Space Technology: Investments in our Future

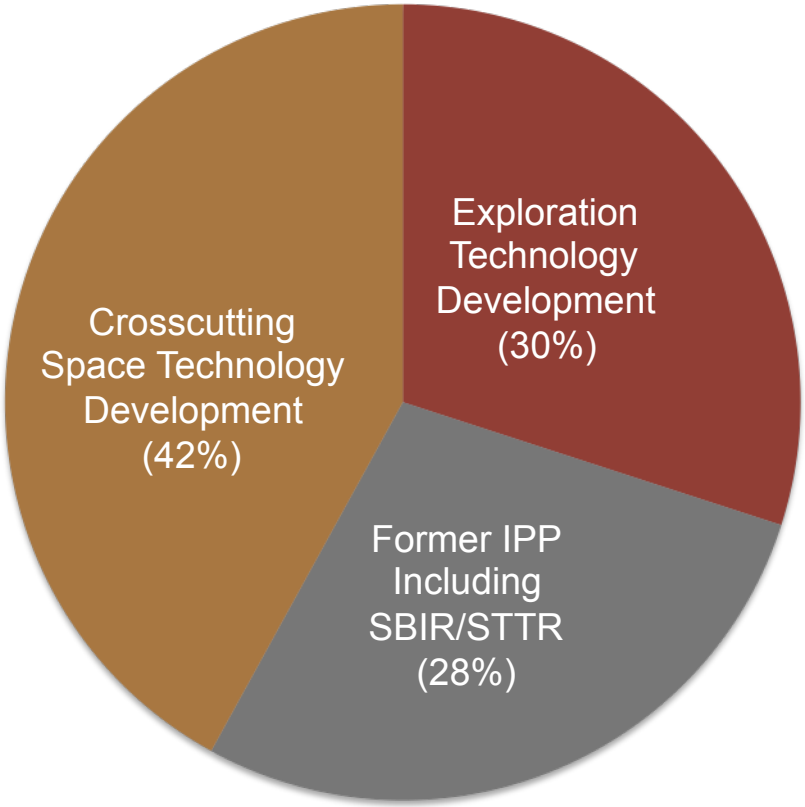
ASEB / SSB
April 2011

Space Technology

- **Space Technology is a budget line in the FY 2012 request for NASA**
  - Technology development and innovation projects that are broadly applicable to the Agency's future missions in science and exploration while providing space technologies that can improve the capabilities and lower the cost of other government agency and commercial space activities
  - Includes Partnerships, Innovation and Emerging Space (PI&ES), Strategic Integration (SI), Small Business Innovation Research and Small Business Technology Transfer (SBIR/STTR), Crosscutting Space Technology and Exploration Technology
  - The President's FY 2012 NASA Space Technology budget request is $1,024 million, a modest increase from the amounts authorized for this suite of programs for FY 2012 in the NASA Authorization Act of 2010, consistent with the Administration's priority on investments in research, technology, and innovation
  - **Managed by Office of the Chief Technologist (OCT)**
- **Space Technology builds on the success of NASA's Innovative Partnerships Program (IPP)**
  - In FY 2011, IPP was integrated into Office of the Chief Technologist and the IPP budget integrated into Space Technology
  - In FY 2012, Exploration Technology activities and budget are integrated into Space Technology
- **Formulation of the Space Technology program is complete**
  - Formally approved by Administrator at July 29 Acquisition Strategy Planning meeting

Proposed FY 2012 Space Technology Budget

- In FY 2012, Space Technology is proposed at approx. 5% of the President's $18.7B request for NASA.
- The $1024M for Space Technology in FY 2012 includes:
  - The SBIR/STTR program and related technology transfer and commercialization activities ($284 million) funded in FY 2010 through NASA's Innovative Partnership Program
  - Movement of a majority of the Exploration Technology Development and Demonstration activities ($310 million) from the Exploration Systems Mission Directorate
  - The Crosscutting technology development activities ($430 million) proposed as part of the President's FY 2011 request.
- All of the Space Technology programs have been carefully formulated over the past year, and have deep roots in technology development approaches NASA has pursued in previous years.
- The FY 2012 request for Space Technology provides a modest increase above the level projected in the NASA Authorization Act of 2010, consistent with the Administration's priority on federal investments in research, technology and innovation across the Nation.
  - The FY2012 request for Space Technology compares with approximately $800 million projected for these same activities in 2012 in the NASA Authorization Act of 2010.



