



A New Business Model for Problem Solving - Infusing Open Collaboration and Innovation Health and Human Services February 17, 2011

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Novel Strategies for Problem Solving

- Discussion Topics
 - Space Life Sciences Overview
 - Strategic Initiatives
 - Visioning Workshop
 - Space Life Sciences Strategic Plan
 - Alliances Benchmark
 - Harvard Business School open collaboration/innovation
 - New Business Model



Space Life Sciences Overview

- Human health and performance in the space environment
 - Space medicine – health care and medical systems
 - Physiological and behavioral effects of spaceflight
 - R&TD on weightlessness, isolation
 - Space environmental monitoring
 - Radiation, air/water, microbiology/toxicology, food systems
 - Human Factors
 - Human centered design, ergonomics, biomechanics, food systems
- Human-centered risk assessment and risk mitigation
- Space Flight Human System standards and requirements
- Host of the ESMD/Human Research Program Office
- Strategy formulation and innovation management



Strategic Initiatives

2006 Visioning Workshop

HQ lead office for life sciences

- Assumption:
 - Low likelihood of returning in next 10 years
- Characteristics
 - Central budget, Fundamental research, NRA's, grants
 - NASA funded partnerships
 - Some institutional costs provided by program

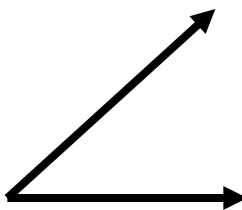


Current state

- Assumptions
 - Current resources, no growth
- Characteristics
 - Focused R+D on TRL/CRL 4-6
 - Inflation, escalation erode content
 - Little low TRL/CRL work

Partner/shared services model

- Assumptions
 - Core capabilities not funded by institution
 - Rapid external pace of change
- Characteristics
 - Consulting, high-end expertise,
 - Partners fill in low CRL/TRL work
 - Leverage with partners



Minimum necessary services

- Assumptions
 - Program need to reduce costs
 - Program buy it by the yard
- Characteristics
 - Outsourcing
 - Minimal R&D
 - Few partners

Space Life Sciences

Exploring Space | Enhancing Life



Strategic Initiatives

- 2006 Visioning Workshop Outcomes
 - A shift from traditional strategies and philosophies to partnerships/collaboration is required
 - Novel strategies to extend our network of experts to remain competitive and at the cutting edge
 - Improve research and operations integration
 - Enhance internal and external communication
 - Impossible to “own” all the experts
 - Cost prohibitive
 - Resource intensive



Strategic Initiatives

- 2007 SLSD Strategic Plan
 - Mission Statement
 - “To optimize human health and productivity for space exploration”
 - Vision Statement
 - "To become the recognized world leader in human health, performance and productivity for space exploration”
 - Strategic Goals
 - Manage balanced internal/external portfolio
 - Drive health innovations
 - Drive human system integration innovations
 - Educate and inspire



Strategic Initiatives

- SLSD Strategic Plan 2007
 - Key strategies for driving innovation
 - Adopt an integrated human system risk management approach
 - Develop/implement an improved business model (collaborative approaches and tools)
 - Establish strategic alliances/collaborative efforts
 - Enhance internal and external communications
 - Establish a virtual center to achieve vision



Strategic Initiatives

- 2008-2010 Alliances Benchmark
 - Developed benchmark process to assess best practices for identifying, establishing, and managing alliances and collaborations
 - 20 organizations interviewed
 - Government agencies
 - Industry
 - Academia



Strategic Initiatives

- 2008-2010 Alliances Benchmark (cont.)
 - Responses: Why Collaborate?
 - 100% response: critical to innovate
 - Enhance portfolios by supplementing internal core capabilities with external capabilities
 - Find innovative solutions quickly and efficiently in a rapidly changing environment
 - Critical Success Factors
 - 100% response: address cultural issues: “Not invented here”
 - Unifying vision, alignment with strategy, clearly defined objectives
 - Annual planning/gap analysis



