Business Planning Methodology to Support the Development of Strategic Academic Programmes

Simon P. Philbin
Enterprise Division, Imperial College London, United Kingdom

Charles A. Mallo
Enterprise Division, Imperial College London, United Kingdom

Abstract: *Higher education institutions are often required to design and deliver a range of strategic academic programmes in order to remain competitive, support growth and ensure operations are financially sustainable. Such programmes may include the creation of new research centres and institutes as well as the installation of major new research facilities. These programmes offer significant academic benefits but can often carry commercial risk associated with the major levels of financial investment that may be needed. There is also the need to develop a compelling case to secure the necessary funding. Consequently, this paper provides details of a management framework based on a business planning methodology, which can be applied to support the development of strategic academic programmes. Adapted from the recognised MSP (Managing Successful Programmes) management process, the framework has been explored as part of a case study investigation of a medical research facility. The case study highlights a number of managerial insights across the people, process, technology and knowledge dimensions that are pertinent to the management of strategic academic programmes. The management framework can be adapted to the needs of other organisations involved in the business planning for such complex initiatives.*

Keywords: *Strategic Academic Programmes, Business Planning, Medical Imaging Facility*

Introduction

Universities and independent research institutions can often be large and complex organisations that need to be flexible and adaptable to continuous change (Navarro & Gallardo, 2003). Indeed universities are required to meet the needs of various stakeholders through providing academic services involving the delivery of education and in the case of research intensive universities, this also includes undertaking research. Furthermore, knowledge exchange activities result in the translation of knowledge and research outcomes into commercial benefits for partners or societal benefits for wider stakeholders (Philbin, 2015). In this context universities have increasingly been viewed as occupying a strategic role through stimulating innovation and economic growth through technology transfer and the resulting commercial exploitation of intellectual property (Hughes & Kitson, 2012).

Universities also face a number of challenges. There is increasing pressure on academic budgets, especially on the funding secured from governmental sources. There is an increasing level of

competition in terms of universities competing on multiple levels, e.g. competing for the best students and staff as well as for research funding. There is also a tendency for universities to be engaged in greater levels of performance measurement to underpin effectiveness across research, teaching and knowledge exchange activities (Ter Bogt & Scapens, 2012). But universities are also faced with the opportunities of adopting modern ICT (Information and Communications Technology) to improve the scope and quality of teaching (Selwyn, 2007). Additional educational channels are under development and offered by an increasing number of universities, e.g. through recent developments of MOOCs (Massive Open Online Courses) (Daniel, 2012). Other opportunities could, for example, be associated with responding to major funding calls and setting up multidisciplinary research centres (Philbin, 2011), or establishing new research facilities that bring together academic faculty to focus on a specific industrial requirement or societal need for research, such as healthcare, security or the environment.

In this context, universities need to be able to adapt to emerging opportunities and respond to strategic programme opportunities in an efficient and effective manner. In the case of major opportunities, there will be the need to assemble a supporting business case that underpins the opportunity. The business case will need to sit alongside the academic case for financial support and will jointly be reviewed by the funding body, which could be a government agency, industrial company, charitable foundation, philanthropic source or even the university itself. Development of a business plan for a new initiative requires appropriate commercial competencies in order to ensure a compelling and attractive case can be assembled, which can thereby attract the necessary funding. While companies are experienced in such business planning, in the Not-For-Profit (NFP) and academic sectors there has historically been less of a need for such commercial competencies and capabilities. This is changing, however, and increasingly universities and NFP research organisations are adopting management practices derived from the corporate world (Nickson, 2014). Nevertheless, in our experience we have found there can be certain challenges encountered, especially for strategic academic initiatives. These challenges are summarised in Table 1.

Table 1. Summary of challenges encountered for strategic academic initiatives pursued by universities.

Challenges for Strategic Academic Initiatives
• An inability to secure sponsorship or capital investment to support the initiative.
• A lack of a robust business case to support the initiative.
• Insufficient leadership of the opportunity, either academic or commercial.
• The need for administration services to rapidly undertake financial and contracts related activities in order for a proposal deadline to be met.
• Difficulties in the estimation of the true costs associated with the initiative.
• Inadequate planning leading to difficulties in delivery of the initiative.
• Difficulty in the effective review of commercial opportunities, which starts from the early conceptual stage and extends through to later stages in the development cycle.
• Incomplete scope of work leading to the need for extensive change control that may result in cost overrun during delivery of the initiative.
• Insufficient capture of risks and the required mitigation measures needed to reduce such risks.

Consequently, this paper will describe an approach developed at Imperial College London in the United Kingdom to help support the development of strategic academic initiatives at universities through use of a structured business planning methodology. The framework is introduced and an illustrative case study is described in order to provide readers with insights into the benefits of adopting a structured business planning methodology at higher education institutions. Such a framework can be deployed to support the development of strategic programme opportunities such as new research centres, major infrastructure investment as well as the creation of new academic capabilities to support research and education delivery.

The Need for Business Planning

The process of business planning needs to capture the customer need in a succinct manner and then derive a viable solution and supporting approach in order for the need to be met. Addressing this need involves the deployment of the necessary resources along with management oversight and the costs for such activities need to be ascertained. There is also a need to identify the risks associated with such a business plan and other commercial factors such as the availability of investment capital and the level of competition from other suppliers in the sector. The use of structured methodologies, such as programme management, offers the ability to provide a systematic approach to support the business planning process. Indeed ensuring there is a robust process to support planning can help improve the success of strategic initiatives. Process considerations include the features of the planning stage, human-dimensions of decision-making, managerial and technical skills available to the team—both the internal and external context for the planning as well as the initial and final outcome measures of performance (Bryson & Bromiley, 1993).

In terms of developing strategic initiatives, there needs to be alignment with the relevant organisational strategy, which could be at the corporate, business or functional level (Grünig & Kühn, 2015). This alignment is required to enable the pursuit of new strategic opportunities and to help organizations receive the necessary funding. The development and maintenance of key infrastructure and facilities can be of strategic importance to academic institutions and initiatives that are pursued in order to maintain enterprise-wide research and associated experimental facilities can benefit from the support of standardised and transparent processes (Grieb, Horon, Wong, Durkin & Kunkel, 2014).

The capabilities required for universities to initiate and deliver strategic initiatives, such as new research centres or subsidiary companies, will be associated with the processes adopted as well as the structures and resources that are available. Moreover, business planning can support the decision-making process required for developing such strategic initiatives but while adopting a structured approach to business planning offers clear benefits it should be balanced against the need to avoid becoming overly rigid or bureaucratic (Oakes, Townley, & Cooper, 1998). Indeed business planning has historically been a recognised approach to support new venture creation (Delmar & Shane, 2003), which is highly dependent on being able to articulate the commercial value to be delivered by the venture. Developing a strategic programme at a university needs to capture and articulate the academic (or technical/scientific) and the commercial case, so it is

logical to draw on best practice from the corporate environment but crucially with refinement to the university/NFP context.

Recognising the best practice and current approaches to programme management as well as business planning for strategic initiatives, we identified the Managing Successful Programmes™ (MSP) framework (Office of Government Commerce, 2007) as a suitable methodology to support the development and management of strategic initiatives at Imperial College London. This was supported by consultations with members of staff at Imperial College on the need for

Table 2. MSP programme definitions and business planning applications for universities.

Type	Programme Definition	Business Planning Applications
Vision-led programme	Focused on delivery of a strategic opportunity for the organisation and often driven top-down to meet a defined vision.	• Development of a new multidisciplinary research centre at a university. • Establishment of a joint venture company for the delivery of, for example, joint testing or analytical services with another organisation. • Development of a new commercial educational initiative to provide university courses through an online platform on an international basis. • Developing a business case for a research services facility in order to respond to a major industrial funding opportunity.
Emergent programme	Evolves from concurrent, uncoordinated projects where there is recognition that coordination will deliver defined benefits.	• Developing a strategic alliance with an industrial organisation that builds on a set of existing research projects that were previously not coordinated as part of an integrated programme. • Linking together several disparate management accounting systems in order to provide an integrated approach to managing research administration activities across the university. • Establishing a single office to support technology transfer and intellectual property management for a university that previously had such activities carried out separately in different departments.
Compliance programme	The organisation has to undertake the programme so that compliance is achieved in the context of an external event such as new legislation.	• Implementation of an equipment maintenance system (including additional resources and new processes) in order to respond to new safety legislation relating to the operation of technical facilities. • Establishment of a research compliance office in order to respond to new legal requirements and obligations placed on the university by a major funding body such as a government healthcare agency. • Resourcing of an administration team for international students in order to administer and manage compliance with a new set of immigration requirements and procedures.

an efficient process for the management of major initiatives and also through capturing views on the matter from a range of senior stakeholders at Imperial College. Consequently, we sought to implement the MSP methodology through adapting the standard process model to Imperial College's requirements for strategic academic initiatives and the process was also streamlined to be aligned with Imperial's administrative systems and thereby avoid excessive bureaucracy.

MSP is a management standard that has been developed over the last several years by the United Kingdom's Office of Government Commerce (OGC). This management approach is not derived from theoretical study but has been established through building on the knowledge and experience of practitioners and the approach therefore represents best management practice. The management standard relates a programme to the implementation of a set of related projects to deliver outcomes and benefits associated with the organisation's strategic objectives. Moreover, a programme is focused on aligning corporate strategy with a delivery mechanism for change in the context of existing business operations, where according to the MSP framework a programme can either be vision-led, emergent or compliance. Table 2 provides the definitions for the three main types of programmes together with a series of illustrative business planning applications for universities according to the three types.

