Space Life Sciences Open Collaboration and Innovation Model

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NAC Technology and Innovation Committee

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Presentation Outline

- SLSD Strategy
- Why collaborate? Driving Innovation through Collaboration
  - Innovation and collaboration at NASA
  - SLSD open innovation pilot summary
- Innovation and collaboration across Federal Government and other organizations
- NASA Human Health and Performance Center (NHHPC)
- Next Steps for Agency Collaboration and Innovation

Space Life Sciences Strategy

Space Life Sciences Directorate (SLSD)

- Core Capabilities–NASA and Wyle team members
  - Technical
  - Strategy formulation and innovation management
- 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

Space Life Sciences Strategy

- 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.“

- Overarching Goals
  - Optimize SLSD portfolio for current and future needs
  - Drive advances in health innovations
  - Drive advances in human system technology innovations
  - Create enduring enthusiasm for space exploration and encourage and support education

Key Strategies

- Key strategies
  - Adopt an integrated human system risk management approach
  - Develop and maintain core capabilities and core competencies; anticipate future needs
  - Establish strategic relationships/collaborations
  - Develop and implement an improved business model
  - Improve our customer focus
  - Enhance internal and external communication

- Developed benchmark process to assess best practices for identifying, establishing, and managing alliances and collaborations

Benchmark Participants and Partners

- Corporate Participants
  - Baxter Healthcare
  - GE Healthcare
  - Genentech, Alliance management and Portfolio Planning
  - Google
  - Merck Research Laboratories
  - Philips, Corporate Strategies and Alliances
  - Wyeth Pharmaceuticals
- Government Agencies/Other NASA Centers
  - National Institute of Standards and Technology
  - National Science Foundation, Biological Sciences Directorate
  - NASA Ames Research Center (seven offices interviewed)
- Academic Institutions:
  - University of Michigan Life Sciences Institute
  - University of Texas M.D. Anderson Cancer Center
  - Harvard Business School

Key Findings

- All use alliances to:
  - Innovate quickly and cost effectively
  - Improve quality of innovation
  - Address technical challenges in a rapidly changing environment
  - Enhance portfolios by supplementing internal core capabilities with external capabilities
  - Remain competitive (for profit or funding)

"Alliances are crucial to driving growth and innovation"

--a benchmark partner

Why Collaborate?

Driving Innovation through Collaboration

- Why Collaborate?
  - Strategy: budget constraints at NASA required new approaches and business models to be innovative
  - June 2009 Alliances Benchmark—100% response that collaboration was critical to achieving innovation goals
  - 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, and required GSA to offer an open innovation platform by July

Driving Innovation through Collaboration

- SLS Key Strategies for driving innovation—recap
  - Integrated human system risk management approach
  - Engaging in alliances/collaborative efforts
  - Developing/implementing an improved business model

➢ Open innovation provides a mechanism for implementing strategies and achieving goals

