Engineering Education Programs at NSF

Webinar for Prospective PIs
September 29, 2015
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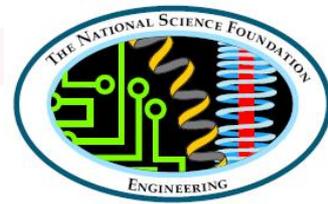
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Professional Formation of Engineers

The formal and informal processes and value systems by which people become engineers.

"To form is more ontological than to instruct or educate, for one's entire being is at stake."

Elements of PFE

- Introductions to the profession at any age.
- Acquisition of deep technical and professional skills, knowledge, and abilities in both formal and informal settings/domains.
- Development of outlooks, perspectives, ways of thinking, knowing, and doing.
- Development of identity as an engineer and its intersection with other identities.
- Acculturation to the profession, its standards, and norms.

Michel Fabre, Penser la Formation. Paris: Presses Universitaires de France, 1994.
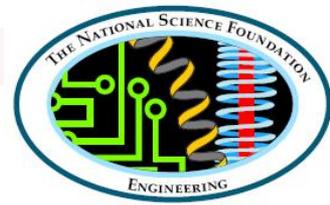
Engineering Education Research in EEC

- *Research in in the Formation of Engineers* program description
  - o Replaces *Research in Engineering Education*
- *Research Initiation in Engineering Formation* solicitation
- CAREER awards
- Workshops, supplements, cross-cutting opportunities, etc…

Current Elements of the Program

- Advancing holistic engineering formation
- Diversifying pathways to and through engineering
- Exploring citizen engineering, credentialing, and expertise
- Developing engineering-specific theories of how engineers are formed
- Understanding how change in engineering formation processes travels, translates, diffuses, and/or scales

The Innovation Cycle of Educational Practice and Research

Educational Practice

identifies and motivates

which help improve

Questions Ideas

Answers Insights

which lead to

that results in

Educational Research

Adapted from Booth, Colomb, and Williams, 2008

Research v. Development

Engineering Education programs emphasize research

Development activities must not be primary focus but can be part of a project where activities are germane to answering specific research questions