Change and Organizational Renewal

- 2008-10: Harvard Business School Collaborations
 - Leading Change and Organizational Renewal: create ambidextrous organizations
 - Conduct business effectively, efficiently—space operations
 - Encourage change, disruptive innovation—R&TD
 - HBS Student Projects (K. Lakhani)
 - Two MBA student projects, ongoing PhD student project
 - Portfolio mapping of gaps to determine when to collaborate, what is optimal collaborative strategy (G. Pisano)
 - All: emphasize encouraging a culture that supports collaborative innovation



Strategic Initiatives

- Why Else Collaborate?
 - Federal government policy
 - The President's Sept 2009 *Strategy for American Innovation* calls on agencies to increase their ability to promote and harness innovation using tools such as prizes and challenges
 - Dec 2009 OMB memo requires agencies to further these principles
 - Mar 2010 OMB memo provides guidance on policies and issues related to using prizes and challenges to promote innovation



Strategic Initiatives

- Novel Strategies for Problem Solving: Summary
 - Visioning exercise and strategic plan
 - Alliances benchmark 2008-2010
 - HBS collaborative innovation models and collaborative projects 2008-2010
 - Open innovation pilot project 2008-2010
 - Virtual center for collaboration established 2010: NASA Human Health and Performance center
 - Pursue collaborative research models 2011
 - Develop Strategic Framework for Innovation 2011



New Business Model

- A new business model is required to infuse open collaboration/innovation tools into existing models for research, development and operations (research announcements, procurements, SBIR/STTR etc)
- Components of a new model
 - Strategic visioning and planning with annual review (material just reviewed)
 - Portfolio definition – what work are you trying to achieve?
 - Portfolio analysis to determine when to collaborate and what is the optimal collaborative strategy
 - Establish decision framework for using novel and established approaches (tools)
 - Evaluate with metrics / reassess on an annual basis
 - Organize to fully implement collaborative model – NASA Human Health and Performance Center (NHHPC)



Implementing Strategy

- Strategy Execution and Implementation Office formed 2008
 - Dedicated staff to drive the 2007 strategic plan
 - Found it impossible to develop and drive the plan using the line organization
 - Insufficient time, resources, engagement
 - Two-year cycle – products folded back into line organization for ownership in 2010 (ongoing)
 - Strategy group evolved into the NASA Human Health and Performance Center (NHHPC) staff
 - Development through the NHHPC
 - Implementation through the Space Life Sciences Directorate



Portfolio Definition

- Human System risks for space flight (the portfolio of work we conduct)
 - evidence based risk management system
 - Space Flight Human System Standards
 - 65 human system risks
 - Human System Risk Board formed April 2008 – combines research and operations into one board
 - developed Risk Management Analysis Tool (RMAT)
 - Captures vertical “standards to deliverables” process
 - Links risks for common elements (e.g. low vitamin D levels common to several risks)
 - Subject matter experts (risk owners) identify gaps in their research and technology portfolio)
 - Gaps became opportunities for open collaborative solutions



Portfolio Analysis

- Portfolio mapping – Dr. Gary Pisano, Harvard Business School (HBS)
 - “Which Kind of Collaboration is Right for You” – Harvard Business Review, December 2008
 - Workshop conducted by Dr. Pisano with NASA – Wyle leadership team July 2009
 - Analyzed 12 gaps for collaborative opportunity, those that mapped to open innovation quadrant selected for pilot projects



Portfolio Analysis: Mapping - Models of Collaboration

The Four Ways to Collaborate

There are two basic issues that executives should consider when deciding how to collaborate on a given innovation project: Should membership in a network be open or closed? And, should the network's governance structure for selecting problems and solutions be flat or hierarchical? This framework reveals four basic modes of collaboration.

