include the construction of complex scientific instrumentation; the construction of first-of-a-kind spacecraft; the design of innovative weapons systems; the construction of large-scale, first-of-a-kind computing infrastructure; longitudinal clinical trials; and bioscience research projects with a singular objective. Due to our focus on university management, we did not address scientific megaprojects, which are typically over $1 billion and international in scope, and extend over
decades (Cross, 2009). Scientific megaprojects are often managed by one or more government agencies rather than universities. Examples of megaprojects include the International Space Station, the Human Genome Project ($3 billion), and the Superconducting Super Collider (expected cost of $8 billion, but cancelled in 1993). While these “Big Science” projects garner much attention, guidance and program evaluation are also needed on middle-range university-led projects, which also represent significant research expenditure.

We defined a project as having a clear objective and timescale and a definable outcome. In contrast, many large-budget scientific operations are research programs with components at multiple universities, across scientific domains, and sometimes representing several countries. Basic research at this funding scale tends to be conducted at dozens of universities working to fulfill a research center’s typically broad mission. NIH funds a number of research programs distributed across multiple universities, such as the Center for AIDS research, national/regional primate research centers, and the general clinical research center. These did not fall under our definition of a project.

Basing the definition on a range of total project costs is likely not the only, and perhaps not the most useful, metric for characterizing these large-scale research projects in a way that facilitates understanding of the management challenges they pose. Large-scale research projects are also often highly complex and uncertain, extend over long time scales, and involve a large number of stakeholders and researchers. Bonnal et al. (2006) characterized large-scale projects based upon the following factors: number of contributors to the project; number of activities the project seeks to perform and the relative complexity of these activities; number of intermediate deliverables that are produced throughout the project’s execution; number of activities outsourced to external contractors; and project duration that can span over a decade, making it difficult to define the long-term objectives of the project at the project’s conception. In fact, these characteristics are more relevant to research projects, which may have smaller budgets than construction projects but be extremely complex in terms of the number of involved actors and institutions; the number of experiments and activities; the long time periods, particularly until the science is translated into a societal benefit; and the number of stakeholders ranging from human subjects to the policymakers and taxpayers funding the research. In summary, large-scale research projects, for the purposes of this study, have a clear and achievable research goal, are very complex, often involving uncertain technologies, typically involve a large number of actors and institutions, often involve relatively
THE CHALLENGES OF MANAGING LARGE PROJECTS AT UNIVERSITIES:
MANAGEMENT KNOWLEDGE AND THE RESEARCH MANAGEMENT PROFESSION

Universities are being called upon to manage increasingly large research and technology development projects, but there has been a surprisingly small subsequent gain in the systematic knowledge of the challenges and risks involved with university research project management (RPM). Universities face challenges in each stage of managing large-scale projects: winning the project, defining the project, and managing the project. Universities face two key conceptual issues when managing large-scale projects. First, universities are not designed as project management organizations and therefore are not necessarily equipped to manage these behemoth projects in an efficient manner. Second, research does not progress in a linear fashion in the way that construction projects often do. Research project managers face the discovery paradox, meaning that discovery occurs in serendipitous ways, but existing management techniques are typically linear and prescribed.

To address these challenges, 1) knowledge of university project management is needed, and 2) experienced research project managers are needed. We will address the need for RPM knowledge first. The traditional project management profession has developed a set of project management tools based initially on experience with construction and infrastructure projects. These tools have been refined for large-scale weapons systems, environmental clean-up and restoration projects, and large-scale information technology projects. This experience and research have even been synthesized in a number of publications, including the Project Management Body of Knowledge published by the Project Management Institute. However, higher education institutions are often the slowest adopters of project management (Kralevich, 2008). While there is some synergy with traditional project management techniques and research project management, PM techniques designed specifically for university are lacking (Austin, 2002; Erno-Kjolhede, Husted, Monsted, & Wenneberg, 2001; Powers & Kerr, 2009). This is a gap in need of further research.

As mentioned above, these research project managers face the scientific discovery paradox. Geles et al. (2000) argued that most project management strategies were designed for business, not science; further, this literature is not
“Research project managers face the discovery paradox, meaning that discovery occurs in serendipitous ways, but existing management techniques are typically linear and prescribed.”

rigorous. Geles et al. outlined some of the project management strategies they believe would be suitable for use in the laboratory, including using a work breakdown structure for planning, charting the overall resource inputs required for the project, planning for risks and contingency, scheduling using Gantt Charts and project milestones, and using a costing scheme that converts resources into a common unit, e.g., U.S. dollars. Others feel more strongly that a completely new set of methods should be developed. Austin (2002) argued that the project management literature is too uniform and is not adaptive enough to be applied to science where there is “genuine discovery” that cannot be anticipated and planned for. Conventional project management strategies are better suited for construction because it is more predictable. Instead of spending a lot of time planning, research projects will require some learning-by-doing. Therefore, Austin argued, dynamic research project management methods with adaptive approaches are needed for innovative projects. This discovery paradox is a key challenge facing research project managers moving forward.

Also needed are experienced research project managers. A National Research Council report argued that Ph.D. scientists have not been trained in management, so large-scale research projects will require a research project manager who should be hired based on management skills, not scientific credentials (Nass & Stillman, 2003). These research project managers fulfill an important role in managing a growing amount of external funding for the university and their level of experience is thought to contribute to keeping projects on schedule and budget. This unique profession interweaves academic, managerial, and public service training and skills (Schuetzenmeister, 2010). It works at the boundary between science and society, managing and negotiating with multiple stakeholders both in and outside of the academy (ibid.).

“...most project management strategies were designed for business, not science ...”

However, the research management profession is still forming its professional identity, struggling to delineate itself from university administration (ibid.). It is also working to prove that it possesses legitimate expertise and a credible identity in laboratories that have traditionally seen
themselves as self-governing. There is a stigma that managing science is not as good as doing science, and large-scale research project managers must work to develop an interactional form of expertise even though they are often not trained in the particular field of study and are often less eminent than the scientists they are managing (Collins & Sanders, 2007). Research project managers face the following challenges in the lab: forces that pull research teams apart, anti-management (i.e., resistance to being managed), goal conflict between scientists and managers, difficulty with performance evaluation, and anti-organization because following the scientific method is viewed as providing sufficient organization (Smith & Tuttle, 1988). Further, large-scale research projects often require management across multiple disciplines and communications barriers may increase the project risk (Sapienza, 2004).

“There is a stigma that managing science is not as good as doing science . . .”

MANAGING COST, SCHEDULE, AND TECHNICAL RISKS IN LARGE-SCALE RESEARCH PROJECTS

All large-scale projects entail a unique set of management challenges. These include the following: the technology involved is often not standard, the decision-making process includes multiple actors with conflicting interests, the project scope and ambition level change over time, contingency estimates are usually inadequate despite statistical forecasts, and misinformation about costs and benefits is the norm (Flyvbjerg, 2005). These factors may result in cost overruns and performance shortfalls in a majority of projects (ibid.). Project management is geared toward increasing planning to reduce project uncertainty and risk. Project risk is a function of complexity, innovativeness, project definition, management experience, regulatory environment, budget certainty, and error (Cash, McFarlan, & McKenney, 1992; Merrow, 1988; Myers et al., 1986; Weil, 1992).

Schedule Slip

Changing project scope and poor project definition are key contributors to schedule slippage. Defining the project includes mapping out the project tasks, task relationships, project environment, and outcomes. Poor project definition has been shown to be a key contributing factor to cost and schedule overruns (Myers et al., 1986). Myers et al. (1986) also found that slippage in the project’s total startup time could be explained by the number of process steps that were not commercially proven and by dispersed project responsibility. It is also widely acknowledged in the literature that
project scope change is a major contributor to risk and uncertainty and drives schedule slippage. For instance, Samid (1994) found that one of the biggest challenges in R&D projects is that there are so many late-planned changes that the project bears little resemblance to the original plan (a reflection of the discovery paradox).

**Managing Cost Uncertainty and Overruns**

Cost growth, or cost escalation, is the difference between the estimated cost and the actual cost of the project (Merrow, 1988). In large-scale projects, technical goals usually take priority over time and cost goals (Grun, 2004). Therefore, cost growth in large government-funded construction and infrastructure projects has been a major focus in the PM literature. Unsurprisingly, cost escalation is identified as a major problem in these larger projects, with overruns of 50–100% being common (Skamris & Flyvbjerg, 1997). It seems that cost overruns are determined early in a project’s lifespan; Christensen (1993) found that defense contracts are highly unlikely to recover from cost overruns incurred in the first 15% of the project.

Cost overruns are also often blamed on mis-estimation. In one study of infrastructure projects, underestimation was found to occur in nine out of ten cases (Flyvbjerg, Bruzelius, & Rothengatter, 2003). Priemus et al. (2008) analyzed cost estimates in megaprojects and found that they have not improved in the past 70 years, and Ramachandran (1989) found that while cost-estimating methodology has become much more sophisticated, the level of accuracy has not improved. There is disagreement in the literature about the reasons for mis-estimation. Sometimes it is attributed to appraisal optimism. Samid (1994) found that in construction projects contingency is often just used to pad cost estimates, rather than being thoroughly analyzed. Bruzelius et al. (2002) found that in megaprojects of $1 billion or more, the difference between the cost forecast and actual costs could not be attributed to inability to predict the future alone. They concluded that project proponents are intentionally biasing the forecasts, leading to poor decision-making by policymakers who are unable to rigorously evaluate the costs and benefits of a project because of these biased forecasts. They assert that technical error is actually a minor part of the cost overrun. Flyvbjerg (2007) recommended subjecting project forecasts for publicly funded projects to rigorous peer review.

“... while cost estimating methodology has become much more sophisticated, the level of accuracy has not improved.”
R&D and Risk

One of the main risk factors addressed in the literature is technological complexity, also referred to as the level of innovation in the project or the use of ‘unproven technologies’ (Parker, Benson, & Trainor, 1988; Sadeh, Dvir, & Shenhard, 2000; Shenhard & Dvir, 1996). The level of technological innovation in the project contributes to uncertainty and can result in cost escalation (Melamed, Skokan, Zenkowich, & Kocher, 2008; Merrow, 1988). The three measures of the level of innovation are whether 1) the project used a first-of-a-kind technology, 2) it employed new materials or methods, and 3) it was the largest project of its kind when it was constructed.

R&D brings with it uncertainty that is difficult to quantify. Pinto and Covin (1989) drew distinctions between R&D projects and construction projects due in part to overt risk. Rigorous, yet flexible, techniques are needed (Samid, 1994). Previous knowledge is required for effective statistical analysis, yet in R&D projects the assumption that previous knowledge can be used to predict outcomes often fails (ibid.). Austin (2002) argued that risk management for highly uncertain R&D projects might need to be different from the risk and uncertainty methodology that has been well developed in the construction industry. In a survey about the usefulness of risk management strategies, Galway (2004) found that construction managers are wedded to risk management, but high technology practitioners are ambivalent toward it.

