



Innovation and Technology



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Innovation in Human Exploration and Operations

HEO Innovation Opportunities

1. Mission focused innovation – problem solving
 2. New or enhancement capabilities – not in critical path
 - Improves acquisition or enhances performance
 3. True participatory public engagement with impact on the mission
 4. Using innovative ways to engage students and the public with the mission
-
- How do we build the framework for the next step though?
 - Need to integrate new tools and solution discovery methods on an ongoing basis.
 - How do we make this part of our day-to-day business?
 - How do we marry these with our current process? Or do we marry it?



Mission Focused Innovation

INTERNATIONAL SPACE STATION

Mission Focused



***Example – The completion and operation of the International Space Station
The International Space Station Vision - A human outpost in space
bringing nations together for the benefit of life on Earth ... and beyond.***

dimensions:

**240 ft. long, 291 ft. wide, 45 ft. high,
25,640 cubic feet of living space.**

Weight at completion:

420,500 kg.

science capabilities:

**laboratories from four inter-
national space agencies – U.S.,
Russia, Europe, and Japan.**

orbital inclination/path:

**51.6 degrees, covering 90% of
the world's population.**

altitude:

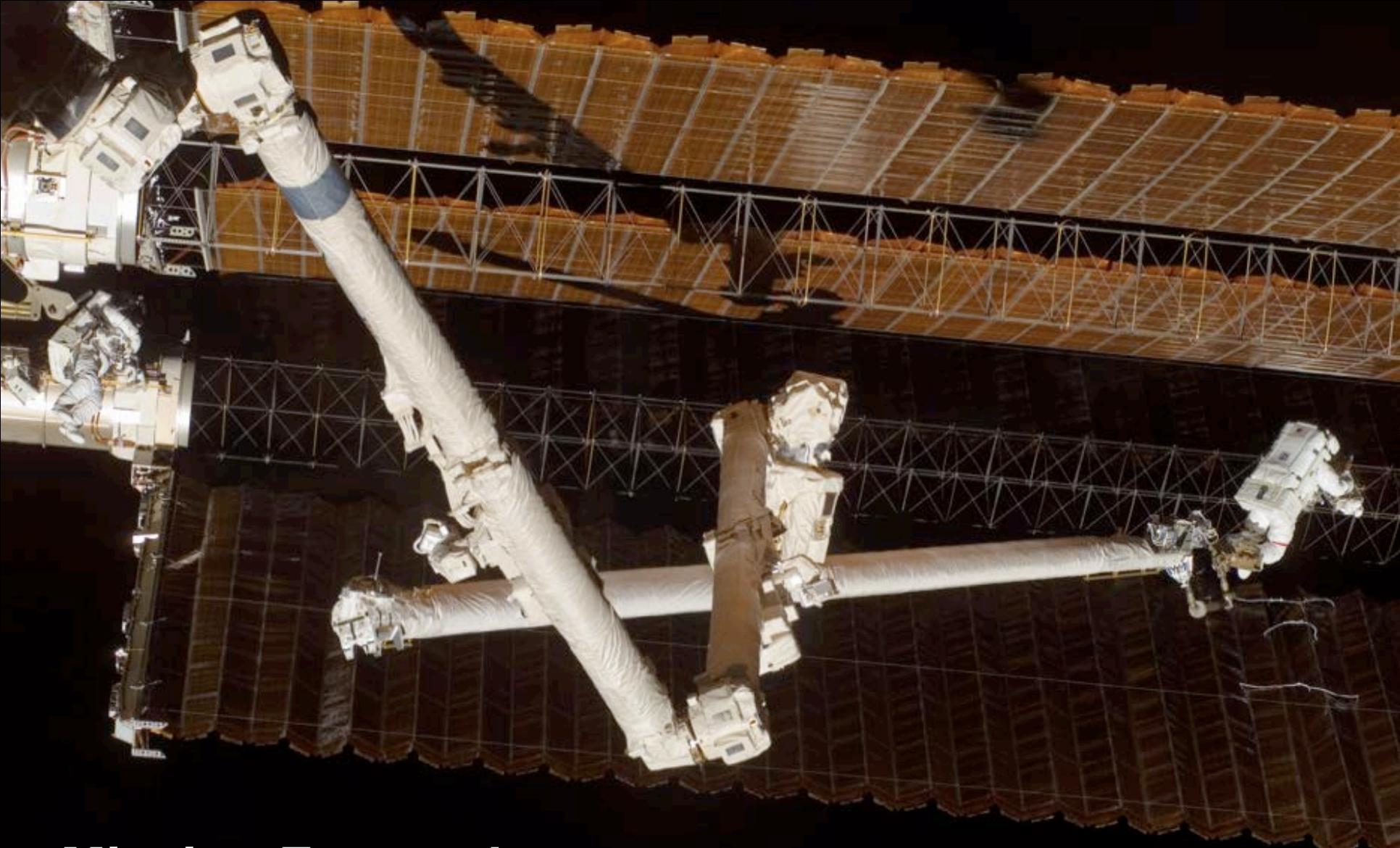
**approximately 220 miles above
the Earth.**