<p>Innovation Mall</p> <p>A place where a company can post a problem, anyone can propose solutions, and the company chooses the solutions it likes best</p> <p>Example: InnoCentive.com website, where companies can post scientific problems</p>	<p>Innovation Community</p> <p>A network where anybody can propose problems, offer solutions, and decide which solutions to use</p> <p>Example: Linux open-source software community</p>	PARTICIPATION	Open
<p>Elite Circle</p> <p>A select group of participants chosen by a company that also defines the problem and picks the solutions</p> <p>Example: Alessi's handicapped group of 200-plus design experts, who develop new concepts for home products</p>	<p>Consortium</p> <p>A private group of participants that jointly select problems, decide how to conduct work, and choose solutions</p> <p>Example: IBM's partnerships with select companies to jointly develop semiconductor technologies</p>		Closed
GOVERNANCE			
Hierarchical	Flat		

HARVARD BUSINESS REVIEW • DECEMBER 2008

From Gary Pisano, Harvard Business School

Space Life Sciences
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Portfolio Analysis – Open Innovation

- Open Innovation Strategies – Dr. Karim Lakhani, HBS, March 2008
 - Procurement authority used for pilot projects – open procurement for 12 challenges (October 2009)
 - Selected InnoCentive and Yet2.com – training began Nov-Dec 2009
 - Gaps developed through the Gary Pisano mapping process were turned into challenges



Open Innovation

- Why open collaboration/innovation?
 - Joy's Law
 - “No Matter Who You Are, Most of the Smartest People Work for Someone Else”
 - Bill Joy, Cofounder Sun Microsystems
 - The Causal Explanation for Joy's Law
 - Knowledge is unevenly distributed in society - Fredrich von Hayek (1945)
 - Knowledge is sticky - Eric von Hippel (1994)

from Karim Lakhani, PhD Harvard Business School



Open Innovation

- Open innovation and collaboration— four pilot projects
 - **InnoCentive**- posts individual challenges/gaps to their established network of solvers (200,000)
 - financial award if the solution is found viable by the posting entity
 - **Yet2.com**- acts as an actual technology scout bringing together buyers and sellers of technologies
 - Option to develop partnerships
 - **TopCoder** - open innovation software company with a large network of solvers (200,000)
 - variety of skill-based software coding competitions
 - **NASA@work**-internal collaboration platform leveraging expertise found across NASA's 10 centers



Open Innovation - InnoCentive

- The challenge posting cycle ranges from 30 to 90 days depending on challenge type
 - NASA Pavilion established to co-locate/advertise challenge
- If a solution is not found, no award fee or success fee is paid
 - Exception: ideation challenge type has to be awarded.
- During the challenge posting process InnoCentive screens questions and proposals based on NASA's requirements.
 - Level of screening is tailored by each individual challenge owner
- After all challenges have been posted/completed, InnoCentive provides an evaluation report to NASA



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



2900 Solvers – 80 countries





InnoCentive Pilot: Challenge Data and Statistics

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	in progress	\$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



Open Innovation – Yet2.com

- No additional award or challenge fees
- Network search agent
 - The goal is to search their network of experts to seek out solution providers or collaborators
 - Client is not identified
 - NASA receives either a contact or network of contacts who may be able to work with NASA on development of a solution for the tech need
- Once the contacts/network has been delivered, it is up to NASA to establish a working relationship



Open Innovation – Yet2.com

Yet2.com

- NASA technical needs chosen based on portfolio mapping exercise
- Yet2 works with NASA technical need owner to develop statements and facilitate initial communication with contacts
- 6 technical needs in process
 - Phase1
 - Bone Imaging
 - A clinically-useful technology with enough sensitivity to assess the microstructure of "spongy" bone that is found in the marrow cavities of whole bones.
 - Water Monitoring (2 components)
 - Preventing growth of and removing microorganisms and bio-films from a potable water system
 - Real-time analysis and reporting of water-borne microorganisms
 - Radioprotectants for humans exposed to chronic and acute radiation
 - Biological, pharmaceutical, or dietary countermeasures to act as radioprotectants for humans exposed to higher doses of radiation, both chronic and acute



Bone Imaging Contacts

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Seeking: Accurate measurement techniques for deep-bone density and structure

Description

OVERVIEW
We are seeking a clinically-useful technology with enough sensitivity to assess the microstructure of "spongy" bone that is found in the marrow cavities of whole bones. However, this technology must be for skeletal sites surrounded by layers of soft tissues, such as the spine and the hip. Soft tissue interferes with conventional imaging and using a more accessible area -- for example, the wrist or the ankle of limbs-- as a proxy for the less accessible skeletal regions, will not be accurate. A non-radioactive technology is strongly preferred.