Open Innovation

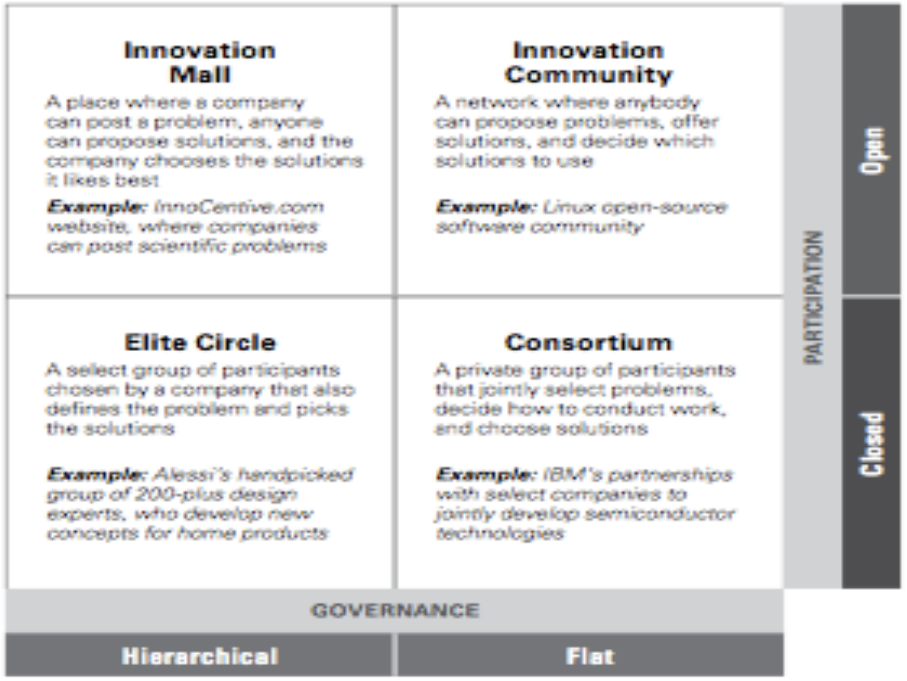
SLS Approach to Innovation

- Key components
  - Evidence-based risk management system
    - Continuously evaluates all human system risks across current and future operations, identifies gaps
  - Portfolio mapping of gaps to determine optimal collaborative strategy
    - "The new leaders in innovation will be those who figure out the best way to leverage a network of outsiders“ – Gary Pisano, HBS
  - Implementation of disruptive innovation
    - New business models vs. traditional approaches/continuous improvement
    - Optimize SLSD research, technology, operations, and service portfolios through strategic alliances and collaboration (including open innovation)
  - Integrating system to blend old/new tools

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.



HARVARD BUSINESS REVIEW • DECEMBER 2008

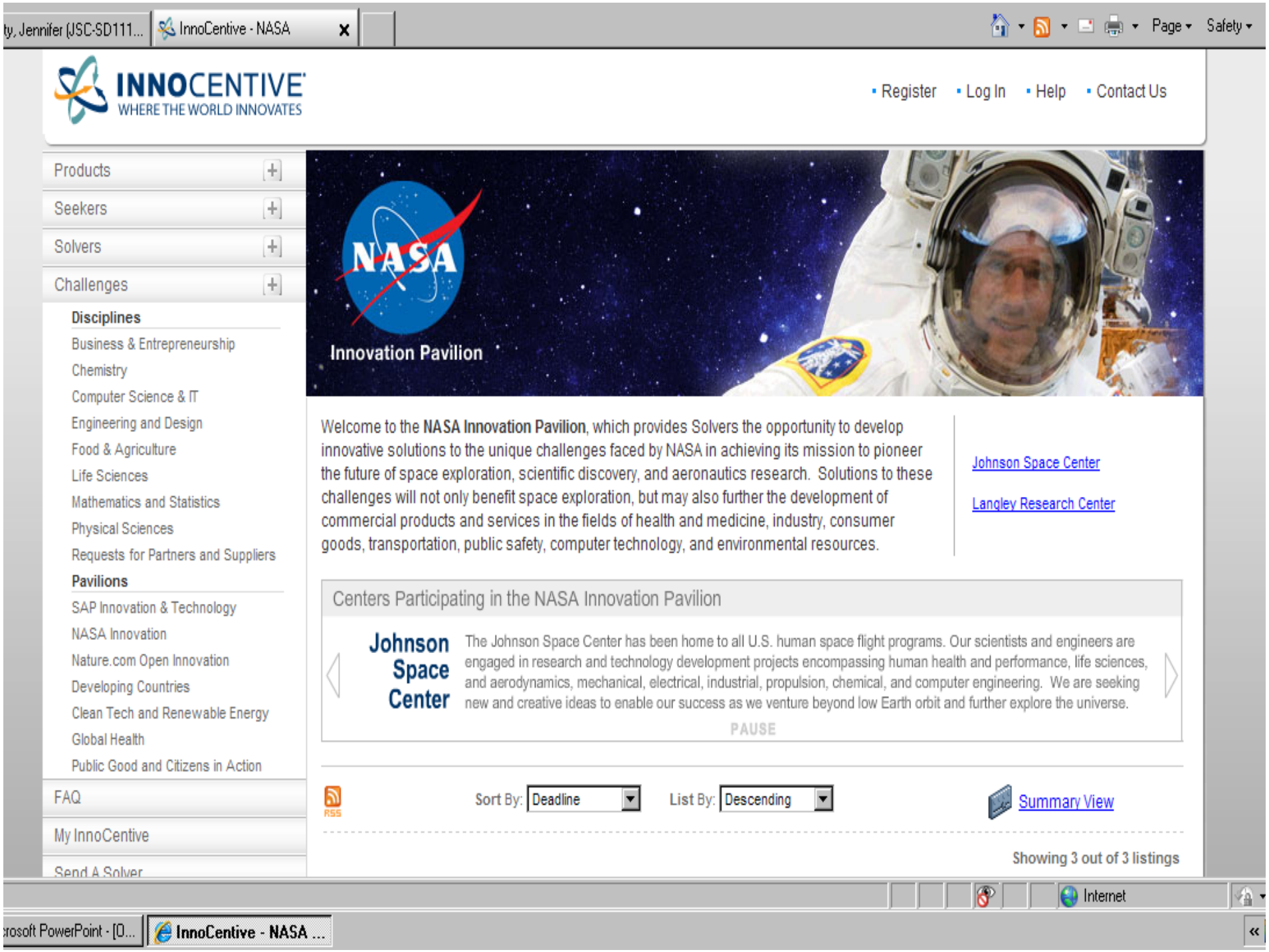
From Gary Pisano, Harvard Business School