speed:

**17,500 miles per hour, orbiting
the Earth 16 times a day.**



INTERNATIONAL SPACE STATION

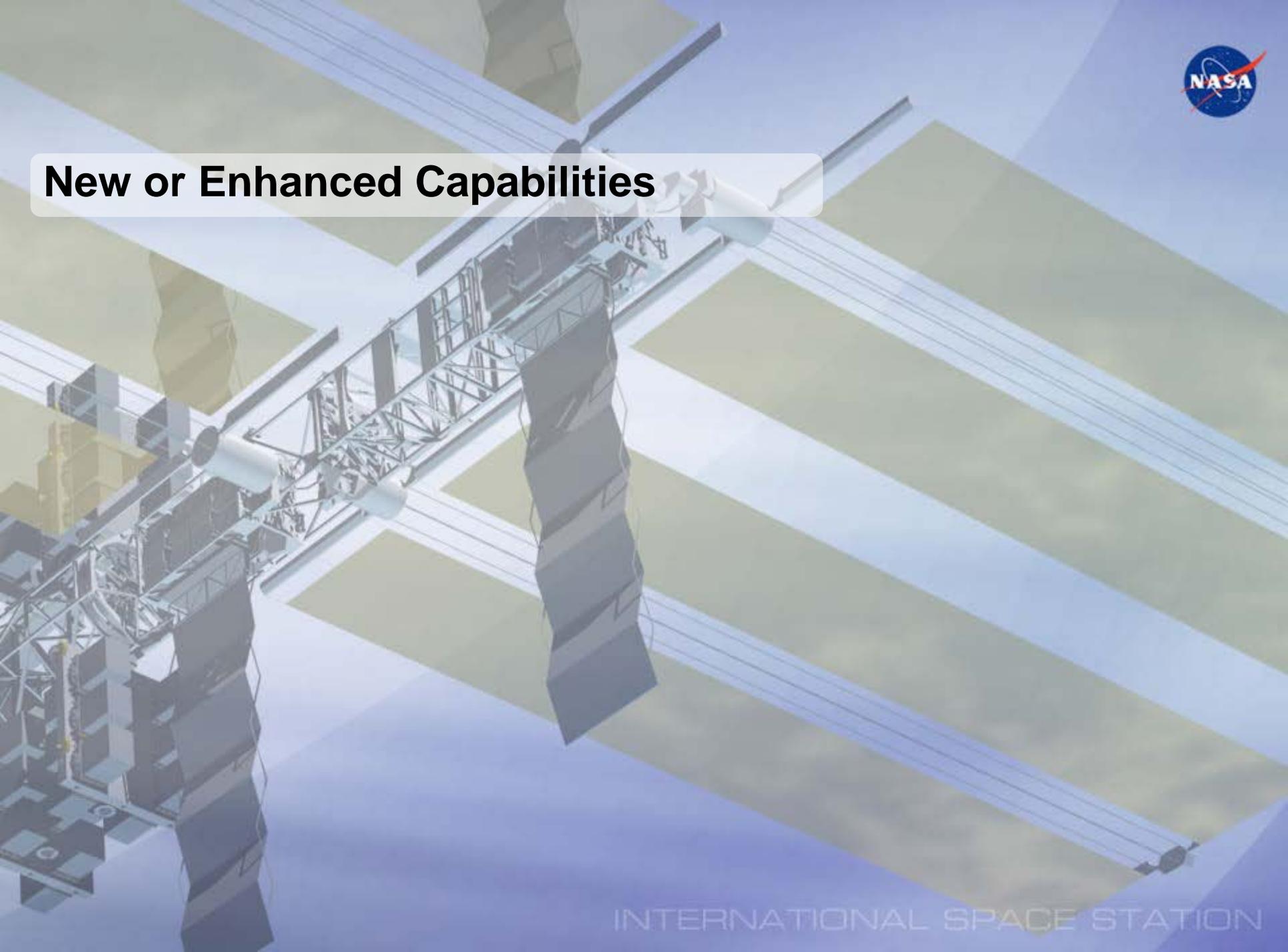


Mission Focused

As we execute the mission we must be innovative



New or Enhanced Capabilities



INTERNATIONAL SPACE STATION

ISS as an Acquisition Test Bed



- ISS is serving as a platform for Research, Commercial, and Engineering Test Bed activities, but there is more we can use it for
- Problem? Does NASA lack innovation in acquisition?

NASA **NEEDS** INNOVATION IN ACQUISITION

- Claims?
 - Contractors claim that if NASA would just tell us what they want the hardware to do and what the interfaces are, they can build it
 - Faster
 - Cheaper
 - Just as reliable
 - Without any more risk

OK..... But are they ready to take the **risk?**

Money on the line?

- Why not use ISS requirements as a way to test some of the concepts?
- The **Industrial Base** that supplies NASA is **shrinking**? Why?

Technical Capability on a Service Contract



Water Production Services on the ISS

What does it mean?

- NASA pays for a service instead of a piece of hardware
- Don't own the hardware once it is built

What does it look like?

- Looks like a utility contract at your house
- You pay for the availability of the service (whether you use it or not, like your land phone line) or the amount used (water, sewer, power)
- Have to define limits on resources used to enable the service
 - In this case: upmass, crew time, and system interfaces

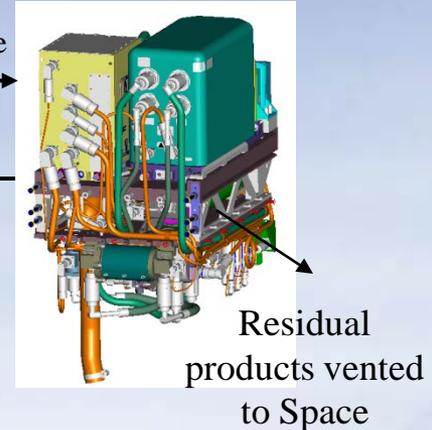
Why would you do it?

- Minimizes NASA risk because we only pay for the service when it is available
 - Fixed price for the service defines NASA maximum commitment and puts the contractor's "skin in the game" throughout the entire life cycle
- Minimizes NASA involvement in design and development
 - If the contractor only gets paid when and if it works, they are more motivated than anyone else to build a high quality/high reliability system
- Demonstrate another type of contract that moves closer to commercialization of space