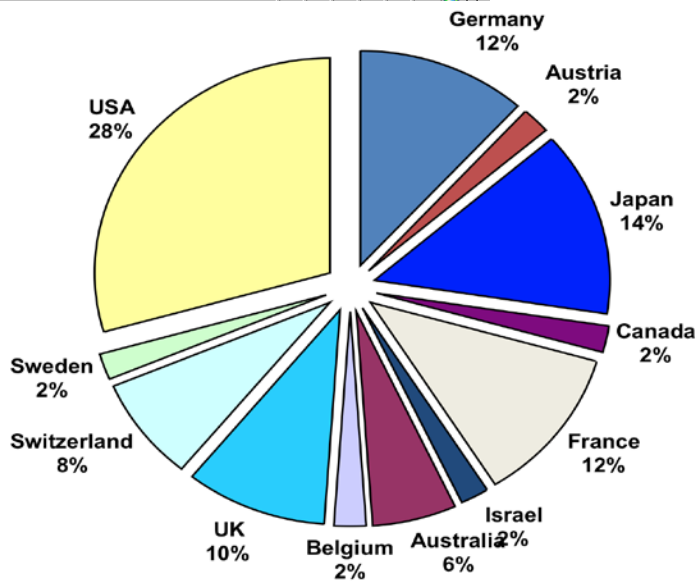
BACKGROUND
The structural arrangement of tiny bones (the trabecular microarchitecture) that are found in the marrow cavity of whole bones is difficult to image. Trying to image the trabecular microarchitecture of the spine or the hip is complicated because of the noise produced by surrounding soft tissue. Studies have reported profound changes to the bone marrow compartments of the hip and spine under certain stresses and conditions. Unlike commonly recognized bone diseases such as osteoporosis, the skeletal changes we have observed are targeted to specific sites of the skeleton. This suggests that the factors -- that cause the bone mineral loss we are seeing -- do not circulate through the body, but are local to the affected skeletal site -- the spine and hip in particular. In other words, measurements conducted at a site at the periphery of the skeleton may not reflect or predict changes at a site located more centrally in the skeleton. Technologies have emerged for the assessment of the trabecular microarchitecture of bone structures. These high-resolution methods, however, are being developed for peripheral skeletal sites (wrist and ankle) because bones are closer to the surface and the signal can be detected better (greater "signal to noise") than for bones surrounded by layers of soft tissue. A similar

Actions

Respond to TechNeed

Create Discussion
Email This TechNeed to a Friend
Contact yet2.com
Print This TechNeed
Return to Search Results

Germany	6
Austria	1
Japan	7
Canada	1
France	6
Israel	1
Australia	3
Belgium	1
UK	5
Switzerland	4
Sweden	1
USA	15
Total	51