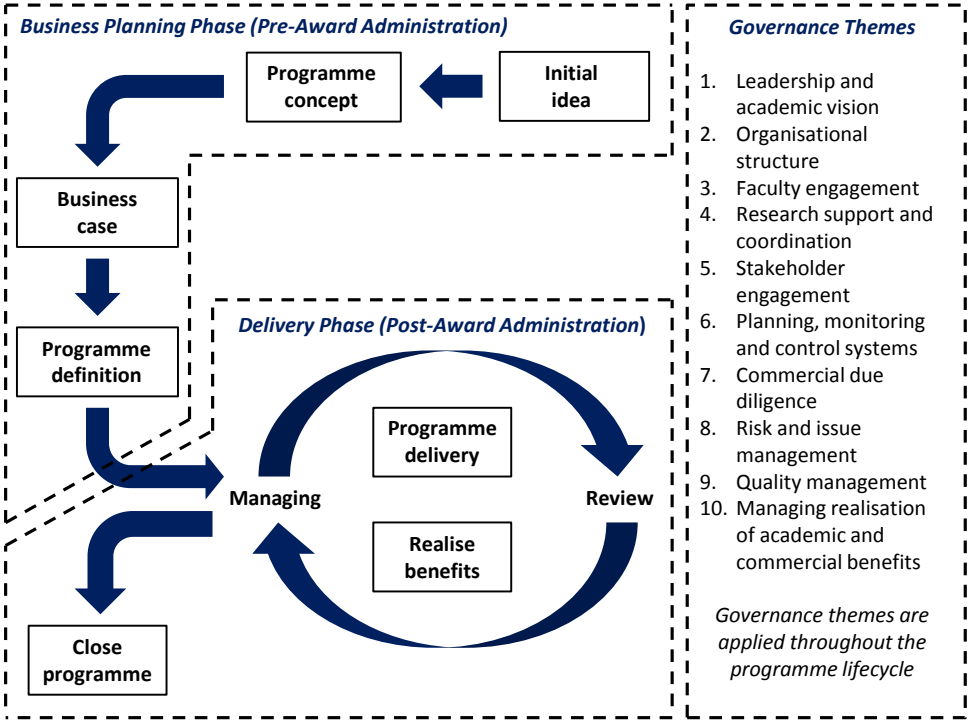


Figure 1. Overall view of the management framework to support business planning and delivery for strategic academic programmes (adapted from the MSP methodology).

Table 2 highlights that there are a range of business planning applications in higher education institutions that can be related to the programme management approach offered by MSP. Adoption of a recognised and structured methodology, such as MSP, offers a university a number of benefits. These include the efficient use of administration resources to support research programmes, effective planning according to recognised best practice for management initiatives, potential to be economical and offering value for money through avoiding duplication of management effort as well as capturing key data and information to support the ethical administration of research programmes.

Business Planning Methodology for Strategic Academic Programmes

The management framework to support business planning for strategic academic programmes has been developed through applying the MSP methodology to the academic context and is provided in Figure 1. The framework includes the business planning phase (pre-award administration) and the delivery phase (post-award administration), which together comprise the different stages of the programme lifecycle. The management framework also includes associated governance themes. The ten governance themes describe the different elements required to support the overall process, such as leadership and academic vision, organisational structure, faculty engagement as well as research support and coordination. These governance themes provide the supporting mechanisms to ensure programmes deliver the required outcomes and remain within corporate visibility and control.

In terms of a lifecycle perspective of strategic academic programmes, ideas for new programmes are initially created (initial idea stage), whereupon they are conceptually developed by the

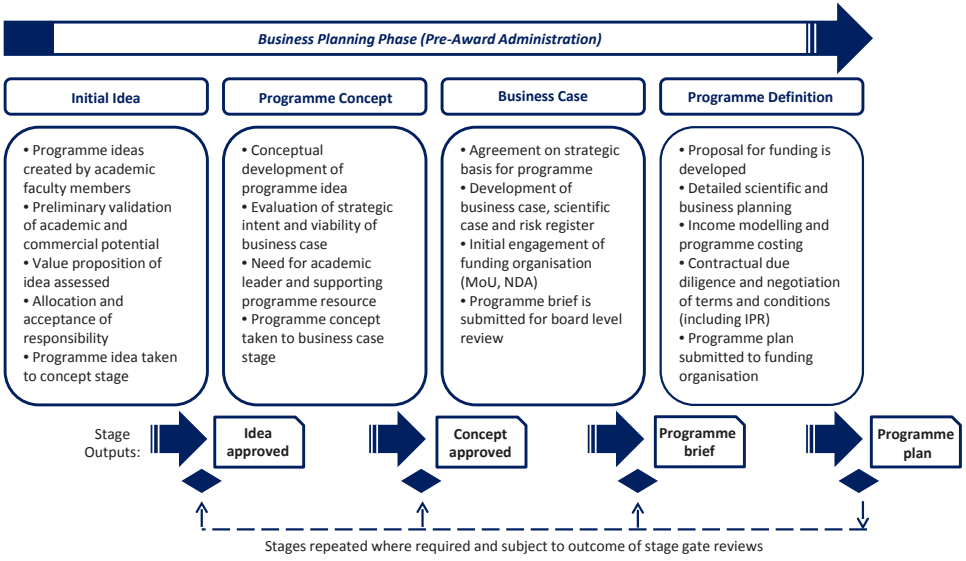


Figure 2. Summary of business planning phase and supporting stages for strategic academic programmes (adapted from the MSP methodology).

relevant team (programme concept stage). This leads to establishment of the business case for the programme (business case stage), followed by programme development where the programme proposal and business case are refined in more detail (programme definition stage). These four stages represent the wider business planning process as part of the planning phase (pre-award administration) and are summarised in Figure 2.

The business planning phase (pre-award administration) includes the primary outputs for each stage as well as the corresponding stage gate reviews. The process recognises that there may be a need for a previous stage to be repeated subject to the outcome of the relevant stage gate review, e.g. where the funding body's requirements have changed, or the stage output may be viewed as

Table 3. Key activities according to the main stages of programme management framework (business planning and delivery phases).

Stage	Key Activities
Initial idea (pre-award)	• This is the preliminary stage where new ideas are driven by university strategy or academic need and created by senior or academic faculty members across the university. • Ideas are validated to ascertain academic and commercial potential. • There will be allocation and acceptance of responsibility for the validated idea to a designated programme leader. • In order for a programme idea to be considered further then it is subject to an initial stage gate review.
Programme concept (pre-award)	• At the programme concept stage there will have already been an initial programme idea that has been communicated to internal stakeholders. • The programme could potentially pass very quickly from programme concept to business case if there is a clear requirement to carry out the programme together with strong backing from the university's leadership. Alternatively, there may be a need for more detailed work in the concept stage in order to qualify the programme opportunity. • At this stage there should be agreement by key stakeholders on the need for the programme and the required trajectory to realise the programme benefits.
Business case (pre-award)	• This stage turns the concept into a tangible business proposition. • A major part of the business case stage involves generating the material to prepare for approval of the programme brief, which is a crucial document that provides background to the programme and defines the expected academic benefits, costs, timescales and risks. • The programme brief should clarify what is to be achieved, thereby allowing a management decision to be made on whether the programme is desirable and appropriate as well as a commitment to be made to move to the next stage in the process (programme definition). • The programme brief should set out the business case for the programme along with the available business structures, which could, for example, be the incorporation of a subsidiary company, or establishment of a strategic alliance with another organisation (university, company or government agency). • There will need to be commercial due diligence on the available business structures and this may require the support of legal advisors as appropriate. • As the programme definition stage progresses there will need to be engagement with the eventual funding organisation. To support the interface with external funders, there may be a need for a supporting Memorandum of Understanding (MoU) (or Heads of Agreement/Term Sheet, as appropriate) that sets out the principles for working together as well as the pathway for programme definition. • The MoU may be accompanied by a Non-Disclosure Agreement (NDA) allowing all parties concerned to easily share confidential information. These pre-contract documents can also help bind the funding organisation to the emerging programme and they may also help clarify the objectives for developing the programme.

Stage	Key Activities
Programme definition (pre-award)	• This part of the process involves development of the detailed proposal documentation in order to secure the funding required to undertake the programme. • The programme definition stage will be informed by the programme brief. • There will need to be detailed planning around the scientific proposal and this will be led by the principal investigator (PI) with input from other faculty members. • Where it is appropriate, multidisciplinary proposals should be developed that draw on the academic strengths from relevant academic departments in order to provide the programme's funder with the highest quality scientific offering. • Programme definition will involve detailed business planning including cost and income modelling. Programme costs should be calculated according to the university's financial procedures, including costs for staff (namely academic, research and support), students (e.g. PhD) as well as laboratory and computing equipment, materials and other costs as required. Appropriate overhead calculations will also need to be carried out. • Typically the programme definition stage will need to include preparation of an outline programme management plan, including a programme schedule for the main programme activities and milestones. This will extend to the programme risk register that identifies the risks in terms of impact and likelihood along with mitigation measures and risk owners. • The programme's governance arrangements need to be considered. There may be a need for appropriate boards of management (such as a strategic advisory board, or operations board) as well as programme reporting arrangements and any relevant performance measurement system such as the balanced scorecard. • Within programme definition there will need to be continued engagement with the potential funders of the programme as well as comprehensive due diligence of the proposed contractual framework. • The terms and conditions of the contract will be reviewed for acceptance to the university's commercial requirements and in particular those relating to the allocation of intellectual property rights (IPR). • In order for the programme to move ahead there will typically be submission of the proposal plan including the business case, scientific proposal and any accompanying documents to the sponsoring organisation(s).
Programme delivery (post-award)	• Programme delivery takes place once funding has been approved and supporting contractual documentation has been signed by all the relevant parties. • Delivery will involve implementation of the programme management plan through appointment of the required staff and in particular there will need to be appointment of the principal investigator of the programme. • Programme benefits are realised as identified in the programme plan to be delivered incrementally over the programme's delivery period so as to avoid an apparent lack of progress in the initial stages. • Programmes should preferably be structured to deliver 'quick wins', e.g. setting performance milestones for the recruitment of staff, or for the commencement of initial research or education activities. Then, over a longer timeframe other benefits should be realised, whether commercial or academic, such as establishment of new facilities, publication of research results in scientific journals, or negotiation of licensing agreements with industrial companies. • During the programme delivery stage there should be periodic review by the programme delivery team (and externally where appropriate) of the programme to check on progress, evaluate benefits realised, make adjustments as well as learn and decide on appropriate action, including eventually programme closure.
Programme closure (post-award)	• Upon completion of all programme activities, or following a strategic decision by the university (with other stakeholders involved as appropriate), formal closure of the programme will be undertaken. • It is suggested that a suitable programme exit plan is developed during programme definition so that programme closure can proceed smoothly if required. • In the case of subsidiary or joint venture companies, care will be needed to minimise the university's financial exposure.

not being acceptable or not of the required quality standard. Once the necessary funding has been secured, programme delivery commences and this involves delivery of the capability alongside realisation of the programme's academic benefits (programme delivery stage). Upon completion of all programme activities the programme is formally closed (close programme stage).

