Office of the Chief Technologist Update

NASA Advisory Council

Dr. Mason Peck
NASA Chief Technologist
November 15, 2012
Technology Transforms Science and Exploration

• Technology can transform our way of thinking about space science and exploration:
  
  – Providing capabilities fundamental to the Agency’s direction and the U.S. space enterprise
  – Enabling the next generation of scientific, robotic, and human exploration missions through aggressive and prioritized technology investments
  – Seeking transformative opportunities through technology innovations from other parts of the economy
  – Maintaining an Agency space technology base to enable future missions
Technology Success: One of Many on Mars

Curiosity with chutes deployed during descent to Mars Surface

Curiosity’s Self Portrait on Mars

Curiosity's Heat Shield during Descent

Final Resting Spot for Curiosity's Heat Shield
This pair of images shows a "bite mark" where NASA's Curiosity rover scooped up some Martian soil (left), and the scoop carrying soil.

This graphic shows results of the first analysis of Martian soil by the Chemistry and Mineralogy (CheMin) experiment on NASA's Curiosity rover.
“Half or more of the growth in the nation’s gross domestic product in recent decades has been attributable to progress in technological innovation”
- NRC, Rising Above the Gathering Storm, Revisited

• NASA must, through the development of technology
  – Provide capabilities fundamental to the Agency’s direction and U.S. space enterprise
  – Transform the path for space science and exploration
  – Enhance national innovation and economic growth
“Half or more of the growth in the nation’s gross domestic product in recent decades has been attributable to progress in technological innovation”
- NRC, Rising Above the Gathering Storm, Revisited

- **NASA technology development addresses National priorities**
  - Directs NASA to work with industry, academia and international partners to implement new space technology development
  - Encourages growth of U.S. commercial space sector
  - Maintain a space technology base that aligns mission directorate investments, increases capability, lowers mission cost and supports long term needs
  - Directs aggressive and prioritized technology investments to supports robotic and human exploration missions
Office of the Chief Technologist

- Serves as Advisor to Administration
- Direct Technology Management and Budget Authority for the Space Technology Program
- Integrates Technology Investment Across the Agency
- Leads Tech Transfer, Partnerships and Commercialization Activities Across the Agency
- Advocates Externally NASA’s R&D Programs
- Demonstrates and Communicates Societal Impacts of NASA Technology Investments
Scientific discovery, technological breakthroughs, and innovation are the primary engines for expanding the frontiers of human knowledge and are vital for responding to the challenges and opportunities of the 21st century.

Administration’s Multi-Agency Priorities (OSTP):

• **Resource sharing and cooperation** among multiple Federal Agencies for success
• Identify and Pursue “Grand Challenges” that require advances in science, technology and innovation to achieve
• **Support the research tools and infrastructure** needed to ensure that U.S. remains at the leading edge
• **Strategic prioritization of resources** to key science and technology activities
• **Promote Innovation and Commercialization** from Federal R&D investments
• **Promote Science, Technology, Engineering, and Mathematics (STEM) Education** where Federal government can have maximum impact

**Key Focus Areas**
- Advanced Manufacturing
- Clean Energy
- Global Climate Change
- Information Technology Research and Development
- Nanotechnology
- Biological Innovation

**NASA’s Office of the Chief Technologist (OCT)** is responsible for direct management of NASA’s Space Technology programs and for coordination and tracking of all technology investments across the agency. The responsibility is shared across the agency.

• **Across NASA’s Space Technology Programs**
  - Early Stage Innovation
  - Crosscutting Capabilities
  - Game Changing Technology

• **Across NASA’s Mission Directorates and Offices**
  - Aeronautics Research
  - Human Exploration and Operations
  - Science
  - Office of the Chief Scientist
  - Office of the Chief Engineer

• **Partnerships with other government agencies, US industry, and internationals**

**NASA Technology is Aligned with the Nation’s Priorities**
NASA’s Technology Portfolio

Top Down Driven Strategic Guidance

Strategic Space Technology Investment Plan

National Science and Technology Priorities

External Technology Portfolio & Partnerships

Mission Directorate Requirements

- ARMD
- HEOMD
- SMD

National Aeronautics Research and Development Plan

Technology Portfolio

- SMD
- HEOMD
- Space Technology
- ARMD

DoD
NRL
NRO
AFRL
FAA
DoE

Bottom Up Driven Requirements

National Science and Technology Priorities

Top Down Driven Strategic Guidance

Strategic Space Technology Investment Plan

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National Aeronautics Research and Development Plan