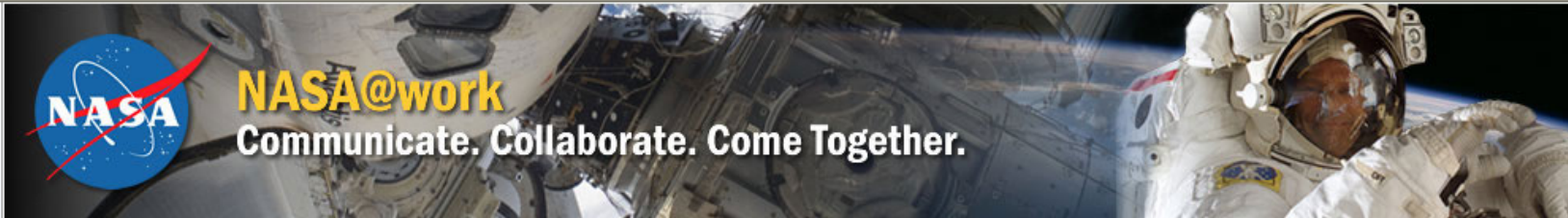


Open Innovation- TopCoder

- Opportunity presented to NASA by Harvard Business School
 - Research project to compare outcomes of collaborative and competitive teams
 - NASA provided the problem statement
 - Optimize algorithm that supports medical kit design
- Competition began on 11/04/2009 and lasted approximately 10 days
 - 2800 solutions were submitted by 480 individuals
 - Useful algorithm developed and incorporated into NASA model
- Team felt this process was more efficient than internal development
- Next steps – SOMD (Jason Crusan) has formed a Tournament Lab with HBS and TopCoder to seek many novel optimization algorithms for ISS



NASA@Work



NASA@work
Communicate. Collaborate. Come Together.

[CHALLENGES HOME](#) | [SUGGEST A CHALLENGE](#) | [INFO EXCHANGE](#) | [MANAGE](#) | [MY ACCOUNT](#) | [HELP](#) | [CORPORATE INTRANET](#)

[Challenge Activity Dashboard](#)

NASA@work Challenges (20 of 20 total)

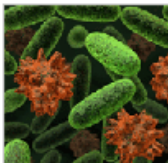
Search Challenges & Discussions: [Search](#) [Switch To Summary View](#)

SORT By: [Deadline](#) in [Descending Order](#) FILTERS - By Status: [Pending](#), [Open](#), [Under Eval](#) By Tag: [Technology Development](#)

Showing 20 out of 20 results

If and When Life Is Discovered on Mars, How Can We Determine If It is Truly Indigenous Mars Life?

Challenge Award: **\$200 USD** Challenge 429 Challenge Owner: **Levine, Joel S. (LARC-E303)** - [Edit This Challenge](#)



Proposals are requested for protocols that would increase the certainty that any life discovered during missions to Mars is indigenous to Mars and does not result from man's exploration of the planet surface ('Forward Contamination'). Input from biologists and experts in habitability and planetary protection is particularly welcome.

[Read Details](#) [Discuss Challenge](#)