Table 3 provides supporting details on the key activities to be carried out for all six stages (both pre- and post-award administration), although it is recognised that business planning refers only to the pre-award administration stage. These key activities are described in order to provide practitioners with greater insight into how the business planning methodology can be adopted in their own organisation. Application to a given organisation should however take account of the local environment as well as management needs and hence the specific activities would need to be adapted as required.

Case Study Investigation

Introductory Comments

The case study investigation involved the business planning for a medical imaging facility at Imperial College London in the United Kingdom. The case study is based on the experience of the authors who were directly involved with the programme through being part of Imperial's Enterprise Division. The division is responsible for providing business development, programme management, commercial planning and support to faculty members across Imperial College and this includes the development of industry funded research projects, European Union funded consortium research projects as well as strategic academic programmes such as new research centres and institutes. The following case study is provided for illustrative purposes. The findings are reported through a process of reflective inquiry (Schön, 1983) by the authors and where appropriate, representative data and information is included to provide further context. The case study highlights the practitioner benefits of utilising the management framework to support the business planning for the development of strategic academic programmes that are pursued by a university or NFP research organisation.

Need for Medical Imaging

The medical research imaging facility includes PET-CT (Positron Emission Tomography–Computed Tomography) and MRI (Magnetic Resonance Imaging) scanning equipment and the initiative related to a requirement to upgrade the facility so that academic research could be carried out on the imaging equipment. PET-CT is a medical imaging technique that combines through a single system a PET (Positron Emission Tomography) scanner and an X-ray CT (Computed Tomography) scanner. This allows images to be taken sequentially from both scanners to build up a co-registered image. The PET imaging involves the patient receiving a small dose of a radioactive tracer, e.g. fluorodeoxyglucose or FDG protocol. The scans provide an image of how the tracer is processed by the body, where the PET-CT technique is based on the use of X-rays to generate images of the body. Conversely, MRI is an imaging technique that produces detailed anatomical images but without the need for radiotracers. An MRI scanner uses magnetic fields and radio waves to form three-dimensional images of the body. For further reference, Suetens

(2009) provides details on the fundamentals of medical imaging. Both MRI and CT scanning are increasingly used in the provision of modern healthcare services and this is illustrated in Figure 3, which highlights the growth in numbers of clinical imaging tests in England from 1995-96 to 2013-14. This data from National Health Service (NHS) England (2014) identifies that the rate of average annual growth over last 10 years for CT and MRI has been 10.1% and 12.1% respectively.

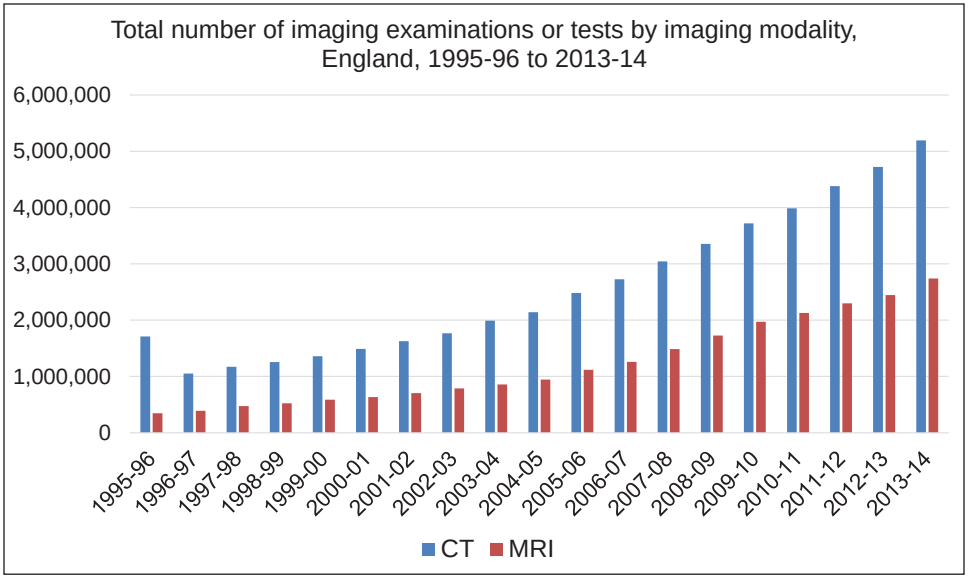


Figure 3. Growth in numbers of clinical imaging tests in England from 1995-96 to 2013-14. Source: NHS England, Annual Imaging and Radiodiagnostics Data, 1995-2014.

Development of Imaging Facility

The programme involved refurbishment of the facility so that it could be used to support the research needs of academic faculty members at the university. The initial idea was identified by senior staff at the university and this was communicated to Enterprise Division so that the business planning work could be initiated. The preliminary assessment of the programme opportunity was carried out and this highlighted the academic needs for the programme as well as the commercial potential. The programme then transferred to the programme concept stage, whereupon more detailed planning was carried out on the scope of the programme as well as the academic benefits. At this stage, a programme steering group was assembled. The steering group was a multidisciplinary team representing different functional areas, such as senior management, finance, facilities management, health and safety as well as general administration.

During the concept stage there was also allocation of a limited amount of internal funds to support an engineering feasibility study that was required in order to ascertain the overall costs

of the main refurbishment and upgrade works. At the first meeting of the steering group, there was discussion on the work packages of the programme, namely the engineering feasibility study and the business case development. The feasibility study was required to determine the total programme costs for upgrading the facility and the business case was needed in order to derive the likely revenues to be generated by the facility through providing an imaging service to members of the academic faculty. After this initial meeting of the steering group, the programme transferred to the business case stage.

Knowledge Dimensions of the Case

The business case was dependent on developing an improved understanding on how the clinical scanning facility would complement other facilities operated by the university, thereby allowing an overall view to be established for the entire scanning services offered across the university. Knowledge was generated on the clinical research areas to be investigated through use of the enhanced medical scanning facility. This knowledge was obtained from a series of academic faculty consultations with leading medical research practitioners across the university's various hospital campuses. Data and information was also acquired that related to the operation of the medical scanning equipment including operating conditions, throughput levels and maintenance regimes. Plus, information relating to sponsor needs was obtained, including potential funding opportunities with research councils and charitable foundations. Table 4 provides a summary of the medical research areas that would be accessible through use of the upgraded medical imaging facility, which were identified during the consultation meetings with faculty members.

Table 4. Summary of medical research areas accessible through use of the upgraded medical imaging facility.

Medical Research Area	Description
Neuroscience	• Investigation of the nervous system, including molecular and cellular research of nerve cells as well as imaging of brain functions. • For example, use of clinical imaging to improve understanding of Parkinson's disease, dementia, movement disorders and multiple sclerosis.
Pharmacology	• Investigation of the biological action of drugs. • For example, use of clinical imaging to understand the drug action pathways in order to improve the treatment of diseases of the central nervous system (CNS).
Oncology	• Investigation of tumours and cancer, which involves abnormal cell growth that occurs in a particular part of the body and which results in cancerous cells destroying surrounding healthy tissue and organs. • For example, use of clinical imaging to monitor the response of cancerous tissue to therapeutic treatment regimes.

Programme Lifecycle Management

Once the business case had been assembled for the enhanced facility and as part of the next stage in the lifecycle, the programme definition stage was undertaken. This involved more detailed financial modelling on the expected level of revenues for the facility that was related to the medical research areas identified in the business case stage. Revenue modelling also included a number of financial scenarios, including the so called best-case scenario (high level of revenues), worst-case scenario (low level of revenues) and base-case scenario (medium level of revenues). This form of financial scenario planning allowed probability factors to be applied to the various sources of funding so that a reasonable estimate could eventually be made through the base-case scenario that took account of the relative levels of risk (and corresponding probability) for each source of funding.

For example, in the scenario where a research programme has already been awarded by a medical research charitable foundation, this was viewed as a low risk source of funding corresponding to a high probability that there would be funding made available for imaging research on the upgraded facility. Whereas, in the case where a research proposal was to be submitted to a pharmaceutical company that had yet to make a decision on programme funding, this was viewed as a high risk source of funding and a corresponding lower probability that there would be funding made available for imaging research on the upgraded facility. Programme definition allowed the full business case to be prepared for the programme, including academic and technical aspects as well as commercial and business considerations. The funding proposal was submitted to the university's management board and after careful consideration the programme's capital expenditure (CAPEX) was approved.

Programme delivery took place after the allocation of programme funds and this involved the upgrade of the facility so that the required medical research could be undertaken using the imaging equipment. This stage proceeded smoothly and included the various engineering works, such as upgrades to the M&E (mechanical and electrical) services as well as installation of additional pieces of equipment. The facilities were tested for effective operations and subsequently opened for use as a medical research imaging facility at the university. Programme closure involved the facility being handed over from the engineering team to the academic department so that medical research studies and imaging activities could commence. Finally, programme finances were reconciled with all outstanding payments met and other programme administration activities completed allowing formal closure of the facilities development programme.

Managerial Insights from Case Study

A number of managerial or practitioner-related insights can be drawn from the case study that involved implementation of the programme management framework and these are summarised in Table 5. The insights are described in terms of the people, process as well as technology and knowledge dimensions.

Table 5. Managerial insights from the case study investigation.

Area of Consideration	Managerial Insights
People	• The medical research facility was a strategic academic programme for the university that required senior level oversight and eventual approval by the university's management board. It was therefore essential that senior stakeholders, including senior academic and management staff, were involved in the programme from the outset through to completion. • The programme steering group benefited from being a multidisciplinary team that represented all the key functional areas that needed to be engaged through the programme lifecycle. This meant that the key internal stakeholders were engaged in the programme from the outset, thereby helping with governance of the programme as well as compliance with the university's various protocols related to research facilities. • The individual consultation meetings that were held with academic faculty members needed to be carried out in a highly structured manner in order to ensure the medical research needs for the facility were properly captured. Such meetings should ideally be conducted in an open and transparent manner to build trust. These meetings also provided the opportunity to highlight the research capabilities of the facility to be upgraded, thereby building a pipeline of potential work for the medical research facility.
Process	• Adapting the MSP methodology to the academic setting provided a clearly defined and structured approach that was used to guide the business planning work required for the medical imaging programme. • Engineering risks were identified at an early stage in the overall process through the feasibility and design study that was carried out. These risks were mitigated through appropriate measures so that the programme could be completed in the required timeframe and according to the overall academic needs for the facility. • Business case development through financial scenarios based on different levels of revenue generation for the upgraded facility supported the decision-making process and thereby helped senior management to weigh up the costs and benefits for the new facility. Process-driven management approaches also help give confidence to senior management that all the required factors have been properly identified when considering substantial CAPEX decisions.
Technology and knowledge	• Both the business planning and delivery phases should be supported by appropriate ICT (Information and Communications Technology). This may include use of the university's ERP (Enterprise Resource Planning) system as well as standard tools, such as those from the Microsoft™ suite of products, such as MS Excel, MS Access, etc.

