AC 2012-3702: GRANTSMANSHIP AND THE PROPOSAL DEVELOPMENT PROCESS: LESSONS LEARNED FROM SEVERAL YEARS OF PROGRAMS FOR JUNIOR FACULTY

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Grantsmanship and the Proposal Development Process: Lessons Learned from Several Years of Programs for Junior Faculty

Abstract

Although new engineering faculty members have an outstanding knowledge of their disciplinary research field, their knowledge and skills in developing highly competitive proposals varies widely and is often less well developed. Proposal development encompasses generating an initial idea, identifying funding sources, preparing and submitting proposals, responding to reviews, and funding or resubmission. It is not a secret process, but a craft that can be learned and honed with hard work and relationship building. Many faculty development and proposal development units and programs have crafted workshops and other faculty development strategies to help new faculty navigate this sometimes confusing and seemingly esoteric process. Fortunately, these offices can benefit through sharing practices they have found effective. The Office of Strategic Research Development of the Texas Engineering Experiment Station (TEES) at Texas A&M University has held proposal development workshops targeting junior engineering faculty and young investigator programs, especially the National Science Foundation Faculty Early Career Development (CAREER) Program, for almost 10 years as well as individual follow-up with the participants. Attendance and feedback from these workshops has resulted in several levels of workshops to address different needs and audiences, including workshops across our university system campuses on varying aspects of overall grantsmanship through regional campus research initiation workshops, graduate student fellowship seminars, presentations at graduate seminars on preparing students for academia, and post-doctoral workshops on grantsmanship. This paper summarizes these grantsmanship development events in the form of lessons that junior engineering faculty can apply when constructing an entire proposal.

Each proposal contributes to a faculty member's reputation and must be approached with thoughtful attention to this end. Common struggles in proposal development include: setting and maintaining a timeline to the proposal deadline, creating goals and objectives and using them to organize a proposal, writing a proposal to sell an idea to a funding agency and not as a manuscript for publication, and focusing text to address review criteria, especially the NSF broader impacts review criterion. Carefully approaching each of the proposal development elements will ensure faculty members submit their best effort, thereby laying a good foundation for a beginning academic faculty researcher.

Introduction

In an effort to encourage faculty to submit more and better proposals to young investigator programs, our office developed a proposal writing workshop in 2003 for College of Engineering junior faculty. The first workshops targeted a single program, the National Science Foundation (NSF) Faculty Early Career Development Program (CAREER)[1]. We simply walked faculty through the program solicitation, invited a past awardee to present lessons learned, handed out a sample proposal, and outlined a timeline to get it all done before the deadline (Table 1).

This is still the basic format we use today; however, over time, we noticed some faculty needed more than this basic information to successfully navigate the proposal development process. Faculty are experts in their technical disciplines, but not necessarily experts in grant writing, so details of proposal parts and how to write them effectively were added to the workshop agenda, including proposal templates and more sample proposals. We also added a guest speaker focusing on an aspect of Broader Impacts[2], to alert the faculty to opportunities available when developing the Education Plans of their CAREER proposals[3]. Unfortunately the broader impacts criterion required of all NSF proposals presents a significant stumbling block to many junior (and not so junior) faculty. Including detailed information on existing and successful educational and broader impacts-type activities helps faculty to tap into and participate in proven programs with solid infrastructure involving limited development effort on their part.

Table 1. NSF CAREER Proposal Preparation Timeline

February	Hold workshop
March	Complete Preparatory Items *Read Program Announcement* *Identify Directorate/Division/Program* *Set Up Cover Page* *Meet with Department Head* *Upload Biosketch, Current and Pending, and Facilities*
April	Prepare Proposal Outline *Introduction* *Approach/Plan of Work* *Qualifications/Preliminary Results* *Budget and Justification*
May	Draft of complete text
June	Near final version of text
July	DEADLINE (Next Due July 23-25, 2012[1])

