Technology and Innovation Committee Report

Esther Dyson
February 10, 2011
Turnover

• Eric Haseltine resigned – personal reasons
• Gordon Eichhorst joined – great addition!
Meetings of T&I Committee
1 of 2

• NASA Langley Research Center, October 20-21, 2010.
  – Members attended Aviation Unleashed conference on October 20 in Hampton, VA.
  – Public session on Oct. 21 at LaRC included tours of research labs; tour of 14 x 22 Subsonic Wind Tunnel; Center overview update; innovation efforts at LaRC; presentations on OCT formulation and the Game Changing Development program.
NASA Langley Core Competencies

**Aerosciences**
Research for Flight in All Atmospheres

**Characterization of all Atmospheres**
(Lasers & LIDAR)

**Aerospace Systems Analysis**

**Entry, Descent & Landing**

**Aerospace Structural & Material Concepts**
What we (LaRC) are doing to encourage innovation

- Lecture Series
- Revolutionary Technical Challenges
- Organization Innovation Plans
- TEDxYouthDay
- [Individual “Beyond the State of the Art” Plans]
- Creativity & Innovation Funds
- Lunch & Learn
- 10% White Space
**Objective:** Solicit innovative ideas enabling new capabilities or radically altering current approaches to launch, build, and operate space systems.

- Matures technologies through the mid-TRL regime to enable useful game changing capabilities for scientific discovery, and human and robotic exploration.
- Projects are intended to be capability-oriented and to move ideas from discovery to use.
- GCD emulates the outcomes of the DARPA approach at technology development.
- Guided by NRC’s Findings and Recommendations*

**Acquisition Strategy**

- **Concept Studies** will be competed to flesh out idea(s), quantify their challenges and identify approaches to overcome them.
- A subject matter expert Project Manager (PM) may recommend the idea for a new project start. If *game changing*, the Chief Technologist may authorize the PM to release a BAA.
  - The BAA asks for many ideas to achieve the project goals from the community. The PM and a committee of experts assess and award multiple elements per project.

* NRC report, America’s Future in Space, 2009

**Awards**

- **Concept Studies:** $300K-$500K; ~120/year (~60 in FY11)
- **Small Projects:** 2 - 3 years, ~$3M/year; ~12 new project starts/ year (~6 in FY11)
- **Large Projects:** 2 - 3 years, ~$12M/year; ~12 new project starts/ year (~6 in FY11)

**Collaboration**

- Teams will include Govt Agencies, academia and industry.

* NRC report, America’s Future in Space, 2009
Meetings of T&I Committee
2 of 2

• NASA Kennedy Space Center, January 11-12, 2011.
Committee:
– Toured KSC research labs,
– Received input from NASA Chief Technologists
– Received briefings on status of NASA Technology Transfer and Commercialization activities, NASA’s Technology Roadmaps, and overview of KSC technology activities.
– Received an update on OCT programs and NASA budget status.
– Toured Space Operations facilities, including VAB with Space Shuttle Discovery - VERY COOL, and also cold!
Research and Technology Capability Areas at the John F. Kennedy Space Center

- Storage, Distribution and Conservation of Fluids (Cryogens, Liquids, Gases)
- Materials for Life Cycle Optimization
- Life Sciences & Habitation Systems
- Remediation and Ecosystem Sciences
- In-Situ Resource Utilization and Surface Systems
- Life Cycle Optimization of Products, Projects, and Programs
- Space Launch and Suborbital Technologies
- Tracking, Timing, Communications (TT&C) and Navigation Technologies
Storage, Distribution and Conservation of Fluids (Cryogens, Liquids, Gases)

Examples of KSC Work:

- High Efficiency Storage, Distribution and Recovery Systems; including Transfer Losses and Re-liquefaction of Boil-off
- Aerogel Insulation Systems for Helium Purge Elimination
- Thermal-Fluid Analysis of Composite Overwrapped Pressure Vessels (COPV) Loading
- Energy Efficient Thermal Insulation Systems
- Helium Life Cycle Cost Reduction and Limited Resource Conservation
- Breathing Air for Propellant Handler’s Ensemble, Environmental Control & Life Support System (ECLSS), and Habitation
- Development of Innovative Components and Instrumentation
- Detection and Isolation of Hazardous Gases and Fluids
Materials for Life Cycle Optimization

Examples of KSC Work:

- Corrosion Detection and Mitigation
- Non-Destructive Evaluation/Inspection
- Wire Fault Detection and Self Repair Systems
- Multilayer Insulation Systems for Superconducting Power Cables
- Environmentally Friendly, Long Life Materials (Anti-Microbial, Low Flammability)
- Electrostatic Charge Dissipation Technologies
- Repair of Composites and Advanced Materials
Examples of KSC Work:

- Microbial, Plant, Cellular and Animal Investigations
- Bio-regenerative and Biological Closed Loop Life Support Systems
- Advanced Protective Equipment Testing and Development, Heat Stress Mitigation
- Commercial Space Flight – Evidence-based Crew and Passenger Medical Screening Tools and Crew and Passenger Medical Standards, Hazards Assessments, In-flight Medical Emergency Treatment Protocols, Passenger Spaceflight Training Programs
- Self Healing for Inflatable Structures
- Space Bio-imaging
- Dust Mitigation on Windows/Solar Panels/Thermal Radiators/Batteries and Power Systems
- Dust Tolerant Seals, Mechanisms, and Connections
- Light Emitting Diode (LED) Technologies to Enhance Human Adaptation

Dust Tolerant Connector

Before

After

Dust Mitigation Technology on Solar Panel

ResQPod increases blood circulation to brain
Groundwater Remediation

- To clean up an Apollo-era mess, Kennedy Space Center and the University of Central Florida partnered to develop a biodegradable environmental cleanup technology.
  - Emulsified Zero-Valent Iron (EZVI).
  - EZVI uses iron particles in an environmentally friendly oil and water base to neutralize toxic chemicals.
- Other partners in this effort include the U.S. DOE, DoD, EPA, GeoSyntec, Inc., and NASA’s STTR Program.
- NASA’s success in remediating this historic launch site has led to numerous non-exclusive licenses for EZVI.
- EZVI is now restoring contaminated sites to health in numerous states including Arkansas, California, Florida, North Carolina, and Texas.
NASA Technology Transfer & Commercialization

- NASA has a long history of transferring technologies for public benefit.
- NASA’s direction to do this traces to the Space Act that created NASA in 1958:
  
  “Provide for the widest practicable and appropriate dissemination of information concerning its activities and the results thereof.”

### Applications of NASA-Derived Technology

- Health and Medicine
- Transportation
- Public Safety
- Consumer, Home & Recreation
- Environmental and Agricultural Resources
- Computer Technology
- Industrial Productivity

### Public Benefits of NASA-Derived Technology

- Economic Growth
  - New Jobs
  - New Markets
  - Increased Efficiency
  - Improved Competitiveness
- Quality of Life
  - Improved Safety
  - New Products
  - Lives Saved or Extended
  - Green Technologies
  - Environmental Cleanup

NASA @ Home & NASA City
http://www.nasa.gov/city
TecFusion Summits

- Large companies have reviewed over 3,700 Phase II technologies.
- 335 SBIR companies have presented over 400 technologies.
- 21 sponsors.
  - 2 have sponsored 3 Summits.
  - 3 sponsored 2 Summits.
  - Some annually and in other cases every year-and-a-half to 2 years.
  - Two are on the schedule for a fourth Summit.
- 12 Fortune 500 companies.
- 65 technologies ongoing discussions with 9 in continuing partnering efforts.
NASA Technologies Helping Sustainability

- Assistance to Developing Countries
  - Clean Drinking Water
  - Improved Agriculture
  - Telemedicine and wireless networks
  - Improved Environmental Decision Making

- Environmental Cleanup
  - Groundwater Remediation
  - Land Mine Cleanup
  - Landfill Cleanup
  - Oil Spill Cleanup

- Use of Green Technologies
  - Aeronautics Technologies
  - Green Buildings
  - Encouraging Green Technologies
  - Solar Power Applications
  - Paint Stripping
  - Global Research into Energy and the Environment at NASA (GREEN)

- Disaster Warning and Relief
  - Earthquake relief
  - Tsunami Warning
  - Wildfire Response
  - Hurricane Warning

NASA-derived technologies are saving lives and improving the quality of life across the country and around the globe.
NASA-Derived Technologies Contributing to Security

• Improving Operational Systems
  – Health & Performance Monitoring for Aviation Security
  – Safe Composite Over-wrap Pressure Vessels
  – Fire-Protective Fabrics & Smoke Masks
  – Intumescent Materials
  – Neutralizing Land Mines
  – Secure Networks for First Responders and Military

• Inspection Technologies
  – Crack Detection in Nuclear Power Systems
  – Hyperspectral Imaging for Food Safety
  – Inspection of Suspicious Liquid/Solid Substances

• Threat Detection
  – Detection/Warning of Chem/Bio Attack
  – Hyperspectral Imaging for Counter-Terrorism
  – Anthrax Smoke Detectors
  – Fiber Optic Chemical Agent Sensing