Area of Consideration	Managerial Insights
Technology and knowledge	• The case study also required the use of programme-specific technologies and this included the various diagnostic and testing systems used to collect environmental data on the facilities as part of the engineering facilities work package. The technical team also employed various clinical related technologies associated with scanning equipment. Such technologies should be driven by the specific needs of the programme and will clearly be different for different types of programmes. • In order for the programme to be effective, it will need to generate the required knowledge and this data and information is needed to inform the business planning phase. In the case study this included the knowledge generated on clinical research areas (namely neuroscience, pharmacology and oncology) that would be investigated through use of the medical scanning facility. A supporting culture of sharing such information is also desirable. Access to such knowledge is therefore a crucial factor in regard to the success of business planning and eventual delivery of complex academic programmes.

Concluding Remarks

Universities and NFP research organisations face a number of challenges that include responding to increased pressure on funding and budgets as well as increasing levels of competition for funding and the recruitment of leading faculty. These challenges are, however, accompanied by various opportunities such as those presented by adopting different forms of ICT in regard to educational delivery as well as opportunities related to establishing major new research initiatives. Moreover, the ability for such organisations to be able to adapt to changing circumstances and drive forward strategic academic programmes is likely to be a major indicator of success in the future.

As distinct from smaller scale research projects, strategic academic programmes are complex initiatives that require coordinated development. This complexity can be associated with a range of factors, such as the need for complicated legal arrangements, company formation, an international dimension, multi-department involvement, or a high-level partnership leading to significant funding. For example, this could include a high-value research programme enabling creation of a new centre or institute, or alternatively there could be development of the business case to support a new joint venture (JV) company, or an overseas campus initiative. In addition to the potential higher academic and commercial benefits, these programmes often carry an enhanced level of risk, for example, involving financial risk in the delivery period, or the possibility for the university's brand to be tarnished. The management framework described in this paper was established in order to support the business planning and development of such strategic academic programmes and to help manage the significant complexity that often arises with such programmes.

The programme management framework was developed through adapting the MSP methodology to the academic setting in order to derive a structured approach that is based on best management practice. This programme lifecycle approach is based on a stage-gate process that involves the business planning phase (including the initial idea, programme concept, business case and programme definition stages) and the delivery phase (including the programme delivery and programme closure stages). This framework provides a robust approach to support the business planning required for strategic academic programmes, including the so called vision-led, emergent and compliance type programmes.

The case study investigation reported in this paper highlights the utility of the programme management framework to support the business-planning phase for an enhanced medical research facility. The imaging facility includes PET-CT and MRI imaging equipment that can be used to support various medical research areas, such as neuroscience, pharmacology and oncology. Implementation of the programme management framework will be highly dependent on the people, process as well as technology and knowledge dimensions of a given a strategic academic programme. A supporting culture that promotes sharing of knowledge across the programme is also an important factor to the success of such programmes. Although the methodology provided in this paper provides an overall route map to help practitioners design and deliver major new academic programmes, the individual activities carried are contingent on the specific organisational context and the needs for a particular programme. Nevertheless, the programme management framework can be adapted to the needs of other universities and NFP research organisations as needed.

Future work is suggested on applying the programme management framework for business planning to other strategic academic programmes, such as the creation of multidisciplinary research centres and institutes or the creation of a new spin-out company arising from the commercial exploitation of intellectual property. Such applications would further highlight the practical benefits of adopting a structured business planning approach to the development of strategic academic programmes that support the growth and financial sustainability of university and NFP research organisations.

Simon P Philbin, PhD MBA
Director of Programme Management
Enterprise Division, Imperial College London
South Kensington, London SW7 2AZ, United Kingdom
Email: s.philbin@imperial.ac.uk

Charles A Mallo, MEng
Director of Academic and Technology Ventures
Enterprise Division, Imperial College London
South Kensington, London SW7 2AZ, United Kingdom
Email: c.mallo@imperial.ac.uk

Correspondence concerning this article should be addressed to Simon P Philbin, PhD MBA, Director of Programme Management, Enterprise Division, Imperial College London, South Kensington, London SW7 2AZ, United Kingdom, Email: s.philbin@imperial.ac.uk

References

Bryson, J. M., & Bromiley, P. (1993). Critical factors affecting the planning and implementation of major projects. *Strategic Management Journal, 14*(5), 319-337. doi:10.1002/smj.4250140502

Daniel, J. (2012). Making sense of MOOCs: Musings in a maze of myth, paradox and possibility. *Journal of Interactive Media in Education, 2012*(3), 1-20. doi:http://doi.org/10.5334/2012-18

Delmar, F., & Shane, S. (2003). Does business planning facilitate the development of new ventures? *Strategic Management Journal, 24*(12), 1165-1185. doi:10.1002/smj.349

Grieb, T., Horon, J. R., Wong, C., Durkin, J., & Kunkel, S. L. (2014). Optimizing institutional approaches to enable research. *Journal of Research Administration, 45*(2), 46-60. Retrieved from http://srainternational.org/publications/journal/volume-xlv-number-2/optimizing-institutional-approaches-enable-research

Grünig, R., & Kühn, R. (2015). Developing and assessing strategic projects at the corporate level. In *The strategy planning process* (pp. 163-170). Berlin: Springer.

Hughes, A., & Kitson, M. (2012). Pathways to impact and the strategic role of universities: new evidence on the breadth and depth of university knowledge exchange in the UK and the factors constraining its development. *Cambridge Journal of Economics, 36*(3), 723-750. doi:10.1093/cje/bes017

National Health Service (NHS) England. (2014). *Annual imaging and radiodiagnostics data 1995-2014*. Retrieved November 12, 2015 from: http://www.england.nhs.uk/statistics/statistical-work-areas/diagnostics-waiting-times-and-activity/imaging-and-radiodiagnostics-annual-data/

Navarro, J. R., & Gallardo, F. O. (2003). A model of strategic change: Universities and dynamic capabilities. *Higher Education Policy, 16*(2), 199-212. doi:10.1057/palgrave.hep.8300016

Nickson, A. (2014). A qualitative case study exploring the nature of New Managerialism in UK higher education and its impact on individual academics' experience of doing research. *Journal of Research Administration, 45*(1), 47-80. Retrieved from http://srainternational.org/publications/journal/volume-xlv-number-1/qualitative-case-study-exploring-nature-new-managerialism

Oakes, L. S., Townley, B., & Cooper, D. J. (1998). Business planning as pedagogy: Language and control in a changing institutional field. *Administrative Science Quarterly, 43*(2), 257-292. doi:10.2307/2393853

Office of Government Commerce (OGC). (2007). *Managing successful programmes* (3rd ed.). London: The Stationery Office.

Philbin, S. P. (2011). An investigation of the development and management of university research institutes. *Journal of Research Administration, 42*(1), 103-122. Retrieved from http://srainternational.org/

Philbin, S. P. (2015). Exploring the challenges and opportunities for higher education institutions: Work domain analysis and development of strategic options. *Proceedings of PICMET '15: Management of the Technology Age, Portland (OR), USA*, IEEE.

Schön, D. (1983). *The reflective practitioner: How professionals think in action*. New York: Basic Books.

Selwyn, N. (2007). The use of computer technology in university teaching and learning: a critical perspective. *Journal of Computer Assisted Learning, 23*(2), 83-94. doi:10.1111/j.1365-2729.2006.00204.x

Suetens, P. (2009). *Fundamentals of medical imaging* (2nd ed.). Cambridge University Press.

Ter Bogt, H. J., & Scapens, R. W. (2012). Performance management in universities: Effects of the transition to more quantitative measurement systems. *European Accounting Review, 21*(3), 451-497. doi:10.1080/09638180.2012.668323

Trends in Large Proposal Development at Major Research Institutions

Lorraine M. Mulfinger, PhD
The Pennsylvania State University, University Park, PA

Kevin A. Dressler, PhD
The Pennsylvania State University, University Park, PA

L. Eric James, JD, MS
Huron Consulting Group, Chicago, IL

Niki Page
The Pennsylvania State University, University Park, PA

Eduardo Serrano
Huron Consulting Group, Chicago, IL

Jorge Vazquez
Huron Consulting Group, Chicago, IL

Abstract: *Research administrator interest in large research proposal development and submission support is high, arguably in response to the bleak funding landscape for research and federal agency trends toward making more frequent larger awards. In response, a team from Penn State University and Huron Consulting Group initiated a baseline study to determine how research-intensive academic institutions are structured to provide large proposal support, with the aim of identifying support factors that are impactful on proposal success as defined by funding being awarded. The first step in this process was the development, administration and analysis of a survey on large proposal support and success rates. This first survey of large proposal support structures, support services, and associated metrics was completed by 20 of the top 100 research institutions as determined by rankings from the 2013 Higher Education Research Development Survey (HERD) as reported by the National Science Foundation. Conclusive findings are: 1) A decentralized College/Department/ Center model is the most commonly used large proposal support model; 2) Different large proposal support models have similar criteria in selecting proposals to be supported, the most common of which is awards equaling or exceeding $1M; and 3) Institutional setting is a factor in success rates for larger proposals more than smaller proposals as evidenced by greater variability in these rates.*

Keywords: *Large Proposals, Proposal Success Rates, Proposal Administrative Support, Research Development, Research Administration Organizational Structure, Team Science*

Introduction

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

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

Background

The Highly Competitive Funding Environment

The National Science Foundation (NSF) recently reported to the National Science Board (NSB) that the number of all proposals acted upon from 2001 to 2013 increased by 53% while the percent of submissions receiving awards (i.e., proposal success rate) over the same period decreased by 9% (National Science Foundation, 2014c), as reported by the NSF Enterprise System. In the same report a similar trend in research awards was noted for the same 2001-2013 period, showing a decrease in success rate of 27% in 2001 to 19% in 2013. NSF noted to the National Science Board that some specific factors (e.g., increase in mean award size and budget changes such as the Budget Control Act of 2011 and American Tax Payer Relief Act of 2012) affected the number of new awards that could be made in 2013 which resulted in a 5% decrease from 2012 to 2013. The overall increase in the total number of awards since 2001 is one story, but the decrease in proposal success rates (those acted upon by NSF) tells another. Although the American Recovery and Reinvestment Act (ARRA) of 2009 provided some temporary relief to the downward trend in funding rates at NSF (boosting the rate to 32% in 2009), this impact was short-lived (NSF, 2014a; 2014c).