NASA FY2012 Proposed Space Technology Budget ($1024M)

Space Technology Principles

Space Technology shall:

- Advance broadly-applicable technology to produce technology products for which there are multiple customers.
- Advance exploration-specific technologies to infuse into NASA's future human exploration missions that provide the long-range, critical Exploration-specific technologies required to conduct future human exploration missions beyond low Earth orbit with reduced risk and life cycle cost.
- Employ a portfolio approach over the Technology Readiness Level spectrum.
- Competitively select research by academia, industry, and the NASA Centers based on technical merit.
- Leverage the technology investments of our international, other government agency, academic and industrial partners.
- Establish a deliberative panel of internal and external stakeholders, including industry and other government agencies, to review and advise OCT on technology development priorities through a transparent and balanced process.
- Result in new inventions, new capabilities and the creation of a pipeline of innovators trained to serve future National needs.

Space Technology Improves Our Lives Everyday

- NASA has a long history of technology transfer.
- **By investing in Space Technology, NASA will continue to make a positive difference in the world around us**. The benefits of NASA technology impact our Nation's economy, creating new services and industries in the fields of health and medicine, transportation, public safety, consumer goods, environmental resources, energy and computer technology.
- Each year since 1976, *Spinoff* magazine highlights 40-50 of NASA technology transfer successes from the prior year.
- Nearly 1,700 Spinoff stories are also available online in a searchable format at: http://www.sti.nasa.gov/spinoff/database
- National media continues to focus on commercialization benefits of NASA technologies. OCT has initiated a new weekly web series entity entitled "*Space Tech Improving our Lives" at:* http://www.nasa.gov/oct

External Input Has Driven Formulation of the NASA Space Technology Program

- **NASA Authorization Act of 2008:** "*A robust program of long-term exploration-related research and development will be essential for the success and sustainability of any enduring initiative of human and robotic exploration of the solar system.*"
- **NRC report, A Constrained Space Exploration Technology Program: A Review of NASA's ETDP, 2008:** *"NASA has created a supporting technology program very closely coupled to the near-term needs of the Constellation Program. This program contains only incremental gains in capability and two programmatic gaps. NASA has effectively suspended research in a number of technology areas traditionally within the agency's scope. This could have important consequences for those portions of the VSE beyond the initial short-duration lunar missions, including extended human presence on the Moon, human exploration of Mars, and beyond."*
- **NRC report, America's Future in Space, 2009:** "*NASA should revitalize its advanced technology development program by establishing a DARPA-like organization within NASA as a priority mission area to support preeminent civil, national security (if dual-use), and commercial space programs."*
- **NRC report, Fostering Visions for the Future: A Review of the NASA Institute for Advanced Concepts, 2009:** "*To improve the manner in which advanced concepts are infused into its future systems, the committee recommends that NASA consider reestablishing an aeronautics and space systems technology development enterprise. Its purpose would be to provide maturation opportunities and agency expertise for visionary, far-reaching concepts and technologies."*
- **Augustine Committee, 2009:** "*The Committee strongly believes it is time for NASA to reassume its crucial role of developing new technologies for space. Today, the alternatives available for exploration systems are severely limited because of the lack of a strategic investment in technology development in past decades.*"
- **NRC report, Capabilities for the Future: An Assessment of NASA Laboratories for Basic Research, 2010:** "*To restore the health of the fundamental research laboratories, including their equipment, facilities, and support services, NASA should restore a better funding and leadership balance between long-term fundamental research/technology development and short- term mission-focused applications.*"