The Strategic Research Development workshop efforts have been successful in generating more NSF CAREER submissions and more awards in the college. Submissions doubled by four years after the initial workshop, and then leveled out to about one-third of eligible faculty submitting each year. In the last five years, Texas A&M Engineering success rates have been at or above overall NSF CAREER success rates. Building on these successes, our annual workshop now includes more details about other young investigator awards to encourage faculty to also consider applying to these programs, but our primary expertise is in submissions to NSF. We have had additional opportunities to present this workshop or adaptations of this workshop to other groups. Research initiation workshops and seminars with TEES regional partners have taken on the form of multiple meetings and follow-up with research teams and junior faculty, focusing more on grantsmanship and targeting overall external funding. We have also presented the CAREER and grantsmanship workshops to graduate and post-doctoral groups preparing for academia, as well as those applying to the NSF Graduate Research Fellowship Program. The proposal development process critical to any research proposal, as presented in most of our workshops, will be detailed following as lessons learned that can help new faculty write more competitive proposals with a higher probability of being funded.

The Proposal Development Process

Proposal development is a continuous process encompassing an initial or revised idea, funding source identification, proposal preparation and submission, proposal review, and funding or resubmission of a revised proposal (Figure 1). It is not a secret process, but a craft that can be learned and honed and that involves hard work and relationship building. A proposal must be approached with thoughtful attention to developing a faculty member's reputation within the funding community. It all starts with an innovative and transformative approach to a problem the principal investigator can uniquely solve and ends with funded proposals leading to peer-reviewed publications, more funded grants, and tenure and promotion. Once the appropriate agency has been identified, a careful study of the agency mission, language, previously funded proposals and specific program requirements will set the foundation for a solidly competitive proposal. By contacting the agency program officer early in the process, faculty researchers can get answers to their questions about the program or review process as well as establish rapport and increase their proposal's competitiveness.

The review process may proceed through a panel or a few separate individuals from a standing or ad hoc cohort ranging in expertise from technical generalists to expert researchers in the proposed niche, so a well-written proposal will appeal to the range of potential reviewers as well as demonstrate a principal investigator's ability to do the proposed research. The proposal development process culminates with either a funded or unfunded proposal. The entire process can take up to 18 months from initial idea to final review, so it is never too early to start. If unfunded, deciding whether or not to resubmit to the same or other agency and program will restart the process. Carefully approaching each element in the proposal development process will ensure a best effort is submitted and thus a good foundation laid for a beginning academic faculty researcher.

Initial Idea *(9 months – 1 year before proposal deadline)*
It all must begin with a great idea and an eye toward the big picture. Good writing will not save a poor idea. To a funding agency, a great idea is one that is innovative and transformative, not merely incremental, and it fits within its agenda for the research they want to accomplish with their money[4]. Agencies want to fund the idea that has the best chance of being successful, but more than that they want the one that will affect the most change and progress in the field.

Know the technical research field surrounding the proposed idea. What is the current state-of-the-art? Who are the top ten researchers? What are they doing right now? What do they consider to be the key research issues? The answers will help researchers recognize before submitting a proposal if their idea fits into the big picture of the current research agenda. The top researchers in a field will also have some input on the direction of new topics in a discipline, so knowing where they stand on cutting issues in a discipline will help a researcher propose ideas that are more likely to complement the current research agenda. This does not mean less creative or less innovative, but means a researcher has an idea that others in the field will appreciate. The ideas most likely to be funded will be the ones that the reviewers look at and say, "I wish I had thought of that."