A similar funding history is seen at the National Institutes of Health (NIH). While current budget discussions portend hope for a significant budget increase for the NIH in the near future, this agency has seen an overall drop in proposal success rates of more than 14 percentage points

between 1999 and 2013. In 1999, the overall success rate for all types of awards was 34% and this reached an all-time low of 18% in 2013 (NIH, 2014). ARRA had much less of an impact at NIH. Here the biggest drop in success rates occurred between 2003 and 2004 (a 32% to 26% drop), concurrent with the end of the historic annual budget increases that doubled the NIH budget between 1998 and 2003 (Smith, 2006).

Large Research Proposals and Team Science

The second factor impacting the size of grant requests and awards has been increased emphasis by funding agencies on collaborations across scientific disciplines, as reflected by an increase in multiple principal investigator (multi-PI) grants (including centers and other multi-year programs) and larger average award sizes. At NSF alone, the number of awards in both single PI grants and multi-PI grants has increased 4.8% and 18.6% respectively between 2004 and 2013 while the success rate of multi-PI grants has remained mostly unchanged with a slight decrease from 18% to 17% (NSF, 2014c). This impressive shift to larger and multi-PI research grants is even more prevalent at the NIH where the number of multi-PI grants has grown by two orders of magnitude from 2006 to 2013 (National Research Council Committee on the Science of Team Science, 2015). Therefore, the opportunity for this larger proportion of multi-PI grants is available and is just as competitive as it was more than 10 years ago. These multi-PI programs are especially attractive to research institutions not only because they are large dollar amounts per award, but most also cover a longer lifespan (5-7 years) compared to typical single investigator grants (2-3 years). This provides a certain level of economic stability not available with singular, smaller grants. Validation for this increased emphasis on team science is provided by a 2014 study by Stipelman et al. (2014) in which the impact of team-based transdisciplinary research was shown to have more rapid and broader impact across the science community than investigator-initiated programs.

Team Science approaches to research is clearly a developing trend among academic researchers. The trend is reflected in the nature of both publications and grants. A co-authorship analysis of articles published in three leading science journals (*Nature, Proceedings of the National Academy of Science USA, and Science*) shows a steady increase since 1958 in the number of authors per publications, extrapolating to a predicted average of 19 co-authors per publication by 2040 (Pavlidis, Petersen, & Semendeferi, 2014). While some agencies like the National Science Foundation (NSF) has long recognized multiple principal investigators on grants, The National Institutes of Health (NIH) formalized this multi-PI status in 2007 (NIH, 2006). NIH currently gives about a fifth of its external awards to projects with multiple PIs, and some suggest this trend could and should grow at the NIH and other funding agencies in the coming years (Chronicle Staff, 2014).

As team science seems to be blossoming, agencies have responded by making more large awards (Figure 1). Between 2000 and 2014 (U.S. Office of Management and Budget, 2014), a general trend toward more awards in either or both the $1-$5M and $5M-$25M ranges can be seen across at least four major agencies: NIH, NSF, USDA [US Department of Agriculture] and DoD [Department of Defense]. It is apparent that, despite often being affected by federal budgeting delays, economic policy change, and special initiatives such as the 2009 American Recovery

and Reinvestment Act, both trends and special windows of opportunity (e.g., DoD and DoE [Department of Energy] in 2010) are obvious for five of the six major agencies explored, even when award sizes are adjusted for inflation.

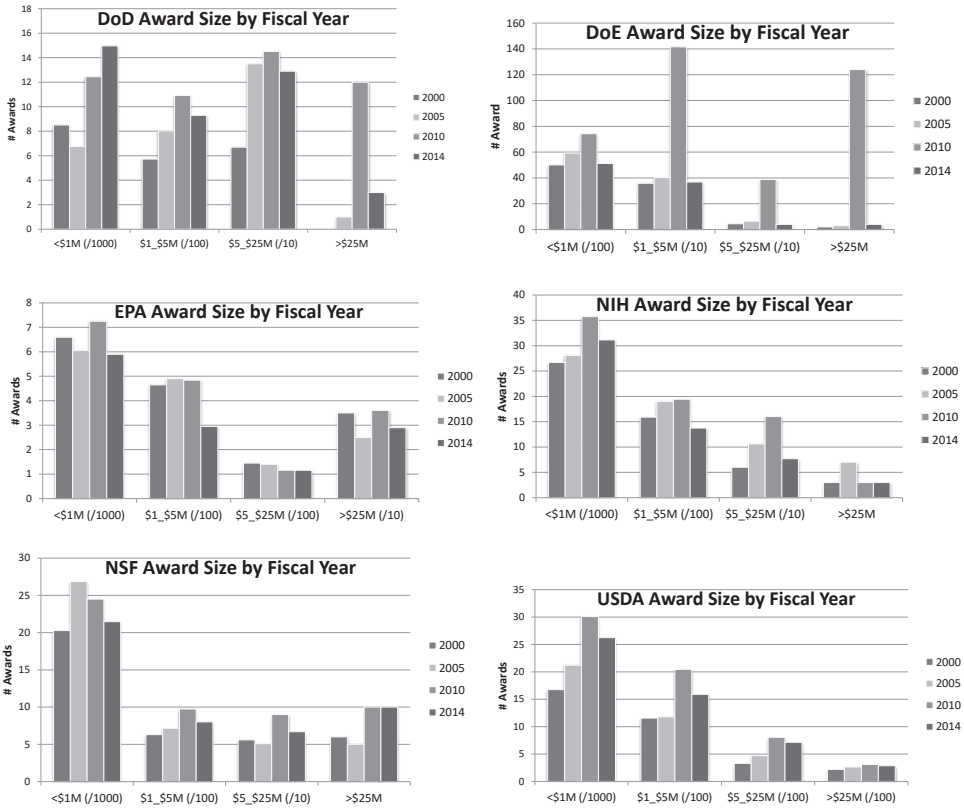


Figure 1. Select federal agency grant awards by size category and fiscal year with amounts adjusted to 2014 dollars. Data Source: USASpending.gov (U.S. Office of Management and Budget, 2014); Inflation Correction: US Inflation Calculator (COINNEWS Media Group LLC, 2014). COINNEWS inflation calculator provided the following rates: 2000-2014: 38.13%; 2005-2014: 21.79%; 2010-2014: 9.08%.

Anecdotal evidence suggests that research administrator interest in the topic of large research proposals is high—arguably in response to the trends described above. Feedback obtained at a session of a major research administrator conference (Dressler et al., 2014), a related webinar, and additional informal conversations around the topic of large proposal development provided anecdotal evidence that support for large, multi-investigator proposals was seemingly heterogeneous. An obvious question of interest for this group is whether evidence exists that specific support models impact proposal-funding success. Thus, a team from Penn State University

and the Huron Consulting Group developed and administered a survey to better understand the models that are being used to support these large, multi-investigator proposals. Many studies have been performed on the science of team science with the most recent comprehensive study published by The National Research Council Committee on the Science of Team Science in 2015 that focused on opportunities to enhance the effectiveness of collaborative research in science teams, research centers, and institutes. While typical science of team science studies such as this one focus on the teaming aspect of these groups, this study focused specifically on proposals submitted by such teams for large proposals. In this way, our research is complementary as this is one of many activities these teams perform in their pursuit of research and education outcomes.

Institutional Responses to Changes in the Funding Climate

A seminal study of the characteristics of research administration infrastructures at colleges and universities was conducted in 1996 by a team from Oak Ridge Associate Universities (ORAU) (Baker & Wohlpart, 1996). The ORAU study was a survey of 80 institutions that represented a wide range of Carnegie Classifications (Carnegie Commission on Higher Education, 1973) from Research 1 (R1) to Master's 1 (M1). While some changes have occurred in the research administration landscape over the past 20 years, the Carnegie Classification and NSF-reported Higher Education Research Development Survey (HERD) expenditures continue to be important institutional characteristics reflecting mission and size. Because R1 institutions can be expected to more frequently submit large proposals, institutions from this category were chosen as the focus for this first exploration of large proposal support, and total HERD expenditures was used as an indicator of the relative size of an institution's research enterprise. The ORAU survey explored many of the same or similar specific features of "Office Functions" and "Office Resources" but without differentiating the type or extent of services specifically devoted to large proposals as is the intent of this study.

The Penn State/Huron survey was designed with input from researchers and research administrators to determine how large proposals are being supported at different research institutions. The survey had two main objectives: 1) to characterize the heterogeneity of large proposal support models, and 2) to determine if there is a relationship between funding success rates and proposal support services or the models themselves. Three working hypotheses regarding successes in objective 2 tested by this survey included: 1) Research institutions with centralized, dedicated Research Development Offices (RDOs)/Large Proposal Offices (LPOs) are more successful at submitting large proposals and having large proposals funded; 2) A relationship exists between the number of dedicated RDO/LPO staff full-time equivalents (FTEs) and the success of large proposals; and 3) Research institutions with RDOs/LPOs have a higher award rate for large proposals than those without RDOs/ LPOs.

The support models included LPO offices, LPO-type activity across different units, and combinations of support elements that can range from fully centralized to fully decentralized. In any case, the focus of this study was whether an institution supports strategic proposals any differently than other proposals, and if so, how. Success was measured as the percent of submitted proposals that were ultimately funded by the target agency (i.e., funding rates).

Methods

The survey content was developed through three main steps: 1) A six-member Penn State/Huron research team developed a draft survey based on team knowledge and experiences in research administration at multiple institutions; 2) The survey concept was shared at NCURA 2014 in a discussion session; and 3) A focus group was held by videoconference to solicit input from research administrators representing eight large institutions. Upon development of the draft survey in step one, the survey and research project plans were submitted to the Penn State Office for Research Protections for review and the project was determined to be exempt from Institutional Review Board review requirements (IRB #44907).

An important function of the survey focus group was to provide input on the definition of *large proposal*. For the purpose of this survey, the consensus of the focus group was to define large proposals as having two or more of the following attributes: 1) requesting funding totaling more than $1M per year, 2) involving more than two collaborating research institutions (i.e., subawards, federal laboratories/partners, industry partners, sites, or other), 3) involving two or more internal university departments participating in the proposal, or 4) responding to a funding opportunity for which submissions are limited by the funder. A fifth attribute identified as being able to function singularly as defining a large proposal was one that is requesting support for an activity that has been designated as strategic by the institution. The focus group also refined the *large proposal support model* definitions.