Hydrogen + Carbon Dioxide



Water



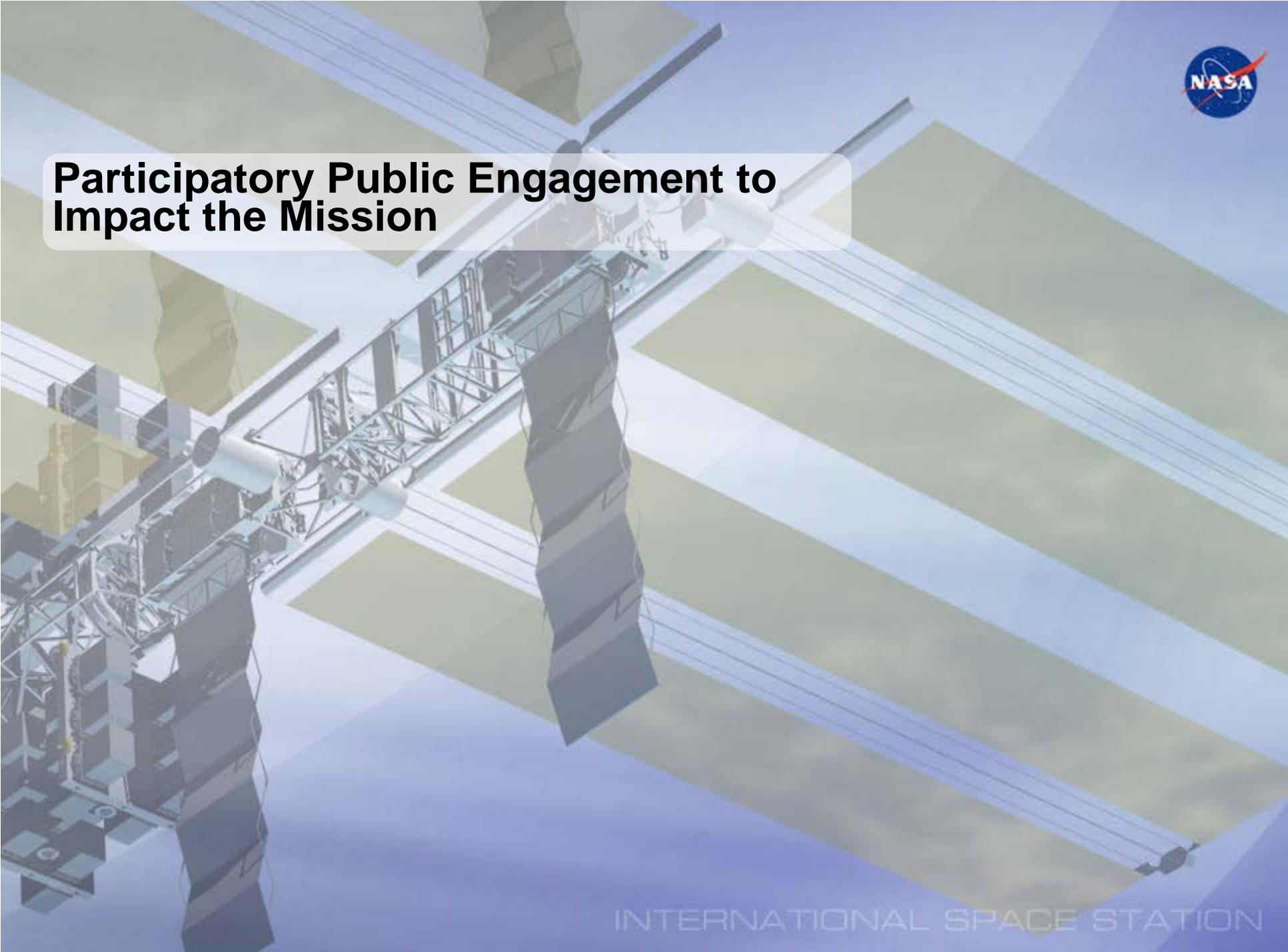


HUMAN – ROBOT INTERFACES





Participatory Public Engagement to Impact the Mission



INTERNATIONAL SPACE STATION



Innovation through Collaboration

It is impossible to “own” all the experts
Cost prohibitive / Scaling / Effectiveness

Joy's Law