Clear research questions

to answer

grounded in

Appropriate methods

Informs methodology to generate

Relevant theory
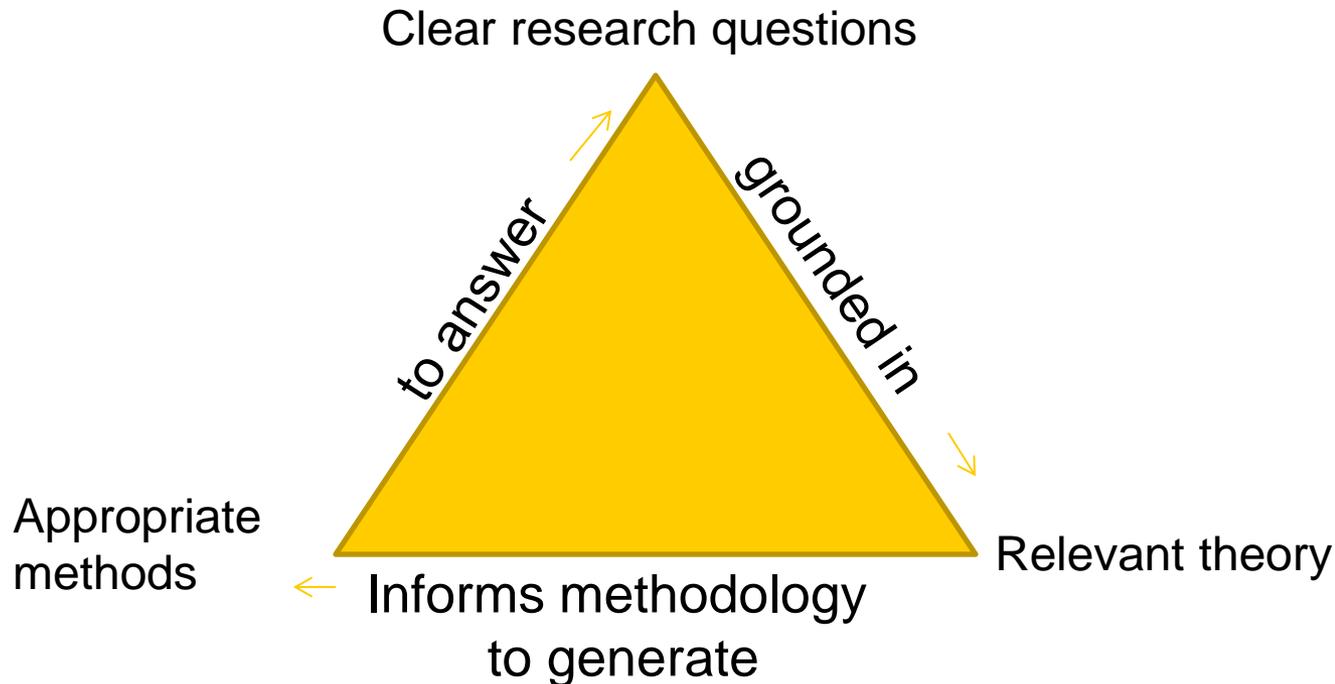
Transformative Projects

Transformative activity involves ideas, discoveries, or tools that radically change our understanding of an important existing scientific or engineering concept or educational practice or leads to the creation of a new paradigm or field of science, engineering, or education. Such research challenges current understanding or provides pathways to new frontiers.

Transformative activity results often do not fit within established models or theories and may initially be unexpected or difficult to interpret; their transformative nature and utility might not be recognized until years later.

Transformative activity

- Challenges conventional wisdom,
- Leads to unexpected insights that enable new techniques or methodologies, or
- Redefines the boundaries of science, engineering, or education.
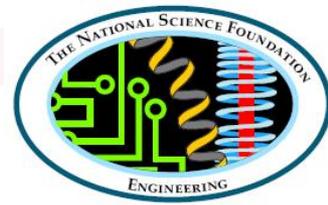
Research in the Formation of Engineers (PD 15-1340)

- *RFE* is a program description
    - brief description of program interests
    - specific requirements defined by GPG
- Five categories of interest
    - See previous slide and program description
- Typical awards are $300-$350K for three years
    - Talk to program director if you want to go beyond that
- Next deadlines are October 29 and February 17
- Review looks at the value of the proposal = impact/cost
    - Larger projects need to have a correspondingly larger impact
    - Small, exploratory, and speculative projects are encouraged
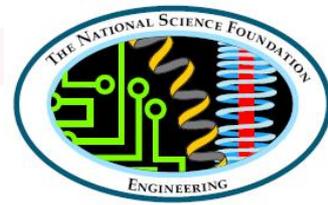
Research in the Formation of Engineers (PD 15-1340)

- Project evaluation is required
  - Both formative and summative to help keep your project on track
  - Type of evaluation depends on scale of project (external evaluator, advisory board, institutional evaluation office, etc.)
- Roadmap on how the project influences practice is required
  - Describes how it will be used by or influence some aspect of the engineering education ecosystem
  - Impact could be beyond the timeline and scope of the proposal
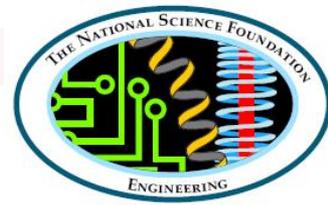
Research Initiation in Engineering Formation (NSF 15-539)

- *RIEF* is a solicitation
  - Specific requirements in addition to GPG
  - All GPG requirements must also be met
- Maximum award of $150K for two years
- Deadline is last Thursday in March
- Everything already described for RFE also applies to RIEF
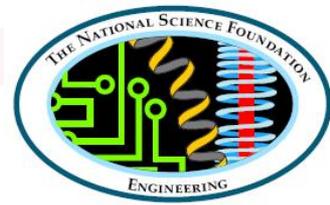
RIEF Additional Requirements

- *RIEF* is intended to increase capacity for engineering education research
- It support researchers new to engineering education research
- Solicitation requirement is that PI must not have received engineering education funding in last three years
  - In practice PI should have little to no experience in engineering education research
- Co-PI acts as a mentor to the PI
- Research should not be an extension of the co-PI's research
- Professional development plan and plans for future research should have equal weight with the proposed research
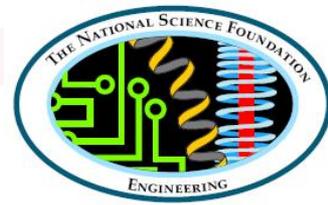
Important Rules for Newcomers

- Read the *Grants Proposal Guide* and follow it
- Your proposal has to come through an eligible institution (typically a university or non-profit)
- Don't send in the same proposal to multiple programs
- Ask questions if you have them
- Consider resubmission with changes from feedback from earlier proposals, but note that all submissions are reviewed from scratch
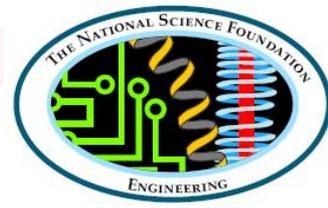
NSF National Science Board Review Criteria

- Intellectual merit: What will we learn? How will it advance science?
- Broader impacts: What will the immediate or eventual impact be on society? How will it make the world a better place?