Public Commentary on the Value of NASA's Space Technology Program

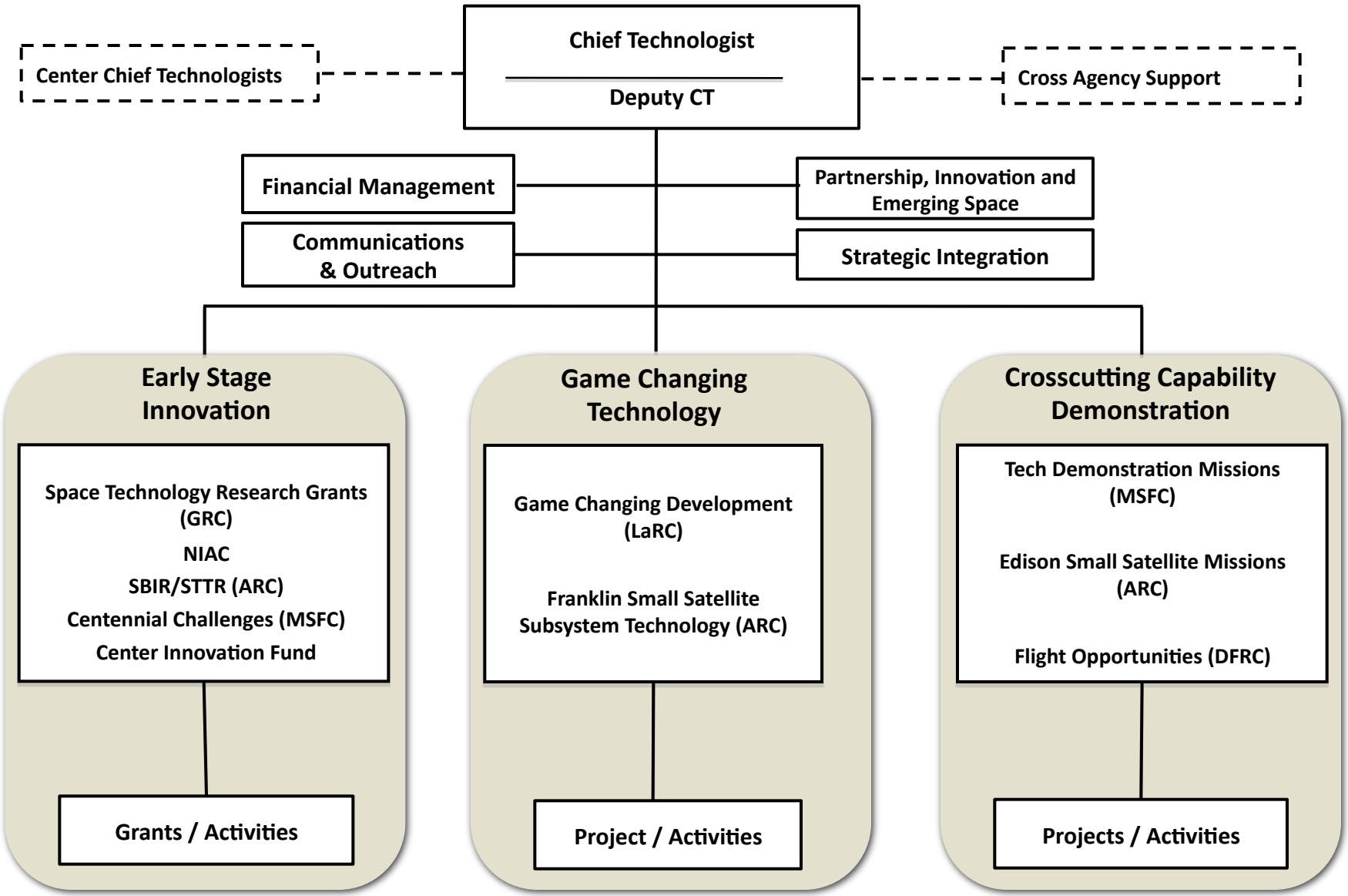
- **Ray Colladay and Bill Ballhaus (9/22/10, Space News): *New Technology for a New NASA***
  "It takes years of steady, robust funding, especially after years of neglect, to build a culture of innovation and collaboration among science and engineering talent in NASA, universities and industry that attracts creative risk-taking to achieve the technology advances that can transform the agency across the breadth of its mission and ensure continued U.S. leadership in space…NASA took an important step in establishing the Office of the Chief Technologist to manage space technology R&D independent of the major engineering development projects, but answerable to the stakeholder users. This is the best way to manage the creative tension between advances promoted by those pushing technology breakthroughs and innovative concepts and technology pulled by needs foreseen by the mission directorates but not yet fully defined by firm requirements…. technologies that could transform NASA and the U.S. space program to once again be an engine for innovation, providing technology solutions that benefit society; creating quality, high-tech jobs that help drive the economy; and inspiring science, technology, engineering and mathematics education.