Open Innovation

- Open innovation provides access to knowledge and expertise that would otherwise remain untapped
- SLSD Pilot Projects - Phase I complete, Phase II underway
- Three Open Innovation Service Providers
  - **InnoCentive (innovation mall)**—seekers post challenges/ gaps to an established network of registered solvers (200,000+)
    - Financial award if the solution is found viable by seeker
  - **Yet2.com (consortium)**—acts as technology scout bringing together buyers and sellers of technologies through a network or networks
    - Option to develop partnerships
  - **TopCoder (innovation community)**—offers open innovation software coding competitions to network of solvers (200,000)

INNOCENTIVE

- InnoCentive package—turnkey solution
  - Solver network of 200,000+ and additional promotion
  - Training (overview, challenge writing, assessment)
  - Submission evaluation support, intellectual property, due diligence of winners, final report and lessons learned
  - NASA 'Pavilion' established to advertise challenge
- For each challenge type there is an associated award fee, and for some a success fee
  - Challenge Types: Ideation, Theoretical, Reduction to Practice (RTP)
  - Must award at least one ideation award
- The challenge posting cycle ranges from 30 to 90 days
- InnoCentive screens all questions and proposals submitted by solvers based on NASA requirements, and submits an evaluation report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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
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.
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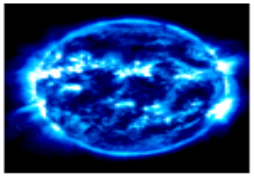
NASA Challenge: Data-Driven Forecasting of Solar Events

Challenge Reward: **$30,000** Challenge Type: **RTP** INNOCENTIVE **9059496**
USD



Forecasting solar activity is important for future manned and unmanned exploration of the solar system. The Seeker wishes to develop the ability to forecast the occurrence of a Solar Particle Event (SPE) within a select window in time. Methods must make use of current real-time space weather measurements and/or archived space weather data. Read More

DEADLINE: **Mar 22, 2010** 362 Project Rooms Posted: Dec 22, 2009

NASA Challenge: Improved Barrier Layers ... Keeping Food Fresh in Space

Challenge Reward: **$15,000** Challenge Type: **Theoretical-IP Transfer** INNOCENTIVE **9050426**
USD

As we go deeper into space and spend more time on the International Space Station (ISS), missions become longer, requiring packaged food to be stored for longer periods of time with even greater restrictions on size, weight and waste disposal. New food packaging technologies are needed that have adequate oxygen and water barrier properties to maintain the foods' quality over a 3 - 5 year shelf life. The new packaging must have improved barrier properties, remain lightweight and be compatible to sterilization processes and proper disposal. Read More

DEADLINE: **Feb 28, 2010** 129 Project Rooms Posted: Dec 18, 2009

NASA Challenge: Mechanism for a Compact Aerobic and Resistive Exercise Device

Challenge Reward: **$20,000** Challenge Type: **Theoretical-IP Transfer** INNOCENTIVE **9051616**
USD

NASA is looking for a novel engineering mechanism for a compact, effective aerobic and resistive exercise device. They are not looking for you to design the complete device, but just the engineering mechanism that could deliver the proper resistive and aerobic motions for exercises in space under very limited or zero gravity. There are very specific size and space requirements. Read More

DEADLINE: **Feb 28, 2010** 400 Project Rooms Posted: Dec 18, 2009

Three NASA Challenges Posted at InnoCentive.com

A Total of 1,317 Solvers from 65 countries opened Project Rooms

(as of April 29, 2010)