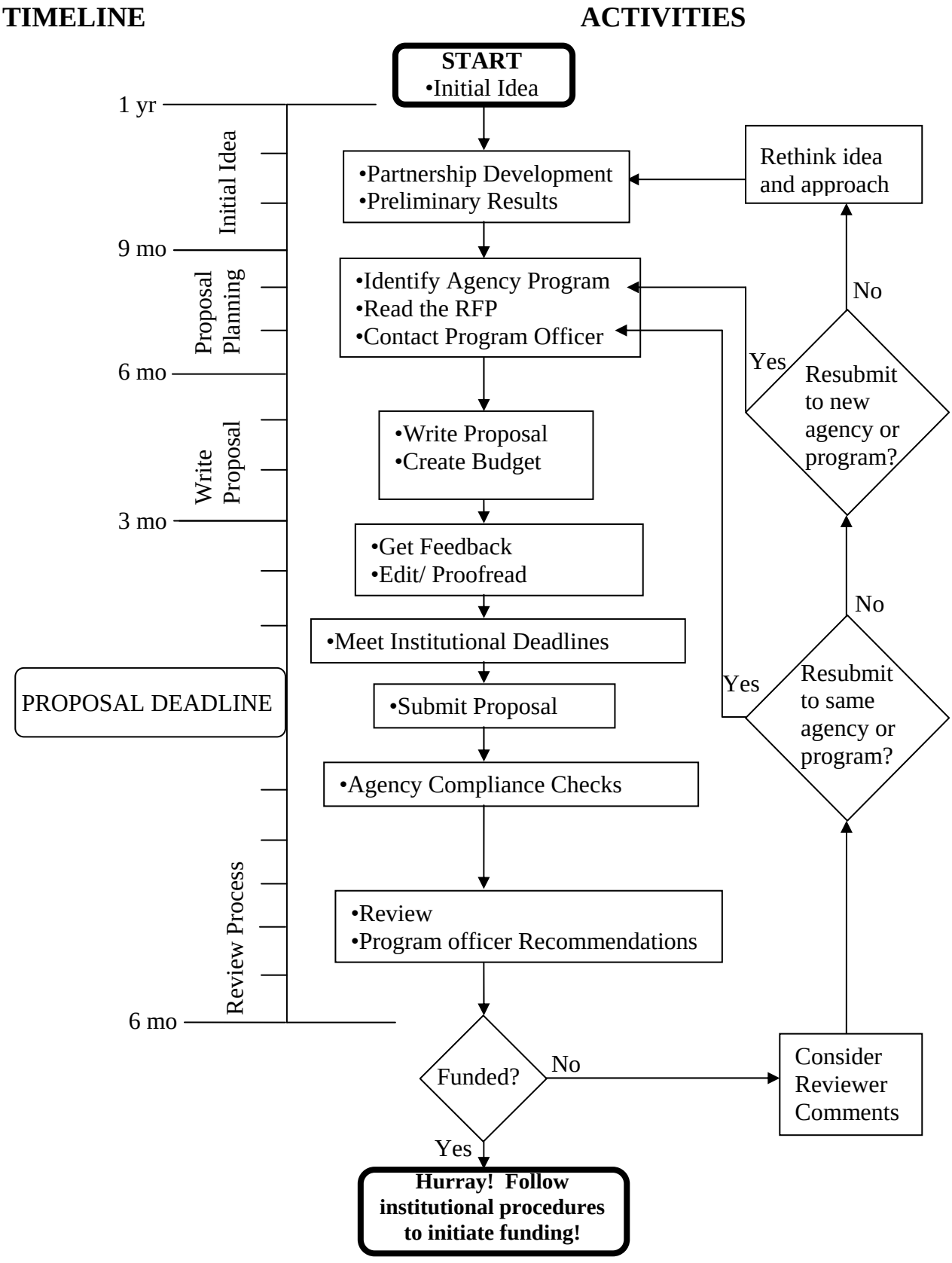

Figure 1. The Proposal Development Process.

Assess if additional expertise or resources are needed, especially if the idea represents a change in research direction for the researcher. Partners should be sought as collaborators to fill gaps in expertise from within the same department, in departments across the campus, at other institutions, and in other disciplines. Developing relationships with other researchers and generating preliminary results will set the stage for a successful proposal effort.

Include preliminary data. Some junior researchers often wonder how much preliminary data are enough, and the answer is: as much as there is. The program being targeted often determines how much preliminary data is required. For example, young investigator programs may require less preliminary data, but larger applications, such as to the National Institutes of Health (NIH) for an R01, their top research award, will need substantial preliminary results.

Proposal Planning *(6-9 months before proposal deadline)*
Identify an agency to target for funding. Once the great idea is in play, a researcher must figure out the best agency or program to approach for funding. Talking to other faculty in the department or across campus doing similar work to see where they get their funding is a good place to start, as well as attending specialized technical conferences to meet other researchers. Knowing where the field's top researchers nationally get their funding gives beginning researchers another good place to start in looking for agencies to apply to for funding. Several federal agencies publish this information in on-line searchable databases (Table 2).

Table 2. Some Funded Projects Lists.