LARGE-SCALE UNIVERSITY RESEARCH PROJECT MANAGEMENT SURVEY RESULTS

Methodology

We developed a sample of recently completed or nearly complete research projects over $50 million in which a U.S. university was the primary leader. Our sample size was 58, which we believe is the total population minus U.S. Department of Defense (DoD) projects. We faced several challenges developing this sample. First, there was little freely available information on the number and manager of large-scale research projects funded in the United States. Second, grant money was often distributed over multiple years or even through multiple grants and thus difficult to aggregate. We obtained project lists from the NIH, Centers for Disease Control (CDC), NSF, DOE, and NASA. Only NSF hosts a publicly available online database that may be searched by project cost. NASA and DOE staff provided us with information from internal databases. DOE maintains an online research and development database, but it is not searchable by cost. The NIH hosts a publicly available database with grant information,
but it also cannot be searched by project cost. NIH and CDC required us to submit Freedom of Information Act (FOIA) requests in order to obtain the data. We were unable to obtain data from the DoD; the DoD officials we contacted were unaware of any DoD-funded university-run projects over $50 million. We also contacted the sponsored projects office at major universities, but most were unable to provide us with a list of their large-scale projects.

We designed a 28-page survey instrument that addressed the characteristics of the project, information about the project manager and project team, whether the project experienced cost overruns or schedule slip, what factors contributed to a successful project, the management and planning techniques used, and demographics. We asked the respondents to report on their initial cost and schedule estimates and their final cost and schedule outcomes to correlate these outcomes with a variety of risk factors. The development of the questions was theory-driven, drawing on factors in the literature thought to contribute to project success.

The survey was administered to project managers online through SurveyMonkey. If the project did not have an RPM or the RPM could not be reached, the survey was sent to the project’s Principal Investigator. We sent an alert letter to both the university’s office of research and to the head of the project prior to sending the survey invitation. We also sent multiple email requests and made follow-up calls aimed at boosting the response rate.

Characteristics of the Project Sample

Our development of the sample offers a unique overview of the characteristics of university-run large-scale research projects. The median university total project cost expenditure for the sample was $93,586,025. The average timescale for these projects was roughly seven years (or a median of 6). The federal government is the main funder of projects of this magnitude. There was no systematic method for searching for state-funded projects, and only one was uncovered through internet and database searches. The sample consisted of three CDC projects, 11 DOE projects, 24 NASA projects, 15 NIH projects, six NSF projects, and one Ohio Department of Transportation project (see Figure 1).

Even though NIH is the largest overall government funder of university research (AAAS, 2012), it does not fund the greatest number of large-scale university-run projects. This is because much of NIH’s research funding is dispersed across universities and is not project-based. For instance, much of NIH’s expenditures are spent on basic research that is expected to one day translate into societal outcomes. NASA is the biggest funder of university-run large-scale research projects.
research projects consists of large NASA space contracts, complex large-scale scientific instrumentation and research using this instrumentation funded by DOE and NSF, and longitudinal clinical trials and other project-based biomedical research

Agency funders of large-scale university research

![Pie chart showing funding agencies for large-scale university research]

- DOE 18%
- NASA 39%
- NIH 11%
- NSF 25%
- OH Dept. of Transport 2%
- CDC 5%

Figure 1. Funding Agencies for Large-Scale University-Run Projects Based on the Number of Recently Completed or Almost Completed Projects (through 2010). Note that this describes the survey sample, not survey respondents.

Four universities stand out as leaders in winning large-scale project contracts: California Institute of Technology (six projects plus one in partnership with Colorado State University, one in partnership with Hampton University, two in partnership with the Southwest Research Institute, and two in partnership with the University of California, Los Angeles), MIT (three projects), Stanford University (five projects), and the University of California, Berkeley (three projects).

As illustrated by Crow and Bozeman (2001), national laboratories provide leverage for universities to win large-scale projects. For example, Caltech’s leadership may be attributed to its close partnership with JPL and its history of leadership in space projects. Many of the universities in the sample have partnerships with national laboratories, including Fermi National Laboratory (University of Chicago), Princeton Plasma Physics Laboratory (Princeton University), Jet Propulsion Laboratory (JPL) (California Institute of
Technology), and Lawrence Berkeley National Laboratory (University of California, Berkeley). Further, NASA provides an experienced project manager through one of its labs—e.g., NASA JPL, NASA Goddard, or NASA Langley—for all projects on which the university is the Principal Investigator. In other cases, a novel university hybrid organization managed the projects. For example, the construction of the High-Performance Airborne Platform for Environmental Research (HIAPER) was managed by a university research consortium, the University Corporation for Atmospheric Research. The project took five-years and was completed in 2006 for a total project cost of $80 million. It was funded by NSF.

"... national laboratories provide leverage for universities to win large-scale projects."

These projects were diverse, including construction of complex scientific instrumentation, construction of first-of-a-kind spacecraft, fundamental research, and clinical trials (see Figure 2). Twenty-four of the projects involved first-of-a-kind space missions. For example, Deep Impact was a mission to impact and take samples of a comet. It was headed by University of Maryland (providing the Principal Investigator and scientific team) with the JPL (providing the project management) and Ball Aerospace & Technologies Corporation (providing the flight hardware). The construction and mission took six years at a total project cost of $330 million, $66 million of which went to the university. In another example, the NASA Wide-Field Infrared Survey Explorer (WISE) mission mapped the sky at four different infrared wavelengths with greater sensitivity than past maps. It was a $320 million mission in total project costs—with $220 million going to Caltech—over 11 years. The Principal Investigator was provided through the University of California, Los Angeles; NASA’s JPL provided the project manager.

The NIH-funded biomedical projects ranged from clinical trials to genetic sequencing. One example is the $156 million Health and Retirement Study by the University of Michigan—a longitudinal in-depth interview study of senior citizens living in the United States. The researchers are interviewing 22,000 Americans over age 50 every two years. Another example is the sequence of the yeast genome by Stanford University at a total project cost of $97.5 million. A third is the BARI II trial at the University of Pittsburgh, which was a multi-country clinical trial on type II diabetes and coronary artery disease funded at a total project cost of $55 million.

NSF and DOE funded a number of complex scientific instrumentation construction projects. For example, the Ice
Cube project, run by the University of Wisconsin-Madison and funded by NSF, entailed the construction of a deep ice neutrino detector at the South Pole. The project required drilling 86 holes and installing 5,160 sensors for a total expenditure of $200 million. Another example is the Earthscope project funded by NSF and managed by Stanford University. It consists of 400 portable seismometers covering the entire United States, global positioning instruments positioned to observe fault zones in North America, and strainmeter instruments for observing and studying plate boundary processes and volcanic events. Other projects in the sample were large-scale research projects conducted on recently constructed complex scientific instrumentation such as the Alcator C-Mod Fusion Research Program funded by the DOE, the National Compact Stellarator Experiment, and the Stanford Linear Collider Research and Development.

![Type of project](image.png)

**Figure 2.** Type of Project Based on the Number of Recently Completed or Almost Completed Projects (through 2010). As categorized by the authors.

**Survey Results**

We received 18 partial responses and 12 complete responses from a sample of 58. Unfortunately, this was not a high enough response rate for statistical significance, but we were able to make some observations, outlined below. The dependent variable was project success, defined by whether the project met technical performance, cost, and schedule goals. Independent variables included key factors that the literature suggested would drive cost and schedule
overruns, such as years of experience of the project manager; adequacy of project planning, particularly cost and risk estimation methods; changes in the scope of the project; inadequate project definition; sufficiency of the cost estimate; and interdisciplinary communication barriers.

Project success, defined as meeting technical performance, schedule, and cost goals, was mixed. The response rate for the cost and schedule slippage questions was low. Only project managers who met their technical performance goals responded to these questions, biasing the results toward successful projects. The response rate for the project cost estimate and actual expenditure was particularly low (n=5), perhaps due to the sensitivity of the question. Only one project manager reported meeting the project budget, while two experienced moderate overruns (5–10% of the estimate) and one experienced a significant overrun (15% of the estimate, or $15 million). Forty-two percent of projects came in on time or ahead, 29% were somewhat behind (i.e., 25–50% over schedule), and 29% were very behind (i.e., 25–50% over schedule) (n=8).

Therefore, while all of the projects delivered on their technical promises, many did so well over schedule. Figure 3 outlines project success, which we defined based upon the significance of the cost overrun, the significance of the schedule overrun, and whether technical performance goals were met. Sixty-seven percent of projects were somewhat successful, 11% were successful, and 22% were very successful. Surprisingly, only half of the projects (n=18) conducted a project risk assessment in the planning phases, suggesting planning for risk and contingency was insufficient.

Figure 3. Project Success, as Defined by Cost, Schedule, and Technical Performance Goals. Source: PASW
Based on findings from the literature, the project manager’s experience level was expected to affect project success. The majority of all managers who responded were highly experienced, with about 85% having five or more years of experience on projects over $50 million. Sixty-four percent had master’s degrees in science, technology, or medicine, and 22% had Ph.D.s. (see Figure 4). Additionally, 61% had training in the scientific sub-discipline related to the project. In 77.8% of cases, project managers reported that the experience of the project staff was also critical to meeting technical performance goals.

**Figure 4.** Project Managers’ Education in Science, Technology, or Medicine
Source: PASW

Fifty-seven percent of the projects experienced turnover in the lead project manager during the project. While we expected to find that turnover in the lead project manager negatively affected the project, two managers stated that the change was positive because the initial project manager was either inexperienced in large-scale project management or was inexperienced in the scientific domain. Several others stated that there was a negative impact at the time of the change, but overall the change turned out to be positive, or even very positive, because they gained a more experienced manager.

The project managers’ qualitative responses revealed challenges with anti-management and university-specific management techniques, reinforcing the findings from the literature on research management outlined above. One of the project managers reported that many of the
PM techniques NASA suggested they use were irrelevant to a university setting. Another pointed out that university clocks operate on different schedules than those of the aerospace contractors. Several managers reported that ‘managing by walking around and speaking informally with people’ was the most important technique. S/he stated, “people working on the mission need to know that you know them and that their contribution is important.” In summary, project communication is important to success.

Five shared frank comments about their experiences with anti-management, with one stating:

...many of the individuals assigned to work on the project were unfamiliar with, and resistant to, the implementation of formal project management processes. This resistance often led to a hesitance (and in some cases a refusal) to work with me and others on the project team to perform appropriate cost, schedule, and status reporting.

This finding reinforces the findings from the literature that research project managers face significant anti-management challenges and adds to it the possibility that these challenges may lead to cost and schedule overruns. One RPM reported significant staff turnover in the project due to anti-management.

Other RPMs reported struggling with scientists who believed management and science were mutually contradictory, with one stating that:

Some scientists within the organization firmly believed that management of the project was contrary to scientific discovery; that managing to a budget, schedule, and scope were ‘anti-science.’

This experience reflects the scientific discovery paradox.

**DISCUSSION AND CONCLUSIONS**

These preliminary findings suggest that there is much more to be learned about managing university projects. Research managers will continue to face challenges with anti-management, the discovery paradox, and university design. Developing project management methods that are tailored to the university setting and to risk factors specific to large-scale research projects is necessary for moving universities toward even greater success in completing research projects on time and on budget.

We discovered throughout the research process that federal agencies and universities lack data and data transparency about their large-scale projects. This makes it difficult to systematically develop a profile of the large-scale university-run research funded by the U.S. government. It also suggests a lack of coordination in this research profile. Additionally, most major
research universities were unable to provide us with data, with one sponsored projects office lamenting that such data were very difficult to collect in their decentralized institution. The NSF has taken an excellent first step with its online database of projects searchable by cost. Other agencies may consider developing such databases, adding cost parameters to their existing databases, or making data available through databases like data.gov.

