National Science Foundation
Division of Engineering Education and Centers (EEC)
Division of Undergraduate Education (DUE)

# IUSE/Professional Formation of Engineers: Revolutionizing Engineering Departments (RED)


**Julie P. Martin**
**Program Director**
Division of Engineering Education & Centers (EEC)

**Heather Watson**
**Program Director**
Division of Undergraduate Education (DUE)


**New Solicitation: NSF 19-513**
**Deadline January 24, 2019**

# Webinar Overview-update this

- Program overview and goals
- Elements of RED proposals
- Common weaknesses
- Questions from the audience

# IUSE/PFE:RED, What are those Prefixes?

- IUSE: Improving Undergraduate STEM Education
  - NSF-wide umbrella for all undergraduate STEM Ed investments
  - Not a program with funding (programs exist underneath IUSE)
- PFE: Professional Formation of Engineers
  - ENG initiative to understand engineering formation holistically
  - Not a program with funding (programs exist underneath PFE)
- RED has many partners
  - Directorate for Education & Human Resources (EHR)
  - All ENG Divisions

# Professional Formation of Engineers

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

**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.

# IUSE/Professional Formation of Engineers: Revolutionizing Engineering Dep (RED)

Change doesn't start with the syllabus, change shows up the syllabus

- ENG, EHR, CISE funded 19 projects as part of the RED program from FY14 to FY16
- Common thread across these projects: focus on organizational and cultural change within the departments, involving students, faculty, staff, and industry in rethinking what it means to provide an engineering program.
- The 19 RED programs are changing department culture and contributing to literature and contributing to the literature on organizational change not simply changing curriculum or pedagogy

National Science Foundation
Division of Engineering Education and Centers (EEC)
Division of Undergraduate Education (DUE)

# IUSE/PFE: RED

## Two Program Tracks

### Innovation

- Radically, suddenly, or completely new approaches and actions
- Producing fundamental, structural change
- Go outside of or beyond existing norms and principles

**Between $1M to $2M**
**Up to 5 yrs**

### Adaptation & Implementation

- Evidence-based and evidence-generating change strategy approaches and actions adapted to the local context

**Maximum $1M**
**Up to 5 yrs**

Proposals outside the budgetary limits will be returned without review

## Major changes from prior solicitation:

- Computer Science is no longer included. The name of the program has been changed back to its original title.
- Revised descriptions are provided that highlight the focus on the middle two years of undergraduate engineering curricula as well as emphasize the attention to cultural, organizational, structural and pedagogical changes that is necessary to reinforce and sustain desired transformations of engineering departments.
- An Adaptation & Implementation (A&I) track was added to foster the propagation of proven change strategies to new contexts.
- The requirement for proposers to submit a Letter of Intent.

# RED Outcomes for Both Tracks

- Fund programs that can serve as exemplars of change
- Revolutionary change to middle two years of undergraduate curriculum
- Connect engineering education research and practice
- Contribute to the literature on change
- Create of a cohort of project teams with activities and collaboration within and across cohorts

# What informed the design of the new RED solicitation?

- Prior research points to the following needs:
  - Faculty development
  - Faculty reward systems
  - Cultures that support faculty engagement
- RED teams from first 3 cohorts are becoming exemplars of change
- Need for adaptation and implementation of existing RED revolutions as well as other revolutionary ideas to other contexts

# Continued emphasis on revolutionary change!

- Radically, suddenly, or completely new; producing fundamental, structural change; going outside of or beyond existing norms and principles
- Focus on significant, systemic department change
- NOT curricular reform
- Create a vision for what it means to have an engineering program in your discipline

# A "typical" attempt at change

"Students always complain about lectures."

"Let's try problem based classes. I heard that's a good way to teach."

"Students are still complaining."

"I guess we should go back to lectures. It's easier for faculty."

"It was worth a try, but lectures have worked in the past so we might as well keep them."

# Paying attention to culture

"What do we want our program to be?"

"Students should be engaged with real world content."

"Let's create field experiences."

"Let's have a faculty retreat to figure out how to change."

"Students still aren't seeing what engineering really is."

"We need another retreat."

# IUSE/Professional Formation of Engineers: Revolutionizing Engineering Departments (RED)

- **Team Members**:

PI – Dept. Chair/Dean

Education Researcher

Organizational Change Expert

# Project Description

- Vision for Revolutionizing your Department
- Project Plan and Evaluation Framework
- Supplementary Documents

# Vision

- Describe the department and the student professional formation experience “after the revolution.”
- How is success defined?
- Provide a concise answer to the question: “What will be different?”

National Science Foundation
Division of Engineering Education and Centers (EEC)
Division of Undergraduate Education (DUE)

# Project Plan and Evaluation Framework

<table>
<tr><th>RED Innovation</th><th>RED A&I</th></tr>
<tr><td></td><td>Rationale & Context: Why change is needed in current department? How does context of original implementation compare to new context? How is original implementation being adapted to the new context?</td></tr>
<tr><td colspan="2">Goals & Objectives:<br>What outcomes and targets at the end of this project will move the department toward the vision? What will change about the department? What will change about the faculty? What will change about the professional formation of students?</td></tr>
<tr><td>Specific Actions: What is the evidence basis from the literature that supports use in the department’s context?</td><td>Specific Actions: How are activities being adapted for success in the new context?</td></tr>
<tr><td colspan="2">What is the theory of change; how and why should these activities effect lasting change?</td></tr>
<tr><td colspan="2">Barriers:<br>What are anticipated barriers to achieving objectives? What contingency plans are in place?</td></tr>
</table>