Agency	Source	Search-able	On-line source
National Science Foundation (NSF)	FastLane	Y	https://www.fastlane.nsf.gov/a6/A6Start.htm
National Institutes of Health (NIH)	RePORTER	Y	http://projectreporter.nih.gov/reporter.cfm
Environmental Protection Agency (EPA)		N	http://epa.gov/ncer/grants/recipients_index.html

Get to know the funder's mission and language. Knowledge and understanding of the program and agency language must be apparent to reviewers as they read the researcher's proposal. Proposing something of no interest to a funder in terms that they do not support can doom an otherwise great idea. The mission and strategic plan of a group are usually published on their web site (such as, NSF[5], NIH[6], DoE[7], EPA[8]). This information provides the basis for how the agency approaches research and is reflected in their proposal review criteria (see Review Process section for more details). Most program solicitations are written with specific terminology and include cited references to describe the program.

Send the proposal to the right program within an agency. The NSF has nine directorates (NSF homepage[9]), each with multiple divisions and multiple programs within each division. The NIH has 27 different Centers and Institutes[10]. There are also list-servs and updates that researchers can subscribe to providing them with the latest information on new program announcements (NSF updates[11], NIH Updates[12], Grants.gov updates[13]). A researcher must navigate these

programs and find the best fit for their research. A proposal sent to the wrong program is a waste of time and effort for the researcher and the agency. This can be avoided by contacting the program officer before proposal submission.

Carefully read the program solicitation, before contacting the program officer. Read it cover to cover, every word, several times. Don't get caught asking a question to a program officer that is already answered in the solicitation. This is a waste of time for both the researcher and the program officer. In addition to technical program details, the program announcement includes other important information, such as PI and institution eligibility, award duration and amount, number of awards, and formatting details. The formatting details within a program solicitation can be used as a filter to limit the number of proposals to review for a program generating many proposals. Do not give reviewers a reason to take your great idea out of the running before they even read it!

If only two awards will be made and a new researcher is not a nationally top-tier researcher in that technical area, it may not be worth the effort to prepare and submit a proposal to a program that is obviously looking for only the top researchers. The announcement was likely written with them in mind, so it might be more strategic for a new researcher to work with a team of seasoned researchers for this type of award. Or if the award is only for a small amount of money, but requires a full proposal, time might be better spent applying to a smaller program that requires less effort.

Contacting a program officer before submitting a proposal gives researchers the opportunity to introduce themselves and their institutions, as well as develop a good rapport with the program officer, thus establishing their credibility and giving them a competitive edge in very close proposal competitions when the final decision of which top proposal to fund lies with the program officer. It is also critical for researchers to request to be a reviewer, when that is available. All these benefits are good, but typically the main reason to initially contact a program officer is to determine if the researcher's idea is a good fit for a particular program. The other benefits are ancillary to this one if a researcher is not sure where to send their idea. The program officer wants to fund projects responsive to the solicitation, and will honestly tell a researcher if an idea fits or not. If it does not, they can suggest other programs in their organization that might be a better fit. Overall, contacting a program officer allows a researcher to gather information to help submit a more competitive proposal and thus increase chances for funding. This information is either in the form of matching program needs or avoiding common pitfalls of other researchers.

Notwithstanding the previously mentioned benefits of contacting a program officer before proposal submission, many junior faculty hesitate to make the initial contact. Some fear that they will be bothering or wasting the time of the program officer. Remember that the program officer wants to fund the best proposals from the best researchers; it is their job to seek potential grantees. Summarized here is advice from several NSF program officers[14, 15, 16] and university research administrators[17, 18] on how to make contact with program officers:

(1) Be prepared – write a brief summary of your proposal idea (1 paragraph, about ¼ of a page), read the program announcement, read recent abstracts and research program funding priorities.

(2) Contact the program officer by e-mail – include the summary and offer to serve as a reviewer for the program, offer to meet in person if you will be in the Washington D.C. area or offer to schedule a conference call. It is always best to schedule meetings, don't just show up at the door.
(3) Prepare for a meeting or conference call – write a longer summary, if requested by the program officer. Make a list of questions to ask during the meeting (Figure 2), but come to a meeting expecting to listen more than speak.
(4) Follow-up with a thank you note – an e-mail is acceptable, but be professional and personable.