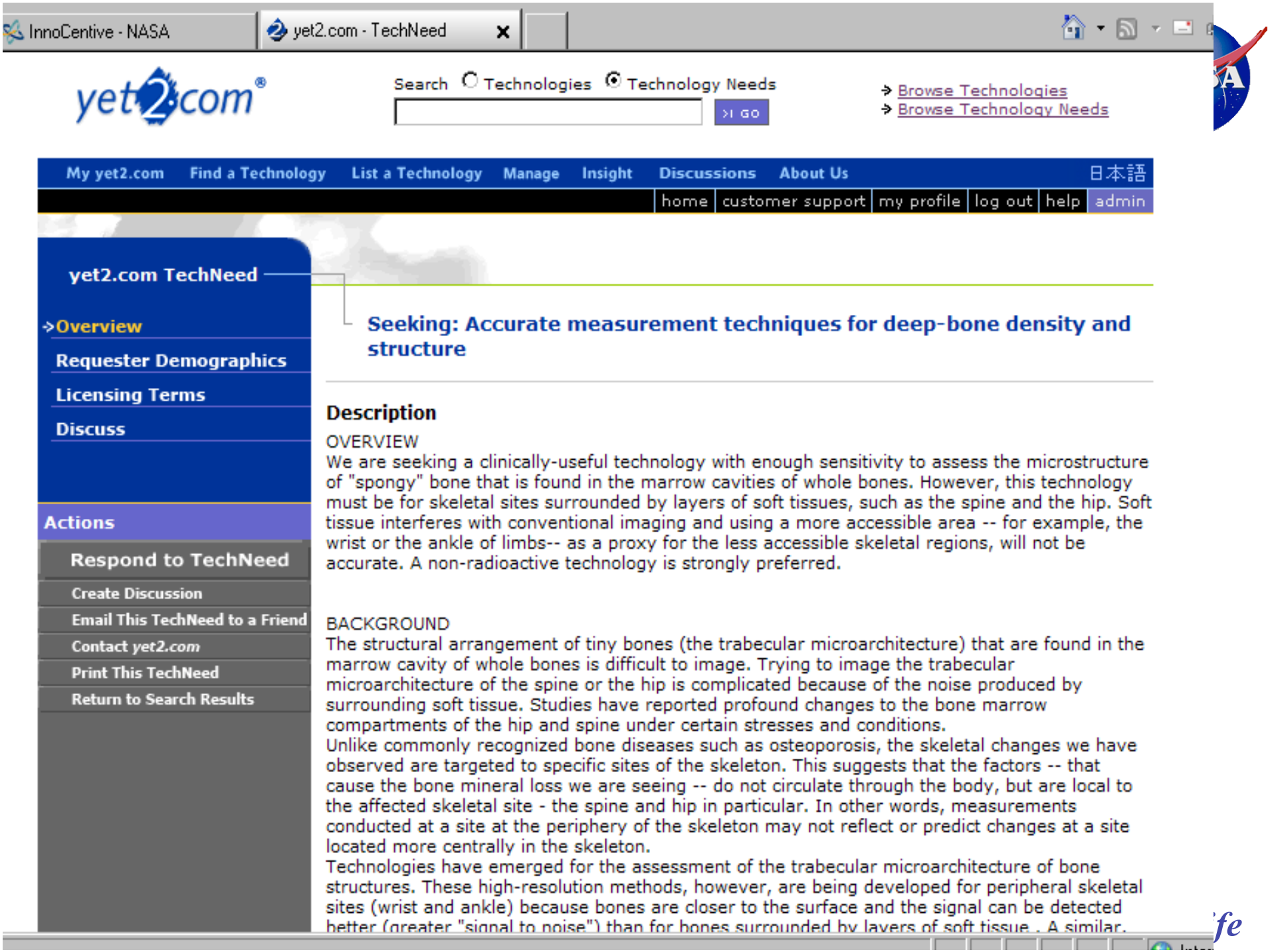
InnoCentive Pilot: Phase 1 Results

Challenge Title	Challenge Type / Award	Final Numbers	Result
Improved food packaging	Theoretical (written proposal)—60 days $15,000	-174 Project Rooms from 33 Countries -22 Submissions from 10 Countries ***16 for Evaluation***	A partial solution ($11,000 award) was found by a scientist from Russia for a flexible graphite material compatible with NASA requirements. NASA pursuing.
Compact, effective aerobic and resistive device	Theoretical (written proposal)—60 days $20,000	-564 Project Rooms from 52 Countries -95 Submissions from 24 Countries ***60 for Evaluation***	A full award has been made to a mechanical engineer from MA for his pneumatic suction device. The solution will be directly infused into current NASA prototype efforts.
Forecasting solar activity	Reduction to Practice (proof of idea/prototype)—90 days $30,000	-579 Project Rooms from 53 Countries -11 submissions from 5 Countries ***4 for Evaluation***	A full award has been made to a retired radiofrequency engineer from rural NH for his SPE prediction algorithm. NASA will work with the solver on implementation into an operational framework.