- **Roger Launius (11/29/10, Space News): *Invest in Tomorrow's Technologies Today***
  "As a percentage of U.S. government investments in R&D, NASA's portion accounted for 14 percent of the nation's total in 1980, but that amount has declined to 7 percent…Without question, the U.S. is at a critical juncture regarding the long-term health of its aerospace enterprise. Knowledge is critical to maintaining America's competitive edge…it is only possible to maintain our leading edge by increasing investments in comprehensive R&D programs."

- **George Will (1/2/11, Washington Post): *Rev the Scientific Engine***
  "Stoking that fire is, more than ever, a proper federal function… Such research is what canals and roads once were – a prerequisite for long-term economic vitality…Today, the prerequisites for economic dynamism are ideas. Deborah Wince-Smith of the Council on Competitiveness says: "Talent will be the oil of the 21st century."… U.S. undergraduate institutions award 16 percent of their degrees in the natural sciences or engineering; South Korea and China award 38 percent and 47 percent, respectively. America ranks 27th among developed nations in the proportion of students receiving undergraduate degrees in science or engineering.…Research, including in the biological sciences, that yields epoch-making advances requires time horizons that often are impossible for businesses, with their inescapable attention to quarterly results…As "Gathering Storm" says: Making the government lean by cutting the most defensible - because most productive - federal spending is akin to making an overweight aircraft flight-worthy by removing an engine."

- **Robert Linberg and Douglas Stanley (2/21/11, Space News): *Let's Not Eat Our Seedcorn***
  "Previous NASA investments in space technology enabled the Apollo mission to the Moon and the development of a reusable Space Shuttle, as well as a series of well documented spinoffs and benefits to the American economy. NASA's investment in space technology has shrunk from 10% of its budget in the '70s to 2% today. Because of this chronic underinvestment in space technology, we are retiring the Space Shuttle with nothing ready to replace it in the near future, and we are ill prepared for human exploration beyond low Earth orbit, despite a consensus among Congress, NASA and the White House to pursue such exploration…. NASA needs to immediately invest in a reinvigorated, balanced space technology program.

Office of the Chief Technologist Organization



Space Technology: A Different Approach

- **Strategic Guidance**
  - NASA Strategic Plan
  - Grand challenges
  - Technology roadmaps
- **Full spectrum of technology programs that provide an infusion path to advance innovative ideas from concept to flight**
- **Technical peer-review and competitive selection**
  - Engaging and building an open community of innovators for the Nation
- **Projectized approach to technology development**
  - Defined start and end dates
  - Project Managers with full authority and responsibility
  - Project focus in selected set of strategically defined capability areas
- **Overarching goal is to reposition NASA on the cutting-edge**
  - Technical rigor
  - Pushing the boundaries
  - Take informed risk and when we fail, fail fast and learn in the process
  - Seek disruptive innovation such that with success the future will no longer be a straight line
  - Foster new capabilities, new approaches, and an emerging commercial space industry

NASA Space Technology Roadmaps

NASA Authorization Bill of 2010 (Sept 2010)

"In the development of the national space technology development policy, the President or the President's designee shall consult widely with academic and industry experts and with other Federal agencies. The Administrator may enter into an arrangement with the National Academy of Sciences to help develop the policy."

In order for NASA to more effectively and efficiently develop space technologies moving forward, it is necessary to establish a sustained set of clearly identified and prioritized technology development goals.

The NASA Space Technology roadmaps, drafted by NASA, and reviewed and vetted for technology investment identification and prioritization by the NRC, will serve NASA as a decadal-like survey, to provide sustained technology investment goals.