“No Matter Who You Are, Most of the Smartest People Work for Someone Else”

- Bill Joy, Cofounder Sun Microsystems

Karim Lakhani from the Harvard Business gives us -

The Causal Explanation for Joy's Law

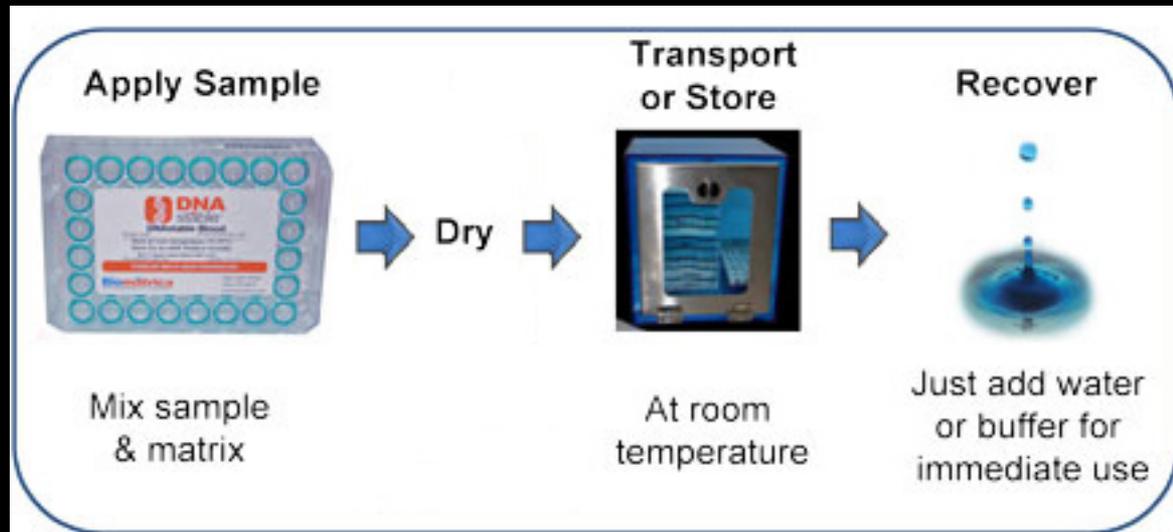
- Knowledge is unevenly distributed in society - Fredrich von Hayek (1945)
- Knowledge is sticky - Eric von Hippel (1994)