InnoCentive Phase 2

- Total of 3 challenges posted to the Pavilion on 5/27/10
  - Simple Microgravity Laundry System
    - Theoretical IP with award amount of 25K
    - Closure 7/27/10
  - Augmenting the Exercise Experience with Audio Visual Inputs
    - Theoretical IP with award amount of 20K
    - Closure 7/27/10
  - Medical Consumables Tracking (JSC & GRC)
    - Theoretical IP with award amount of 15K
    - Closure 7/27/10
- InnoCentive pilot program draft assessment and lessons learned report by 9/15/10

- Yet 2.com package-
  - 6 Technical needs
  - Enrollment/Challenge selection and qualification Fee
  - Challenge/Search Execution fees
  - Training and travel fees
- There are no additional award or challenge fees
- Yet2 works as a network search agent over a ~3 month period.
  - The goal is to search their network of experts to seek out solution providers or collaborators on the identified NASA technical need.
  - 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
    - In some cases they will find a contact that already does have a solution developed/engineered.
- Once the contacts/network has been delivered to NASA it is up to NASA to establish a working relationship to develop the solution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Return to Search Results
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

Yet2.com Pilot: Phase 1

- NASA technical needs chosen based on portfolio mapping exercise
- Works with need owner to develop statement and facilitate initial communication with contacts
- 6 technical needs in process, 5 have been posted, 1 closed
  - Phase1
    - Bone Imaging
      - Received 37 contact leads
        - » Investigated 15
        - » 1 of primary interest-Osteotronix
      - **Tech need closed**
    - Water Monitoring (2 components)
      - Received 45 contact leads
      - 1 of primary interest-Quartek-requested samples
      - 9 remain of strong interest
    - Radioprotectants for humans exposed to chronic and acute radiation
      - Received 26 initial contacts
      - 18 remain of interest

Bone Imaging Results: 5 Most Promising Leads

1. New technique for characterizing anatomical structures using magnetic resonance data.
2. High field and high resolution magnetic resonance imaging for quantitative characterization of the morphology and function of the musculoskeletal system
3. Imaging of Bone Ultrastructure - advances existing MR techniques with the ability to image structures and tissues that are invisible to conventional MRI.
4. Hip Bone Mineral Density (BMD) system
5. Magnetic Resonance - work demonstrated the feasibility of using MRE to measure the stiffness of trabecular bone

Yet2.com Pilot: Phase 2

- Phase2
  - Life on Mars (LRC), 2 components posted on 4/19
    - System for qualitative analysis of microorganisms and their taxonomic classification
    - Ideas and protocols that can differentiate terrestrial life from indigenous exobiological life
      - 22 leads under review
  - Imaging analysis (JSC + GRC)
    - Technical need went live on 6/28/10
  - Food Packaging
    - Technical need went live on 7/8/10
- Yet 2.com pilot program assessment and lessons learned report by 9/15/10

TopCoder

- An open innovation software company with a large network (200K+) of programmers, developers, and software architects that compete in a variety of skill-based software coding competitions
- Opportunity presented to NASA by Harvard Business School
- Competition began on 11/04/2009 and lasted approximately 10 days
  - 2800 solutions were submitted by 480 individuals under an Open Source License
- All winning competitors provided solutions with similar evacuation probabilities, kit contents, mass, and volume
  - Contest limited competitors to coding in Java, C, VB .Net, and C# .Net which is not directly compatible with the current IMM platform (SAS 9.1)
- Competition did not provide code sufficient for immediate integration, however insight into strategies used by the competitors gives NASA a significant head start in the coding of IMM optimization algorithms

NASA@Work Pilot

- Internal innovation through collaboration platform
  - Pilot contract awarded to InnoCentive
    - Site launches August 9th
  - Will provide an internal collaboration platform that facilitates internal problem solving and communication
    - The goal is to leverage the breadth and depth of NASA technical expertise
  - Pilot will include 10 Centers
    - 20 Challenges were purchased
      - 2 allocated to each center
      - Civil Servants may submit solutions
      - Awards will be given for winning solution and participation

