CPS 2017 Mock Panel Briefing
Medium and Small Proposals

for the Aspiring CPS PIs Workshop
Arlington, VA
3-4 August 2017

Warning: This is not an official National Science Foundation document. These slides are intended to provide a glimpse of the CPS panel review process, for those who have not had the chance to serve as a panelist. They are derived from a briefing for review of proposals submitted to the 2017 CPS Solicitation. I added slides to provide more detail on some topics I feel are relevant to the workshop, and removed slides on meeting logistics and the Fastlane panel review system. Panel briefings for 2018 are likely to differ in some details. T.P. Baker

Outline

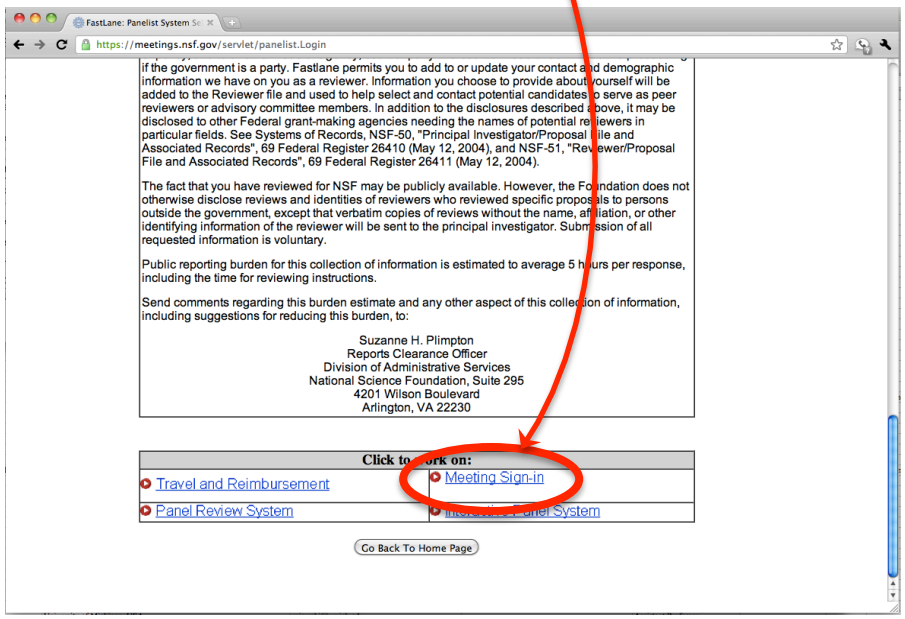
- Introductions and Sign-In
- Agenda
- Conflicts of Interest & Confidentiality
- CPS Program Overview
- Evaluation Criteria
- Panel Procedures
- Panel Summaries

Introductions & Administrative Details

- **Thank you for coming!** (Introductions)
- **Details:**
  - Digital Sign In – ensures reimbursements
  - EFT Information and travel reimbursement
  - "Conflict of Interest" Form

    everyone must sign in

    before the panel begins



Typical Panel Agenda – Pre-panel and First Day

- Pre-panel
  - Read and prepare reviews for **all** the proposals assigned to you (**including** those for which you are also scribe).
  - Enter reviews into Fastlane **several** days before you arrive at the panel.
- First day
  - Objective – make a first pass through all the projects
  - Events
    - Start the panel 8:30 AM
    - Introduction and panel brief
    - Lunch around 12:30 PM
    - End the day – usually between 5 and 6 PM
  - Discuss proposals
  - Make initial recommendation (HC, C, LC, NC, ND)
  - Homework – prepare and submit for review panel summaries assigned to you

Typical Panel Agenda – Second Day

- Objective: Complete and approve panel summaries for all proposals in panel, and finalize proposal recommendations
- Events
  - Convene 8:30 AM
  - Discussion on proposal recommendations
  - Discuss and finalize panel summaries
  - Finalize recommendations
  - Departure (frequently by 3 PM – sometimes earlier)

Conflicts of Interest (COI)

- **Financial (statutory) Conflicts**
  - Immediate family *(e.g., spouse*) employment
  - Previous (*12 months*) or possible future employment at the institution
  - Paid advisor, honorarium >$1500 (excluding travel reimbursement)
- **Intellectual (regulatory) Conflicts**
  - Thesis advisor or student
  - Family member or close friend
  - Co-author of paper or project collaborator within *48* months
  - Co-editor of journal, proceedings, or compendium within *24* months
- **Declare actual or perceived conflicts to panel moderators**
- **Panel moderators will determine how to manage COI with a proposal**
- **Sign and Turn In COI Forms**

IF you participated in an FY17 CPS Medium proposal

you CANNOT participate in a Medium proposal panel!