- *Interim report: Sept 2011*
- *Final Report: Jan 2012*

NASA SPACE TECHNOLOGY ROADMAP
TECHNICAL AREA BREAKDOWN STRUCTURE

More information at http://www.nasa.gov/offices/oct/home/roadmaps/index.html

Partnerships, Innovation and Emerging Space

FY 2010 Accomplishments

- Technology Transfer: 300+ Space Act Awards; 290 license agreements; 575 software use agreements; about 80 patents awarded
- Innovation: 41 Innovation Fund Projects; and infused 68+ technologies into various NASA programs

FY 2012 Program Plans

Partnerships

- Transfer and commercialize NASA technology to create jobs, to increase U.S. economic competitiveness, and to save and improve lives every day.
- Leverage resources: a win-win-win for NASA, our partners, and the taxpayer

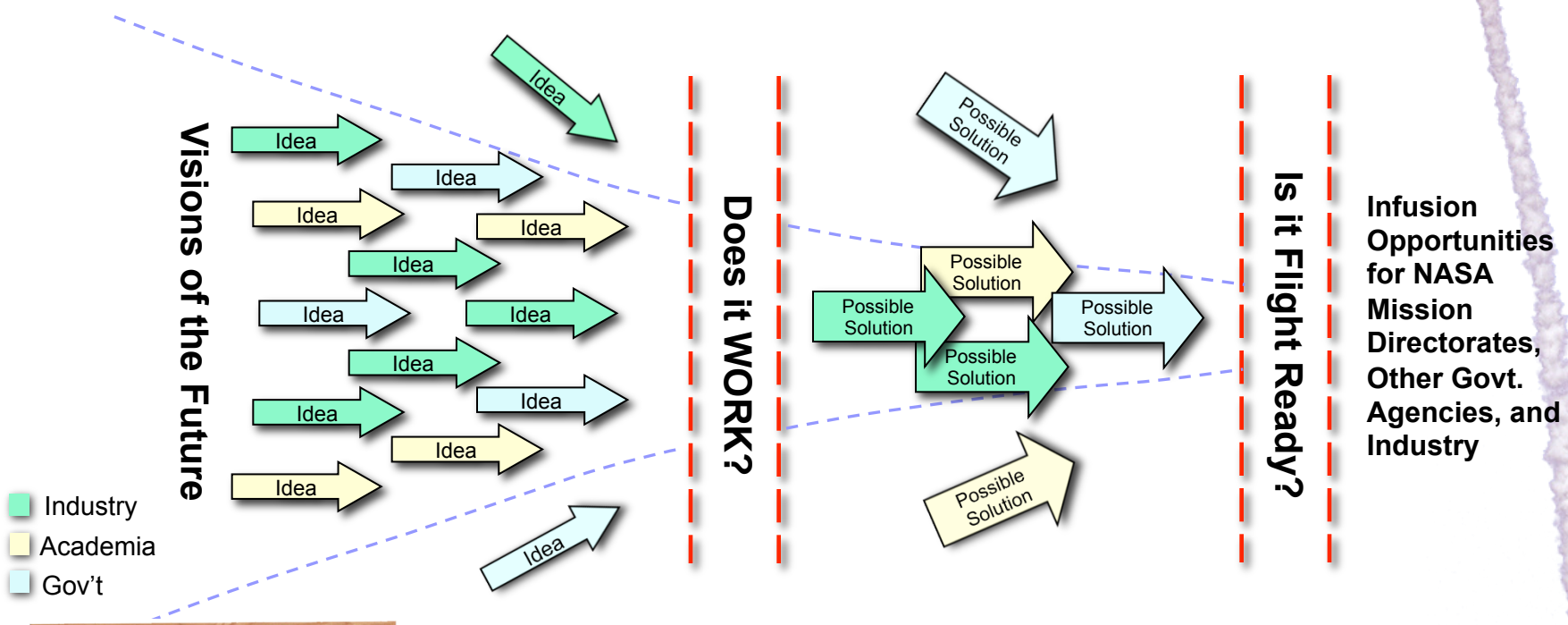
Innovation

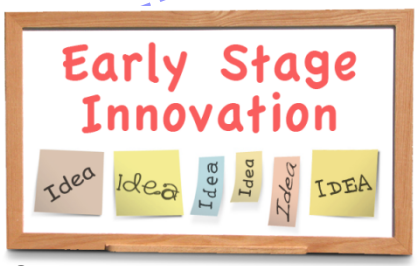
- Explore new models to nurture innovation inside and outside of NASA to accelerate the development of state-of-the-art technology

