Update on DRIVE Science Centers Program

Janet Kozyra
Program Scientist
Heliophysics Division
Science Mission Directorate
1. **Comments about, “an O2R-R2O component and shared funding with other programs/agencies”**

- Delay until more commitment from NOAA’s upper management
- Add an “R2O Enhancement Option” funded by NOAA, for example. Potentially needs a separate pool of reviewers

2. **Comments about, “# of co-existing Centers. budget & lifetime, funding profile needed”**

- **Lifetime**: 5 years at minimum, but funding for the last 2 years contingent on a successful comprehensive review. After 5 years, propose R2O as an optional extension of the center. 4-year lifetime with possible extension. Four years is the lifetime of LWS FST teams
- **Number**: Ideally, more than one Center at any one time constrained by the budget situation
- **Funding**: $3M/yr, bare minimum of $2M/yr.
The reason teams are formed is to enhance communication and to apply collective intelligence to solve problems. As team size increases:

- More difficult for members to contribute to their full potential
- Hinders balanced contributions
- In interdisciplinary teams, full contributions from all members are essential.

“Understanding the relationship between scientific productivity and research group size is important for deciding how science should be funded.”

Hoegl [2005]; Blenko & Mankins, [2010] and many others found:

- As size increases, good communication requires increasing resources (time, attention, etc.).


- Not strongly correlated with member intelligence (average or maximum)
- Correlated with member’s:
  - Average social sensitivity
  - Equality in conversational turn-taking
  - Proportion of females

Research evidence does not provide an absolute optimal team size. Three key factors in optimum size:

1. Level of communication
2. Complexity of the team’s work
3. Collective intelligence, the “c factor”
**Optimum Size of Team**

- **4-9 members**
  - Is thought to be the “Sweet Spot” for teams.
  - Lower end for highly collaborative work
  - Upper end for work with little collaboration.

**One mitigation strategy [Hoegl, 2005]:**
- Multiple small teams with 6-7 members
- Team of team leaders also 6-7 members
- So by this measure, 36-49 center members in 6-7 institutions is in the sweet spot.
- Most communication takes place locally

Ganging-up effect decreases performance

Illustration of communication lines

Most often cited as ideal size

Effective team communication starts to become difficult
Revisit RFI Recommendations

### Personnel

- 8-10 senior researchers at 2-3 months each + 6 postdocs + 6 grad students + 10 part-time undergrads
  - **Total cost salaries + overhead ~ $2.5M** (32 researchers)
  - + 2 admin + 2 techs = **36 people**
  - 5-6 institutions, ~6-7 people each

- 10 senior researchers at 50% FTE + 12 grad students + 6 postdocs
  - **Total cost salaries + overhead ~ $3.95M** (28 researchers)
  - + 2 techs & 2 admin = **32 people**
  - 5-6 institutions, ~5-6 people each

**Note:** Annual cost assumes:
- GRA + tuition ~$100K; Postdoc ~$125K; Researcher @ 100% = $400K; undergrads ~$10K ea

### Resources Needed

- **Allocations on Pleiades, Blue Waters, petaflop-level computers (5M node-hours/year; 4M SBU per year)**

- **Visualization & advanced computer graphics**

- **Mass storage, work stations, graphical processing units**

- **Heavily leverage other grants & institutional resources**

- **Leverage NASA-NSF strategic capabilities**

### Cost/Lifetime

- **$3M/yr, $2M/yr, $4M/yr for 5 yrs**

- **$1-2M/yr for 5-6 yrs**

- **$1-3M/yr, $2-2.5M/yr, $2.5-3M/yr for 6 yrs**

- **$1M/yr to join together & enhance several major funded**

**$2M-$4M annually may be consistent with literature on optimum team size – if multiple institutions**
Use 2-Phase center model (example CCI)? Minimize cost & duplication between Centers with shared resources model (example: MRSEC)?

- 2-phase center - if budget more than $2M/year
- Helpful to share system engineers to support the effective use of NASA’s High-Performance Computers

- Single-Phase Center removes uncertainty of down-select. Speeds things up. Maximizes amount of money to the Centers.
- A steering committee of Center PIs could provide venue for sharing.

Reverse site-visit model or site-visit model for proposal review? Add program-specific review criteria?