“Developing project management methods that are tailored to the university setting and to risk factors specific to large-scale research projects is necessary for moving universities toward even greater success in completing research projects on time and on budget.”

While rigorous project evaluation may improve future project success rates, it is difficult to execute. Barriers to effective project evaluation include: difficulty tracking evolving projects; concern over disclosure of proprietary information; and a lack of incentive for managers to participate, particularly if the project was unsuccessful (Galway, 2004). While the key objective of our survey was to determine the significance of cost and schedule overruns in these projects, the response rate in that section of the survey was particularly low. Further, several project managers reported to us that they were not allowed to participate in such a survey. The length of the survey also contributed to the low response rate, particularly since there are few incentives for extremely busy managers to devote time to program evaluation. The research management profession and funders should consider counteracting these barriers, perhaps with incentives offered for participating in program evaluation. As management methodologies improve, research project managers will likely benefit from focusing on and improving project definition and structuring projects to reduce their complexity. Conducting a project risk assessment at the initiation of the project is also likely to aid in success. Universities may also consider opening a project management office to aid in winning these projects and successfully managing them.

ENDNOTES

1. In this study, ‘research’ describes the spectrum of fundamental and applied scientific research as well as innovative technology projects.
2. This excludes the U.S. Department of Defense projects, for which data were unavailable.
3. For a discussion of scientific research and serendipity, see Hackett, Parker, Conz, Rhoten, and Parker (2006).
4. Project duration data and total university expenditures were available for 48 of 58 projects. The data gaps for cost were for NASA projects; the agency told us that the university contract was above $50 million for the list of projects they provided, but they did not provide us with the exact amount. We were unable to locate this information in the public domain for 10 projects. If data were available for the missing 10 projects, it would likely increase the median cost because NASA total project costs were generally higher. Note that cost expenditure and project duration data, where available, were provided by agency databases, except for NASA. NASA cost/duration data were obtained from govbudgets.com NASA edition or from project websites.
5. These data were only available for nine projects.

WORKS CITED


Crafting a Sales Pitch for Your Grant Proposal

Robert Porter
University of Tennessee

ABSTRACT
Experienced grant writers know that reviewers are quick to decide whether they like or do not like the proposals they are reading. Therefore, much of the success of any given proposal rides on the strength of the first page—its capacity to “sell” the research idea to skeptical reviewers. This paper describes a writing technique designed to elicit a positive response from grant reviewers at the outset. While the three-paragraph template does not guarantee a winning outcome, it will set the stage for high reviewer scores now required for success in the increasingly competitive world of sponsored research.

INTRODUCTION
In many fields, we know that first impressions count, from job interviews to curbside appeal in real estate. In the highly competitive world of seeking funds to start new businesses, conventional wisdom holds that a good pitch is a short pitch. Venture capitalists are an impatient audience; unless a business idea engages them from the start, they quickly lose interest (Schroter, 2007). In seeking funding for their research, grant writers face a similar challenge, as reviewers form strong first impressions immediately upon reading the abstract (Molfese, Karp, & Siegel, 2002). The pressure is undeniable: Grant writers must find timely ways to win over reviewers before their proposals are mentally consigned to the “do not fund” category.

“Seasoned grant reviewers will admit to making up their minds on the very first page of the proposal, and rarely change their posture as they read the rest of the document.”
One of the more daunting challenges facing new grant writers is the need to adopt a different rhetorical style. Instead of the expository mode that characterizes most academic writing, a strong grant proposal has to be persuasive from the outset, i.e., it must sell the fundamental idea to a body of grant reviewers who, like venture capitalists, quickly adopt a mental “thumbs up/thumbs down” attitude toward the document they are holding. Seasoned grant reviewers will admit to making up their minds on the very first page of the proposal, and rarely change their posture as they read the rest of the document (Porter, 2005, 2007). A strong grant proposal can be defined as an elegant sales pitch. Therefore, it is critical that the proposal sell itself to the reviewers, and do so quickly, preferably on the first half of the first page. Typically, grant-writing guides recognize the importance of creating a strong first impression, but few offer specific advice. An exception is Friedland and Folt’s Writing Successful Science Proposals (2009), which presents a two paragraph model for writing an effective abstract, but does not emphasize the use of persuasive rhetoric.

**CONSTRUCTING THE PITCH**

This paper describes a three-paragraph template that grant writers can use to construct a sales pitch for their proposals (Table 1). These are not long paragraphs; consisting of three to four sentences each, in total they should take up no more than one-third to one-half of the proposal’s first page.

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**Table 1. Constructing the Sales Pitch: Three Paragraphs**

<table>
<thead>
<tr>
<th>I. Set the Stage—Lay Out the Problem (“Who Cares”?)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Get the reviewer interested at the outset</td>
</tr>
<tr>
<td>B. Identify the importance and stress the need</td>
</tr>
<tr>
<td>C. Summarize the state-of-the-art and its limitations</td>
</tr>
<tr>
<td>D. Describe challenges to solving the problem and potential benefits</td>
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<table>
<thead>
<tr>
<th>II. State the Theme—Your Solution</th>
</tr>
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<tbody>
<tr>
<td>E. Introduce your concept and establish its credibility</td>
</tr>
<tr>
<td>F. Describe your project’s fundamental rationale</td>
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</table>

<table>
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<tr>
<th>III. Create a Vision (“So What”?)</th>
</tr>
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<tbody>
<tr>
<td>G. Show how your work will advance the field</td>
</tr>
<tr>
<td>H. Envision the world with the problem solved</td>
</tr>
</tbody>
</table>

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I. Set the Stage—Lay Out the Problem

While grant reviewers are critical readers, they are not inherently negative.
disappointment is more likely, so their first unspoken question is: “Who cares”? To leap this hurdle, the proposal must introduce a problem of unquestioned importance to an academic discipline or to society as a whole, and convince the reviewer that this is an issue worth caring about. For a strong start, the first paragraph of the pitch should consist of four sequential statements (phrases or whole sentences), designed to set the stage:

A. Get the reviewer’s interest at the outset. Seasoned public speakers know how important it is to start with a memorable line or phrase. Lincoln’s “Four score and seven years ago” evoked Biblical language to frame the Gettysburg Address. Franklin Roosevelt forever defined December 7, 1941 as a “date that will live in infamy.” Clearly, grant writers need not reach for such exalted rhetoric, but they should craft the opening statement in such a way that it grabs the reviewer’s attention. In the sample sales pitch below (Table 2), notice how section (A) in the first paragraph introduces a threatening equine disease with the simple declaration that it strikes 50% of mature horses.

B. Identify the importance and stress the need. Once you have the reviewer’s attention, you can sharpen interest by citing widespread recognition of the problem and a sense of urgency to address it. Notice how section (B) of the sample mentions euthanasia of some horses and a national conference specifically convened to find better ways to prevent and manage the disease.

C. Summarize the state-of-the-art and its limitations. The purpose of this section is to heighten the reviewer’s awareness of current knowledge or practice and why we should not be satisfied with it. In the sample, (C) is a one-sentence summary of the inadequacies of current therapeutic methods in veterinary medicine. Citations of current literature strengthen the validity of the claim. (Note: The sample was composed some years ago and no longer reflects current veterinary practice. It is presented as a structural model only.)

D. Describe challenges to solving the problem and potential benefits. This section adds to the reviewer’s understanding of the reasons why current practice fails to address the problem. The concluding sentence of D (“Clearly, current research shows a need for more effective RAO treatment modalities”) directly solicits the reviewer’s support for a new approach.

Properly constructed, this first paragraph of the pitch should be the beginning of a mental alliance between the proposal writer and the reviewer.
Table 2. Sample Sales Pitch for a USDA Grant Proposal, “Intravenous Magnesium as a Treatment Modality for Equine Recurrent Airway Obstruction”

I. SETTING THE STAGE
(A) Recurrent Airway Obstruction (RAO) is a progressive, debilitating respiratory disease, occurring in 50% of mature horses, (B) with 5% affected severely enough to result in an end to their working careers or to euthanasia.1,2 It is a chronic, recurrent condition with clinical characteristics that are well recognized, although its pathogenesis is complex, multifactorial, and currently not well understood. As an indication of industry concern, in June of 2000, 30 of the world’s leading investigators were joined by pharmaceutical companies at a Michigan State University conference devoted entirely to improving RAO prevention and management.3 (C) Further, current management and therapeutic regimens for horses with chronic or severe disease are either not efficacious or are not able to be implemented. (D) For example, drugs commonly used to manage RAO, such as corticosteroids with anti-inflammatory properties and bronchodilators that open the passageways, also stress the heart, adding additional risk to an already debilitated animal.4,5 Strategies to remove environmental precipitators such as dust and mold often fail as many horse owners are unable or unwilling to comply with such recommendations. Clearly, current research shows a need for more effective RAO treatment modalities.

II. PROJECT THEMES
(E) With this study, we propose to administer intravenous magnesium to horses with acute and chronic RAO to determine if this treatment improves respiratory function and/or reduces arterial hypertension, without the deleterious side effects of other commonly administered drugs. Recent case reports show magnesium to be efficacious for acute human asthmatics who fail to respond to more conventional therapy.6,7 (F) As RAO is increasingly seen as an equine analog to asthma in humans (replacing the previous use of the COPD model),8 and severely affected RAO horses demonstrate many of the same clinical signs as human asthmatics, RAO horses could be equally responsive to this treatment.

III. VISION
(G) Should the research hypothesis be supported, clinicians will have another viable treatment modality at their disposal, one that is inexpensive, and effective in treating a resistant disease without the damaging side effects of other modalities. (H) Additionally, horse owners and breeders could reduce the significant financial losses caused by the malady, currently estimated at more than $1.5 billion annually in the U.S. alone.9

Note: Footnote/endnote numbers in this table are for illustrative purposes only.

II. STATE THE THEME—YOUR SOLUTION
Having set the stage by laying out a pressing problem, the grant writer must now introduce a credible approach to finding a solution. From a writer’s perspective, if you have succeeded in piquing the reviewer’s interest in a
problem, there is a natural desire to know what you want to do about it. The second paragraph serves the critical function of persuading the reviewer that the scientific rationale for the proposed research is sound and worth testing.

“From a writer’s perspective, if you have succeeded in piquing the reviewer’s interest in a problem, there is a natural desire to know what you want to do about it.”

E. Introduce your concept and establish its credibility. This is best done with a simple, direct summary of the overall research idea. In the sample, section (E) uses first-person and active voice to describe the research approach and how it would avoid the drawbacks associated with existing treatment methods. It also cites relevant research which shows that magnesium has shown promise in treating asthma in humans.

F. Describe your project’s fundamental rationale. Here (F) is the crux of the researcher’s argument: The shortcomings of existing ROA treatment modalities may be due to adopting the wrong model of human disease, i.e., RAO is to horses as chronic obstructive pulmonary disease (COPD) is to humans, and therefore COPD treatments ought to be beneficial to RAO-afflicted horses. The researcher suggests that asthma, not COPD, is a more fitting human analogue to ROA. If so, and we know that some asthmatics are reacting well to magnesium treatments, it is reasonable to test whether RAO horses might benefit from a similar modality.