IF you participated in an FY17 CPS Small proposal

you CANNOT participate in a Small proposal panel!

Confidentiality

- Participation on NSF Panels is Confidential!
  - OK to say you participated (e.g., résumé)
  - Not OK to say which panel or which day
- Proposals contain sensitive information and are not in the public domain
  - Do not copy, distribute, or quote from proposals
  - Do not discuss content of proposals outside the meeting
  - Leave all proposal materials in room to be destroyed.
  - Delete all electronic copies, and destroy paper copies.
- Panel results are Confidential!
  - Do not discuss results or recommendations.
  - The panel makes recommendations not award decisions.
  - Avoid hallway conversations, tweeting, social media, etc.

CPS Program Overview

- Program Goal:
  - The goal of the CPS program is to develop the core system science needed to engineer complex cyber-physical systems upon which people can depend with high confidence
  - Reveal cross-cutting fundamental scientific and engineering principles that underpin the integration of cyber and physical elements across application sectors.
- Major Changes from 2016
  - Medium *replaces* Synergy – similar intent. Focus on multidisciplinary projects requiring integrated perspective
  - Small *replaces* Breakthrough – similar intent. Focus on new, emerging, and innovative ideas with high impact on CPS
  - Autonomy and Smart and Connected Communities – removed as focus areas – but *still of interest*. Addressed in separate solicitations

What are Cyber-Physical Systems

Deeply integrating computation, communication, and control into physical systems

Characteristics of CPS

- Pervasive computation, sensing and control
- Networked at multi- and extreme scales
- Dynamically reorganizing/ reconfiguring
- High degrees of automation
- Dependable operation with *potential* requirements for high assurance of reliability, safety, security and usability
- With / without human in-the-loop
- Conventional and unconventional substrates / platforms

Application Domains

Transportation

- Faster and safer aircraft
- Improved use of airspace
- Safer, more efficient cars
- Manned and un-manned

Energy and Industrial Automation

- Homes and offices that are more energy efficient and cheaper to operate
- Distributed micro-generation for the grid

Healthcare and Biomedical

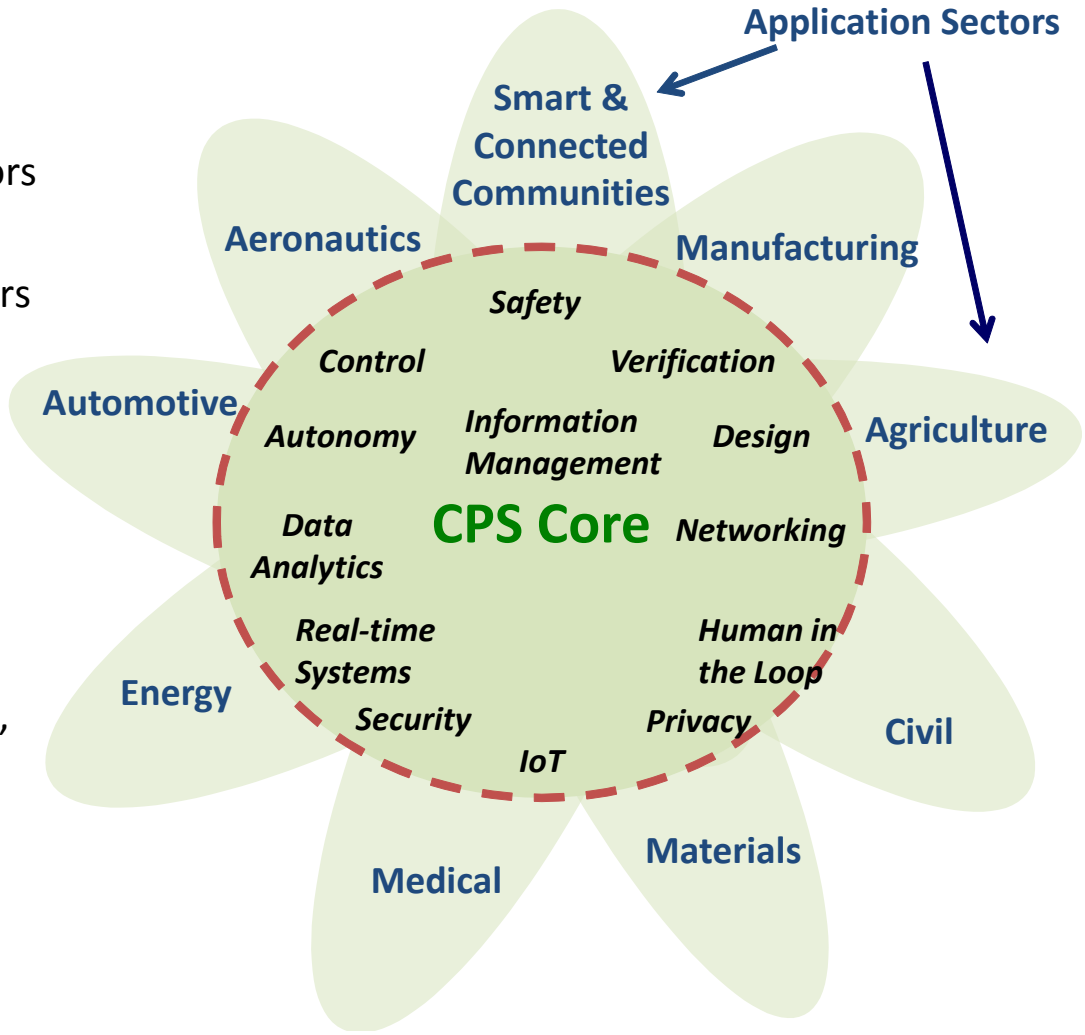
- Increased use of effective in-home care
- More capable devices for diagnosis
- New internal and external prosthetics