Questions to ask the Program Officer
• Does **my idea fit** in the program technical focus? • What are **common shortcomings/problems** the program officer has seen in proposals? • Are there particular things a PI should include or address in a proposal to help it get funded? • What is the **typical funding cycle** and/or the typical project scope? • What are typical program **funding rates**? • **Review process** – type of review, who reviews, how can you volunteer to review • Specific RFP/program **questions**
Questions **NEVER** to ask the Program Officer
• Do you like my idea? • Will you fund my project? • Can you recommend a Co-PI for this project? • Will you review my proposal before submission? • Will you serve on the advisory board for this project?

Figure 2. Program Officer Questions

Write Proposal *(3 – 6 months before proposal deadline)*
The general parts of a proposal include a descriptive title, a summary or abstract, a project description or narrative, the budget, a management plan, evaluation, and dissemination. The summary must be engaging, impeccably prepared, and unimpeachable in technical merit or the reviewers may not read any further. The bulk of the proposal is the project description or narrative where a principal investigator must prove their skills and background to complete the research plan. The budget must match the research plan, the necessary funds should be budgeted for the proposed activities, and there should be no additional funds budgeted for activities not described.

The writing process starts with creating an outline of the complete proposal based on the requirements presented in the program announcement as well as other proposal guidelines, such as the NSF Grant Proposal Guide[19, 20] or NIH application guide[21]. Templates and examples[22, 23] are available (Table 3). The exact name of each section is not always the same, but the overall information in a completed proposal is similar. Reading both funded and unfunded proposals gives a researcher an idea of what makes a good proposal. Many principal investigators are

willing to share their funded proposals if asked, but there is no better way to understand what makes a good proposal than to serve as a reviewer.

When beginning to write a proposal, a researcher must keep in mind that a proposal is different from a manuscript for publication. A proposal is selling a research idea, not just explaining it[4]. The tone of the text should be more engaging and exciting in a proposal, with headings, sub-headings, and bold text to guide the reviewers. There are many books and resources on writing tips available for technical writers[24], but the main message is that text must be clear, simple, and ordered, with a minimum of jargon, and effective judicious use of figures and tables.

Table 3. National Science Foundation and National Institutes of Health proposal templates, with corresponding similar sections listed across from each other.

NSF Proposal Template[19, 20]	**NIH Proposal Template**[21, 22]
Cover Sheet (II.C.2.a*)	Cover Letter
Project Summary (II.C.2.b*)	Abstract
Project Description (II.C.2.d*)	Project Narrative
	Introduction (for resubmissions/revisions)
References (II.C.2.e*)	Bibliography and References Cited
Biographical Sketch (II.C.2.f*)	Key Personnel and Biosketches
Current and Pending Support (II.C.2.h*)	
Budget and Justification (II.C.2.g*)	Budget and Justification
Facilities/Equipment/Other Resources (II.C.2.i*)	Environment
	Equipment
	Project/Performance Sites
Supplementary Documentation (II.C.2.j*)	

*Sections listed refer to the NSF Grant Proposal Guide (GPG) section[19].

Once a complete draft of a proposal is done, the researcher must seek out colleagues and mentors to give feedback on their ideas and presentation. The person who will give critical feedback is the one to be sought for this task. Choose someone who has the time and is not afraid to critically critique the draft. Also have less technical people read the proposal to see if the first few pages are written at a level to engage more than just the experts. One reviewer of this paper suggested engaging new graduate students for early critiques of proposal text to help gauge its readability and understandability. A final grammatical edit and proofread is essential. A few misspelled words or poorly constructed sentences can give the reviewers the impression that a researcher is not careful in their work, thus translating into not being careful in their research. If a researcher is not a native English speaker, they should strongly consider a technical writer to review the text for correct English.

Title. The proposal title is a label, not a sentence, so it must be accurate and succinct. It is the best chance to make a strong first impression on reviewers. Catchy is okay, but not at the expense of clarity. Some agencies specify length or request a short title as well. A title must highlight significant content of the proposal. An inadvertent key word in a title indicating another research area may send a proposal to the wrong section, likely resulting in poor reviews, and a wasted effort for both the researcher and reviewers.