Educationally focused projects often have a hard time disentangling these, but you need to separate them out in your proposal
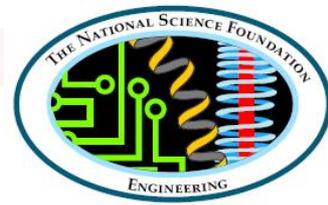
Elements of the NSB Criteria

The following elements should be considered in the review for **both criteria**:

1. What is the potential for the proposed activity to make a difference?
   a. By **advancing knowledge** and understanding within its own field or across different fields (Intellectual Merit); and
   b. By **benefitting society** or advancing desired societal outcomes (Broader Impacts)?
1. To what extent do the proposed activities suggest and explore **creative, original, or potentially transformative** concepts?
2. Is the **plan** for carrying out the proposed activities well-reasoned, well organized, and based on a sound rationale?
3. Does the plan incorporate a **mechanism to assess success**?
4. How **well qualified** is the individual, team, or institution to conduct the proposed activities?
5. Are there **adequate resources** available to the PI (either at the home institution or through collaborations) to carry out the proposed activities?
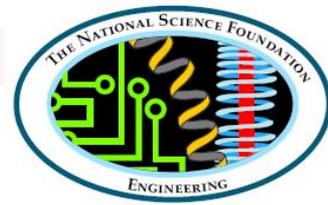
The submitter's three jobs

- Identify the right funding opportunity
- Conceptualize a fantastic project
- Write a persuasive proposal in 15 pages
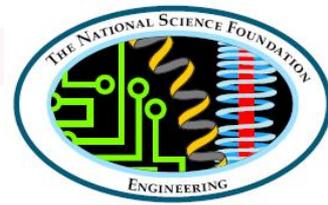
Actually ~100 pages

- Cover sheet 'signed' by AOR
- Summary and Narrative (1+15p)
- References cited
- Biosketches (2p ea.)
- Budget(s) (1p per year + 1p total budget) and Budget Narrative(s) (3p max)
- Current and Pending Support
- Facilities and Resources
- Data Management Plan (2p)
- Postdoc Mentoring Plan (1p)
- Other Supplemental Documents **ONLY** as allowed
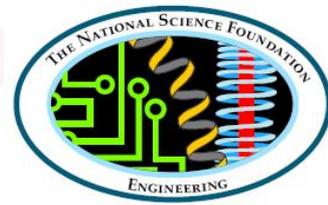
Conceptualize a Fantastic Project

- Avoid a focus on topics, ensure a focus on activities that people want to see occur
- Any part of the project that you can do before the funding arrives, you should do before submitting the proposal (locate partners, design studies, do preliminary design work, submit IRB, etc.)
- You will necessarily have thought through more detail than you may be able to express
- Your project must contribute to the knowledge base; typically evaluation is not enough
- You **MUST** align with the solicitation or program description
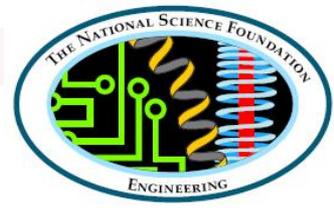
Conceptualizing Your Project: Common Issues

- **Fit with program**
  Must match program goals
- **Clarity and specificity**
  Should have important decisions made, plans laid out
- **Research and development**
  Methods must match questions, build on literature, and contribute to knowledge
- **Expertise and collaboration**
  You need to incorporate expertise appropriate to the contributions you want to make, both in project and in proposal
- **Innovation and impact**
  You should be addressing an important problem, and not reinventing the wheel
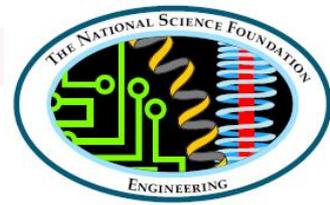
Writing a Persuasive Proposal

- By the end of page 1, the reviewer needs to know what you will do (roughly)
- The activities alone are not persuasive; you need an argument for why those activities lead to desired outcomes in both intellectual merit and broader impacts
- Ensure the expertise of your team is adequate to do the work and their expertise is reflected in your proposal
- Build trust in the reviewers that what you can't fit in the page limit is within your grasp
- You **MUST** follow the rules of the solicitation if you are submitting to one, and the GPG in any case
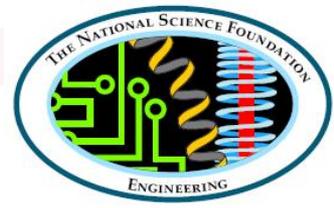
Writing a Persuasive Proposal: Help the Reviewers