Critical Infrastructure

- More reliable power grid
- Highways that allow denser traffic with increased safety

NSF Cyber Physical Systems Research Model

- Abstract from sectors to more general principles – and apply these to problems in new sectors
- Build a CPS community – over 350+ current funded researchers
- Multiple agency participation (DHS, DoT, NIH, and NASA)
- Investment
  - Over $240M in current awards
  - 300+ awards
  - Over $40M in each of FY14, FY15, and FY 16



CPS Research

Cyber-Physical Systems – systems in which the cyber and physical components are tightly integrated at all scales and levels. Problem space includes computation, sensing, control, networking, and physical world

- Motivated by an application
- Advance foundational science
- Address important and relevant technical challenges
- Can it be applied across several domains?
- In other words, answer the question, “if I do this, so what, who cares, and what difference will it make?”
- Meet NSF criteria for intellectual merit and broader impact

Reviewing CPS Proposals

All proposals must address...

- Intellectual Merit
- Broader Impact

Some Considerations –from NSF 17-529

- Welcomes projects that explore next and future generation CPS applications in conjunction with research in one or more of the three CPS research target areas above (Science, Technology, Engineering). Such projects should incorporate careful experimentation designed to inform CPS science and technology.
- It is essential that proposals **not simply describe the development of a CPS, but also emphasize the areas of CPS research contributing to this development in which novel and foundational research contributions are being made.**

More Considerations –from NSF 17-529

- Please note that the mission agencies, in general, are looking to the CPS solicitation for basic research for **new and creative project ideas** that are **not typically submitted to their agency solicitations**.
- All proposals, whether targeted for a mission agency or NSF, will be reviewed by NSF panels adhering to standard review criteria for intellectual merit and broader impacts.

TTP Option – Maturing CPS Research (Only discussed if "C" or better)

- Expected impact on the deployed environment
- Extent to which the value of the proposed CPS research and development is described in the context of a needed capability and potential impact;
- Feasibility, utility, and interoperability of the capability
- Plan for accomplishing the transition
- Tangible metrics to evaluate the success of the capabilities developed, and the steps necessary to take the system from prototype status to production use
- Appropriateness of the budget.

Separate this from the overall evaluation of the proposal. The presence or absence (or quality) of a TTP option should not affect the overall rating of a proposal.

All proposals must ...

- **Be relevant to CPS program goal and vision**
- Make specific contribution to CPS science, technology, or engineering;
- Explain how the project research fits the Program Description for the type of Proposal (Small, Medium, or Frontiers);
- Describe the roles, responsibilities, and expertise of the team members, and how they contribute to the program;
- All projects of more than three years in duration must include experimentation on an actual cyber-physical system.
- Provide plans for disseminating the research and education outcomes
- Explain the rationale for multi-institutional collaboration and its importance for a successful outcome

Looking for transformative research – not incremental advances

Intellectual Merit Questions

- Do the backgrounds of the proposing team cover the set of skills needed to realize the project goals**?** *Are their planned interactions likely to achieve integration across disciplinary areas?*
- Does the project include a plan for validation of the research by experimentation and prototyping?
  - For projects of more than 3 years: Will the experimentation be on an actual CPS?
  - Are human or vertebrate animal subjects involved? If so, is there IRB approval?
- If the proposal involves more than one PI, how is it more than just an aggregation, and how will effective continual collaboration be assured? *(Consider the Collaboration Plan.)*
- If more than one institution, is there a compelling rationale for this structure?
- If there is unfunded collaboration, e.g. from industry, are there letters of commitment?
- What scientific questions are addressed, and is the research plan truly innovative?