Innovation and Collaboration in the Federal Government

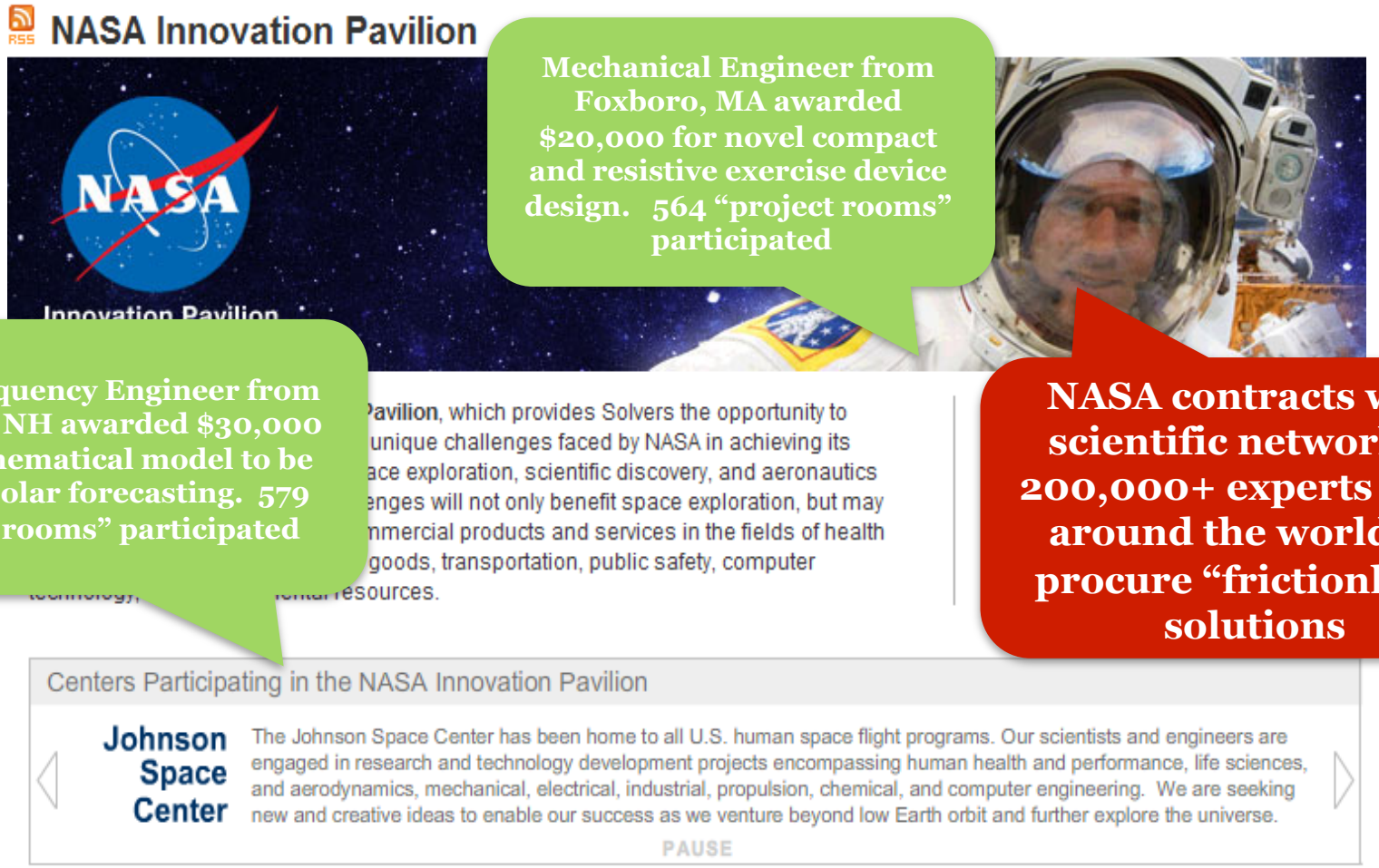
Exploring Space, Enhancing Life

Innovation and Collaboration in Federal Govt

- Office of Science and Technology Policy (OSTP), Executive Office of the President
  - April 2010: Sponsored Promoting Innovation: Prizes, Challenges, and Open Grantmaking Workshop for federal agencies with The Case Foundation Social Innovation
  - Aneesh Chopra, U.S. Chief Technology Officer
    - Presented SLSD open innovation results in keynote speech to personal democracy event in June to "validate that knowledge is widely dispersed, and that platforms like InnoCentive help us find them"
  - Invited SLSD to post pilot results as case study for White House Innovations Gallery as a "terrific example of collaboration" http://www.whitehouse.gov/open/innovations