- Make what they are looking for easy to find, using the language of the review criteria and headings to highlight the elements of the project description
- Don't assume that all reviewers will know the jargon of your discourse community or commonly used acronyms
- Consider how your proposal will read both when reading start to finish and when a reviewer skims to look for certain elements
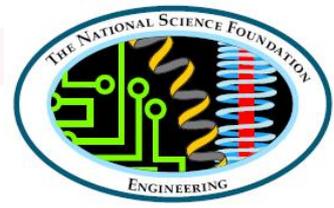
Writing a Persuasive Proposal: Common Problems

- Ignoring requirements stated in the solicitation or the Grant Proposal Guide
- The "Trust Me" approach: provide citations or evidence for critical assertions made, and detailed plans that can be evaluated
- The oversell of yourself or your project; take a neutral tone and let the evidence speak
- Pages of general, vague, or rambling narrative without precision and details
- Overemphasis of rationale for the project at the expense of methodology and details of what will actually be done
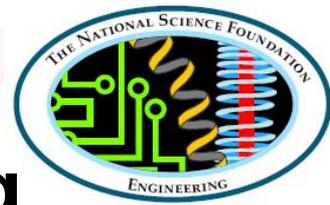
Common Mistakes in Engineering Education Proposals

- The PI fails to provide a roadmap for eventual impact
- Insufficient description of prior related work; The proposal fails to place the work in the context of existing literature and/or to make a case for why the work will add coherently to this literature
- No clear research question
- A research question that is too broad
- A course/lab/curriculum development proposal that does not advance understanding of engineering formation
- The methodology and/or research plan are deficient
- Lack of an appropriate theoretical framework that will be used in the research
- Failure to identify an appropriate audience for the research results and dissemination plans
- Not having the right team to achieve meaningful dissemination
- No clear value proposition is stated
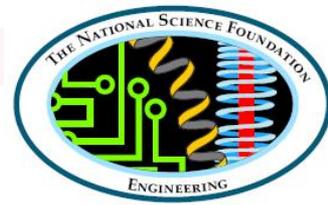
Contacting Program Officers

- Generally better to email rather than call
- Online face-to-face or phone meetings are just as good, no need to travel to DC
- Don't mass email—multiple POs may work on a program, talking to many creates redundant work
- Be prepared to say what you're asking for: advice on where to submit an idea, feedback on a one-pager to a program, procedural advice or answers to specific questions
- Consider the Policy office for legal/policy
- Recognize that program officers are *busy*
- Consider volunteering to review (send a CV right near a program deadline)
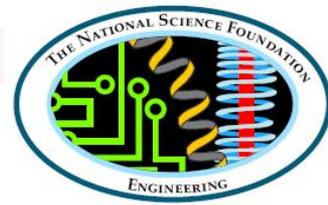
Possible Timeline for Proposals

- 12-6 months ahead: identify opportunities from prior years, read award abstracts and outcome reports
- 6 months ahead: begin discussing with any partners
- 3 months ahead: read final solicitation carefully. Alert sponsored projects office
- 1.5 months ahead: share draft proposal for feedback with colleagues. First draft of budgets.
- 2 weeks ahead: upload everything except narrative, if possible; ensure subcontract paperwork done
- 1 week ahead: final edits by PI, partners, and sponsored projects; mop up any last supporting docs
- Day before due date: submit if possible
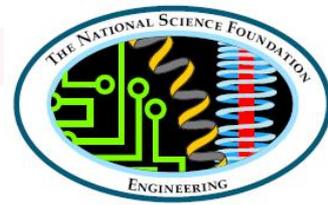
Timeline for Merit Review Process

- 4-6 weeks after deadline: Administrative review, compliance checking
- 2-3 months after deadline: Potential panelists contacted, panel finalized
- ~ 3 months after deadline: Panel meets
  - Panel provides guidance to PO, NOT a decision
- 3-6+ months after deadline: PO considers panel input and other factors, may contact PI for additional information, decides on recommendations
- 3-6+ months after deadline: PO makes recommendation, recommendation is reviewed at higher levels
- 3-6+ months after deadline: Notification received by PI and/or SPO
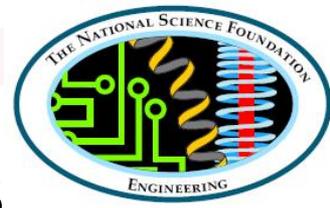
Merit Review and Award Process Considerations

- Panel provides guidance to PO. Even if a proposal was highly recommended by panel it may not be awarded
- Receiving a request for additional information does not guarantee an award will be made
- If a proposal is shown in Fastlane as recommended, be patient. The PO has made a recommendation and it is being processed at higher levels
- Overdue reports will delay awards, and in some cases can mean an intended award will not be made
    - o Reports should be submitted by the due date. The 90 days between the due date and overdue date are for the PO to review and request changes
    - o Overdue reports will prevent an award for any proposal you are associated with

Questions?