Emerging Space

- Analyze and facilitate emerging space industry, modeled after how the NACA sparked the growth and success of the world-leading American aviation industry

Space Technology Development Approach

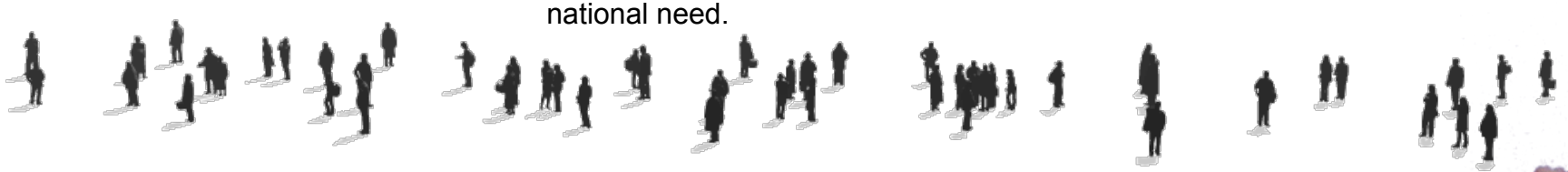




Creative ideas regarding future NASA systems or solutions to national needs.

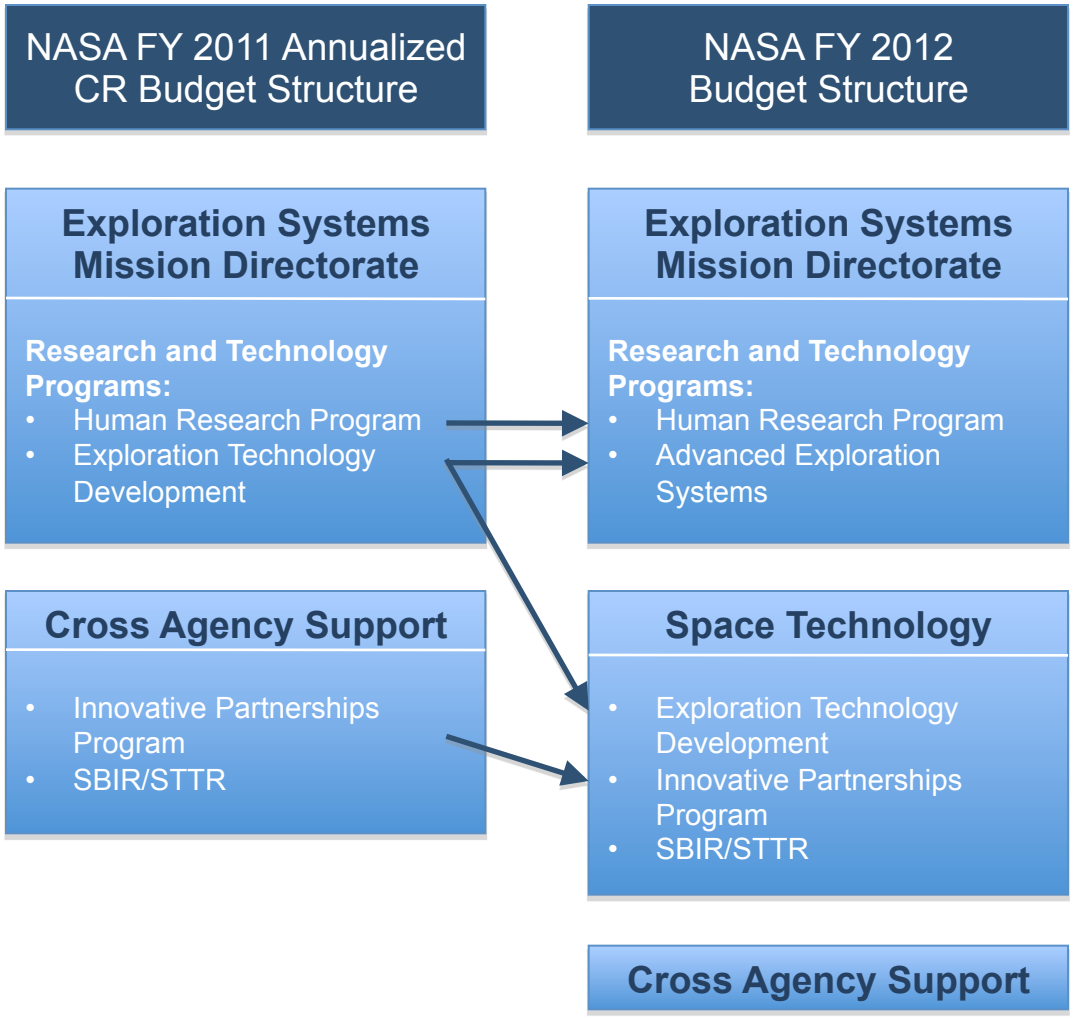
Prove feasibility of novel, early-stage ideas with potential to revolutionize a future NASA mission and/or fulfill national need.