Summary/Abstract. The summary or abstract should describe the complete proposal and expected outcomes, including objectives, methods, and approach. This is not a teaser for an idea drop and run; a proposal is not a mystery novel where the conclusion is hidden until the end. Usually limited to one page or less, economy of words in the summary is essential. Expect numerous iterations to produce an excellent summary. It is likely the first page read by reviewers, but it may be the only part read if it is poorly written. For funded proposals, the summary often serves as the public release document, so it should be geared to a technically literate audience, not only to experts in the field. This is particularly salient if the proposal is to be reviewed by a panel, rather than mail-in reviews, as the content of the panel usually includes some technical generalists (See Review Process section for more details).

Project Description/Narrative. The distribution of pages among sections in a 15-page proposal follows each heading below. Take note that the research plan is 6-10 pages (up to 2/3) of the project description, and the background and literature review is only 2-3 pages. The funding agency wants to know what a researcher will DO with the money if the grant is awarded.

Introduction/Significance and Objectives (1/2 – 1 page of 15). This section should be a clear overall statement of what will be done in the proposed effort, do not "dance" around ideas that never state in plain straightforward language exactly what is planned. All terms should be defined here. A restatement of the goals and objectives, exactly as worded in the summary, should be included in this section and is best placed as either the opening sentence or the concluding one. The rationale and scope of the work should be clearly explained and the method(s) of investigation should be stated and justified. This section should paint a picture of the problem and solution so the reviewer concludes that the work proposed is not only necessary, but the best next step to solving the very important problem.

Background/Statement of Need/Literature Review (2-3 pages of 15). This is where a researcher justifies the need for the proposed work – locally, nationally, and globally, all within a thoroughly processed literature review. A processed literature review does not include every article written on the topic at hand, but carefully merges the seminal and cutting-edge works (including those by the principal investigator) to show where the field is, who is doing the most important research, and gaps or needs in the existing knowledge. The importance and efficacy of filling the exposed gap by the researcher's proposed work is justified.

Research Plan/Narrative (6-10 pages of 15). This will be the bulk of a proposal, including preliminary results, and details and clarification of goals and objectives. The preliminary results serve to verify the researcher's experience and ability to conduct the proposed methodologies, and the institution's capacity for the proposed effort. It will certainly include data from past preliminary experiments, proof-of-concept studies, or publications related to the proposed research. If a researcher is new to an institution, it can also serve to verify that the needed resources and expertise are in place to continue previous studies completed at another location. The clarification of goals and objectives will include a detailed plan of how to complete them, placed within an outline of the goals and objectives stated in the summary and introduction. For example, if there are 3 objectives, the research plan should have 3 sections, labeled one for each objective, with detailed tasks or activities to accomplish each objective contained within the section. Organization within each section can include separate statements of rationale, methods, expected results, and limitations and alternatives.

Management (1/2 – 2 pages of 15). The most important part here will be a timeline of all project years and activities, showing reviewers that each activity has been addressed by the

researcher, who has a plan for completing them in the time allotted. For a single PI proposal no more information is needed for this section. However, for efforts with multiple collaborators at multiple institutions, a plan for distributing the work load and how the geographically disparate team will maintain communication as the work is getting done are vital. A chain of command must be established, identifying responsible parties for each objective task and for decision making. There must be a plan for handling long-distance communications and advisory or visiting committees. Research collaboration success depends on effective communications between researchers.

Evaluation/Assessment (1 page of 15). The evaluation of technical research is its acceptance for publication in peer-reviewed journals. This process typically starts with graduate or undergraduate student posters which are built into conference proceedings and in turn are fashioned into full manuscripts for publication. An evaluation process may not be so readily apparent for educational activities or programmatic efforts. These may take the form of internal and/or external evaluation with dedicated evaluators, to assess the meeting of goals and objectives as they are occurring (formative evaluation) and to assess the project once it is completed (summative evaluation)[25]. Depending on the activities, this may take the form of tracking participation and demographics to focus groups. Evaluation is a process and if built into a project from the start, it can improve the project as it progresses by identifying less successful elements that can be refocused to become more successful. Funding agencies are stressing accountability and need to be able to verify that their funds are well used. The evaluation efforts must be reflected in the budget, from funding an external evaluator to hiring a part-time student to collect and compile necessary data.