Platforms, Prizes, Procurement Spur Jobs

Scientific Expert Network Matches Micro-Entrepreneurs to Needs



Source: www.innocentive.com

Innovation and Collaboration in Federal Govt

- OSTP (continued)
  - Robynn Sturm, Advisor for Open Innovation to the Deputy Director of OSTP
    - Requested SLSD briefing in April re: open innovation strategy and successes
    - Facilitated meetings with multiple federal agencies (GSA, EPA, Dept Ed, FCC)
    - Posted blog on White House OSTP site based on NASA press release on InnoCentive
  - Aman Bhandari, Health Policy Analyst
    - Requested SLSD briefing and facilitated meetings with two Human Health and Services (HHS) organizations

OSTP Blog: http://www.whitehouse.gov/blog/2010/07/13/nasa-open-innovation-competition-delivers-three-winning-solutions

NASA Open Innovation Competition Delivers Three Winning Solutions

Posted by Robynn Sturm and Phil Larson on July 13, 2010 at 09:39 AM EDT

Going where no one has gone before may demand new solutions from unexpected places. NASA—with the help of the public's best problem solvers—is ready.

Last week, NASA announced "outstanding results" from three pilot Challenges posted on InnoCentive, an online innovation marketplace where more than 200,000 of the world's brightest minds solve tough problems for cash awards. Tapping the expertise of top scientists, inventors, and entrepreneurs around the globe held special appeal for an agency with no shortage of tough problems to solve.

The extreme conditions of outer space take a toll on the human body in a number of ways. Dr. Jeffrey Davis and his team at the Space Life Sciences Directorate at NASA's Johnson Space Center in Houston are charged with anticipating and addressing the human risks of space flight. Their job is to keep astronauts healthy during long duration missions in space…..

Innovation and Collaboration in Federal Govt

- U.S. General Services Administration (GSA)
  - Bev Godwin, Director, Center for New Media and Citizen Engagement, Office of Citizen Services and Innovative Technologies
    - Developing Challenge.gov open innovation platform for all federal agencies and policies to reduce barriers for usage
    - Requested SLSD briefing on open innovation
    - Requested NASA/Wyle participation to test Challenge.gov
    - Requested SLSD challenge posting on Challenge.gov (implemented by Wyle)
    - Invited J. Davis to serve on FedScoop's 2nd Annual Lowering the Cost of Government with Technology Conference in Engaging Citizens Panel-Best Practices from GSA, NASA, and USDA Aug 2010

Innovation and Collaboration in Federal Govt

- Department of Health and Human Services (HHS)
  - Briefings requested by Aman Bhandari, OSTP
    - Congress authorized $10 billion CMS (Medicare/ Medicaid) Innovation Center to start Jan 1, 2011
  - Presented SLSD strategy and results to:
    - Center for Innovation and Strategic Planning/Centers for Medicare and Medicaid Services (Senior Advisor to the Deputy Administrator and staff)
    - Office of the National Coordinator for Health Information Technology, Special Assistant, Innovations
    - Personalized Health Care Initiative staff plus others
  - Follow-up best practices sharing with CMS Innovation Center planned

Innovation and Collaboration in Federal Govt

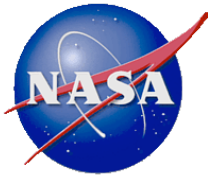
- National Science Foundation (NSF)
  - IdeasLab: collaborative, theme-based research model—joint projects with SLSD under assessment
- National Institute for Standards and Technology (NIST)
  - Technology innovation program
  - Collaborative projects with SLSD to be discussed
- Federal Communications Commission (FCC)
  - Requested briefing on SLSD innovation strategy and results—briefed July 8, 2010

Innovation and Collaboration with Other Organizations

- Harvard Business School
  - Workshops, lectures, case studies
  - MBA student projects and Wyle student interns
  - Projects and corporate connections: TopCoder and GE
- MIT Sloan School of Management Innovation Lab
  - Nike (Sustainability and Innovation)
  - The World Bank Institute Innovation Practice
  - Google
  - Mozilla
  - SAP (Sr. VP Community Network)
  - Pitney Bowes
  - General Mills (VP Innovation)