After the survey was adjusted according to feedback, an invitation to participate was distributed to senior administrators at the top 100 Research and Development (R&D) expenditure institutions, as reported by NSF for 2013 (NSF, 2014b). The top 100 were selected as a sample group because of the higher probability that they regularly submit large proposals, have established tracking systems, and have considered purposeful mechanisms for supporting such efforts. The survey was executed online using Qualtrics and managed by professional survey staff at the Penn State Survey Research Center.

Data

Survey participants were assured that the research team would not share the identities of the participating institutions and that published reports would avoid the inclusion of data that potentially could be used to identify individual institutions.

Following completion by the participants of the online survey, a data cleansing step included research team contact by telephone conference with each responding team to ensure that the survey questions were interpreted consistently across the participants and to verify input. These contacts used a standardized set of data follow-up questions. Subsequently, minor adjustments (e.g., adjustments to number of faculty, correction to R&D expenditures reported, inclusion of overhead when estimating proposal or award value) were made by a portion of institutions. Data and analysis in this report are inclusive of those minor adjustments. Importantly, none of these adjustments had significant effects on the reported results as the result of their inclusion.

Institutions were invited to report on either FY 2012 or FY 2013 depending on the window for which they could provide the most recent complete data. ARRA-funded projects were included if present in reported expenditure data for both of these fiscal years, but would not impact the success rates for either 2012 or 2013 because those awards were made only in 2009 and 2010. Because expenditure reporting was used only as a surrogate for institutional size, it is not viewed as a confounding factor for analyzing survey data on success rates and proposal support during the 2012-2013 timeframe.

Table 1. Large Proposal Support Models

Model 1 - VPR Office
1. The Sponsored Projects Office (SPO) handles the submission of the large proposals but staff members in the Vice President/Provost for Research (VPR)'s Office give special attention and support to proposals that fit within the definition of "large proposal."
2. The VPR Office may also support proposals that are designated as strategic or that require some sort of internal selection process because applications from an institution are limited.
3. The VPR Office staff may not be supporting the whole proposal development process, and may be only managing or assisting with portions of some of the proposals or other internal factors such as internal selections or formation of collaborative teams.
4. A variation may include a VPR Office that has hired a proposal developer as part of their office to assist with the development of proposals.
Model 2 – General Staff in SPO (G_SPO)
1. "Large proposals" are handled in the same fashion as any other proposal proceeding through SPO for submission.
2. Proposals are not assigned to any particular individual but are assigned in the same fashion as all proposals.
Model 3 – Colleges, Departments & Centers (CDC)
1. A "decentralized" model exists where proposal development occurs within the departments, centers, etc., and the SPO function is limited to the review and certification of the final submission.
2. A variation may be a system in which SPO handles the development of most proposals, but a specific center or department may have an in-house team devoted to developing and supporting "large proposals" for their particular area of expertise.
Model 4 – Special Unit or Staff in SPO (S_SPO)
1. SPO employs individuals who specialize in the development and submission of "large proposals."
2. Large proposal support staff report directly to the head of SPO through the normal SPO chain of authority.
3. The large proposal experts may or may not have been specifically hired as such and may have gained expertise through handling "large proposals" through various years of submission; or they may have specifically hired as expert grant writers or technical writers but are working within the SPO hierarchy.
4. The key distinction of this model is that large proposal staff report through SPO and not a separate entity.
Model 5 – Independent Office (LPO)
1. This office is a named entity separate from SPO and other units that handles proposal development and/or submission for "large proposals" for other units.
2. The office may or may not have its own authorized organizational representative (AOR) who can submit proposals on behalf of the institution so there may still be a connection with the SPO at the institution.
Model 6 – External Consultant (EXT_C)
1. The Institution has an established practice of hiring external consultants as a technical or grant writers or in some other capacities to support the development and submission of "large proposals."

Proposal support data were differentiated among six models (Table 1) as determined by feedback from the NCURA 2014 conference and the pre-survey pilot group. James et al, (2015) described the six models in more detail—they reported that models may not be all-inclusive but were meant to capture the heterogeneity of support infrastructure, known to this team, and the pre-survey feedback mentioned previously. Institutions can employ a multitude of models for large proposal support that includes elements from different models. For example, an institution may offer support functions that are both centralized (Model 1) and decentralized (Model 3) as their approach. A summary of model definitions is provided below and may also be found in James et al. (2015) where the models below were used to develop a conceptual model.

Results

Participating Institution Demographics

Twenty respondents from the 100 invited top-ranked research institutions (NSF, 2014b) provided partial or complete responses to the survey. The 20-institution sample was diverse with respect to the institution types and classifications represented by the overall top 100 from the 2013 HERD survey to the extent reflected by Table 2. The mix of public and private institutions was very similar.

Table 2. Institutional characteristics of survey participants and the top 100 institutions as ranked by 2013 research expenditures.

Institutional Characteristic	Survey Participants	Top 100 R&D Institutions
Carnegie Classification: RU/VH (research universities – very high research activity)	95%	84%
Members of Association of American Universities (AAU)	70%	54%
Public non-profit	65%	66%
Private non-profit	35%	33%
SPEC/MED (medical schools and medical centers)	5%	11%

Proposal Success Rates by Award Size

Reported proposal funding success rates were requested across four dollar ranges defined by $250K steps up to $1M. These results are summarized in Figure 2. Not surprisingly, a clear trend is evident for a lower mean funding rate as proposal values increase. Of interest, however, is that the larger range of institutional success rates seen for the category of proposals above $1M is larger than for any other category. This uniquely larger range might be indicative of institution-specific variables that impact proposal success in this size range more than in the lower ranges.

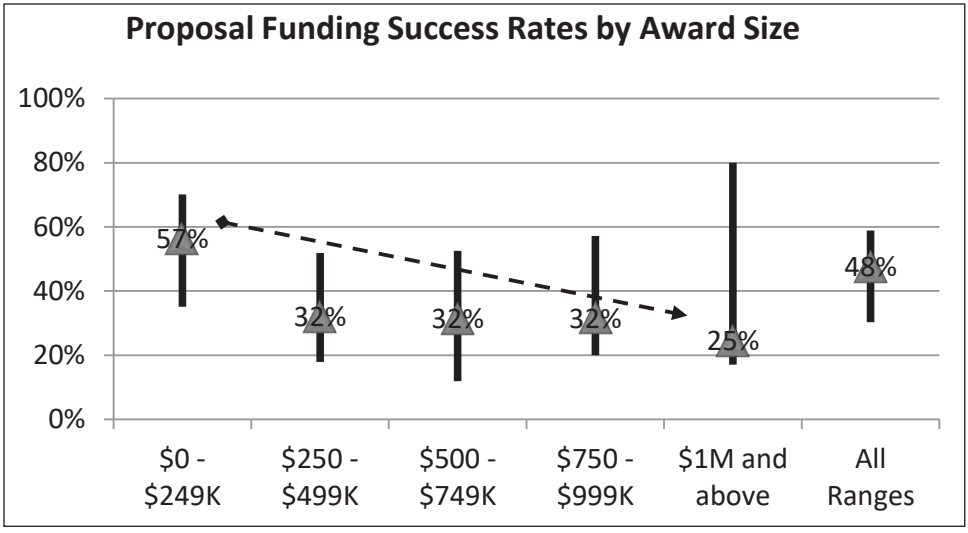
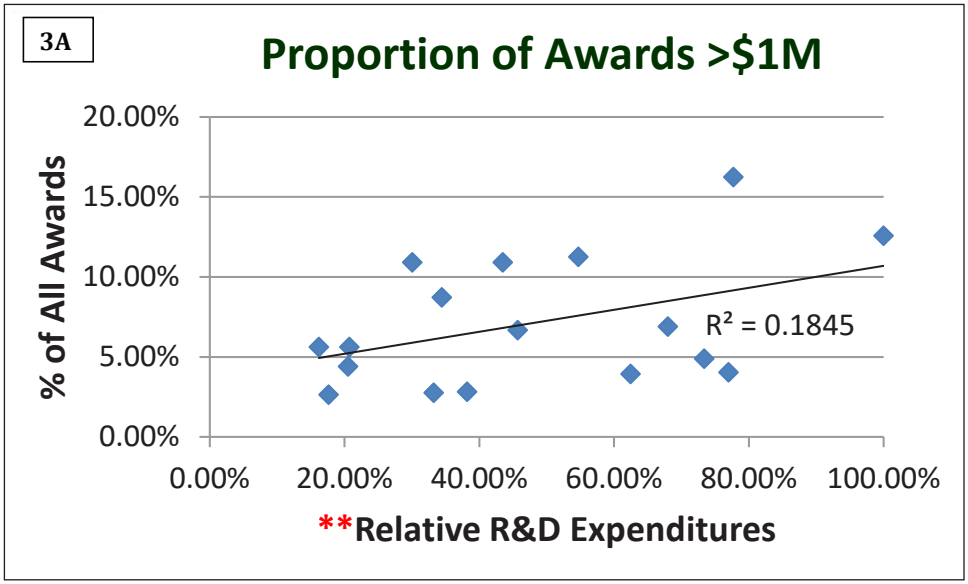


Figure 2. Means and ranges of proposal funding success rates at 20 major research institutions by award size.

Institutional Expenditures and Proposal Success Rate

Noting the different average and variability in success rates for proposals over $1M, the survey data was next analyzed to determine if the size of the research funding base of the respondent institutions might correlate with proposal success.

As a standardized metric for institutional size and research funding, institutions were asked to provide the amount total of research expenditures reported to NSF for the HERD reporting year corresponding with their other reported survey data (FY2012 or FY2013) (NSF, 2013; 2014b). To provide anonymity, the expenditure number was then converted to a Relative R&D Expenditure Percentage based on the highest reported institutional spending level (i.e., the institution with the highest reported spending level has a 100% relative R&D expenditure). Based on this metric, success rates at the >$1M proposal size as well as across all award sizes were explored to determine any association with institutional relative R&D expenditures (Figure 3). A low, but positive correlation with R&D expenditure level was noted across the survey respondents for awards >$1M (Figure 3A; note the positive slope with $R^2 = 0.1845$) (NSF, 2013; 2014b). However, no positive correlation was evident between success rates of all proposals (i.e., any award size) and relative R&D expenditures (Figure 3B; note the negative slope). The correlation of expenditures with success rates for awards over $1M (Figure 3A) but not for awards in general (Figure 3B) suggests that institutions with larger expenditures may be doing something differently to facilitate large proposal success. Moreover, the lack of strong R^2 suggests that expenditure rates is not the only variable and that a closer look at other institutional characteristics is warranted in order to determine a formula for success and, thus, validated the need to look at other survey variables.