Today's Knowledge and Information era requires a shift in traditional strategies and philosophies – Extensions to our Network are required



“always keep on the lookout for novel ideas that others have used successfully.” Thomas A. Edison

Vs.





Emerging Tools – Open Innovation



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TopCoder is revolutionizing the software design and development process by tapping in to our

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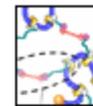
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Tech of the Week™

Promising technologies
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Self-healing Slide-Ring Material paint makes fine scratches disappear on mobile phones, laptops, other surfaces -- When the SRM surface is disturbed by abrasion, there is enough mobility across the supramolecular network that the coating is soon tugged back into place, effectively erasing the abrasion.

NASA Pavilion on InnoCentive

NASA Innovation Pavilion



Welcome to the **NASA Innovation Pavilion**, which provides Solvers the opportunity to develop innovative solutions to the unique challenges faced by NASA in achieving its mission to pioneer the future of space exploration, scientific discovery, and aeronautics research. Solutions to these challenges will not only benefit space exploration, but may also further the development of commercial products and services in the fields of health and medicine, industry, consumer goods, transportation, public safety, computer technology, and environmental resources.

[Johnson Space Center](#)

[Langley Research Center](#)

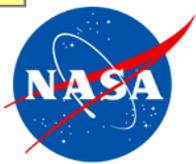
[Glenn Research Center](#)

Centers Participating in the NASA Innovation Pavilion

**Johnson
Space
Center**

The Johnson Space Center has been home to all U.S. human space flight programs. Our scientists and engineers are engaged in research and technology development projects encompassing human health and performance, life sciences, and aerodynamics, mechanical, electrical, industrial, propulsion, chemical, and computer engineering. We are seeking new and creative ideas to enable our success as we venture beyond low Earth orbit and further explore the universe.

PAUSE



InnoCentive Pilot Results

Challenge Title	Ctr	Posted	Deadline	Proj Rms	Sub	Award Date	Award Amount
Improved Barrier Layers ... Keeping Food Fresh in Space	JSC - SLSD	12/18/2009	2/28/2010	174	22	5/7/2010	\$11,000
Mechanism for a Compact Aerobic Resistive Exercise Device	JSC - SLSD	12/18/2009	2/28/2010	564	95	5/14/2010	\$20,000
Data-Driven Forecasting of Solar Events	JSC - SLSD	12/22/2009	3/22/2010	579	11	5/13/2010	\$30,000
Coordination of Sensor Swarms for Extraterrestrial Research	LRC	2/27/2010	4/26/2010	423	37	6/4/2010	\$18,000 (3)
Medical Consumables Tracking	GRC	5/17/2010	7/27/2010	365	56	10/28/2010	\$15,000 (3)
Augmenting the Exercise Experience	JSC - SLSD	5/27/2010	7/27/2010	229	18	9/20/2010	\$10,000
Simple Microgravity Laundry System	JSC - EA	5/27/2010	7/27/2010	598	108	9/21/2010	\$7,500