Technology Portfolio

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- ARMD

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NASA’s Space Technology Portfolio

2010

Space Technology Roadmaps
- 140 challenges (10 per roadmap)
- 320 technologies
- 20-year horizon

2011

National Research Council (NRC) Study
Prioritization:
- 100 top technical challenges
- 83 high-priority technologies (roadmap-specific)
- 16 highest of high technologies (looking across all roadmaps)

2012

SSTIP
Updated ST Roadmaps:
- Incorporate NRC Study Results

Developing a Strategic Space Technology Investment Plan:
- current investments
- current MD/Office priorities
- opportunities for partnership
- gaps vs. current budget and capabilities
- 20-Year horizon with 4-year implementation cadence

Execution
Investment Portfolio
- Technology Developments (across full Technology Readiness Level (TRL) spectrum)
- Flight Demonstrations
- Must accommodate:
  - Mission Needs
  - Push Opportunities
  - Affordability
  - Technical Progress
  - Programmatic Performance
  - Commitments

- Revised every 4 years
- Requested every 4 years
- Revised every 2 years
- Budgeted annually
Strategic Space Technology Investment Plan (SSTIP) Summary

- 20-year horizon, investment guidance for the next four years
- Framework:
  - Goals
  - Capability Objectives
  - Technical Challenges
- Four-year investment approach
  - 70% - 8 Core technologies represent 12 of 16 NRC top priority recommendations
  - 20% - Adjacent Technologies: Not part of the Core but are part of the NRC’s 83 high priorities
  - 10% - Seeding Innovation: Smaller Investments in remaining technologies in the roadmaps that were not part of the NRC’s 83 high priorities.
Innovative Partnerships Office (IPO) Programmatic Elements

**Technology Transfer:** Agency-level management and oversight of intellectual assets, including transfer of NASA-developed and owned intellectual property to outside entities. Includes new invention capture, intellectual property management, licensing activities, technology transfer-focused partnerships, and programmatic reporting/tracking.

**Strategic Partnerships:** Partnerships to expand and strengthen NASA’s ability to execute its mission, ranging from non-traditional partnerships to systematic engagements with regional, state, and local partners that accelerate technology transfer and commercialization in support of regional economic innovation and growth.

**Prizes and Competitions:** Agency-level leadership and coordination of the use of prizes and competitions to spur innovation, diversify pool of solvers addressing NASA problems, advance technology development in a flexible, “on-demand” way, and lower mission design costs to leverage government dollars for technological breakthroughs.

**Emerging Space Office:** Managed out of ARC, and principally a consultative office, examining the role of the government in support of the emerging space industry.
Prizes Have a Long Track Record of Spurring Innovation

“[T]otal funds from large prizes have more than tripled over the last decade to surpass $375 million.”

- And the winner is…
  McKinsey 2009

“The Federal government should … use high-risk, high-reward policy tools such as prizes and challenges to solve tough problems.”

- President Barack Obama
  August 5, 2009

- 1919 Orteig Prize
  - Charles Lindbergh: Non-Stop Flight NY-Paris

Aggregate Prize Purses over $100k
NASA’s Track Record with Prize Success

- The results of many of NASA’s prize competitions have started to illustrate the value of this tool to NASA.

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<tr>
<th>Observed Value</th>
<th>Case Study</th>
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<tr>
<td>Results from Unexpected Places</td>
<td>A challenge to forecast an algorithm to protect America’s astronauts from radiation exposure in space was won by a retired radio-frequency engineer in rural New Hampshire to an 85% accuracy.</td>
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<td>Results, Quickly</td>
<td>A data-mining competition to map “dark matter” was solved in under a week. The solution outperformed the state-of-the-art algorithms most commonly used in astronomy for mapping dark matter.</td>
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<td>Leveraging Government Dollars for Technology Breakthroughs</td>
<td>NASA’s $1.65 M Green Flight Challenge to build and demonstrate a super-fuel efficient full-scale aircraft leveraged taxpayer dollars by stimulating an additional $7 M in investment. Two winning teams exceeded the performance requirements by nearly a factor of two, flying more than 200 miles on the energy equivalent of just half a gallon of gas, all while averaging 100 mph with two people on board.</td>
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NASA Rewards Innovation

- NASA is the leader in the Federal Government in prize competitions.
- Prizes are particularly suited for makers’ invention, creativity and resourcefulness.
- Create never-before-seen technologies, win money, learn about space tech, and get involved in the exciting challenges of space exploration!

