A Novel Approach for Engaging Academia in Collaborative Projects with NASA through the X-Hab Academic Innovation Challenge

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Outline

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X-Hab Introduction

• X-Hab Academic Innovation Challenge is currently in its Sixth Year of Execution
• It is run through KSC for NASA Human Exploration Operations Mission Directorate
• Solicitation partnering NASA and academia on technologies and studies for deep space missions
• NASA awards grant funds (~$10k - $50k) to design and produce functional products of interest
• Universities propose on a variety of projects suggested by NASA and are then judged on technical merit, academic integration, leveraged funding, and outreach.
• Universities assemble a multi-discipline team of students and advisors that invest months working together, developing concepts, and frequently producing working prototypes.
• Students gain a quality experience, working real world problems that have the possibility to be implemented, and they work closely with subject matter experts from NASA who guide them through a formal engineering development process.
• The first X-Hab in 2011 was run as a head to head competition. After that, it was decided to pursue a diverse portfolio of projects each year to gain more from the investment.
Notional Selection Schedule

- February  Solicit project ideas, funding for projects in next fiscal year
- Early March  Release solicitation
- Early April  Questions for online technical interchange due
- Mid April  Responses for questions published online
- Late April  Proposal due date
- Late May  Award announcements and announce selections for the fall
- June  Collect project funding and obligate to NSGF
Project Execution Schedule

- September  Project kickoff meetings for new projects
- October    Requirements and System Definition Review
- November   Preliminary Design Review
- January    Critical Design Review
- March      Progress Checkpoint Review
- May        Project Completion and Evaluation by NASA
X-Hab 2011

- **Inflatable Habitat Loft competition**
  - University of Maryland (bottom right), Oklahoma State University (right), and University of Wisconsin (below)
X-Hab 2012

- Ohio State University: Plant Growth Monitoring System
- University of Bridgeport, Connecticut: Sample Handling System for GeoLab glovebox (pictured)
- University of Maryland, College Park: vertically-oriented habitat study.
- Oklahoma State University: horizontally-oriented habitat study.
X-Hab 2013

- University of Alabama, Huntsville: Microgravity Random Access Stowage & Rack System
- California Polytechnic State University: Vertical Habitability Layout and Fabrication Studies (pictured)
- Oklahoma State University: Horizontally Oriented Inflatable Deep Space Habitat
- Texas A&M University: Wireless Smart Plug
- University of Colorado: Remote Plant Food Production Capability
X-Hab 2014

- University of Wisconsin, Madison: Badger Compartmentalized Onboard Material Extrusion Technology
- University of South Alabama, Mobile: Closed Environment Air Revitalization System Based on Metal Organic Framework Adsorbents
- Rice University, Houston: SpaceRing: a Versatile, Scalable Power-Generation and Cooling System
- University of Colorado at Boulder: Plant Anywhere: Plants Growing in Free Habitat Spaces (pictured)
- University of Maryland, College Park (2 projects): Vertical Habitability Layout Studies, Neutral Buoyancy/Parabolic Flight Habitat Studies
- Oklahoma State University, Stillwater: Horizontal Habitability Layout Studies
X-Hab 2015

- University of Colorado at Boulder: Deployable Greenhouse for Food Production
- Oklahoma State University: Deployable Greenhouse for food production on long-duration exploration missions
- University of South Alabama: Development of a Volumetric Absorption System for CO2 and H2O Multicomponent Isotherm Measurements
- University of Vermont: Design of a "Smart-Structure" Deployable Airlock (top)
- University of Wisconsin - Milwaukee: Design of a Carbon-fiber/Fused Deposition Modeling Spacecraft Structural Fabrication System (bottom)
X-Hab 2016 (Sept 2015 kickoffs)

- University of Maryland, College Park, Md. - Inflatable/Deployable Airlock Structures
- Pratt Institute, Brooklyn, N.Y. - Human Centered – Designs for Mars Transit Habitat
- Oklahoma State University, Stillwater, Oklahoma - Deep Space Mars Transit Habitat Layout Studies
- University of South Alabama, Mobile, Alabama - Development of a Concentration Swing Frequency Response Device
- University of Puerto Rico at Mayagüez, Puerto Rico - Technology Development of Low-Power Required Manufacturing of Metals for the Zero Gravity Environment Project
- Utah State University, Logan, Utah - Student Experimental Microgravity Plant System (SEMPs)
- The Ohio State University, Columbus, Ohio - Water Assurance: Improve water delivery of a modular vegetable production system
- University of Colorado-Boulder, Boulder, Colo. - Performance Characterization and Enhancement of the MarsOASIS Space Plant Growth System
X-Hab Selections 2011-2016

- X-Hab 2011, 2014
  - University of Wisconsin - Madison

- X-Hab 2015
  - University of Wisconsin - Milwaukee

- X-Hab 2016
  - University of Vermont
  - University of Bridgeport
  - University of Maryland
  - University of Alabama, Huntsville
  - University of Puerto Rico - Mayaguez
  - University of South Alabama

- X-Hab 2013
  - California Polytechnic University
  - University of Colorado Boulder
  - Oklahoma State University
  - Texas A&M University

- X-Hab 2014
  - Rice University
Benefits

• Reports and Prototypes
  ▪ NASA gets products in which they are interested at low cost

• Outreach
  ▪ Teams do excellent outreach nationally and locally in conferences, schools, and various media

• Financial Flexibility
  ▪ Cooperative Agreement with National Space Grant Foundation facilitates solicitation ahead of academic year

• Student Experience
  ▪ Good project cycle experience ahead of employment
Future Plans

• X-Hab has been run under one project within HEOMD’s Advanced Exploration Systems Division
• Now supports multiple divisions in HEOMD and projects within AES
• Collaboration has become the norm rather than the exception with limited funds in architecture and technology development activities
• X-Hab can continue to grow to support HEOMD activities and engage the creativity of academia
The X-Hab Academic Innovation has evolved and matured as it enters its sixth year of operation.

This model can serve as an excellent mechanism to engage academia in research and technology efforts not only within NASA but any government agency.

The model benefits government with creative, low cost focused research through academic partners while the universities can tailor the curriculum to give their students a good systems engineering experience guided by the expertise of the agency.
Questions?

- Thanks to the following folks:
  - Kriss Kennedy at JSC who created the concept of X-Hab
  - All the civil servants and contractors around NASA who have supported X-Hab project teams
  - National Space Grant Foundation
  - The university teams and their partners who have been so successful in executing projects.
For more information

- NASA X-Hab Academic Innovation Challenge Public Page
  - [http://www.nasa.gov/exploration/technology/deep_space_habitat/xhab](http://www.nasa.gov/exploration/technology/deep_space_habitat/xhab)

- NASA Deep Space Habitat Facebook page

- National Space Grant Foundation (NSGF) X-Hab site
  - [https://www.spacegrant.org/xhab](https://www.spacegrant.org/xhab)

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