In two paragraphs (steps A–F), the writer forges a concise argument in two parts: 1) introduction of an important problem; and 2) a general description of a research approach that promises success. A straightforward, persuasive case constructed in this manner enhances the likelihood that the reviewers’ early responses to the proposal will be positive.

III. Create a Vision (“So What”?)

Even when the reviewer buys into the basic research idea, there is still the question of impact. If the project is funded and the research accomplished, what will be the result? As evidence that funding agencies are increasingly concerned with this question, one need only cite the revised peer review system at the National Institutes of Health, where “Impact” is the newest and most important criterion, to be scored independently from all other considerations (National Institutes of Health, 2011). Given this dynamic, the essential purpose of the third paragraph is to persuade the reviewer that there is a reasonable expectation that the requested funding will result in desirable outcomes.

“Even when the reviewer buys into the basic research idea, there is still the question of impact.”
**G. Show how your work will advance the field.** In the sample (G) summarizes the advances this research could bring to veterinary medicine, emphasizing the potential improvements over existing clinical practice.

**H. Envision the world with the problem solved.** This element is the most idealistic of all, as (H) projects with extreme optimism the potential clinical and economic impact of research findings, suggesting a strong return on investment.

**CONCLUSION**

It should be emphasized that a well-written sales pitch does not guarantee success with reviewers; like an overture in the theater, it merely “warms the audience” and makes them more receptive to the total package. What follows in the proposal—the goals and objectives, the review of current literature, the research design and evaluation method—must be equally persuasive. Similarly, reviewers will be assessing criteria unique to specific grant programs, such as the National Science Foundation’s “broader impacts” requirement. So while a strong start does not guarantee success, the converse is genuinely ominous for grant writers: A weak start rarely results in a winner. This template, then, is offered as just one tool in the grant writer’s kit of effective techniques. But it is, arguably, a tool of considerable power.

“**So while a strong start does not guarantee success, the converse is genuinely ominous for grant writers: A weak start rarely results in a winner.”**

**LITERATURE CITED**


Behind Door #3: The Hard-to-Please Grant Reviewer

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University of Wisconsin-Eau Claire

ABSTRACT

After months of waiting, the grant reviews came back: “excellent,” “excellent,” and “fair.” What?! How can this be? Why is the third review so out of line with the first two?

On more than one occasion a principal investigator (PI) has been frustrated not only by a negative funding decision but more so by the accompanying reviewer evaluation forms that contain diametrically opposed feedback. Research administrators are in a prime position to help faculty unpack reviewer comments and to better understand the existence and nature of the hard-to-please grant reviewer. This article applies an analytic model to compare and contrast fourteen dimensions of grant structures and processes at the National Institutes of Health, National Science Foundation, and U.S. Department of Education that have an effect on grant outcomes. It examines five specific aspects of inconsistencies in ratings among grant reviewers that are of greatest concern to unsuccessful applicants. It also offers strategies that can be used by research administrators to propel the PI forward—to revise and resubmit, to pursue a different sponsor, or to consider a new line of investigation. PIs who anticipate the needs of reviewers and satisfy those expectations in the proposal increase their odds for grant success.

INTRODUCTION

On more than one occasion a research administrator has met with a principal investigator (PI) whose grant reviews have just come back and who was frustrated with the result. In some instances, the PI pushes the reviews across the table and demands to know, “How can this be?” Scanning the documents, the research administrator quickly identifies the point of concern:
Reviewer #1: Rating = Excellent  
This proposed work addresses a problem of national relevance for students.

Reviewer #2: Rating = Excellent  
Potentially great merit in the development of methods for teaching fundamental entry level math for STEM.

Reviewer #3: Rating = Fair  
The intellectual merit of this proposal is rather low. The proposers understand that there is a problem, but they demonstrate no new insights into solutions.

In short, the PI expects the research administrator to be able to explain why the third review is so out of line with the first two. This article explores the existence and nature of the hard-to-please grant reviewer so that research administrators can better serve their faculty.

**ANALYTIC FRAMEWORK**

Research administrators are in a prime position to help faculty unpack reviewer comments, assuming that PIs do indeed wish to understand and learn from the written feedback. Some PIs may be more interested in venting or grieving. They could have concerns that this grant rejection will adversely impact their project plans, individual status, and career trajectory. PIs are used to being the experts; they might be less comfortable with anonymous challenges to their ideas, capabilities, and qualifications. In some instances, akin to coping with the loss of a loved one, they may progress through the stages of death and dying: denial, anger, bargaining, depression, and acceptance (Kubler-Ross, 1969). That is, PIs who start off on the defensive, shielding themselves from the pain of a grant “failing,” could switch to the offensive, blaming reviewers for not comprehending the inherent beauty and necessity of the proposed project.

“Research administrators are in a prime position to help faculty unpack reviewer comments, assuming that PIs do indeed wish to understand and learn from the written feedback.”

Rather than engaging in a “pity party,” as a prelude to providing an impartial analysis of the reviewer comments research administrators can ask PIs one simple question: “Do you think that grant reviews are fair and objective or biased and random?” While there is no right or wrong answer to this attitude-based question, experience suggests that about one-third of PIs believe the reviews are fair and objective, one-third believe they are biased and random, and one-third say, “I don’t know.” Regardless of their response, an opening now exists to discuss the existence
and nature of the hard-to-please grant reviewer. The conversation begins with an examination of the relationship among grant outcomes, processes, and structures.

The structure-process-outcome analytic model, initially proposed by Avedis Donabedian in the 1960s to assess healthcare quality, is a valuable framework that can be adapted to grantseeking. Modifying Donabedian’s definitions (1966) slightly to meet the needs of research administrators, “structure” refers to the environment in which grants are reviewed, “process” refers to the method by which grants are reviewed, and “outcome” refers to the consequence of the grant review. More significantly, these concepts are linked: good structures promote good processes which in turn promote good outcomes (Donabedian, 1988). Thus, when PIs feel a final funding decision—a grant outcome—is unfair, it is valuable to examine the grant structures and processes that led up to the result. The intent is not to find fault or to assign blame—for instance, to the sponsor for having an inadequate grant system, to the reviewer for having insufficient capacity to understand the project, or to the PI for not clearly communicating a project vision. Rather, the aim is to gain insights that will propel the PI forward—to revise and resubmit, to pursue a different sponsor, or to consider a new line of investigation.

“... the aim is to gain insights that will propel the PI forward—to revise and resubmit, to pursue a different sponsor, or to consider a new line of investigation.”

**ANALYTIC FRAMEWORK APPLIED: NIH, NSF, ED**

To illustrate the structure-process-outcome framework in action, this analytic model is applied to grant programs offered at three federal agencies: the National Institutes of Health (NIH), the National Science Foundation (NSF), and the U.S. Department of Education (ED). Specifically, fourteen dimensions of grant structures and processes, as they existed in FY 2010, are compared and contrasted across five grant programs, including:

- NIH’s Academic Research Enhancement Award (AREA) Parent R15: supports small research projects in the biomedical and behavioral sciences conducted by students and faculty in health professional schools and other academic components that have not been major recipients of NIH research grant funds.
- NSF’s Transforming Undergraduate Education in Science, Technology, Engineering, and Mathematics (TUES) program: supports efforts to create, adapt, and disseminate new learning
materials and teaching strategies to reflect advances both in STEM disciplines and in what is known about teaching and learning. The program supports projects representing different stages of development, ranging from small, exploratory investigations to large, comprehensive projects.

- **ED’s Fund for the Improvement of Postsecondary Education (FIPSE) Comprehensive Program**: supports and disseminates innovative reform projects that promise to be models for improving the quality of postsecondary education and increasing student access.

- **ED’s Hispanic-Serving Institutions (HSI) program**: provides grants to assist HSIs to expand educational opportunities for, and improve the attainment of, Hispanic students. The HSI program grants also enable HSIs to expand and enhance their academic offerings, program quality, and institutional stability.

- **ED’s Transition and Postsecondary Programs for Students with Intellectual Disabilities (TPSID) program**: provides grants to institutions of higher education or consortia of institutions of higher education to enable them to create or expand high quality, inclusive model comprehensive transition and postsecondary programs for students with intellectual disabilities.

Much has been written already about the ins and outs of securing major research project grants from NIH and NSF; thus, this article focuses on grant programs that have broad appeal to institutions of higher education, particularly comprehensive universities, liberal arts colleges and community colleges, whose missions center on teaching and learning.

**Grant Structures**

NIH, NSF, and ED each have grant structures in place that have an effect on grant outcomes. The following seven questions consider dimensions of the environment setting before, during, and after grant applications are reviewed:

- **Before**: How are grant reviewers identified and selected?
- **Before**: How much training do grant reviewers receive?
- **During**: What review criteria are used to evaluate proposals?
- **During**: What scoring rubrics do grant reviewers follow?
During: How do grant reviewers determine their final scores?

After: How are grant reviewers compensated for their efforts?

After: What is the relationship between reviewer scores and funding awards?

Table 1 summarizes responses to these questions and makes clear that similarities and differences exist across programs at these three federal agencies. For instance, on the front side, the sponsors share a common approach to identifying and selecting grant reviewers—namely, a combination of proactive and reactive strategies is used to recruit reviewers with general and specialized experience. Program officers may draw from their knowledge of experts in the field, references included in the proposal, recent professional society programs, literature reviews, volunteers who expressed interest and availability to serve, past grant winners, and, in the case of NSF, recommendations of specific individuals who should and should not review a proposal (Feldman, Meszaros, & Nader, 2007). NSF estimates that over a three-year period, more than half of the PIs who submitted proposals also served as grant reviewers (National Science Foundation, 2008a). What’s more, these three sponsors provide some basic training to grant reviewers. Regardless of whether individuals are novice or veteran reviewers, for continuity and consistency purposes all reviewers are usually required to go through the one-hour training session, which includes an overview of the program’s purpose and eligible project activities and expenses, an outline of roles and responsibilities and the review schedule, an introduction to the online grants management system, and a general question-and-answer period. The training helps to set context, parameters, and expectations for the review.

On the back side, NIH, NSF, and ED hold a mutual belief that reviewers deserve modest compensation for their volunteer efforts. Whether calculated on a per proposal, per day, or flat rate basis, honoraria for completing a program review are currently in the range of $1,000–$2,000. Given the magnitude and intensity of the task, this stipend often equates to working for nearly three straight weeks at the federal minimum wage rate. No one does the work for the honorarium! They do it for other reasons, such as gaining access to insider information, networking with program officers and professional colleagues, keeping abreast of the latest approaches and techniques, and giving back to the profession (National Institutes of Health, 2011b; National Science Foundation, 2008b; U.S. Department of Education, 2010a). NIH, NSF, and ED also share a common approach to determining funding awards; namely, feedback from reviewers is
advisory only. Program officers analyze the feedback and make recommendations to a higher authority that is ultimately responsible for making the funding award determination. Of the three federal agencies, NSF allows its program officers greater flexibility than NIH and ED in making award recommendations that run counter to feedback from reviewers: an analysis of average reviewer ratings for NSF awards and declines for FY2010 revealed that 1,312 proposals scoring “excellent” were declined and 98 proposals scoring “fair to good” were awarded (Strausser, 2011). That is to say, higher-scoring proposals can get bumped in favor of lower-scoring proposals that address special considerations, such as geographic distribution of awards, PI status as a novice applicant, organizational status as a primarily undergraduate institution, prior funding history with the sponsor, and extensive collaborative relationships (Miner & Miner, 2008; Miner, Miner, & Griffith, 2011).