Dissemination (1/2 page of 15). This is the broad distribution of research results. It includes publication of results in books, peer-reviewed journals, and at conferences. In addition, other venues such as web-pages, short courses, K-12 education initiatives, student researchers, course modules, community education and outreach should be considered.

References

The reference list must be complete and include the state-of-the-art research in the technical field. Each entry must include complete reference citation information reported in a consistent style. Overall, it will show the reviewers that the researcher is current in the field and can synthesize the information available. Additionally, one of the top researchers in the area may be reviewing the proposal and will want to be acknowledged as one of the top in the literature review, so it must be comprehensive. Any relevant references mentioned in the solicitation must also be cited. For example in the NSF CAREER there are nine education resources cited in the program solicitation[1]. If an education plan includes any of the topics addressed by these references, they should be included in the proposal references list.

Budget and Justification

Some reviewers begin their review with the budget, to see what the researcher really plans to do. Budget requests usually include faculty and student salary support, travel to conferences or field sampling sites, research supplies, and course development. If there is no or very little money requested to support a particular activity that does require money to occur, it may indicate to reviewers that the proposer has not done sufficient preparation to actually do this activity. The budget justification can be used to clarify seeming discrepancies in the budget numbers, or justify under-funded or unfunded activities supported by institutional infrastructure or other cost-

sharing. Don't give the reviewers a reason to think that any aspect has been overlooked or forgotten.

For a collaborative proposal, the money distribution among partners is a strong indicator of the strength of the partnership. For example, if a Research I institution leads with a smaller college as a partner, but minimal funds are proposed to support efforts at the smaller college, it may appear to the reviewers that their participation is only for appearance and not a real collaboration.

Biosketch/Curriculum Vita

The biosketch is an important part of the proposal story. It will be reviewed and it must support the proposed work by showing a researcher's capacity to do the work, based on publication record, service, and other activities. Most agencies have a specified format for biosketches that must be followed. Not following the format can lead to the proposal not being reviewed. For example, NSF requires only 10 publications be included, naming up to 5 related to the project and 5 other significant publications. Any deviation from this can cause problems, proposals have been returned for including 11 publications or for not separating into the 2 specified groups. Follow the directions!

Submitting the Proposal

At a minimum of several weeks before the funding agency deadline, a researcher must engage the Office of Sponsored Research (or similar group) at their institution to let them know they will be submitting a proposal. There will be internal institutional deadlines to meet as the deadline approaches. Final copies will likely need to be uploaded into an on-line proposal system such as NSF FastLane[26] or Grants.gov[27]. Submitting early will help avoid potential on-line system problems, such as crashing as high volume deadlines approach, and give the submitter time to review their submission and make corrections before the deadline.

Once the proposal is submitted, let it go! Start on the next idea now.

Review Process *(up to 6 – 12 months following proposal submission)*

The review criteria for an organization are published (Appendix A). These should be studied before and during the proposal writing process. Knowing how a submission will be judged will let a researcher address these criteria as the proposal is written. For example, NSF reviews proposals for intellectual merit and broader impacts -- no more, no less. Two separate paragraphs are required in the summary addressing these two criteria.

In addition to the review criteria is the actual review process. An ad-hoc review is conducted by reviewers pulled together only for that specific review session, versus a standing committee where reviewers will serve continuously for several months or more. The process may be a panel of 6-8 individuals or more together in the same room or may be mail-in where the proposals are sent out for review to individual experts for written reviews, similar to how journal articles are reviewed. NSF typically has ad hoc panels, although there may be some repeat reviewers. NIH has standing panels, chosen from previously funded principal investigators. In an ad hoc review, a researcher cannot anticipate exactly who will be reviewing their proposal, as compared to the standing committee that is known ahead and will likely review a proposal resubmission. A panel will be composed of individuals with several levels of expertise as

required to review all aspects of a proposal: (1) experts in the field and actively publishing, (2) experts in the field but no longer actively publishing or doing research, (3) technical generalist with some level of technical expertise in a related area, but not the niche represented by the proposal, and/or (4) other experts in education or outreach. So a proposal written for a panel review will need to begin with a strong summary and introduction that states plainly, without jargon, what is proposed and how it fits into the grand scheme of research in the area. A proposal for mail-in review will go to an expert in the field, so should be written in a higher level of technical detail than a proposal to a panel. Some organizations have less formal reviews and the program officers will have greater input in to the final proposals to fund, such as for the Department of Energy and the Department of Defense. Since the review process may take on several different forms, it is important that this information is learned a priori through contact with a program officer.