What's Next -



NASA Tournament Lab

- Utilize the principles of distributed innovation to allow participants worldwide to contribute to solving internal NASA technical challenges by developing innovative computational algorithms.
- **Objectives:**
 - Create novel, high quality working software for NASA-wide algorithmic/ computational challenges
 - Contribute towards the development of empirically validated science of innovation tournaments
 - Participants earn prize money, prestige, and reputation
- **Participants:**
 - Open to anyone but with strong participation by Masters, Doctoral, and Post-Doc students
 - Over two-hundred thousand coders worldwide who participate in TopCoder® tournament challenges (439 participated in a limited NASA study in 2009 in a single tournament)
- **Approach to Engagement:**
 - TopCoder will issue the initial challenge at October 2010 TopCoder® Open
 - Future years activities in negotiation
- **Existing Relationships:**
 - Contract with Harvard University and Top Coder – However funding is centered around the operations of the platform
 - Two prominent researchers in Open Innovation theory from Harvard and London Business School





Innovative Methods for Communication

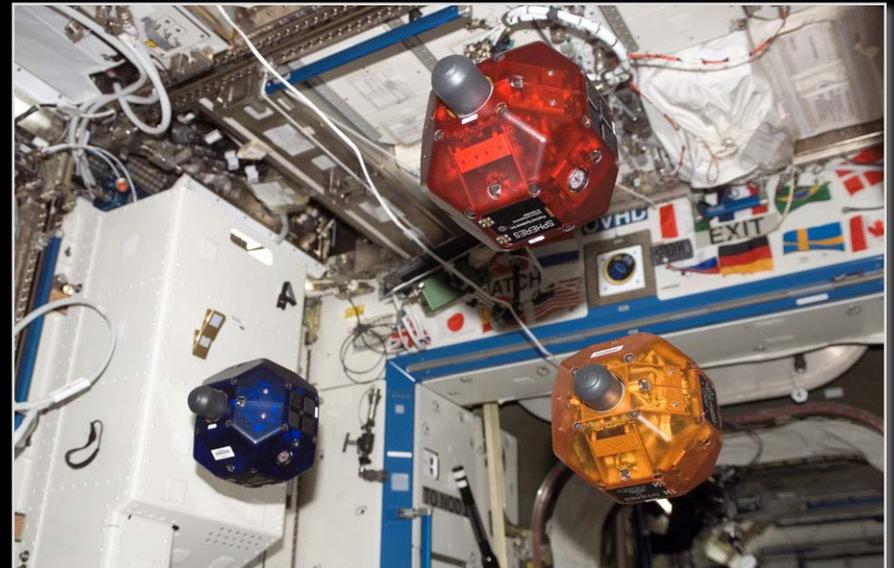
INTERNATIONAL SPACE STATION

Impact when it comes together!



ZERO-Robotics - ISS National Lab Education

- Students experience the SPHERES satellites on the International Space Station by writing challenge code to control the satellites
- Includes significant ground based program with computer simulation and flat floor competitions
- **Objectives:**
 - Extend the benefits of space research on the ISS down to middle schools and high school students
 - Expands the scope of activities available on the ISS National Lab
 - School students build critical engineering skills, such as problem solving, design thought process, operations training, teamwork and presentation skills.
- **Participants:**
 - High school students, Grades 9-12 (opportunities for Middle School Students have also been done)
 - Teachers and subject Matter experts will assist the students
- **Existing Relationships:**
 - Contracts with MIT, Aurora Flight Sciences
 - Partnership with DARPA
 - **Private funding starting to support teams**
- **Milestones:**
 - Fall 2011 completion and regional competitions
 - Culminates in a 27-team final competition on the ISS in late 2011

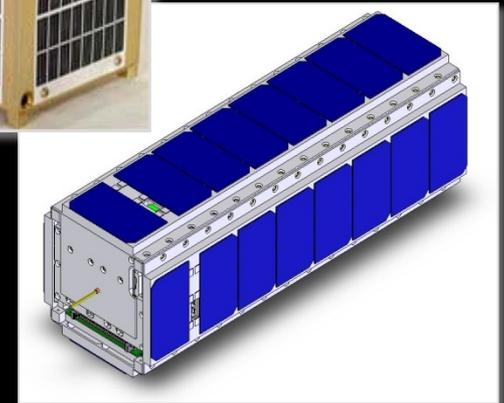


Impact when it comes together!