**Masten Space Systems**

**Peter K. Homer, Maine**
Citizen Space

• Makers are already taking the development of space technology into their own hands.

• CubeSat: a low-cost, hacker-friendly spacecraft standard
  – Standard interface and form factor for small spacecraft: COTS parts, Arduino-friendly
  – Developed independent of government work at Stanford and Cal Poly
  – Now one of the most commonly built types of spacecraft in the world.

• NASA has followed the lead of citizen innovators
  – Embraced the standard
  – Created a new launch program: over 50 US university CubeSats are manifested to be launched for free through NASA
Why Small Spacecraft at NASA?

Enable commercial the new, small-space commercial sector
Benefit from the rapid pace of market-driven technology growth
Spin off / spin in

Open Source COTS Interface Standards
Innovation Culture Grass-Roots Infusion New Hires Workforce Development
Citizen Space Cloud Exploration
New solutions New investigations
Rapid Development Agile Programmatic Responsiveness
Another great example is the success of spacecraft crowd-funded on Kickstarter: several different American DIY spacecraft efforts have raised more than their goal, some over $100k.
NASA’s CubeSat Launch initiative (CSLI)

- NASA’s CubeSat Launch initiative (CSLI) provides opportunities for small satellite payloads to fly on rockets planned for upcoming launches. These CubeSats are flown as auxiliary payloads on previously planned missions.

- CSLI promotes and develops innovative technology partnerships among NASA, U.S. industry, and other sectors for the benefit of Agency programs and projects.

- NASA has selected 33 small satellites to fly as auxiliary payloads aboard rockets planned to launch in 2013 and 2014.

- 32 CubeSat missions have been selected for launch in the previous two rounds of the CubeSat Launch Initiative. Eight CubeSat missions have been launched (including five selected via the CubeSat Launch Initiative) to date via the agency's Launch Services Program Educational Launch of Nanosatellites, or ELaNa, program.

- More information can be found at [http://www.nasa.gov/directorates/heo/home/CubeSats_initiative.html](http://www.nasa.gov/directorates/heo/home/CubeSats_initiative.html)
TechEdSat Deployment from ISS

• Oct 4, 2012: Demonstration of the JAXA J-SSOD on board the ISS for deployment of CubeSats
TechEdSAT Video
Engaging Universities
Space Technology: Investments in Our Future

• **Enabling Our Future in Space:** By investing in high payoff, disruptive technology that industry cannot tackle today, *Space Technology* matures the technology required for NASA’s future missions in science and exploration while proving the capabilities and lowering the cost for other government agencies and commercial space activities.

• **NASA at the Cutting Edge:** Pushing the boundaries of aerospace technology and seizing opportunities, *Space Technology* allows NASA and our Nation to remain at the cutting edge.
NASA Technology Days
Cleveland, Ohio
November 28-30, 2012

Join NASA, the NIA, and AIAA for this three-day event and technology showcase. It will bring together a broad community of stakeholders from industry, academia, and the U.S. federal government to engage in strategy development, partnership building, and implementation of ways to foster technology transfer and innovation.

- Get a comprehensive overview of NASA’s technology programs for space exploration and aeronautics, and discover innovative and advanced technologies that are stimulating the economy and sustaining our nation’s global competitiveness
- Learn about the Space Technology Program objectives, successes, and plans for the future
- Get an in-depth overview of NASA’s potential industry partnerships and opportunities
- Discuss Agency-wide technology transfer and commercialization efforts
- Engage with program managers and network with peers on potential collaborative enterprises
- Explore mature NASA technologies primed for commercialization in the aerospace, advanced energy, automotive, manufacturing and biomedical sectors
- Participate in the technology showcase featuring mature technologies in the fields of Aerospace, Advanced Energy, Innovative Manufacturing, Human Health, and Automotive. The demonstrations and displays will provide attendees opportunities for networking, business development and forging new partnerships, while learning about the leading technologies contributing to American economic growth and innovation
NASA Technology Days

NASA TECHNOLOGY DAYS
NOVEMBER 28-30, 2012
PUBLIC AUDITORIUM
CLEVELAND, OH


Engage NASA leaders about the Space Technology Program’s objectives, successes and future plans. This 3-day event and technology showcase will bring together a broad community of stakeholders from industry, academia, and the U.S. government to engage in strategy development, partnership building, and implementation of ways to foster technology transfer and innovation.

Registration is now open!
For more information visit
www.aiaa.org/NASATechDays

Register at
www.aiaa.org/nasatechdays