“...higher scoring proposals can get bumped in favor of lower scoring proposals that address special considerations. ...”

More differences begin to emerge among NIH, NSF, and ED grant structures during the time in which applications are reviewed. While reviewers are all trained to score proposals on their own merit rather than comparing applications, the sponsors take varying approaches to the use of review criteria. For instance, NIH and NSF use standardized review criteria that apply across the vast majority of their programs, including AREA and TUES, respectively, whereas ED review criteria are program-specific. Further, even though the FIPSE, HSI, and TPSID programs are all administratively housed within the ED Office of Postsecondary Education, they utilize assorted review criteria: HSI and TPSID consider “quality of key personnel,” but not FIPSE; TPSID and FIPSE consider “significance,” but not HSI; they all consider “quality of project evaluation,” but only HSI considers “quality of budget.”

NIH, NSF, and ED provide reviewers with a scoring rubric, but these tools differ in multiple respects. NIH reviewers must score each review criterion on a 1- to 9-point scale from “exceptional” to “poor”; the final score reflects an assessment of overall impact, not a numerical average of the five review criteria scores. Overall impact expresses a reviewer’s estimation of “the likelihood for a project to exert a sustained, powerful influence on the research field(s) involved,” but it is not a review criterion in itself (National Institutes of Health, 2011c). Of note, AREA grants (R15), unlike traditional research project grants (R01), do not receive a percentile rank that reflects the approximate percentage of applications
which received better overall impact and priority scores during the past year. At NSF, grant reviewers do not assign numerical ratings to proposals. They consider two standardized review criteria, which need not be weighted equally, in a broad context so that the final rating reflects an overall assessment on a 5-point Likert-type scale from “excellent” to “poor.” ED reviewers assign points to each review criterion and then add up all the points to determine a final score; a 100 point scale is used, though TPSID allows bonus points to be earned for meeting competitive priorities—thus, a final score could exceed 100 points. FIPSE weighs review criteria uniformly at 20 points each, whereas HSI and TPSID weigh review criteria independently, with items having values of 7 to 25 points each. What’s more, HSI defines point ranges within each criterion. For instance, the “quality of project evaluation” section is worth a total of 15 points and can be assigned points according to the extent to which data elements and data collection procedures are identified: excellent extent = 15–12 points; good extent = 11–9 points; average extent = 8–6 points; minimal extent = 5–1 points; not addressed = 0 points. In other words, HSI minimizes disparities between reviewers who are “tough graders” and “easy graders” because the value of one point is predetermined. FIPSE and TPSID, on the other hand, allow reviewers to settle on their own understanding of the worth of a single point.

### Table 1. Grant Structures at NIH, NSF, and ED

<table>
<thead>
<tr>
<th></th>
<th>NIH AREA</th>
<th>NSF TUES</th>
<th>ED FIPSE</th>
<th>ED HSI</th>
<th>ED TPSID</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Reviewer Selection</strong></td>
<td>Based on general and specialized knowledge, experience, skills</td>
<td>Based on general and specialized knowledge, experience, skills</td>
<td>Based on general and specialized knowledge, experience, skills</td>
<td>Based on general and specialized knowledge, experience, skills</td>
<td>Based on general and specialized knowledge, experience, skills</td>
</tr>
<tr>
<td><strong>Reviewer Training</strong></td>
<td>1 hour orientation</td>
<td>1 hour orientation</td>
<td>1 hour orientation</td>
<td>1 hour orientation</td>
<td>1 hour orientation</td>
</tr>
<tr>
<td><strong>Reviewer Criteria</strong></td>
<td>• Significance • Investigator • Innovation • Approach • Environment</td>
<td>• Intellectual Merit • Broader Impacts</td>
<td>• Need • Significance • Design • Evaluation • Resources</td>
<td>• Comprehensive Development Plan • Activity Objective • Implementation Strategy • Personnel • Management Plan • Evaluation • Budget</td>
<td>• Need • Significance • Design • Services • Personnel • Resources • Evaluation</td>
</tr>
</tbody>
</table>
Table 1 cont’d.

<table>
<thead>
<tr>
<th>Scoring Rubric</th>
<th>NIH AREA</th>
<th>NSF TUES</th>
<th>ED FIPSE</th>
<th>ED HSI</th>
<th>ED TPSID</th>
</tr>
</thead>
<tbody>
<tr>
<td>Each criterion receives a separate score:</td>
<td>Criteria are considered broadly and need not be weighted equally:</td>
<td>Criteria are weighted equally; 20 points each</td>
<td>Each criterion is weighted independently, from 7–25 points; within each criterion, point ranges are defined for responses that are excellent, good, average, minimal, and not addressed</td>
<td>Each criterion is weighted independently, from 10–20 points</td>
<td></td>
</tr>
<tr>
<td>1=Exceptional</td>
<td>• Excellent</td>
<td></td>
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<td>2=Outstanding</td>
<td>• Very Good</td>
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<td>3=Excellent</td>
<td>• Good</td>
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<td>4=Very Good</td>
<td>• Fair</td>
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<tr>
<td>5=Good</td>
<td>• Poor</td>
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<td>6=Satisfactory</td>
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<td>7=Fair</td>
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<td>8=Marginal</td>
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<td>9=Poor</td>
<td></td>
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</tr>
<tr>
<td>Final Score Determination</td>
<td>Priority score reflects an assessment of the overall impact, not a numerical average of criteria scores</td>
<td>Rating reflects an overall evaluation</td>
<td>Criteria scores are added together for a maximum score of 100 points</td>
<td>Criteria scores are added together for a maximum score of 100 points; up to 9 additional points may be awarded for meeting competitive priorities</td>
<td></td>
</tr>
<tr>
<td>Compensation</td>
<td>$200 per day</td>
<td>$1,200 flat rate</td>
<td>$100 per proposal</td>
<td>$1,000 flat rate</td>
<td>$1,000 flat rate</td>
</tr>
<tr>
<td>Award Recommendation</td>
<td>Program officers study established paylines, examine priority scores, analyze feedback from reviewers, and make award recommendations to the Advisory Board/Council; Institute and Center Directors make final funding decisions</td>
<td>Program officers analyze feedback from reviewers and make award recommendations to the Division Director; Division Director makes final funding decision</td>
<td>Program officers analyze feedback from reviewers and make award recommendations to the Secretary; Secretary makes final funding decision</td>
<td>Program officers analyze feedback from reviewers and make award recommendations to the Secretary; Secretary makes final funding decision</td>
<td></td>
</tr>
</tbody>
</table>

Grant Processes

NIH, NSF, and ED each have grants processes in place that have an effect on grant outcomes. The following seven questions consider dimensions of the review methodology:

- How many grant reviewers are assigned to each proposal?
- How many proposals are grant reviewers assigned to evaluate?
• What is the maximum length of the proposal’s core narrative?
• What type of review is used?
• How much time do grant reviewers have to complete the review?
• What is the average length of grant reviewers’ written commentary?
• How are score variances across grant reviewers addressed?

Table 2 summarizes responses to these questions and highlights contrasting approaches used to assess grant proposals submitted to programs at these three federal agencies. These sponsors share commonalities in a couple of aspects of their grants processes. For instance, a minimum of three reviewers evaluate each grant proposal. At ED, only three reviewers score each proposal. At NIH and NSF, review panels may consist of more than three reviewers, perhaps up to twenty reviewers, depending on the degree of specialization needed to assess the proposal. As illustrated in an NIH video (2010) and NSF webinar (Fang & Millard, 2010) of a mock review session, while at least three reviewers will have read each proposal and prepared written comments for examination, other panelists may participate in the general discussion, even if they have not been assigned to read the proposal. NIH, NSF, and ED also permit program officers to take an active role in ensuring that all proposals receive equitable treatment. Program officers may ask questions of reviewers regarding written comments to make certain they are reflective and supportive of the assigned score, as well as make certain they are analytical, in no ways offensive, and grammatically correct.

Differences in grants processes at NIH, NSF, and ED influence the workload of proposal reviewers. At NIH, AREA reviewers had six weeks to review 6–10 proposals that, at their narrative core, were 12 single-spaced pages in length each. At NSF, TUES reviewers had three weeks to review 12 proposals that were 15 single-spaced pages in length each. At ED, FIPSE reviewers had two weeks to review 8–12 proposals that were up to 20 double-spaced pages in length; HSI reviewers had three weeks to review 10 proposals that were 50 double-spaced pages for individual projects or 70 double-spaced pages for cooperative projects; and TPSID reviewers had two weeks to review 28 proposals that were 40 double-spaced pages. In practical terms, TPSID reviewers on average engaged in double the amount of work experienced by HSI, FIPSE, TUES, and AREA reviewers; they needed to complete two reviews on average per day to finish on schedule, whereas the others needed to complete one review or less on average per day.

NIH, NSF, and ED each employed, at a minimum, a mail review. Proposals were made available electronically to reviewers (i.e., the eco-friendly version of proposals
being copied and mailed) and were reviewed independently from the comforts of their homes and offices. A reviewer’s evaluation form was completed online for each proposal, which included an assessment score and approximately 1–4 single-spaced pages of analysis commentary. Of the five programs, FIPSE was the only one to use a mail review exclusively. Said differently, FIPSE reviewers did not have opportunity to meet each other or to share their perceptions of proposal merits. On the other hand, AREA and TUES reviewers engaged in mail and in-person panel reviews. Reviewers critiqued proposals individually and uploaded their analysis into an online grants management system. Subsequently, they convened in Washington, DC for 2–3 days to conduct panel discussions in person, modify comments, and make final submissions. AREA reviewers knew that proposals ranking in the bottom half of all applications would not be discussed or receive priority scores and TUES reviewers knew that every application would be discussed and scored. Nevertheless, completing the reviewer evaluation forms online in advance of the panel review encouraged reviewers to prepare for deliberations. HSI and TPSID reviewers, in addition to mail and in-person panel reviews, participated in teleconference panel reviews. That is, after reviewers completed their independent assessments of proposals and uploaded their responses into an online grants management system, program officers coordinated conference calls, typically one hour in length, where proposal strengths, weaknesses, and scores were discussed. During the final week of the HSI and TPSID review process, reviewers came together in Washington, DC to panel the remaining proposals in person. The advantage of the teleconference panel reviews is that they allowed chemistry to develop among reviewers, which fostered collegial dialogue during the in-person panel reviews.

“In the words of the program officer, ‘Institutions are notorious about challenging reviewers’ comments when there is a large discrepancy—and, of course they give more credibility to the higher score than the lower score as being justified!’”