- Program-specific to assess relevance to the DRIVE initiative vision.
- External advisory committee is necessary to maintain focus.
- Annual 2-3 days meeting for all the teams to get together and present their work (similar to a design review).
5. How to address increased computational demands of centers? How to support deep knowledge integration & efficient virtual communication?

- HPD needs to increase HEC support. Request HEC budgeted in proposals.
- Center communication plan needed. Center should be run as an open diversified institute instead of just a few senior people making the decisions. Should train the next generation modelers.
- NASA HPC is oversubscribed. Use model similar to NCAR climate supercomputing: a portion of HPC yearly allocations reserved for priority use by selected HSC teams. Leverage combined NASA HPC and NSF XSEDE resources.

6. Post-award reviews? Metrics for success?

- Post-award reviews by a combination of the advisory committee, ad-hoc panels and NASA/NSF program managers track and evaluate progress. Checks if the center has achieved the DRIVE initiative objectives.
- Deliverables will depend on each proposal. Broad community benefit and engagement (e.g., if a model is built, develop scenarios for community use.)
Drive Center plans that follow, take into account:

- NAS, *Enhancing the Effectiveness of Team Science*, 2015
- NAS, *Report Series: Committee on Solar and Space Physics: Heliophysics Science Centers. CSSP, 2017 & 2018 discussion with CSSP*
- RFI input from scientific community, 2017
- 2017 HPAC discussion & individual inputs
- 2017-2018 Discussions with NSF
- Research into 6+ other NASA & NSF Center programs
- Discussions within NASA HPD

Learning from 2016 LWS FST team formation activities

- Guided by recommendations from the NAS 2015 Team Science report
Basic Principles for DRIVE Center Program

- The transformative nature of DRIVE Centers is best supported by:
  - Openly competing science objectives (not defining beforehand)
  - Giving proposers the freedom to define tools, methods, team composition and management
  - Requiring metrics and making their evaluation part of the proposal selection process
  - Limiting renewals, expecting significant progress or solutions in the Center primary lifetime. Enables Centers to be used as agile tools for addressing pressing strategic research problems as they emerge.

- Uniquely configured to support interdisciplinary science and innovative approaches.

- Supply valuable research and educational experiences for the broader community (visiting scientist programs, workshops, summer schools, etc.)

- Present a very real potential for positive societal impacts

- Augment not replace existing research elements

- Multiple centers provide opportunities for enriching cross-center interactions
Features of DRIVE Center Program

✓ NASA – NSF collaboration under a MOU agreement. Ensures that science goals and eligibility criteria and metrics for proposal selections are consistent with each agencies priorities
✓ Focused on key science problems of solar and space physics that have a “compelling justification for a center approach” – Science objectives, center structure, and metrics selected through open competition
✓ Multidisciplinary teams of theorists, observers, modelers, and computer scientists
✓ $1M-$3M per year for 6 years,
✓ Program ramping to $8 million per year
✓ Required elements evaluated in selection process:
  o Communications plan
  o Deep knowledge integration plan
  o Management plan
✓ Two phase structure: Six pre-centers, with downselect to two 6-yr Centers after two years. Funding for the last 2 years possibly contingent on a successful comprehensive review
✓ Considering possible supplemental center funding, GI program, Early Career Program, R2O-O2R enhancement or extension options, etc.
### DRIVE Pre-Center→Center Draft Plan

<table>
<thead>
<tr>
<th>Year</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
<th>2023</th>
<th>2024</th>
<th>2025</th>
<th>2026</th>
<th>2027</th>
</tr>
</thead>
<tbody>
<tr>
<td>$8M</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$6M</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$4M</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$2M</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Pre-Center (Phase A)**: ~600K/yr for 2 yrs.
- **$3M/yr for 4 yrs**
- **$2M/yr for 2 yrs**

#### Funding Breakdown:

- **Yr 1**: Center Year 1
- **Yr 2**: Center Year 2
- **Yr 1**: Center Year 3
- **Yr 2**: Center Year 4
- **Ramp Down Yr 5**: Ramp Down Yr 6

#### Additional Funds:

- **GI, ECIP, Supplemental Center Funds**

- **Guest Investigator, Early Career Investigator, Supplemental Center Funds**
References

- Blenko, Mankins, Harvard University Press, 2010
- Hoegl, Martin, Smaller teams – better teamwork: How to keep project teams small, Business Horizons, 48, 209-214, 2005
Thank You!