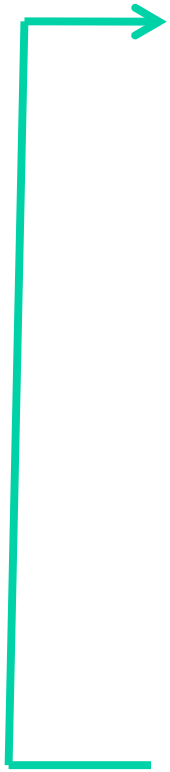
Strategic Framework for Innovation

SLSD Approach to Innovation



- Key components
  - Evidence-based risk management system
    - Continuously evaluates all human system risks across current and future operations, identifies gaps
  - Portfolio mapping of gaps to determine optimal collaborative strategy
  - Implementation of disruptive innovation
    - Optimize SLSD research, technology, operations, and service portfolios through strategic alliances and collaboration (including open innovation)
  - Integrating system to blend old/new tools
    - Disruptive innovation vs. traditional R&TD approaches and continuous improvement

Key Capabilities required across the Collaborative Innovation Spectrum



Strategy formulation → Strategic planning

Program development → Strategic planning; Innovation/program management

Legal/procurement

Program implementation → Discipline expertise; Innovation management

- Evidence base/gaps analysis
- Portfolio analysis
- Challenge definition
- Solution evaluation
- Collaborative Research
- Program management

Portfolio Assessment → Strategic analysis

Technology Devt/Ops

Commercialization → Strategic partnerships

NASA Human Health and Performance Center (NHHPC)

NASA Human Health and Performance Center

- Overarching Goals (*DRAFT)*
  - Integrated human health and performance efforts across NASA and with member organizations
  - Advanced human system research and technology, process, and practice innovations
  - Collaborative projects to enable human spaceflight capabilities and to address broader 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 road map

NASA Human Health and Performance Center

- Objectives (*DRAFT*)
  - Provide a platform to collect, integrate, and disseminate knowledge, best practices, and innovations to advance research, technology development, requirements development, and innovative human health and performance solutions, including in the areas of fundamental biology and cell science;
  - Develop and implement collaborative projects among participant organizations to maximize the use of resources and enable projects that no one organization could do alone;
  - Assess and promote the use of innovative models for solving human system problems, including the use of open innovation platforms and collaborative research models;
  - Provide a forum to facilitate integration and coordination of NASA Center responses to Agency budget calls;
  - Facilitate exchange of requirements and risk assessments between NASA programs and human system research and technology development and operations support to inform the human exploration road map;
  - Develop and implement education and outreach products and programs;
  - Provide virtual and in-person forums for information exchange and to address high priority needs.

NASA Human Health and Performance Center

- Member Organizations
  - will include any entity interested in advancing the goals of the NHHPC and willing to share information and engage in collaborative projects to achieve these goals
  - Initial member recruitment will be focused on NASA Centers to establish the infrastructure for the NHHPC; recruitment of other member organizations will follow.

NASA Human Health and Performance Center

- Federal Agencies interested
  - NIH (ISS utilization)
  - NIST (biomarkers, innovative technologies)
  - NSF (IdeasLab)
  - FAA AST(commercial space workshop)
  - Health and Human Services (multiple agencies)
  - ISS Partners (collaborative human system risk forum)

- Other organizations interested
  - Nike (health, exercise, nutrition)
  - GE (portfolio management, technology development)
  - Philips (technology development)
  - Virgin Galactic, Blue Origin (human system workshop)
  - FAA Center of Excellence

NHHPC Implementation Plan

NHHPC Launch and Operational Milestones

Activity	Delivery Date
LAUNCH (Phase 1)	
• Secure FY10 funding and hire HHP Web Community Manager and Innovation Coordinator	Complete 5/24/10
• Recruit NASA center members	5/10-ongoing
• Recruit other organization members	9/10-ongoing
• Establish Executive Council	9/15/10
• Launch initial phase NHHPC	9/15/10
• Develop draft protocol Russian International Partners	8/30/10
• Recruit International Partner (IP) members	9/10-ongoing
• Define Phase 2 milestones and deliverables	12/15/10
OPERATIONAL (Phase 2)	
• Define administrative structure/process	2/1/11
• Establish operational phase NHHPC	2/15/11

Next Steps

Next Steps

- How do we create an Agency-wide approach to advance collaboration and innovation?
  - Establish NHHPC as Agency resource
  - Expand strategy and innovation management capabilities to other centers
  - Develop multi-center collaborative projects and proposals
  - Create inter-agency partnerships and joint initiatives

Next Steps

- Resource requirements to establish Agency wide approach to collaboration and innovation through the NHHPC
  - Workshops and collaborative initiatives
  - Infrastructure (web) development and support
  - Expanded strategy and innovation management capability for other NASA Centers
  - Open innovation/collaborative innovation platforms and awards (IDIQ contract to build upon successful pilots)
  - Ongoing collaborative projects with HBS (student projects)