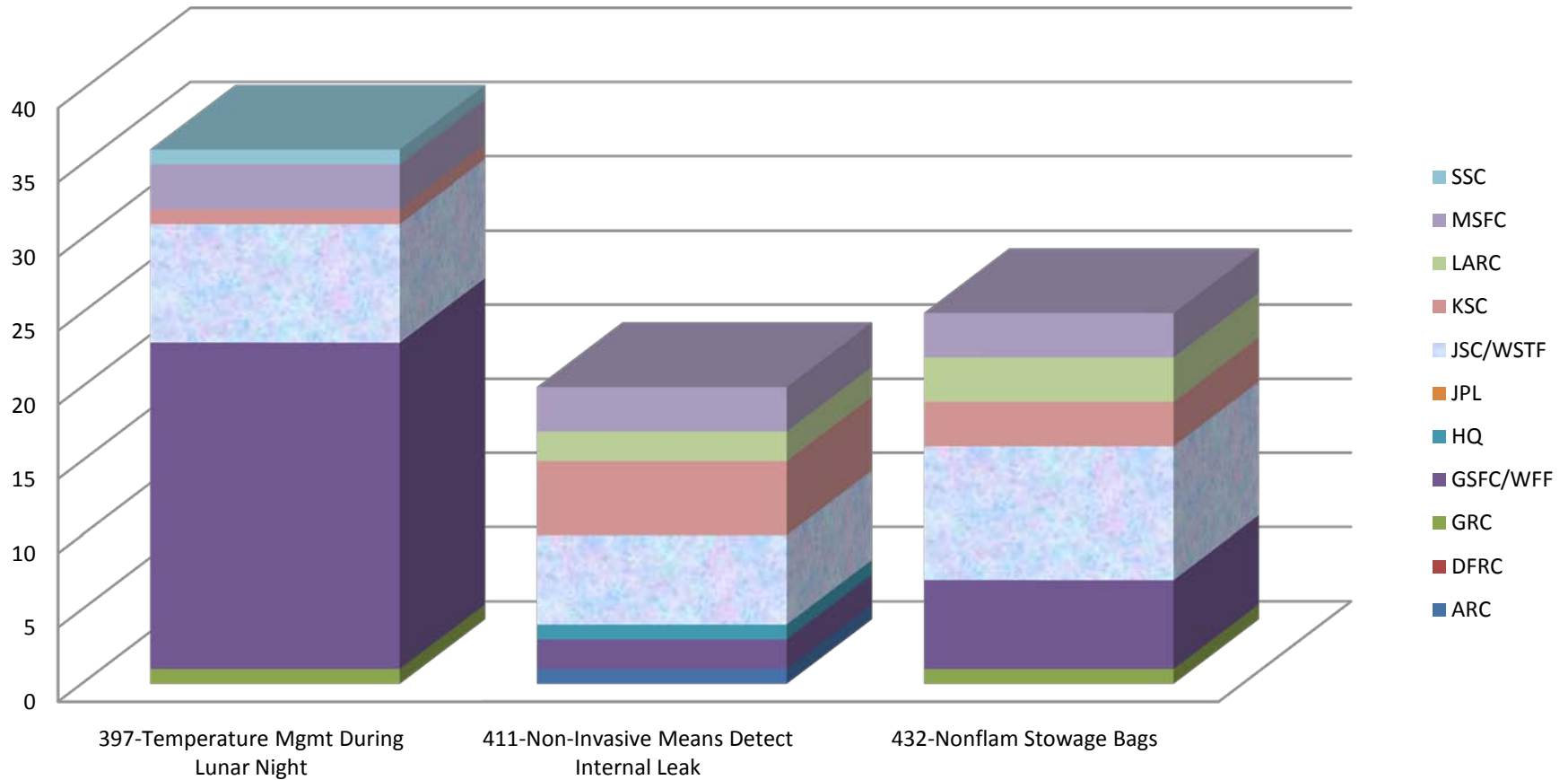
NASA@Work Center Participation

Center	Challenges Posted	Registered Solvers	Discussion Posts	Participants
Ames	3	310	18	11
Dryden	0	146	13	9
Glenn	1	467	12	9
Goddard	2	564	101	13
Jet Propulsion Lab	2	1	0	0
Johnson	3	1380	46	29
Kennedy	2	1067	73	39
Langley	4	425	31	12
Marshall	0	700	23	14
Stennis	2	148	22	5
Headquarters	1	267	15	9



NASA@Work

JSC Challenges





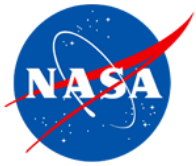
NASA@Work

- Early Findings
 - Connected 10 NASA centers horizontally (peer to peer)
 - Connected areas of expertise previously untapped
 - Enthusiasm for the pilot and willingness to use again
 - Positive comments about NASAA trying a new business model
 - Solid solutions for some technical problems