LSP CubeSat Launch Initiative

- NASA collaborates with US High Schools and Universities to demonstrate viable launch opportunities for CubeSat payloads as auxiliary payloads on planned NASA missions.
- **Objectives:**
 - CubeSat payloads must investigate an aspect of science, exploration, technology development, education, or operations identified in the NASA Strategic Plan and/or Education Strategic Coordination Framework.
 - **Participants get their payloads placed in orbit!**
- **Participants:**
 - Initial participation is expected to be by High School / College Students and teachers
 - Potential for a total of 44 CubeSat Units in Space (44U available over 4 flights)
- **Approach to Engagement:**
 - NASA has issued two Announcements of Launch Initiatives
 - Engaging with existing CubeSat community
 - Will issue additional Announcements of Launch Initiatives as space on manifests is identified
- **Existing Relationships:**
 - Contract with CalPoly to support integrated deliver of PPODs and CubeSats
 - First announcement resulted in Partnerships with 12 Universities, room to grow through current second announcement
- **Milestones:**
 - Launches begin in 2011



Innovative Communication Methods

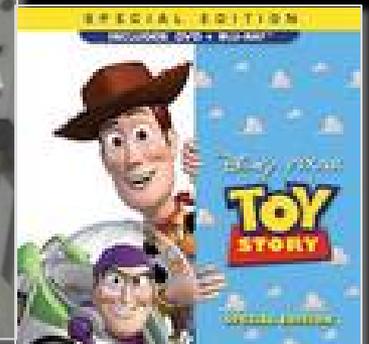
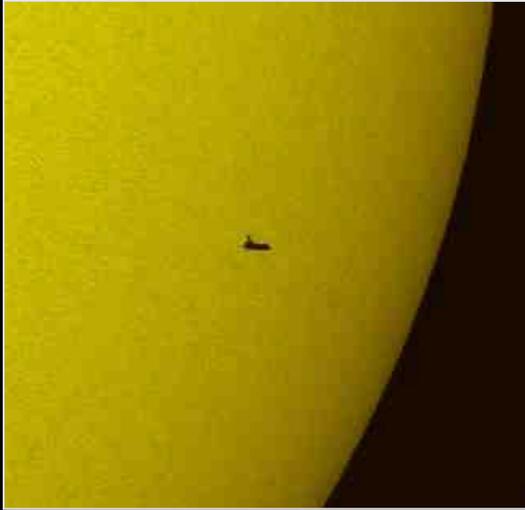


Image Tweeted from Space



Astro_Soichi

Questions you may be able to help with.....

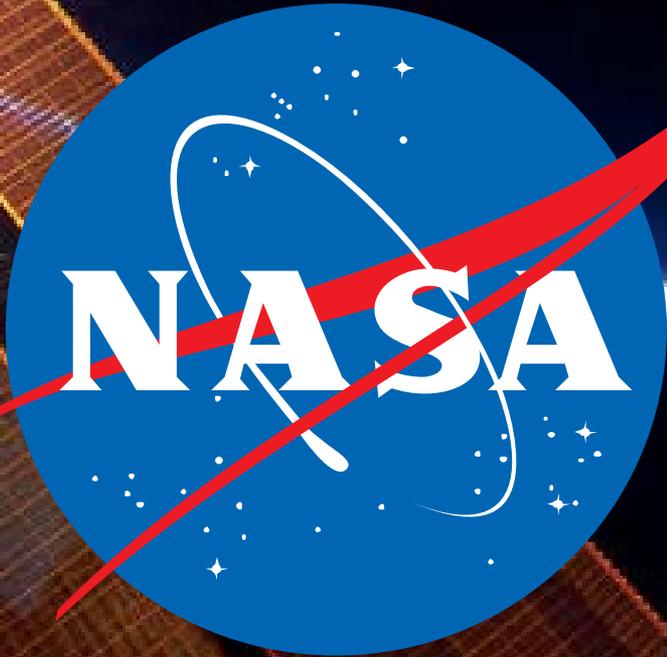


Do we need to include innovation to remain competitive and relevant? Is innovation required or a “nice to have?”

Can we predict disruptive innovation?

Does innovation conflict with the organizational desire to maintain the status quo? How do we incentivize the organization to innovate?

Can the cost of not innovating exceed the cost of failing in the introduction of an innovation?



www.nasa.gov