The NIH, NSF, and ED programs have their own procedures for managing instances of significant variance among reviewers’ scores. AREA and TUES have reviewers upload their individual critiques in advance of the in-person panel review. As a result, program officers have an early alert to which proposals may require substantive discussion. Program officers are allowed to ask reviewers to further justify their comments if an inconsistency seems to
exist with the rating; reviewers are not obligated to resolve differences in scoring. For AREA proposals, after paneling, individual reviewer scores are averaged and the result is multiplied by 10 to determine the final priority score. For TUES proposals, based on the panel discussion, a collective summary review is written; however, rather than averaging scores, individual ratings are retained to provide an indication of the relative merits of different perspectives. FIPSE is a unique case precisely because reviewers are only allowed to have discussions with program officers, not other reviewers. During the FIPSE training program, reviewers are informed that when a variance of 15 points or more exists, they will be contacted and given the opportunity to reconsider their scores and comments; reviewers are not obligated to change their scores, but further justification may be necessary. In the words of the program officer, “Institutions are notorious about challenging reviewers’ comments when there is a large discrepancy—and, of course they give more credibility to the higher score than the lower score as being justified!” HSI and TPSID tolerate a more narrow range of variance: applications with a 10-point or more divergence in scores must be discussed during the panel review (U.S. Department of Education, 2010b, 2010c). If reviewers are not able to reach closer agreement after substantial dialogue, they must complete and sign a “Record of Discussion” form that details the basis of the impasse. To avoid making additional work for themselves, reviewers are frequently willing to compromise to keep scores within the acceptable variance range. Put another way, the hard-to-please reviewer is more difficult to spot at ED than at NIH and NSF.

**IMPLICATIONS**

Undeniably, receiving a sponsor’s “I regret to inform you that...” negative funding decision letter is disappointing. More aggravating, though, are the reviews that contain mixed, or even contradictory, feedback. In a survey of unsuccessful grant applicants, Wood, Meek and Harman (1992) identified five specific aspects of inconsistencies in ratings between grant reviewers that were of greatest concern to PIs: (a) a mismatch of topic and reviewers; (b) a lack of understanding of the topic; (c) a perceived bias against high-risk research; (d) the brevity of comments provided; and (e) a failure to substantiate criticisms. In the following discussion, each of these concerns is examined through the lens of the structure-process-outcome analytic model. Also offered are strategies research administrators can use to help PIs understand the existence and nature of the hard-to-please grant reviewer. As a result, PIs will be better positioned to determine appropriate next steps.
Table 2. Grant Processes at NIH, NSF, and ED

<table>
<thead>
<tr>
<th></th>
<th>NIH AREA</th>
<th>NSF TUES</th>
<th>ED FIPSE</th>
<th>ED HSI</th>
<th>ED TPSID</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number of Reviewers</strong></td>
<td>3+</td>
<td>3+</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td><strong>Number of Proposals</strong></td>
<td>6–10</td>
<td>12</td>
<td>8×12</td>
<td>10</td>
<td>28</td>
</tr>
<tr>
<td><strong>Proposal Length</strong></td>
<td>12 SS page</td>
<td>15 SS page</td>
<td>20 DS page</td>
<td>50 DS page, 70 DS page</td>
<td>40 DS page</td>
</tr>
<tr>
<td><strong>Review Type</strong></td>
<td>● Mail</td>
<td>● Mail</td>
<td>● Mail</td>
<td>● Mail</td>
<td>● Mail</td>
</tr>
<tr>
<td></td>
<td>● In-person panel</td>
<td>● In-person panel</td>
<td>● In-person panel</td>
<td>● Teleconference</td>
<td>● Teleconference</td>
</tr>
<tr>
<td><strong>Time to Review</strong></td>
<td>6 weeks</td>
<td>3 weeks</td>
<td>2 weeks</td>
<td>3 weeks</td>
<td>2 weeks</td>
</tr>
<tr>
<td><strong>Response Length</strong></td>
<td>1–3 pages</td>
<td>1–2 pages</td>
<td>1–2 pages</td>
<td>1–4 pages</td>
<td>1–3 pages</td>
</tr>
<tr>
<td><strong>Score Variance</strong></td>
<td>Program officers may ask questions during panel; individual reviewer scores are averaged and the result multiplied by 10 to determine the priority score</td>
<td>Program officers may ask questions during panel; they may ask for comments to be further justified if an inconsistency seems to exist with the rating</td>
<td>Proposals with a 15 point or more divergence in scores will serve as a prompt for program officers to ask for comments to be further justified or for scores to be reconsidered</td>
<td>Proposals with a 10 point or more divergence in scores must be discussed during panel; a record of discussion must be completed when no closer agreement is reached</td>
<td>Proposals with a 10 point or more divergence in scores must be discussed during panel; a record of discussion must be completed when no closer agreement is reached</td>
</tr>
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**A Mismatch of Topic and Reviewer**

NIH, NSF, and ED have established grants structures for identifying and selecting reviewers to evaluate the applications they receive. These sponsors typically assemble a group of individuals who possess specialized knowledge of the topic and general knowledge of the field. Whether participating in one type or a combination of mail, in-person panel, and teleconference panel reviews, reviewers provide feedback that, collectively, assesses the specifics of the project and the larger context in which it is situated (Jayasinghe, March, & Bond, 2001; Trumbo, 1989).

Sponsor efforts to balance the representation of a depth and breadth of experience could contribute to PIs’ perceptions that a mismatch exists between proposal topics and reviewers. In these instances, PIs may be assuming that hard-to-please reviewers are (poorly) filling the role of subject matter specialists when in reality they are filling the role of branch generalists.
“...because there is considerable turnover annually of individual reviewers and of review panels, it can pay to be persistent; funding chances usually improve with resubmissions.”

In other words, elements of chance exist within grants structures that influence grant outcomes; namely, the assignment of specific proposals to specific reviewers and the assignment of individual reviewers to in-person and/or teleconference panels. Cole, Cole, and Simon (1981) offered a quantifiable estimate of the impact of this phenomena: “The fate of a particular grant application is roughly half determined by the characteristics of the proposal and the principal investigator, and about half by apparently random elements which might be characterized as the ‘luck of the reviewer draw’” (p. 885). Lead reviewers play a critical role in setting the tone for the rest of the panel. While differences in professional opinion are inevitable among reviewers, the manner in which they are handled can affect the final result. One veteran NIH grant reviewer reported, “I have been in a couple of meetings where people have felt their reputation was at stake, and it was a personal insult if the committee didn’t agree with them. And I’ve been on others in disagreement where the tone was, instead, ‘Oh I’m so sorry. I must have missed something,’ as opposed to ‘You’re wrong and I’ll prove it to you.’ You can just feel the difference” (Hebert, 2002). More significantly for PIs, because there is considerable turnover annually in individual reviewers and in review panels, it can pay to be persistent; funding chances usually improve with resubmissions. Consider: in FY2010, NIH research project grants that were new submissions had an 11.5% success rate whereas resubmissions had a 34.9% success rate (National Institutes of Health, 2011d). Research administrators should encourage PIs who are turned down the first time to consider revising and resubmitting the proposal based on feedback from reviewers (Miner & Miner, 2008).

A Lack of Understanding of the Topic

Even when NIH, NSF, and ED grants structures suitably match proposal topics and reviewers, PIs may hold tight to the belief that the hard-to-please reviewer is not expert enough to fully grasp the subject matter. In practicality, in any collection of three or more reviewers, including ones with similar academic credentials, differences will still exist in their experiences, ideas, and ways of understanding the world. Consequently, there is intersubjectivity among reviewers. Three reviewers may share the same point-of-view on a proposal and yet score it in a different way (Cole, Cole, & Simon, 1981). At NIH, this manifests itself when reviewer #1’s rating of “outstanding” equates to
reviewer #2’s rating of “excellent,” which equates to reviewer #3’s rating of “very good.” All three scores are respectable, yet PIs perceive reviewer #3 as being hard-to-please because the score reflects the proposal as having a medium impact while the other two scores reflect it as having a high impact.

In an interview with faculty who were veteran NIH, NSF, and U.S. Department of Agriculture grant reviewers as well as grant writers, one offered the following sage advice: “I used to write to a peer; now I write to a committee. I write to teach both the specialist scholar in my particular field and the generalists, who make up the majority of the panel” (Porter, 2005, p. 9). This notion of grant writer-as-teacher is particularly important not only when the specialist-generalist gap needs bridging but also when reviewers share the same field as the PI but not the same sub-field. Persuading these hard-to-please reviewers means working from the known to the unknown. Research administrators can probe with PIs to target an appropriate level of shared understanding from which a case can be built; PIs can subsequently adapt their narrative to meet reviewers’ needs and expectations (Ede & Lunsford, 1984). When done effectively, the proposal will motivate one or more reviewers to act as a “champion” for the project (Altman, 2009; Obrecht, Tibelius, & D’Aloisio, 2007). Inspired reviewers will, for instance, read articles cited in the bibliography to gain a greater familiarity with the topic (Member, 2003; Molfese, Cervelin, & Miller, 2007; Trumbo, 1989). Thus, reviewers can advocate on the PI’s behalf for a favorable enough final score that the project will garner grant funding.

**A Perceived Bias against High-Risk Research**

Beyond the identification and selection of reviewers, NIH, NSF, and ED have grant structures in place to train grant reviewers. Training sessions typically last about one hour and address contextual, logistical, and technological considerations. For example, reviewers are briefed on the sponsor’s mission and the priorities of the grant program, their performance expectations and the timeline for the review, and nuances of the online grants management system. In their roles, reviewers act as the conscience of the community, ensuring that grant funds are spent wisely. To catch the attention of reviewers, PIs recognize that, among a stack of proposals, projects must have some intellectual sex appeal. Yet some PIs also hold the perception that a bias exists against high-risk research (Berezin, 1998; Obrecht, Tibelius, & D’Aloisio, 2007; Wood, Meek, & Harman, 1992). Unless they have served as grant reviewers themselves, these PIs may not fully appreciate that being a good steward of sponsor funds often means distinguishing scientific fact from professional judgment and may mean
supporting research that takes the next methodical step along established lines (Office of Management and Budget, 2004).

This perceived bias against high-risk research is particularly sensitive at NIH. “Innovation” is one of five review criteria NIH uses to assess grant applications, and a series of questions guide reviewers in their consideration of the extent to which a project is path-breaking:

Does the application challenge and seek to shift current research or clinical practice paradigms by utilizing novel theoretical concepts, approaches or methodologies, instrumentation, or interventions? Are the concepts, approaches or methodologies, instrumentation, or interventions novel to one field of research or novel in a broad sense? Is a refinement, improvement, or new application of theoretical concepts, approaches or methodologies, instrumentation, or interventions proposed? (National Institutes of Health, 2011c)

In her “Rock Talk” blog, Sally Rockey, NIH Deputy Director for Extramural Research, presented the results of a study of the correlation between overall impact scores and criterion scores on nearly 55,000 research grant applications submitted in FY2010. Multiple regression analysis ranked the order in which criteria carried the greatest to least weight: approach, significance, innovation, investigator, and environment. That is to say, reviewers consider innovation as a central but not the foremost among NIH review criteria. With this in mind, research administrators can help PIs to reframe their project so that it is “innovative” but not so “highly innovative” that it will be deemed “risky.” Research administrators can also remind PIs that reviewer comments should not be interpreted as personal attacks. According to Buller (2002), drawing from his experiences as an NIH reviewer, “when a reviewer is interested in an idea, they often provide tough, detailed critiques of an application in order to help the researchers ultimately produce an application that can be evaluated highly by the entire review team” (p. 414). This sentiment is also shared by Wiley in his aptly titled article, “Peer review isn’t perfect…But it’s not a conspiracy designed to maintain the status quo” (2008).