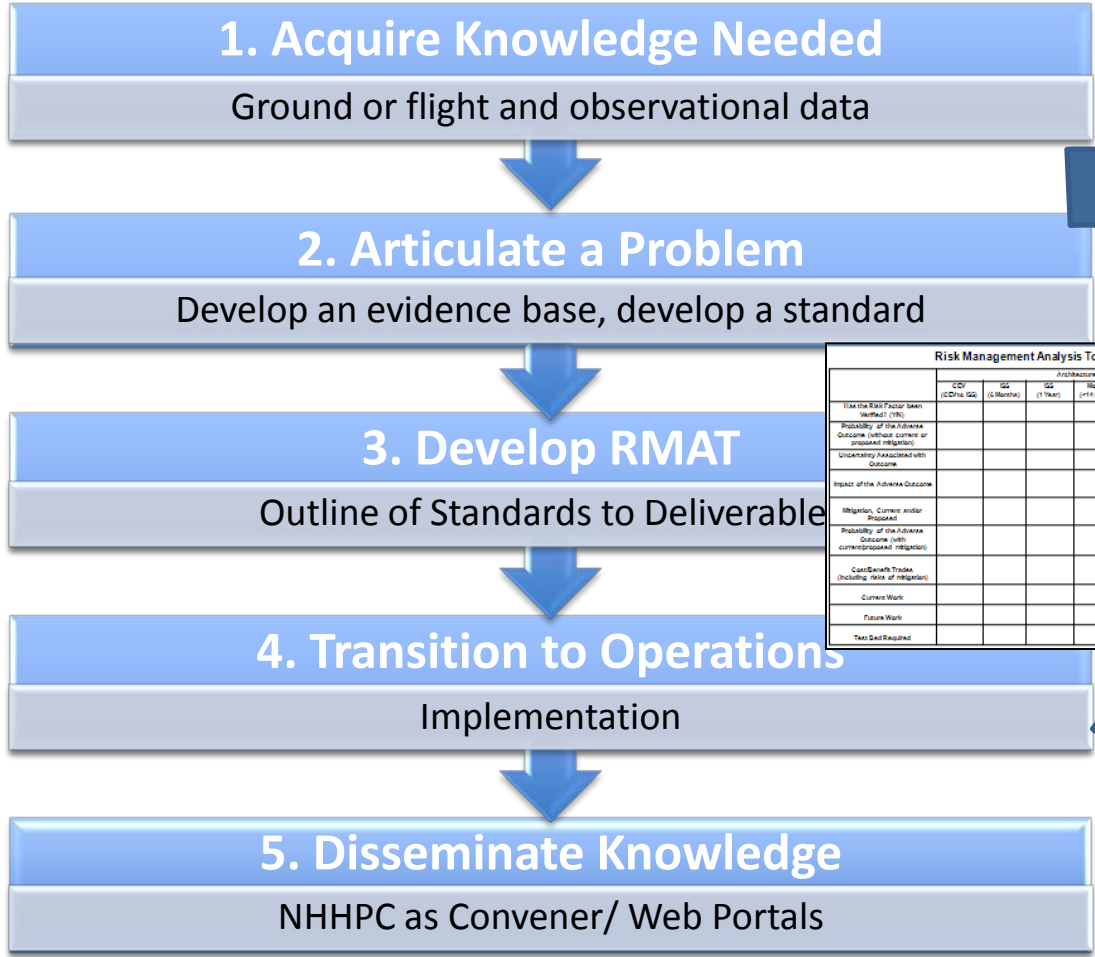


Decision Framework

- Initial work to date
 - Use a stages of knowledge process (Harvard Business School analysis April 2010)
 - Develop entrance and exit criteria for each stage
 - Determine the best use of novel and existing tools and their inter-relationship at each stage
 - For example, run an ideation challenge prior to releasing a research announcement, procurement, or SBIR
 - Current thinking – not a strictly linear (stage-gate) process
 - Feed forward, feed back loops etc



Communication/Dissemination



Possible Pathway for Standards

	Architecture					
	CDI (CD/ha SS)	SS (6 Months)	SS (1 Year)	Mean (r14 days)	Mean (Quarterly)	Max
Fix the Risk Factor (see Verbal?) (%)						
Probability of the Adverse Outcome (with current or proposed mitigation)						
Uncertainty Associated with Outcome						
Impact of the Adverse Outcome						
Mitigation, Current and/or Proposed						
Probability of the Adverse Outcome (with current/proposed mitigation)						
Cost/Benefit Trade (including risk of mitigation)						
Current Work						
Future Work						
Time and Resources Required						



Decision Framework

Stages of Knowledge

Ignorance

Awareness

Ability to Measure

Ability to Mitigate a Problem

Implementation

Dissemination

Framework Step

1. Acquire Knowledge Needed

Solution Spaces

NASA

Research
"Inner Circle"

Professional
Research

General
Knowledge



1. Acquire Knowledge Needed

Ground or flight and observational data

2. Articulate a Problem

Develop an evidence base, develop a standard

3. Develop RMAT Pathway

Outline of Standards to Deliverables

4. Transition to Operations

Implementation

5. Disseminate Knowledge

NHHPC as Convener/ Web Portals



Decision Framework

Framework Step Example: Acquire Knowledge Needed

Entrance Criteria to Discern Stages of Knowledge that are Needed:

1. Relevance-
 - Is Acquiring Knowledge relevant/necessary to question/problem at hand?
2. Importance-
 - Relative importance of gleaning this information to inform question/problem?
3. Criticality-
 - Cost/benefit of completing step vs. not (e.g. time factor)

Exit Criteria Required to move from current Stage of Knowledge:

1. Completeness-
 - Has sufficient evidence been collected from available sources?
2. Utility-
 - Does the information collected satisfy current stage?
 - Is the evidence gathered inform next (and/or other) Stage(s) of Knowledge?



Portfolio Analysis - Metrics

- Metrics in development
 - Direct costs of open innovation tools
 - Indirect costs (NASA/Wyle team member time)
 - Determine “best” success rate for challenges conducted
 - Compare to existing tools
 - For example, average challenge <\$50K to phase I SBIR \$100K; grants usually much more
 - Intangibles
 - Connect NASA expertise internally
 - Develop new collaborations externally
 - Promote the space program (participatory exploration)



Organize for Ongoing Collaborations - NASA Human Health and Performance Center

- Established October 18, 2010 – overarching goals:
 - Integrate human health and performance efforts across NASA and with member organizations
 - Advance human system research and technology, process, and practice innovations
 - Facilitate collaborative projects that enable and advance human spaceflight capabilities, and address national and global human health and performance needs
 - Resource for integration and coordination of NASA proposals, risk assessments, and requirements to inform the human exploration missions and technology needs



NASA Human Health and Performance Center

- Why the NHHPC?
 - Key strategy in the Space Life Sciences Strategic Plan
 - Publishes NASA needs in an open collaborative forum to facilitate potential collaborative partnerships
 - Benefits all member organizations by closing gaps in the research and technology human health and performance portfolio of work
 - Leverages resources of all members
 - Facilitates rapid data sharing among members
 - Enables collaborative project discussions
 - Facilitates project prioritization, tracking and information dissemination



NASA Human Health and Performance Center

- Membership <http://nhhpc.nasa.gov>
 - Six NASA Centers
 - ISS partners – JAXA, probable CSA, DLR
 - Other government orgs: FAA, GSA, USAF Research Labs (Dayton); NIH Public-Private Partnerships; USAID; contacted CDC, NSF, EPA, NIST, FDA
 - Academia - Stanford (FAA COE), MIT, UTMB, Baylor (NSBRI), Tufts, Clemson
 - Corporate - InnoCentive, Yet2.com, Cazneau, Philips, Johnson & Johnson, Proctor & Gamble, General Mills, Nike; GE; contacted IBM, Ford
 - Commercial space (invited)
 - Nonprofits - National Center for Human Performance – TMC – 49 institutions, BAHEP, San Diego Zoo (biomimicry), Draper Lab; contacted Gates Foundation
- First Workshop January 19, 2011 – Collaborative Innovation: Strategies and Best Practices



NASA Human Health and Performance Center

- Administration and operations
 - Shared NASA leadership (JSC and Ames) – located at JSC
 - Executive council to determine topics
 - No fees or agreements to join
 - NASA team provides communications, workshops, facilitates Space Act Agreements
 - Links legal, procurement, external relations resources
 - All material cleared for the public domain
 - Member connect area of website (password)
 - Projects among non-traditional partners (e.g., NASA and San Diego Zoo in Biomimicry)



NHHPC Summary

- NHHPC
 - An internal and external integrator model based on collaboration
 - Realizes Space Life Sciences Strategy for collaboration
 - NHHPC to disseminate knowledge, enable collaborative projects
 - Address themes (health, performance, habitability, research, education)
 - Integrate a discipline (e.g., space medicine, human factors, biotechnology)
 - Multiple platforms to enable human spaceflight and address issues in challenging environments on Earth

Space Life Sciences

Exploring Space | Enhancing Life



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 - Organize to fully implement collaborative model – NASA Human Health and Performance Center (NHHPC)