Finally, consider the conditions under which reviewers must perform. Each panel reviewer may be assigned 10-12 (or more) proposals at once. The proposals will be read the week before the panel, some may be read on the airplane in route to the panel session. It is possible some reviewers will only spend 30 minutes on a proposal. That is not enough time to carefully read every word, so the proposer must make it easy for the reviewer to understand, by using legible fonts and spacing, with liberal use of figures and white space.

Funded or Declined

If the proposal is funded… hurray! Follow the contracting procedure of your institution and get started. One possibility is that the funding agency may want to fund a proposal, but only at a reduced budget. In this case, the researcher will need to generate an impact statement of this budget reduction on the proposed research, detailing the originally proposed work that will not be done and a new statement of work. If there is not as much money, less will have to done.

If not funded, a decision to resubmit must be considered. First, get copies of the reviewers' comments and determine the specific items to address in a rewrite. Do the comments indicate that maybe this proposal was submitted to the wrong program, or can a rewrite to address key points make it acceptable for funding? Early in this process talk to the program officer for some insight into the panel process and any specific information they can share to help in resubmission. If the idea was definitely a mismatch for a program, do not be afraid to try a different program. The only proposal that has no chance of getting funded is the one never submitted.

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Appendix A. Review Criteria for NSF and NIH.

NSF review criteria[19]:

Intellectual Merit

- *How important is the proposed activity to advancing knowledge and understanding within its own field or across different fields?*
- *How well qualified is the proposer (individual or team) to conduct the project? (If appropriate, the reviewer will comment on the quality of the prior work.)*
- *To what extent does the proposed activity suggest and explore creative & original concepts?*
- *How well conceived and organized is the proposed activity?*
- *Is there sufficient access to resources?*

Broader Impacts

- *How well does the activity advance discovery and understanding while promoting teaching, training, and learning?*
- *How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc.)?*
- *To what extent will it enhance the infrastructure for research and education, such as facilities, instrumentation, networks, and partnerships?*
- *Will the results be disseminated broadly to enhance scientific and technological understanding?*
- *What may be the benefits of the proposed activity to society?*

Secondary

- *Integration of education and research*
- *Diversity*

NIH review criteria[28]:

Significance

- *Does the project address an important problem or a critical barrier to progress in the field?*
- *If the aims of the project are achieved, how will scientific knowledge, technical capability, and/or clinical practice be improved?*
- *How will successful completion of the aims change the concepts, methods, technologies, treatments, services, or preventative interventions that drive this field?*

Innovation

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

Approach

- *Are the overall strategy, methodology, and analyses well-reasoned and appropriate to accomplish the specific aims of the project?*
- *Are potential problems, alternative strategies, and benchmarks for success presented?*
- *If the project is in the early stages of development, will the strategy establish feasibility and will particularly risky aspects be managed?*
- *If the project involves clinical research, are the plans for 1) protection of human subjects from research risks, and 2) inclusion of minorities and members of both sexes/genders, as well as the inclusion of children, justified in terms of the scientific goals and research strategy proposed?*

Investigators

- *Are the PD/PIs, collaborators, and other researchers well suited to the project? If Early Stage Investigators or New Investigators, or in the early stages of independent careers, do they have*

appropriate experience and training?

- *If established, have they demonstrated an ongoing record of accomplishments that have advanced their field(s)?*
- *If the project is collaborative or multi-PD/PI, do the investigators have complementary and integrated expertise; are their leadership approach, governance and organizational structure appropriate for the project?*

Environment

- *Will the scientific environment in which the work will be done contribute to the probability of success?*
- *Are the institutional support, equipment and other physical resources available to the investigators adequate for the project proposed?*
- *Will the project benefit from unique features of the scientific environment, subject populations, or collaborative arrangements?*