The Brevity of Comments Provided

One aspect of the reviewer training provided by NIH, NSF, and ED, respectively, deals with the preparation of written comments. They emphasize that grant reviews are written for two audiences—program staff and applicants. Program staff use the feedback to justify award recommendations and applicants rely on feedback to determine whether a declined proposal should be revised and
resubmitted. The sponsors offer a range of supports to reviewers: questions to consider associated with each review criterion, checklists of review do’s and don'ts, samples of completed reviewer evaluation forms, and names of program staff who can be contacted to clarify technical and financial aspects of the review. ED even specifies minimum length thresholds for written comments:

Both successful and unsuccessful applicants will appreciate receiving Technical Review Forms that correspond with their applications with three or more lines of comprehensive, written comments. **ONE WORD/ONE LINE WRITTEN COMMENTS FOR STRENGTHS OR WEAKNESSES WILL NOT BE ACCEPTED** (U.S. Department of Education, 2010c, p. 10, emphasis original).

While these grant structures set performance expectations for reviewers, sponsors’ grant processes influence the fidelity to which they are followed. It often boils down to a workload issue (Abrams, 1991; Cook et al., 2005). Reviewers attempt to balance the quality of feedback with the number and length of proposals and the time available to complete the review. Likewise during the review period, program officers attempt to balance the number of requests they make of reviewers to edit the previous reviewer evaluation form with the need to press forward and complete the next proposal review.

“**Program staff use the feedback to justify award recommendations and applicants rely on feedback to determine whether a declined proposal should be revised and resubmitted.**”

Repeated calls for greater substance and clarity in commentary can come at the expense of maintaining an overall time-to-review equity and of adhering to the established review timeline. ED offers a conservative estimate that reviewers will devote two to three hours per application, including time to read the proposal, write an evaluation, and submit the review online; however, ED’s online grants management system, G5, is set to time out after 20 minutes; thus, reviews are often composed in a separate word-processing program and then responses for each criterion are cut-and-pasted into G5. This extra step increases the time spent on each application and the overall workload, but does not enhance the volume or quality of feedback. Regardless of the length of comments, research administrators should encourage PIs to contact program officers to discuss reviews. In response to an open-ended request such as, “Help me to
understand the apparently divergent perspectives reviewers had on my proposal,” program officers often provide reflections and advice over the phone that is much more candid than they would ever put in an email message.

**A Failure to Substantiate Criticisms**

Though NIH, NSF, and ED each provide relatively standardized orientation trainings, reviewers internalize and apply this information in different ways. In-person and teleconference panels, especially, tend to develop their own chemistry (Obrecht, Tibelius, & D’Aloisio, 2007; Porter, 2009; Tufts University, 2010). Reviewers find their expertise niche—specialized content knowledge, familiarity with instrumentation, general experience with target populations, knowledge of pedagogy, skill in assessment, proficiency with budgets—as they dialogue with one another. According to research by Klahr (1985), who served as an NSF panel review member for several years, “the positive aspects of a proposed study are usually acknowledged by all of its reviewers, but different weaknesses are discovered by different panelists” (p. 150). Individual written critiques, then, may demonstrate varying depths of analysis: a reviewer drawing from personal grounding can spell out criticisms in detail whereas other panelists, who agree at least to some extent with the reviewer but are outside of their expertise niche, are left to capture the spirit of the concern and summarize it in their own words. Further, the grant processes at ED, more so than at NIH and NSF, strongly encourage reviewers to reconcile variances in proposal scores. ED reviewers discuss, negotiate, and horse-trade to get scores within the acceptable range so that they do not have to write a dissenting opinion. Because the final score is an average of the sum of panelist’s criteria scores, savvy reviewers know where they can compromise on points to get within a range at the criteria level and yet not change the overall funding recommendation. Consider: prior to paneling, reviewers might have initial scores of 91, 86, and 75, which produce an average score of 84 and have a variance of 16 points. After deliberation, reviewers might adjust their scores to 88, 84, and 80, which also produce an average score of 84 but have a variance of only 8 points. As a consequence of this attention to scoring, individual critiques may be thinly written. When viewed together, however, reviewers’ written commentary presents an air of authority with the collective wisdom and judgment of the group.

Beyond examining intra-panel agreement, researchers have also investigated the extent to which inter-panel agreement exists. To be precise, two sets of panels were given the same proposals to review independently and their funding recommendations were compared. Johnson (2008) conducted a statistical analysis of R01
grant applications at NIH and concluded that 25% of funding decisions would be reversed had the proposals been reviewed by a different panel. Cole, Cole, and Simon (1981) examined grant applications submitted to three programs at NSF and estimated a reversal rate of 24–30%. Obrecht, Tibelius, and D’Aloisio (2007) studied research training fellowship proposals submitted to the Canadian Institute of Health Research and determined that 27% of applications would be overturned by a new panel of reviewers. It is logical that some reversals would occur near the payline. That is, Panel A might rank a proposal 9th while Panel B might rank a proposal 11th and the cutoff for funding was the 10th proposal; the funding decision would be reversed by the second panel. Research administrators can urge PIs to solicit the program officer’s reactions to the written comments, namely, to find out which of the weaknesses cited were the most significant and how far below the funding line the proposal landed. A PI might find the proposal was a near-miss and that funding success is really closer than originally imagined.

CONCLUSION

It may be natural for a PI, frustrated in general by a negative funding decision and specifically by diametrically opposed reviewer comments, to question whether grant reviews are more biased and random than fair and objective. However, among faculty who have served as grant reviewers, there is a firm belief in the objectivity of review panels. While acknowledging that peer review is not perfect, they cite as strengths the transparency of the grant system (Kessel, 2006), explicit and uniform processes used (Wiley, 2008), and democratic and self-correcting quality of panels (Porter, 2005), and they underscore that instances of bias and cronyism are infrequent (Molfese, Cervelin, & Miller, 2007). These faculty also point out that volunteering to serve as a reviewer is a great way for PIs to learn the inner workings of grant programs and panels. To a similar end, when the structure-process-outcome analytic model is applied to NIH, NSF, and ED, it can be seen that hard-to-please reviewers exist in programs at all three federal agencies. Given their respective grant structures and processes, though, hard-to-please reviewers are more difficult to pinpoint at ED because they are masked through the formula for reconciling score variance. An element of random chance is also present in the grant system of each of these sponsors—chiefly, the assignment of specific proposals to specific reviewers and the assignment of individual reviewers to review panels.
“With the benefit of time and some distance, PIs may recognize that reviewer commentary contains kernels of truth—sections weren’t as clear as they could have been, details were omitted, alternative options were not considered—that can actually lead to a stronger application.”

More broadly, research administrators can use the structure-process-outcome framework with PIs to contextualize reviewer feedback and to position them for future grant success. Research administrators should encourage PIs to always contact program officers for a debriefing after learning a grant outcome. When a proposal is funded, PIs can talk with program officers to determine exactly which dimensions of the project caught reviewers’ attention and whether there are minor issues that need to be addressed; when a proposal is not funded, PIs can find out which aspects were of the greatest concern to reviewers and what it might take to convince them that the project does indeed merit funding. Of note, debriefing is a time to listen, not to argue. Aggressively challenging the program officer and formally appealing the grant outcome are unlikely to be successful. Differences in judgment will not change the final result; only when it can be proven that a procedural mistake occurred in the grant review process do PIs have even the slightest chance of overturning a funding decision (Trumbo, 1989). PIs are better off spending that emotional and intellectual energy systematically analyzing reviewer feedback and then, as appropriate, revising and resubmitting their proposals. Research administrators can counsel PIs to let the reviews sit for a short period and come back to them with fresh eyes, as if written by a friend (Wiley, 2008). With the benefit of time and some distance, PIs may recognize that reviewer commentary contains kernels of truth—sections weren’t as clear as they could have been, details were omitted, alternative options were not considered—that can actually lead to a stronger application. Tinkering changes to the narrative, most likely, will not be enough. At the same time, proposals do not need to be perfect to attract funding; rather, they need to be persuasive (Miner & Miner, 2005). PIs who anticipate the needs of reviewers and satisfy those expectations in the proposal increase their odds for a positive grant outcome.
ENDNOTE

1. This bulleted list represents five of the items in the literature cited: National Institutes of Health, 2011a; National Science Foundation, 2011; U.S. Department of Education, 2011a,b,c. The grant programs are described as they existed in FY 2010; specific websites were accessed in 2011.

LITERATURE CITED


VIDEO REVIEW

NIH Peer Review Revealed


Nancy B. Bell
Principal, Research Image

ABSTRACT

When writing a grant application for peer review, new investigators need to be exposed to as many different tools and resources as possible. The instructions in all agencies’ guidelines are purposefully flexible to provide for investigator imagination, but it is the peer review process that determines which applications may receive an award. The NIH has provided many tools and resources that aid investigators in better understanding the application presentation and peer review processes. A newly updated National Institutes of Health video, “NIH Peer Review Revealed”, provides insight into the peer review process and how it works. Research administrators wishing to assist new investigators in gaining grant-writing skills will find that this agency-sponsored resource can be easily accessed on the Internet. Potential principal investigators who view it will see active scientists reviewing the proposed work of other active scientists.

An updated version of the video, “NIH Peer Review Revealed”, was issued on September 29, 2011, by the Office of the Director, National Institutes of Health (NIH). The video, which lasts 14 minutes and 52 seconds, provides an efficient overview of the grant application peer review process. It will be valuable for new investigators as well as those experienced investigators submitting revised or new applications. The video offers insights into how decisions are made within the Center for Scientific Review regarding which study
section and institutes or centers within the NIH to assign applications for funding. The video focuses on the process followed in selecting reviewers who then will work together to evaluate the best grant applications; approximately 20,000 scientific peers review 80,000 applications each year. In the process of selecting reviewers, the Scientific Review Officer (SRO) strives to find expert, experienced individuals who will treat each application individually and fairly.

Two separate fictional yet realistic applications from fictional investigators are addressed during the video—one from a new investigator (one who has not yet received substantial funding from the NIH) and one a resubmission from an established investigator. Both applications are introduced to the review panel with a reminder that one is from a new investigator. Reviewers also are reminded about the need for confidentiality and integrity in the review process. The subsequent “reviews” then provide insight into how decisions are made. Each application is assigned at least three reviewers, each of whom is asked to provide an impact score of 1–9 with 1 being the best score. At the end, all other panelists assign a confidential score to the application. These scores comprise the final score recommended by the study section.

For the first application considered, that from the new investigator, the study section chair asks for preliminary scores from the three chief reviewers and asks the primary reviewer to provide a synopsis of the application, including both high and low points. Each reviewer then adds comments, praise, and concerns about the application in light of the NIH review criteria: Significance, Innovation, Investigators, Environment, and Approach. In this particular review, incomplete documentation, technical concerns, and equipment used are concerns. The ensuing general discussion includes all panel members. One important aspect of the discussion has to do with trouble-shooting, a matter of concern when funding any new investigator. Should the investigator reach a dead end or roadblock in the research process, it is possible that the problem will be perceived to be or actually insurmountable. Documentation on collaborators who will advise a new investigator, upon request, appears to satisfy the reviewers.

Next, the second application—the revised proposal—is discussed and does not appeal to reviewers. Although the principal investigator is well-established, the application garners no enthusiasm from the reviewers—the techniques and clinical design contain no new approach or views that advance what has already been done.
The clinical design is particularly flawed in its lack of scientific controls to govern the anticipated study subject population. All in all, the study probably will not lead to new information.