National Science Foundation
Division of Engineering Education and Centers (EEC)
Division of Undergraduate Education (DUE)

# Project Plan and Evaluation Framework

| RED Innovation | RED A&I |
|---|---|
| **Research Plan:** What are your ***research questions***? What ***educational or sociological theories*** inform them? What ***methods*** answer the research questions posed? These can be qualitative or quantitative as appropriate to the question and theoretical orientation. | |
| **Evaluation Plan:** Matches the scope of proposed work. Based on the theory of change and desirable outcomes of the proposed revolution. | **Evaluation Plan:** Focuses on implementation of the proven strategies in the local context. |
| What are the appropriate ***indicators of success*** related to accomplishing the goals and objectives and a timeframe to seek measurable change? | |
| **Roadmap to Scaling & Adaptation:** How will the project make an impact both locally and regionally/nationally by supporting revolutionary change in other departments? | **Dissemination Plan:** How will knowledge from the adaptation be diffused to other departments and institutions? |

# Supplementary Documents

- Letters from Institutional Leadership
- Postdoc Mentoring Plan (if required)
- Data Management Plan (n.b.: Human subjects considerations around privacy and sharing)

# Successful RED Proposals

- **Vision:** ***How revolutionary*** is the vision in light of a well-grounded understanding of the history, context, and culture of the department?
- **PI Team:** Is the RED team ***complete***, with all required expertise? Is each member fully qualified to perform the proposed work?
- **Institutional Commitment:** Do the letter(s) of commitment provide ***evidence of support*** for the project sufficient to achieve the goals and objectives?
- **Connection to Professional Practice:** Is there a sufficient connection in the proposed project to professional practice?
- **Faculty Development Plan:** Is faculty development well planned and ***properly incentivized*** to build department cultures that support the holistic professional formation of engineers?

# Successful RED Proposals

- **Potential for Success and Scalability:** How ***achievable and significant*** are the proposed changes in the ***middle two years*** of the technical core? How responsive are the changes to the call to focus on ***professional skills***? Reviewers will take into account justification of the research plan using the ***literature***, comprehensiveness of the plan, institutional leadership commitments, ***sustainability of change*** (including leadership changes and financial sustainability)
  - RED Innovation: Is the *theory of change* valid and well-justified? How well-justified are the *propagation* roadmap/transferability of change strategies?
  - RED A&I: How *reasonable* and *appropriate* is the reach of the dissemination plan?
- **Connection to Research on Engineering Education**: How well-informed are the vision and execution plan by the literature and ***prior attempts***, if applicable, to implement change? Is the expectation of success well-justified?
- **Adaptation & Scaling:** How likely is the new knowledge generated about how to change department culture to be received and utilized by others? How well-conceived are the plans for accomplishing these goals?

# RED Proposal Pitfalls

- Fails to address culture
- Missing important elements
  - Structural change, faculty development, specific institutional commitments, plans for sustainability and scaling
- Explains what will be done, but not how it will be done
- Lack of appropriate grounding in the literature
- Weak evaluation component
- Does not sufficiently engage engineering education and/or organizational change expertise on the team

# Frequently Asked Questions

- How many proposals can be submitted by an institution?
  - A  maximum of proposals per institution are allowed.
- Does 2 proposals from each institution mean one for each track?
  - It's up to your institution how you want to do this as long as no more than 2 proposals are submitted per institution.
- My institution has a RED project, can I submit a proposal?
  - An institution that already has a RED award can submit a RED A&I proposal to the new solicitation. Institutions with existing RED awards may not submit a proposal to the RED Innovation track.
- Can computer science departments submit proposals?
  - Computer Science departments are no longer eligible to submit proposals to the RED program.
- Can proposals be submitted from engineering technology departments?
  - Yes! We encourage engineering technology departments with four year programs to submit to the RED program.

# Reading List


- Webinar *Developing a Competitive RED Proposal* presented by current RED awardees, https://academicchange.org/
- *Journal of Engineering Education* Special Issue: The Complexities of Transforming Engineering Higher Education, April 2014, 103(2): 183-361.
- Johri, A. and Olds, B. (2014). *Cambridge Handbook of Engineering Education Research.* New York: Cambridge University Press.
- National Academy of Engineering. (2013). *Educating Engineers: Preparing 21st Century Leader in the Context of New Modes of Learning*. Washington, DC: National Academies Press.
- ASEE. Transforming Undergraduate Education in Engineering: Phase I: Synthesizing and Integrating Industry Perspectives, May 9-10, 2013. Workshop Report. http://www.asee.org/TUEE_PhaseI_WorkshopReport.pdf

# Reading List


- Jamieson, L., and Lohman, J. (2012). *Innovation with Impact: Creating a Culture for Scholarly and Systematic Innovation in Engineering Education*. Washington, DC: American Society for Engineering Education.
- Watson, K. (2009). Change in Engineering Education: Where does Research Fit? *Journal of Engineering Education*, 98(1): 3-4.
- Spalter-Roth, R., Fortenberry, N., and Lovitts, B. (2007). The Acceptance and Diffusion of Innovation: A Cross-Curricular Perspective on Instructional and Curricular Change in Engineering. Washington, DC: American Sociological Association and National Academy of Engineering Center for the Advancement of Scholarship in Engineering Education.
- National Academy of Engineering (2005). *Educating the Engineer of 2020: Adapting Engineering Education to the New Century*. Washington, DC: National Academies Press.