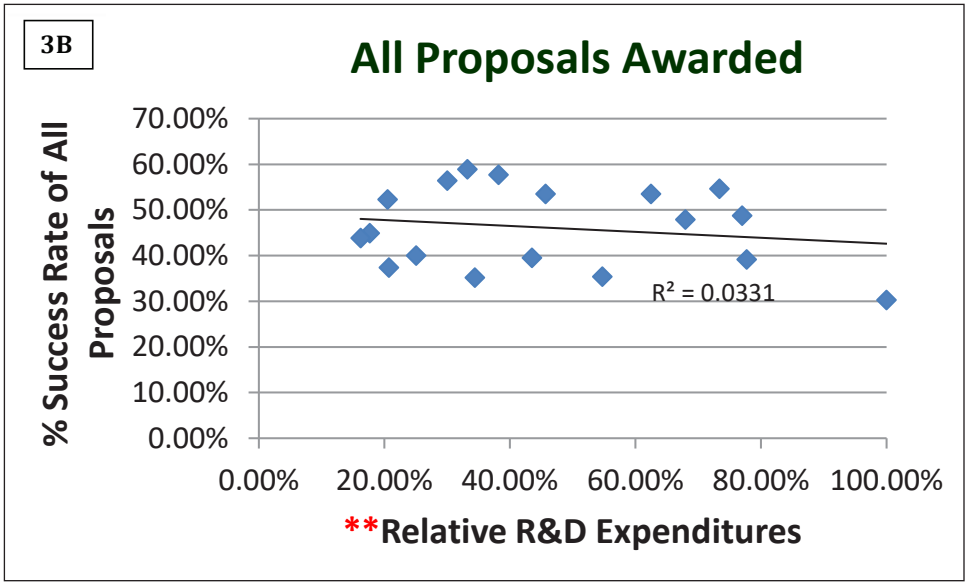


Figure 3. Award success rates as function of A) the percentage of awards greater than $1M and B) total institutional expenditures.

Support Model Types and Funding Rate of Proposals

The next step of the data analysis was to look for correlation of proposal success rates for any of the six models for large proposal support reported by institutions. Table 3 shows results for 20 participant institutions in order of overall proposal funding rates. Included are their institutional ranking within the survey sample based on R&D expenditures (i.e., relative R&D expenditure ranking), their funding rates for two larger proposal categories ($750K-$999K and >$1M), and their LP support models. When analyzed with respect to >$1M funding rates, there is clear heterogeneity in support model infrastructure among the institutions with 50% of them employing a combination of models. The CDC support model was most prevalent and present in 70% of the institutions, highlighted in the last column. Only three institutions reported separate LPO models; these were broadly distributed across success rates.

Table 3. Funding rates and support models for large proposals by institution. Funding rates and support models for large proposals by institution.

St Dev Mean - Overall Funding	Overall % Funding	Relative R&D Expenditure Rank	% Funding ($750K+)	% Funding ($1M+)	Models	Most Common Model
+2	58.88%	12	65.55%	80.00%	CDC	CDC
	57.68%	10	73.53%	79.73%	VPR, CDC, G_SPO	CDC
	56.44%	13	40.63%	40.91%	**LPO**	
+1	54.66%	4	42.86%	45.12%	NONE	
	53.52%	6	21.06%	21.33%	CDC	CDC
	53.51%	8	34.57%	30.65%	VPR, CDC, G_SPO, EXT_C	CDC
	52.30%	18	22.50%	22.90%	VPR, CDC, G_SPO	CDC
	47.91%	5	27.60%	25.93%	**LPO**, CDC, EXT_C	CDC
	48.71%	3	46.21%	46.67%	CDC	CDC
-1	44.90%	20	22.52%	21.18%	VPR, CDC	CDC
	43.88%	19	23.08%	20.77%	CDC, G_SPO	CDC
	40.00%	15	40.00%	40.00%	S_SPO	
	39.52%	9	18.56%	18.35%	G_SPO, CDC	CDC
	39.13%	2	28.37%	27.75%	VPR, CDC	CDC
-2	37.35%	17	26.00%	22.54%	**LPO**	
	35.40%	7	24.92%	23.78%	CDC	CDC
	35.21%	11	18.53%	17.07%	VPR, CDC, G_SPO	CDC
	30.26%	1	25.14%	24.83%	CDC	CDC
	Not Reported	16	Not Reported	Not Reported	G_SPO	
	Not Reported	14	Not Reported	Not Reported	VPR, EXT_C	

Note: For each of the Overall %, $750K+, and $1M+ columns, values within one standard deviation of the mean within that category are in light grey and values between one and two standard deviations are in dark grey. Institutions with an LPO are highlighted by hatching in the models column.

Percent Effort in Relation to Proposal Funding

Data on the number of staff FTEs (Full-Time Equivalent Employees) dedicated to large proposal support was requested from survey participants. Percent FTEs were converted to number of hours using the formula: 100% FTE = 40 hours per week for 48 weeks or 1920 hours per year. This information was then plotted against the percentage funding of large proposals (Figure 4). Recognizing that this effort might be quantified with several highly variable approaches, two templates were offered to participants for systematically collecting this information.

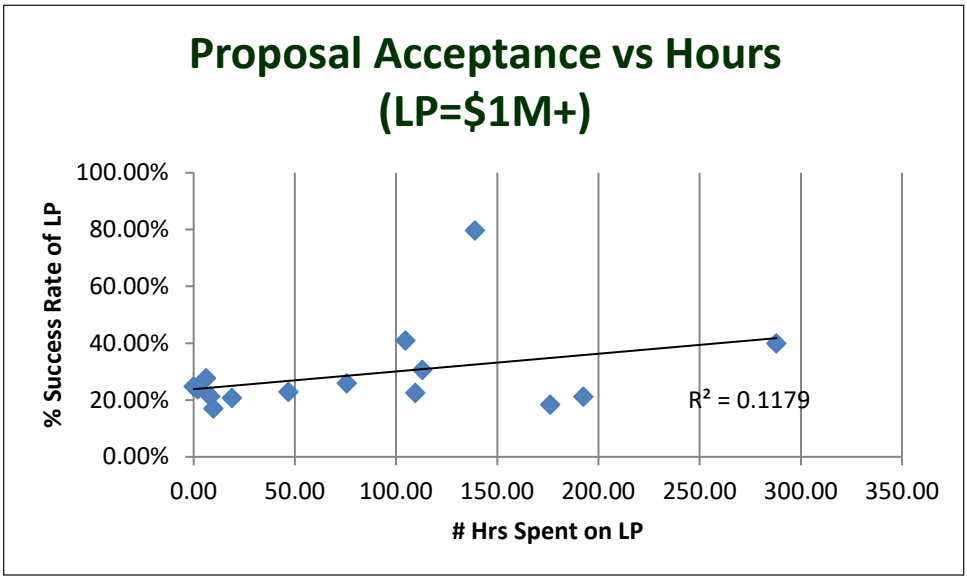


Figure 4. Large proposal funding relation to personnel time.

In Figure 5, the percent funding of awards greater than $1M is plotted against all awards. The significant R^2 value of ~0.4 indicates that these are related. This may indicate that success factors for large proposals may be related to the success factors for all proposals and vice versa. Successful institutions are successful in general and are resourcing personnel time for large proposals.

Discussion

This study is a baseline assessment of pre-award support for large proposals and various models that are employed at research-intensive institutions. The results provide a first look into how successful institutions with diverse characteristics address large proposals. A strong trend toward decreasing success rates as proposal size ranges increase is evident when considering the institutional medians, but trends are weak or inconclusive when success rates are associated with specific institutional characteristics such as overall R&D expenditures or support models.

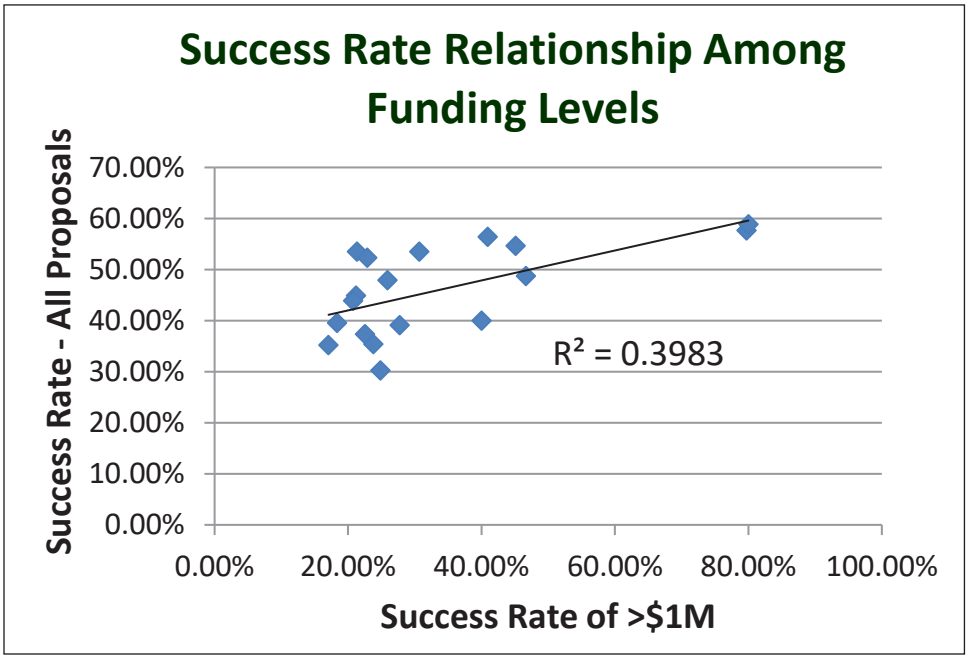


Figure 5. Significance of funding among large proposals and all proposals.