In conclusion, the video moves along quite nicely, covers a wide array of information on peer review, and is well done. The NIH summary of “active scientists reviewing active scientists” demonstrates the epitome of scientific peer review.
BOOK REVIEW

Managing Research, Development, and Innovation: Managing the Unmanageable, 3rd ed.
John Wiley & Sons, Inc., 2010,

REVIEWED BY:
JO ANN SMITH
University of Central Florida

ABSTRACT

Research administrators must master the skills of working with a variety of people in research and innovation development. This book is written from the viewpoint of researchers and research managers. The text discussed the values that often motivate researchers and how that insight can guide and build research administrators’ capacity to collaborate a collaborative and productive culture within our research organizations.

Research administrators must communicate and collaborate with scientists who are highly self-motivated, focused, and determined toward their personal and professional goals, and often culturally diverse. Having knowledge of the research culture and some insights from the behavioral sciences can better equip research administrators to communicate and collaborate with research faculty and staff. This book provides multiple perspectives from the authors, but is specifically focused on management within the research enterprise.

Each of the three authors has a different and complementary specialty that provides a holistic view of research and development organizations. Ravi Jain, Dean and Professor of Engineering and Computer at the University of the Pacific, Stockton, California, provides the perspective of an engineer, scientist, and administrator within a research-intensive university department. Harry Triandis is an Emeritus Professor of Psychology and Labor Industrial Relations at the University of Illinois, Urbana, Illinois.
His perspective indicates the view of a social and organizational psychologist—highlighting psychological characteristics and attributes that are common among innovators and inventors. Cynthia Weick is a Professor of Management at the University of the Pacific, Stockton, California. Her specialty as a management educator is in how research and development affect organizational structure in an organization.

This book is meant to provide comparative illustrations and information for university and industrial research directors and managers. The authors recognize that university department heads, research administrators, technical consultants, and science and technology policy-makers might also benefit. The authors also state their intent to encourage research managers and researchers to be actively involved in influencing the direction of science policy in the United States while improving R&D organizations.

Several chapters describe typical psychological characteristics and attributes of innovators and inventors. New research administrators might especially benefit from these insights.

This is the third edition of the book; the authors have updated it due to the rapidly changing nature of R&D. In particular, this edition updates current research management practices, including recent changes from global networks and other technological innovations. Discussions of technology transfer strategies and organizational change are particularly welcome as they are topics that have not been previously discussed in detail in our literature.

This book may be particularly pertinent to new Master’s in Research Administration programs that are being initiated across the country. Professional research administrators will benefit from the book’s contribution to their knowledge of R&D and its growing impact on the field.

Although the book focuses more on commercial research development organizations, the authors connect the importance of basic research and collaboration with universities. They also include an excellent discussion of trends in research and the future of R&D.

An excellent addition to the short list of books available to research administration graduate programs, this book would also helpful in employee training and professional development.
ABOUT THE AUTHORS

Abrar Ahmed received his bachelor’s degree in biomedical engineering from Jawaharlal Nehru Technological University, Hyderabad, India. Currently, he is a master’s student in computer science at University of North Carolinas, Charlotte, NC. He worked as a research scholar in research administration at Cannon Research Center, Carolinas HealthCare System, and completed a project on efficiency and quality improvements in research administration. He continues to work on projects related to efficiency and quality improvements in research administration.

Nancy B. Bell is the Principal of Research Image, a consulting company that provides workshops and other services to institutions wishing to increase investigator grantsmanship skills. She has had more than 30 years of experience in research administration, including grant writing, principal investigator, workshop provider, and pre- and post-administration positions. Her experiences with faculty extend across a wide variety of funding agencies and academic research arenas. Upon “retirement” from the public sector, she founded Research Image to continue her work with faculty investigators. Currently, she is the developer of the SRA Grantsmanship certificate program and recently received the SRA Distinguished Faculty Award.

Julia Lane Glenn recently received her master’s in research administration from the Medical University of South Carolina (MUSC). The resource described within this paper was the culmination of her master’s project, in which she focused on identifying a research administration need at MUSC and developed a means of addressing that need. At MUSC, she holds the position of Research Navigator within the SUCCESS Research Support Center of the South Carolina Clinical and Translational Research Institute (SCTR), the academic home for the National Institutes of Health (NIH), Clinical and Translational Science Award (CTSA) U54 grant mechanism for research infrastructure and training support. In this role, Ms. Glenn assists in providing investigators and research staff research support services spanning the entire research spectrum from inception of ideas through technology transfer and dissemination of best practice models. Ms. Sampson served as her mentor on the aforementioned project.

Darren Gronseth is currently serving as the Manager for the Office of Research Quality at Mayo Clinic. Mr. Gronseth has been involved in operational and quality management in both manufacturing and service provider settings for over twenty years. He was first introduced to formal quality management in the early 1990s while assisting his employer in obtaining International Organization for Standardization (ISO) 9000 certification. Mr. Gronseth is an American Society for Quality-certified Six Sigma green belt and holds degrees in economics and business administration. He started working in research administration at Mayo Clinic in 2002.
Shailaja Hanumandla received her medical degree in alternative medicine from India and a master’s degree in healthcare management from the University of North Carolina, Charlotte, NC. Dr. Hanumandla served as a research intern in research administration at Cannon Research Center, Carolinas HealthCare System, and completed a project on efficiency and quality improvements in research administration. Currently, she works as a Clinical Research Coordinator for the California Allergy & Asthma Medical Group, Los Angeles, CA.

Jeremy T. Miner is director of grants and contracts at the University of Wisconsin-Eau Claire and president of Miner and Associates, Inc., a nationwide consulting firm that provides grantseeking and fundraising services to academic, healthcare, and other nonprofit organizations. In addition to developing and administering grant proposals, serving as a reviewer for federal and foundation grant programs, and presenting grantseeking workshops, he coauthored several leading books on grant writing, including Greenwood’s Proposal Planning & Writing, Praeger’s Models of Proposal Planning & Writing, and Greenwood’s Collaborative Grantseeking: A Guide to Designing Projects, Leading Partners, and Persuading Sponsors. Miner also co-edits Grantseeker Tips, a free, biweekly electronic newsletter on successful grantseeking.

Sharlissa Moore is a Ph.D. student in the Human and Social Dimensions of Science and Technology program at Arizona State University (ASU). Her research explores project management of large-scale research and the policy and societal aspects of energy innovation and renewable energy development. She is a Research Associate in ASU’s Consortium for Science, Policy and Outcomes. She also is engaged in the professional science and technology policy domain, having worked for the White House Office of Science and Technology Policy and the Science and Technology Policy Institute. She is the President of Student Pugwash USA, a non-profit organization that engages students in issues of social responsibility in science and technology. She earned her B.A. in astronomy with a minor in physics from Smith College.

Robert Porter is Director of Research Development, University of Tennessee, where he conducts grant-writing workshops for faculty and graduate students. Over the past ten years he has presented papers and workshops on grant writing at national conferences and has published prize-winning articles in the Journal of Research Administration and Research Management Review. Dr. Porter has previously taught at Virginia Tech, Swarthmore College, and Eastern Washington University. He holds graduate degrees in Speech Communications from the University of Michigan.

Dhanonjoy C. Saha completed his postdoctoral work at the University of Medicine and Dentistry, Newark, NJ, and later received a Certificate in Information Management from New York University that led him to research administration. As a scientist, he authored or co-authored over 30 publications and presented over 50 abstracts and presentations, mostly in the area of sepsis and septic shock. Dr. Saha worked as the Director of Research Information and Development at New York Medical College, Chairman of IRB at New York City Department of
Health, and Director of Office of Research and Sponsored Programs at University of Connecticut Health Center. He currently works as Assistant Vice President for Research Administration and Operations at Cannon Research Center, Carolinas HealthCare System, Charlotte, NC. He focuses on intellectual properties, research development, research compliance, research operations, and efficiency and quality improvements in research administration. He has presented over 20 seminars and workshops globally in these areas. Last year, he was awarded a NCURA International Research Management Fellowship. In addition, Dr. Saha serves as an Adjunct Professor of Biology at University of North Carolina, Charlotte, and a Research Associate Professor of Family Medicine at UNC School of Medicine at Chapel Hill, NC.

Royce Sampson is a Research Assistant Professor in the Department of Psychiatry and Behavioral Sciences, Medical University of South Carolina. She holds positions as the Chief Operations Officer, SUCCESS Center Director, and the Finance and Administration Director for the South Carolina Clinical and Translational Research Institute (SCTR). The SUCCESS Center, a research support service center, serves as the “front door” to SCTR programs and services and provides expert guidance, training, and support to researchers and their study team members related to regulatory affairs, recruitment and retention, budget development and grants management, and research conduct. Ms. Sampson has extensive research experience and has served in a variety of research management and grant administrator roles. She served as the Associate Director for Geriatric Psychiatry and the Alzheimer’s Research and Clinical Programs. She also served as the Regulatory and Quality Assurance Director and Node Coordinator for the NIH, National Institute on Drug Abuse, Clinical Trials Network, Southern Consortium Node. Prior to the CTSA grant, Ms. Sampson served as the Co-Administrative Director, Administration and Finance, for the NIH, NCRR, General Clinical Research Center and the Business and Grants Manager for the Department of Psychiatry, Clinical Neuroscience Division, which conducts research in addictions and co-morbidity under the direction of Dr. Kathleen T. Brady.

Rick Shangraw is the chief executive officer of the ASU Foundation for A New American University. Prior to joining the foundation in November 2011, he served as ASU’s Senior Vice President for Knowledge Enterprise Development and Director of the Global Institute of Sustainability. He was responsible for ASU’s growing annual $350 million research portfolio, which placed ASU among the top 20 research institutions in the country without a medical school. Before joining ASU, Rick was the founder and CEO of Project Performance Corporation, a research and technology consulting firm specializing in environmental, energy and information management issues. He has a B.A., magna cum laude, in political science and a certificate in environmental studies from Dickinson College in Pennsylvania; a Master of Public Administration from the Maxwell School at Syracuse University; and a Ph.D. from the Maxwell School with a specialization in technology and information policy and organization design. He
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**Jo Ann Smith** is an Assistant Professor and Coordinator of the Master of Research Administration graduate program at the University of Central Florida. She earned a Ph.D. in Instructional Systems Technology and is a Certified Research Administrator (CRA) with over 20 years’ experience in sponsored programs. Her efforts in research and grant development with universities, hospitals, federal, state, local, and nonprofit agencies have collectively resulted in approximately $100 million in funding. She has been a state and federal proposal reviewer, a program evaluator, and a presenter at local and national conferences. She has taught qualitative and quantitative research methods and Strategic Planning and Management.

**Steven C. Smith** is currently serving as the Chair of Research Administration at Mayo Clinic. Prior to joining Mayo he worked in Senior Leadership at the University of Michigan Medical Center and started his career as a consultant for a subsidiary of Deloitte. Mr. Smith received a B.A. degree from St. Olaf College and a Master of Healthcare Administration degree from the University of Minnesota. He subsequently completed post-graduate training programs in Healthcare Administration in the British National Health Service. Mr. Smith is board-certified as a Fellow in the American College of Healthcare Executives and as a Fellow in the American College of Medical Practice Executives.