Mature crosscutting capabilities that advance multiple future space missions to flight readiness status



Exploration Technology Development Move Into Space Technology

- In FY 2012, a significant portion of the FY 2010 Exploration Technology Development Program as well as the exploration technology activities in planning for FY 2011 will move from ESMD to Space Technology.
- These efforts focus on developing the long-range, Exploration-specific technologies to enable NASA's deep space human exploration future.
- Integrating Exploration technology activities with Space Technology consolidates the management of NASA's space technology programs within an organization focused on technology development and mission infusion and eliminates the potential for overlap had NASA's space technology investments been split among two accounts.
- OCT will manage the Exploration Technology Development (ETD) within its existing divisions and programs: Game Changing Development (GCD) and Technology Demonstration Missions (TDM)
- OCT will work with ESMD in FY 2011 to complete this transition by the start of FY 2012. In FY12, ESMD will provide prioritized requirements and will remain the primary customer for ETD products.
- Additional guidance planned in March.



Opportunities

- SBIR/STTR, Flight Opportunities, Center Innovation Fund, Centennial Challenges are ongoing programs, funded in FY 2011 CR based on enacted FY 2010 levels.
- Inaugural Space Technology Graduate Fellowship call closed on February 23. Selections anticipated for start of Fall 2011 semester.
- Initial NIAC, Game Changing Development, Technology Demonstration Missions calls released on March 1. Presently open.
  - NIAC seeks transformative ideas to enable new aeronautics and space systems capabilities.
  - Game Changing Development is soliciting proposals for research and technology development for revolutionary improvements in America's space capabilities.
  - TDM proposals are sought in four areas: high-bandwidth deep space communication, navigation and timing; orbital debris mitigation or removal systems; advanced in-space propulsion systems; and autonomous rendezvous, docking, close proximity operations and formation flying.

    http://www.nasa.gov/offices/oct/home/solicitations.html
- All proposals must align with the Agency's Space Technology Roadmaps and Grand Challenges. Awards are contingent on availability of fiscal year 2011 appropriations.
- OCT is not planning to make awards in Space Technology Research Grants, Franklin Small Satellite Subsystem Technology and Edison Small Satellite Demonstration Missions until FY12.

NASA Space Technology: Part of a Broader National Strategy

- **Space Technology is the central NASA contribution to a revitalized research, technology and innovation agenda for the Nation. These investments will stimulate the economy and build our Nation's global economic competitiveness through the creation of new products and services, new business and industries, and high-quality, sustainable jobs.**
  - A renewed technology emphasis balances NASA's long-standing core competencies of research and technology, spaceflight hardware development, and mission operations.
  - An enhanced technology and innovation focus at NASA responds to the recommendations of multiple external stakeholders.
  - 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 of other government agencies and commercial space activities .
- **Pushing the boundaries of aeroscience and taking informed-risk, Space Technology allows NASA and our Nation will remain at the cutting-edge.**
- **In addition to providing a more vital and productive aerospace future, by investing in Space Technology, NASA will continue to make a difference in our lives everyday.**

President Obama, February 3, 2011, at Penn State: "*Innovation is what this country is all about. Sparking the imagination and creativity of our people, unleashing new discoveries -- that's what America does better than any other country on Earth. That's what we do. We need you to seek breakthroughs and new technologies that we can't even imagine yet.*"