Broader Impacts

- How well will the project benefit society?
- Are there sufficient and novel contributions to education and outreach
  - At the graduate and undergraduate level?
  - K-12 and community outreach?
  - Broadening participation amongst under-represented groups?
- How will the project disseminate results?
- Enhance the infrastructure for research and education

Note: Broader Impact should not be a secondary consideration in your review!!

Medium Proposals

- They are well suited to multi-disciplinary efforts that accomplish clear goals requiring an integrated perspective spanning the disciplines. **The proposal has to have that perspective** --- it is not an investigator issue!
- Medium project descriptions must be comprehensive and well-integrated.
- Project funding total award value
  - from $500,001-to-$1,000K for 3-to-4 years

    …not just a project that happens to be of medium size!
- Experimentation on an actual cyber-physical system required for projects longer than 3 years
- Collaboration Plan, if more than one investigator --- not just for multiple institutions
- approximately 20 Medium projects to be funded

Small Proposals

- Focus on new, emerging, and innovative ideas that will have impact on the field of CPS. Frequently of a more exploratory nature with less developed research plan.
- Clearly identify and explain a major advance in fundamental CPS science and/or CPS technology that will result from the project.
- Must have statement of up to one page that persuasively reasons why the research to be undertaken, if successful, would significantly impact the field of cyber-physical systems. **This statement must be submitted as a document under Supplementary Documents. It should be clear, concise, and not generic.**
- Project funding total award value up to $500,000 for up to 3 years --- *not just a project that happens to be of small size!*
- Frequently single investigator or single institution, can be multi-institution. ***Must*** have collaboration plan for more than one investigator.
- Approximately 10 Small projects to be funded

Reviews and Ratings

- Ratings can range from E to P
  - E – Excellent
  - V – Very good
  - G – Good
  - F – Fair
  - P – Poor
- You can use half scores (e.g. V/G)
- Think of your rating as a grade in a class, where E≈“A”, V≈“B”, G≈“C”, F≈“D”, and P≈“F”.

G is good, not great. While it may be “a quality proposal, worthy of support”, this is a tough competition. Proposals with many G’s are unlikely to be funded.

Avoid Bias

- Beware of sources of implicit bias
- Evaluate the proposal as written
- Focus on strengths and weaknesses under each review criterion
- Weigh the strengths and weaknesses to arrive at an overall rating

Think like a an investor

- You are not reviewing for a journal or conference, or awarding a prize for best-written proposal.
- You are advising the NSF on how to invest taxpayer $$.

Emphasize Transformative Research

Transformative research 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 Research

Transformative research 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*.

Characteristics of transformative research are that it:

- Challenges *conventional wisdom*,
- Leads to *unexpected insights* that enable new techniques or methodologies, or
- *Redefines boundaries* of science, engineering, or education.

High-Risk, High-Reward

It is OK to fund "high-risk, high-reward" proposals even if some do not succeed:

- If there is a reasonable chance PIs would deliver, give them benefit of doubt
- Don't expect all the creative work is done

It is NOT OK to only fund flawless projects that would "predictably" lead to incremental results

Look for

- Exciting and bold vision
- Articulation of challenging problems
- Outline of the proposed solutions/approach

Assess true value

- Balance risk against potential payoff.
- Game-changing proposals are unlikely to have all the details worked out.

Which if these is more valuable?

Glass

Diamond

Further Considerations for Review

- We are looking for strong and substantive reviews. Think of the review you are preparing, does it provide the feedback and level of detail that **you** would want to see in a review of your proposal?
- **Avoid simply saying the proposal is "incremental" or "transformative"** – be specific and describe what made it incremental, or why is it transformative
- **Avoid unsupported generalities, e.g.**
  - **"the proposal lacks detail"**
  - be specific, what would you like to have seen and where
  - be realistic; if you ask for more detail in one place, also suggest what might be cut, to balance
- Discuss the basic elements that make it a CPS proposal - the science, technology, or engineering. Go beyond just a "cool application".