A weak but positive trend was shown when considering the amount of personnel time spent on large proposals. The response rate for this aspect of the survey suggests that it was indeed challenging data to collect: only 14 respondents provided this data and only 21% confirmed use a template. While it might be expected that institutions with LPOs would be able to provide greater personnel time, Table 3 shows that only three institutions had LPOs and provided no suggestion of any trend of LPO offices being related to number of awards above $1M. Two of the three institutions with a specific LPO were within 1 and 2 standard deviations of the mean for the 4th and 12th, respectively. Two of the respondents (R&D ranks 14 and 16; see Table 3) did not report funding rates. However, the respondent institutions with Large Proposal Offices all indicated that they employ varied selection processes for determining which proposals they support, and none of the respondents indicated that these LPOs support all large proposals. These are key points because they confound any attempts to assess the impacts of Large Proposals Offices on funding success rates for proposals >$1M in this survey dataset.

The sample size for this study was relatively small, and could be confounded by a number of reporting variables. Data inquiry follow-ups with the respondents revealed that certain participants chose to report for a single institutional unit rather than institution-wide. Others indicated that success rates were likely boosted by inclusion of a large relative percentage of non-competing renewals in their portfolios.

Conclusions

This study was a baseline investigation into large proposal support. Conclusive findings are limited to three: 1) The decentralized College/Department/Center model is the most commonly used large proposal support model; 2) Large proposal offices and units have similar criteria in selecting proposals to be supported, the most common of which is awards equaling or exceeding $1M; and 3) Institutional setting is a factor in success rates for larger proposals more than smaller proposals as evidenced by greater variability in these rates.

While the conclusions are limited by data originating from a sample of 20 participants out of a possible 100, this study had broad representation (Table 1), and it is valuable in providing a structure for the data and metrics needed to more fully access proposal support infrastructure. For example, in addition to simply quantifying the number of staff FTE involved in the support process, the characteristics and experience of these personnel may be important. Looking forward, as more institutions may be considering establishing LPOs, it will be of interest to know how these offices select research teams worthy of proposal development support and how they identify funding opportunities appropriate for pursuing.

Over the long term, it will be worthwhile to assess whether certain LPO support models grow or diminish in popularity over time. Information that could help drive an informed choice of LPO models by institutions would include data on how large proposal success rates may be impacted by the time span over which a specific model is in existence at a particular institution. For example, institutions that chose to adopt new support models and infrastructures such as an LPO could consider tracking the overall number of proposals being submitted that are greater than $1M as well as the number of proposals they supported from this pool. This would allow them to measure the impact of any support infrastructure changes on the funding rate of large proposals within their institution. For example, if an institution's overall funding rate drops from 21% to 19% while funding rates for large proposals not supported by an LPO goes from 14% to 17% and the funding rate for the proposals supported by the LPO goes from 14% to 29%, a closer look at the metrics associated with these two models would be warranted. This would then enable institutional resource decisions to be made based on quantifiable data and return on investment. However, a major caution to this approach is that environmental factors (e.g., uneven funding priorities across disciplines, geographical priorities among agencies, consistency among review panels, etc.) can be at play in large competitions, leading to a comparisons of "apples to oranges" from one proposal support unit to another or even within a competition. Large proposals are developed in teams and direct impact of singular inputs or activities are difficult to measure, especially given that proposal reviews do not generally identify items that produce tipping points, positive or negative. Thus, it is often difficult to measure the direct impact of LPO support on a proposal because of these and other confounding factors.

While funding rate is a typical metric used by administration to understand the bottom line, it is not a user-centric (i.e., faculty) assessment addressing overall impact. Additional user-centric metrics not assessed in this study but equally as important to successful proposal support models are parameters such as PI satisfaction, repeat PI customers, PI-valued services

(e.g., budgeting, reviews, grant writing, proposal coordination, etc.), and other support infrastructure variables (e.g., data management, outreach or diversity programs, dedicated proposal staff, etc.). Understanding faculty needs and the services they value most may provide the best potential for increasing the levels of skilled faculty participating in large proposals. An essential element of large proposal success is the leadership of an experienced, credible PI; thus, PI satisfaction with the process is essential to retaining a solid pool of willing PI candidates.

While this study focused only on pre-award proposal development support, post-award administration may be equally important to future large proposal successes. Institutional records for post-award management are often part of agency evaluation and selection criteria when awarding large projects. It is apparent through a limited set of ancillary questions and follow-up that post-award management of strategic awards is clearly complicated, but highly valued. Moreover, strategic awards often undergo greater scrutiny by sponsors and external auditors. In light of potential for more scrutiny and increased complexity, concerns expressed by the participants ranged from needed specialized training for individuals responsible for managing these strategic awards to significant administrative burdens that arise from reporting requirements, necessary relationships with subawardees, and daily oversight. Thus, future studies may want to address the relationship between resources and success in post-award management and future funding success for large proposals.

Author's Note

This manuscript reports the results of a collaborative investigation conducted by the six authors that has been described in part during presentations at the 2014 and 2015 annual national meetings of the National Council of Research Administrators (NCURA) and in a poster prepared for the 2015 national meeting of the Society of Research Administrators. Survey administration services were purchased from The Penn State Survey Research Center. This research was supported in part by The Pennsylvania State University and Huron Consulting Group; however, the authors are responsible for the content which does not represent the opinions or endorsements of either organization. The authors would like to thank Matthew Faris of Huron Consulting for connecting the research team and providing ongoing support through the survey development, implementation, analysis and dissemination. The authors would also like to thank the institutional representatives who participated in the draft survey focus group for survey refinement and the institutional representatives who gathered the extensive data necessary for survey participation by their institutions.

Lorraine M. Mulfinger, PhD
Director for Strategic Initiatives and Research Program Development
The Pennsylvania State University
101B Beecher Dock House
University Park, PA, 16802, USA
Telephone: 814-865-7787
Fax: 814-863-2830
Email: LXM14@psu.edu

Dr. Kevin Dressler, PhD
2DCC-MIP, Operations and User Facilities Director
The Pennsylvania State University
N-339 Millennium Science Complex
University Park, PA, 16802, USA

L. Eric James, JD, MS
Manager, Research Services, Education & Life Sciences Practice
Huron Consulting Group
550 W. Van Buren Street
Chicago, IL, 60607, USA

Niki L. Page
Grants and Contracts Manager
The Pennsylvania State University
334 Health and Human Development Building
University Park, PA, 16802, USA

Eduardo Serrano
Director, Research Services, Education & Life Sciences Practice
Huron Consulting Group
550 W. Van Buren Street
Chicago, IL, 60607, USA

Jorge Vazquez
Associate
550 W. Van Buren Street
Chicago, Illinois 60607
Mobile 312-758-8236

Correspondence concerning this article should be addressed to Lorraine Mulfinger, PhD, Director for Strategic Initiatives and Research Program Development, The Pennsylvania State University, 101B Beecher Dock House, University Park, PA, 16802, USA, LXM14@psu.edu.

References

Baker, J. G., & Wohlpart, A. (1996). Research administration in colleges and universities: Characteristics and resources. *Research Management Review, 10*(1) 33-48. Retrieved from http://www.ncura.edu/Portals/0/Docs/RMR/v10n1.pdf

Carnegie Commission on Higher Education. (1973). *A classification of institutions of higher education*. Berkeley, CA.

Chronicle Staff. (2014, September 30). Team science is tied to growth in grants with multiple recipients. *The Chronicle of Higher Education.* Retrieved from http://chronicle.com/blogs/ticker/team-science-tied-to-growth-in-grants-with-multiple-recipients/87077

COINNEWS Media Group LLC. (2014). US inflation calculator. Retrieved from http://www.usinflationcalculator.com/

Dressler, K., Faris, M., James, E., Merki, A., Mulfinger, L., Page, N., & Serrano, E. (2014, August). Large research proposals and the process for successful proposals. 56th Annual Meeting of the National Council of University Research Administrators. Washington, DC.

James, L. E., Mulfinger, L., Dressler, K., Page, N., Serrano, E., & Vazquez, J. (2015). 2x2 model for research administration organizational structures as they pertain to large proposal development. Paper presented at the 2015 Society of Research Administrators International Annual Conference, Las Vegas, NV. Retrieved from http://srainternational.org/sites/default/files/documents/SRA%20Symposium%20Paper_E%20James.pdf

National Institutes of Health. (2006). Establishment of multiple principal investigator awards for the support of team science projects (NOT-OD-07-017). *NIH Funding Opportunities and Notices*. Retrieved from http://grants.nih.gov/grants/guide/notice-files/NOT-OD-07-017.html

National Institutes of Health. (2014). Success rates and funding rates. Retrieved from http://report.nih.gov/NIHDatabook/Charts/Default.aspx?showm=Y&chartId=275&catId=13

National Research Council Committee on the Science of Team Science. (2015). *Enhancing the effectiveness of team science*. N. J. Cooke & M. Hilton (Eds.). Washington, DC: National Academies Press. doi:10.17226/19007

National Science Foundation. (2013). Higher education R&D expenditures, ranked by FY 2012 R&D expenditures: FYs 2003–12. Retrieved from http://ncsesdata.nsf.gov/herd/2012/html/HERD2012_DST_20.html

National Science Foundation. (2014a). Funding rate by state and organization. Retrieved from http://dellweb.bfa.nsf.gov/awdfr3/default.asp

National Science Foundation. (2014b). Higher education R&D expenditures, ranked by FY 2013 R&D expenditures: FYs 2004–13. Retrieved from http://ncsesdata.nsf.gov/herd/2013/html/HERD2013_DST_17.html

National Science Foundation. (2014c). Report to the National Science Board on the National Science Foundation's merit review process. Retrieved from http://www.nsf.gov/nsb/publications/2014/nsb1432

Pavlidis, I., Petersen, A. M., & Semendeferi, I. (2014). Together we stand. *Nature Physics, 10*(10), 700–702. doi:http://doi.org/10.1038/nphys3110

Smith, P. W. (2006). The National Institutes of Health (NIH): Organization, funding, and congressional issues: CRS Report for Congress RL33695. Washington, DC. Retrieved from http://digital.library.unt.edu/ark:/67531/metadc806903/m1/1/

Stipelman, B. A., Hall, K. L., Zoss, A., Okamoto, J., Stokols, D., & Börner, K. (2014). Mapping the impact of transdisciplinary research: A visual comparison of investigator-initiated and team-based tobacco use research publications. *Journal of Translational Medicine and Epidemiology, 2*(2), 1033–1039.

U.S. Office of Management and Budget. (2014). USASpending. Retrieved from http://www.usaspending.gov/