Phaeton: Training Young Engineers at JPL

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Current NASA Workforce

• NASA scientists & engineers over 70 outnumber those under 25 by a factor of 6
• 33% of NASA scientists & engineers are eligible to retire today
• Average age of NASA scientists & engineers is 47.6 years of age
• Increasing by 0.3 years of age annually

How do we capture the knowledge from experienced employees and transfer it to younger employees?
Solution

Rapidly train and develop early career hires (ECHs) to be future system-level thinkers by instilling in them the experience of senior staff.
Phaeton: An Overview

• Combine training classes, mentoring, and project-based learning
• Multiple concurrent small projects staffed and run by ECHs
• Rapid experience for participants
• Interdisciplinary training
• Multiple-phase exposure
• Small-scale technology development and testing
• Mentors staffed in a 1:1 to 1:2 ratio with participants and provided a charge number
Project Details

- Modeled after NASA AO Step 1 and Step 2 stages, appropriately scaled
- Phaeton Program Office releases request for concepts (RFC) lab-wide to all personnel
- Technical review board selects all reasonable project concepts
- ECH teams choose projects for pre-phase A proposal
- Proposal teams submit:
  - Written proposal
  - Poster display
  - Presentation
- Proposals judged by Technical review board
  - Evaluation based on training potential, scope, risk, technical benefits, and recruiting potential
- All ECHs in Phaeton work on selected projects
- All selected projects are different, but include all major reviews
**Terrain Relative Guidance System (TRGS)**

**Objectives:**

- Capture Exo-Atmospheric and Descent Imagery, IMU and GPS Data Sets During a Sounding Rocket Flight
- Collect and Analyze imagery, Inertial Measurement, and GPS Data During a Sounding Rocket Flight to Advance the Development of Terrain Relative Navigation Technology

**TRGS Functional Block Diagram**

**Mission Scenario**

**Funding Profile ($K):**

<table>
<thead>
<tr>
<th></th>
<th>FY '08</th>
<th>FY '09</th>
<th>FY '10</th>
</tr>
</thead>
<tbody>
<tr>
<td>41.068 NT/Seybold launching from White Sands Missile Range 5 April 2006</td>
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<tr>
<td>FY08-FY10 Key Milestones</td>
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<tr>
<td>FY’08: Major Procurements Completed</td>
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<tr>
<td>FY’09: PMSR (Oct 2008)</td>
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<td>SRR (Mar 2009)</td>
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<td>PDR (Jun 2009)</td>
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<tr>
<td>FY’10: CDR (Oct 2009)</td>
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<td>I&amp;T (Jan 2010)</td>
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<tr>
<td>Launch (Mar 2010)</td>
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<td></td>
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<tr>
<td>Data Processing Complete (Jun 2010)</td>
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Design, Build, and Deliver a sensor package to measure on-orbit mast vibration for the purpose of characterizing the dynamics of the NuSTAR observatory mast.

Phaeton Mast Dynamics (PMD)

Caltech Collaboration (WBS 04.01)
- Working with S. Pellegrino
- PMD budget plans for 0.1 to 0.4 FTE until delivery in March of 2010
- Mission operations, analysis and testing to be completed with Caltech
- Only ITAR approved information will be provided

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PMD will be launched with NuSTAR in August 2011
- Non-mission critical instrument
- Some resources will be provided by NuSTAR

Funding/ECH Labor Profile ($K/FTE):

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<tr>
<th>Fiscal Yr</th>
<th>'09</th>
<th>'10</th>
<th>'11+</th>
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<tbody>
<tr>
<td>Phaeton Project Funds, $K Real Yr, Burden</td>
<td>600</td>
<td>400</td>
<td>100</td>
</tr>
<tr>
<td>Phaeton Project Workforce, Work Years, ECH</td>
<td>3.2</td>
<td>2.2</td>
<td>0.25</td>
</tr>
</tbody>
</table>

Major Milestones:
- PMSR – 10/30/2008
- SRR – 11/13/2008
- PDR – 1/2009
- CDR – 5/2009
- TRR – 10/2009
- HRCR – 2/2010

Results

- 19 participants from all branches of engineering, business, and procurement
  - From a total of 70 applicants

<table>
<thead>
<tr>
<th></th>
<th>Very much so</th>
<th>Somewhat</th>
<th>Not at all</th>
</tr>
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<tbody>
<tr>
<td>Recommend Phaeton to others</td>
<td>77%</td>
<td>23%</td>
<td>0%</td>
</tr>
<tr>
<td>Excited about their project</td>
<td>69%</td>
<td>31%</td>
<td>0%</td>
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<tr>
<td>Provided with adequate tools</td>
<td>57%</td>
<td>43%</td>
<td>0%</td>
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Results

• What about the project is most stimulating to you?
  – “I find it stimulating that I am working on developing technology that will advance the state of the art. I also find it exciting to be a critical part of that process.”
  – “Being fully responsible for work in my area of expertise.”
  – “The fact that I'm responsible for the entire software, rather than just a small chunk.”
  – “The opportunity to work with other ECHs”
Results

• What additional tools or resources can we provide to help you be successful?
  – “More money”
  – “More direction before we need it, not after.”
Results

• What about the project is draining the excitement?
  – “Too much paperwork. Too much emphasis on procedure when a small project would not normally do this.”
  • 3 other similar responses
  – “This is a 100% time-commitment job, but we only have budget to work 50%.”
Results

• What do you need?
  – “Nothing, the program and the staff supports are great.”
  – “Things are on the right track! I'm looking forward to the next year.”
  – “Make training classes more relevant.”
  – “Guaranteed launches and the freedom to fail.”