Panel Procedures

Panel Tasks

- Discuss each proposal
  - Scribe starts with objective summary, then evaluation
  - Other assigned reviewers comment, scribe takes notes
  - Other panelists join in with questions
- Place the proposal into one of four categories
- Scribe prepares Panel Summary for each proposal
- Finalize all reviews/ratings and panel summaries before panel adjourns
  - *Update your individual review if-and-only-if your opinion has changed as a result of the discussion*

Panel Recommendations - Categories

- Highly Competitive – top priority for funding
- Competitive – worthy of funding
- Low Competitive – deficient on one or more ways
- Not Competitive – deficient enough that it would not be a good basis for revision & resubmission
- Not Discussed – proposal has been triaged and not discussed by panel

Rank order within HC and C

Triage

- The panel may agree **not to discuss** proposals that received uniformly unenthusiastic reviews. The triage decision will be based on unanimous consent by the panel. A proposal is **NOT** a triage candidate if it has: at least one rating above G; or all G's
- Any panelist (or program officer) **may** request that a proposal be discussed. If a request is made, the proposal will be discussed, and a panel summary will be prepared. Some potential reasons:
  - Early career PI
  - First time CPS submission
  - Interesting but very immature nugget
  - Substantial time available to discuss the proposals on the panel

Panel Charge

- The panel's recommendations are advisory to the NSF – final recommendations for awards by the CPS team must also consider a variety of other issues
- The panel is charged with using its individual and collective expertise and judgment to evaluate and recommend appropriate proposals
  - Reserve the Highly Competitive (HC) ranking for only a small number of the very strongest proposals with respect to intellectual merit, broader impacts, and the additional CPS review criteria
  - Competitive (C) proposals are strong with respect to intellectual merit, broader impacts, and the additional CPS review criteria

Panel Summaries

Each panel summary must address:

- **Intellectual Merit** (strengths and weaknesses)
- **Broader Impacts** (strengths and weaknesses)
- **Solicitation-specific criteria** (strengths and weaknesses)
- Panel recommendation and rationale
  - Should make the case for the panel's classification of the proposal (HC, C, LC, NC)

Use the template that is provided to you.

(Don't forget to delete the instructions, but keep the required final sentence.)

Writing Good Reviews & Panel Summaries

Appendix

Writing Good Reviews/Summaries

Reviews and Panel Summaries are sent to PIs

- Important feedback to PIs, therefore comments in individual reviews and of the panel summary should be
  - constructive, relevant
  - informative, substantive, unbiased
  - non-inflammatory
  - anonymous
  - written with as much care as you expect of the proposal writer

Put yourself in the position of the PIs.

Writing Good Reviews

- Use the Fastlane form, and fill out all sections.
- Use the full rating scale (E through P) as appropriate
  - Avoid fence-sitting
  - Keep the Triage criteria in mind
- The "Summary" section is for a summary of your assessment, justifying the rating you assigned, in terms of your overall assessment of the project with respect to responsiveness to the solicitation and the review criteria.

Do not use the summary section to summarize the proposal.
Do that as the first paragraph under Intellectual Merit.

Avoid Self-Deprecation

- You are on the panel because you are an expert
- Comment on those aspects you feel qualified to judge
- Do not say: “I am not an expert in the area of X, so I am not really qualified to evaluate its novelty” or “I am not qualified to review this proposal ..”.
  - Such comments prompt submitters to doubt the entire review
- You may state that “This reviewer is unsure if X is novel”, and the panel summary should address such individual comments, as per the consensus of the panel

Remember to

- Read the solicitation carefully before you read the proposals
  - What is every proposal expected to address?
- Cover all 5 review elements
  - For activities to achieve broader impacts as well as research
- Support your rating with specific reasons
- Be judgmental
  - Identify strengths and weaknesses
  - Make it clear what is intended as praise vs. criticism.
    - Avoid descriptive statements

Writing Styles to Avoid

- Exaggeration
  - "There is no evaluation plan", if the proposal devotes even one sentence to the subject. Better: "The evaluation plan is not adequately explained."
- Ad hominem comments on the author
  - "The PI is not aware of prior work." Better: "The proposal does not demonstrate awareness of relevant prior work."
- Unsupported criticisms, generalities without specific examples
  - Claiming inadequate discussion of prior work w/o any specific citations.
- Accusations
  - Report plagiarism/ethical issues directly to the program officer
- Vacuous praise = "feel goods"
- Instructions that imply the proposal will be funded if followed.
  - "The PI should revise the proposal to … and resubmit." Better: "The proposal could be improved by …"
- Comparisons with other proposals
  - "The best proposal I read"