• Identification & Investigation
  – Pattern Recognition for Security Applications
  – Video Enhancement Supporting Criminal Investigations

These examples represent how NASA-derived technologies are being put to work and making the world a safer and more secure place.
Initial Draft Roadmaps Received, Internal Review Completed, & Publicly Available

We now have draft 25 page reports in for each of the 14 roadmaps on the OCT website (reviewed by):

- MD POCs and whomever in NASA they ask to help
- Center Chief Technologists and up to 15 others they can ask
- OCT Division Leads and up to 3 others
- OCT SI members, especially the POCs to each roadmap team

http://www.nasa.gov/offices/oct/home/roadmaps/index.html
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Some PERSONAL observations

• Visited synthetic biology seminar at Ames
• Synbio as an addition to 14 areas?
• The dangers of making tech so “special” it disappears into a directorate...
• The Nanoracks story
• Technology and IMPLEMENTATION
T& I Observations, Findings and Recommendations

• Observation: Both LaRC and KSC have significant and important technology and innovation work underway. The Committee was particularly impressed with the Multifunctional Electrospun fibers, the Electron Beam Free-form Fabrication, the Boron Nitrite Nanotubes and plans for Airborne Wind Capture at LaRC. The Committee was impressed with the Cryogenics laboratory and research, the smart coating research for Corrosion and Detection and Protection, Dust Mitigation Technologies, and the “smart wiring” research and technologies at Kennedy Space Center. Many of these technologies have various immediate or potential commercial applications. The Committee encourages the continuation of this grass-roots innovation and research at all NASA Centers. The Committee believes the adoption of Center Chief Technologists at all of the NASA Field Centers encourages innovation by the NASA Civil Servant workforce.

• Observation: During the Committee’s visit to both LaRC and KSC, there seemed to be issues with technologists being isolated and not sharing or even seeking knowledge beyond their own organization or Center. Additionally, in some cases researchers need to be encouraged to be less risk-averse – especially in the technology development and commercialization arena. More discussion needs to happen throughout the Agency about managed risk and pushing the risk envelope in innovation and technology development – and making the distinction between risk that one can learn from and risk that endangers lives. NASA should consider changes to the reward system to encourage researchers to take informed risks.
T& I Observations, Findings and Recommendations

• Observation: NASA should consider reviewing its approach towards intellectual property protection and administration. A more active approach could assist in reinforcing the Agency’s reputation as a technology hub, validate the efforts of leading NASA technologists, safeguard the public investment into NASA technology developments, and provide a more direct link between specific NASA technology and how it benefits humankind.

• Finding: NASA needs to address knowledge management in the area of innovation, research and technology development. Many NASA researchers are not familiar with research and innovation taking place within and outside of their discipline, Center or Agency. An important aspect of in developing cutting-edge technology and innovation is knowledge and ability to share information across a wide spectrum of potentially interested parties. OCT’s Strategic Integration and PICS offices are beginning to address this difficult problem. We applaud their initial portfolio capture and management efforts, but believe a more centralized effort that develops processes for a flexible, unified knowledge database on NASA’s technologies for users within and outside of the Agency. This database should support an annual technology review for validity that shows growth and decline.
T& I Observations, Findings and Recommendations

• Finding: The Committee also discussed the underutilization of NASA and commercial ELVs and RLVs launch capacities for secondary flight payloads for technology validation and demonstrations. The Committee believes that NASA should encourage missions with additional payload capacity to make it available for research. Secondary payloads are vital for testing and proving many technology capabilities, especially in times of constrained budgets and resources.
Committee Name:

- Technology and Innovation Committee

Committee Chair:

- Esther Dyson

Date of Public Deliberation:

- January 11-12, 2011 at KSC
Short Title of the Proposed Recommendation: Use of Secondary Payloads for Technology Demos

Proposed Recommendation:

- The Committee recommends that the NASA Administrator encourage the use of secondary payloads on future NASA and commercial missions as an important capability for testing, validating and demonstrating new technologies and scientific payloads in the coming years.
Major Reasons for Proposing the Recommendation:

• The Committee discussed the underutilization of NASA and commercial ELVs and RLVs launch capacities for secondary flight payloads for technology validation and demonstrations. The Committee believes that NASA should encourage missions with additional payload capacity to make it available for research. Secondary payloads are vital for testing and proving many technology capabilities, especially in times of constrained budgets and resources.
• Consequences of No Action on the Proposed Recommendation:

• Missed opportunity to utilize an underused resource for technology demonstrations. Many transformative technologies that could be validated as a secondary payload would remain at a lower TRL level and may not advance for use on later NASA missions.