The Power of Crowd Based Challenges

NASA's Practical Toolkit for Open Innovation

NASA's Center of Excellence for
Collaborative Innovation (CoECI)

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NASA's Mission

Drive advances in science, technology, aeronautics, and space exploration to enhance knowledge, education, innovation, economic vitality, and stewardship of Earth.

Translation for NASA Workforce

Develop/Improve designs and methods that safely accomplish this mission within the constraints of the NASA budget.

This largely involves **developing systems** that can:

Get the job done (mostly to overcome the challenges of physics)

Minimize Mass and/or **Volume**

Minimum Power

Maximum Reliability

Minimum Cost

Other: Thermal, Safe for Humans, Stands up to Harsh Environments

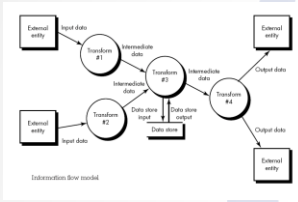
Current Toolset

To Accomplish This Mission

Center of Excellence for Collaborative Innovation

Innovative Methods

Brainstorm, Structured Analysis, Sprint

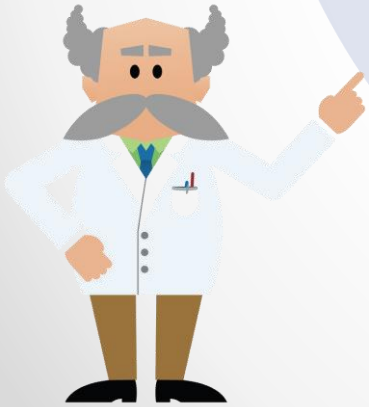


Technical Journals & Associations

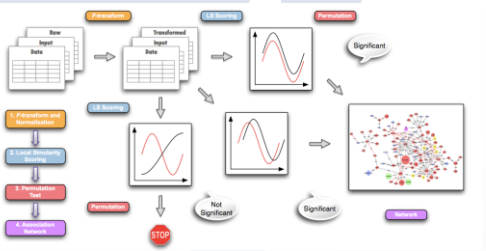
Smart, Innovative Team Members with Lots of Training, Degrees, and Experience

Experts

Grey Beards, Consultants, Contractors



Internet Search



Labs & Analysis Tools

Training

A New Toolset is Now Available

open

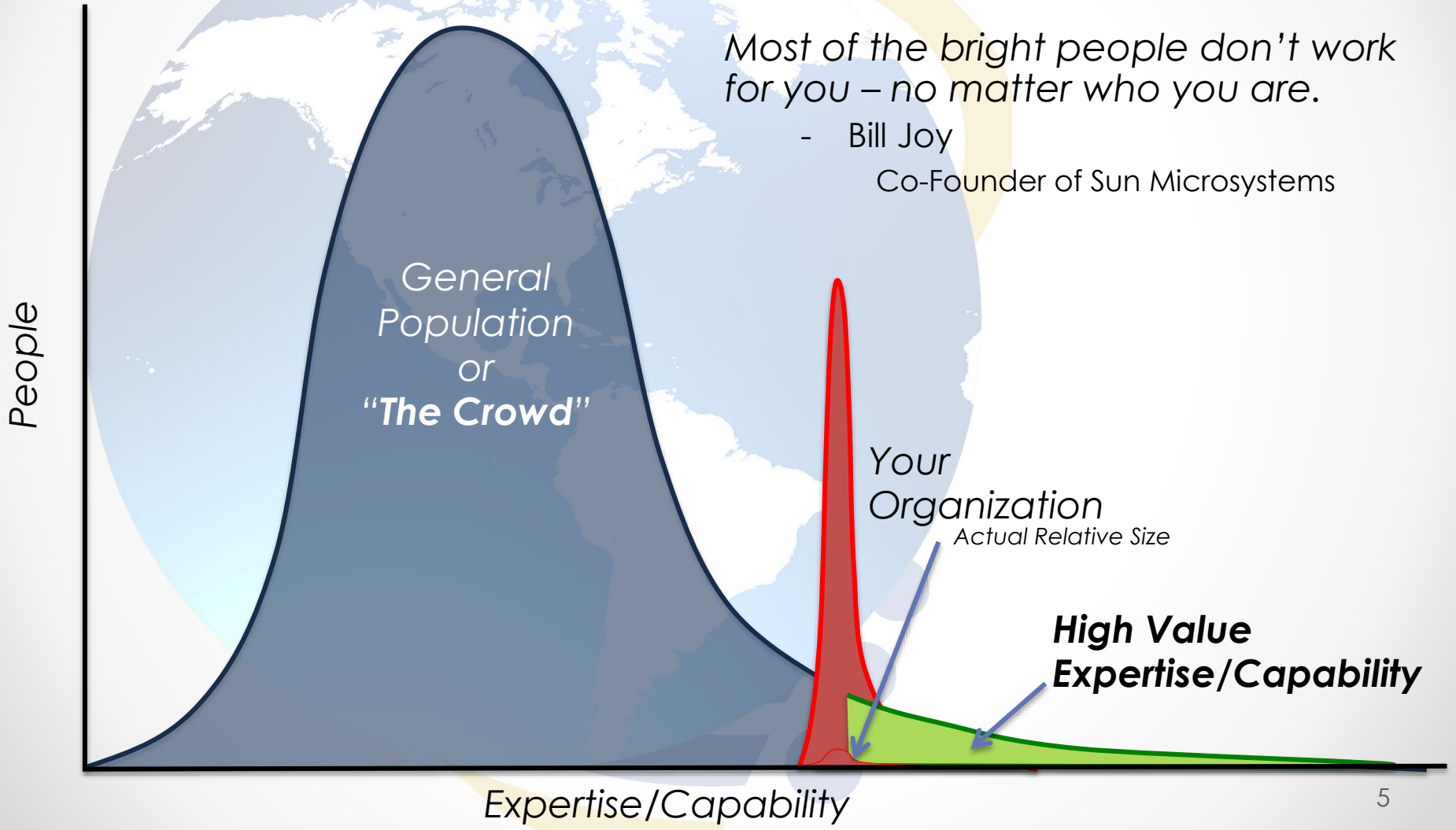
Accessing people outside your organization up to and including the global public

to find

Innovation

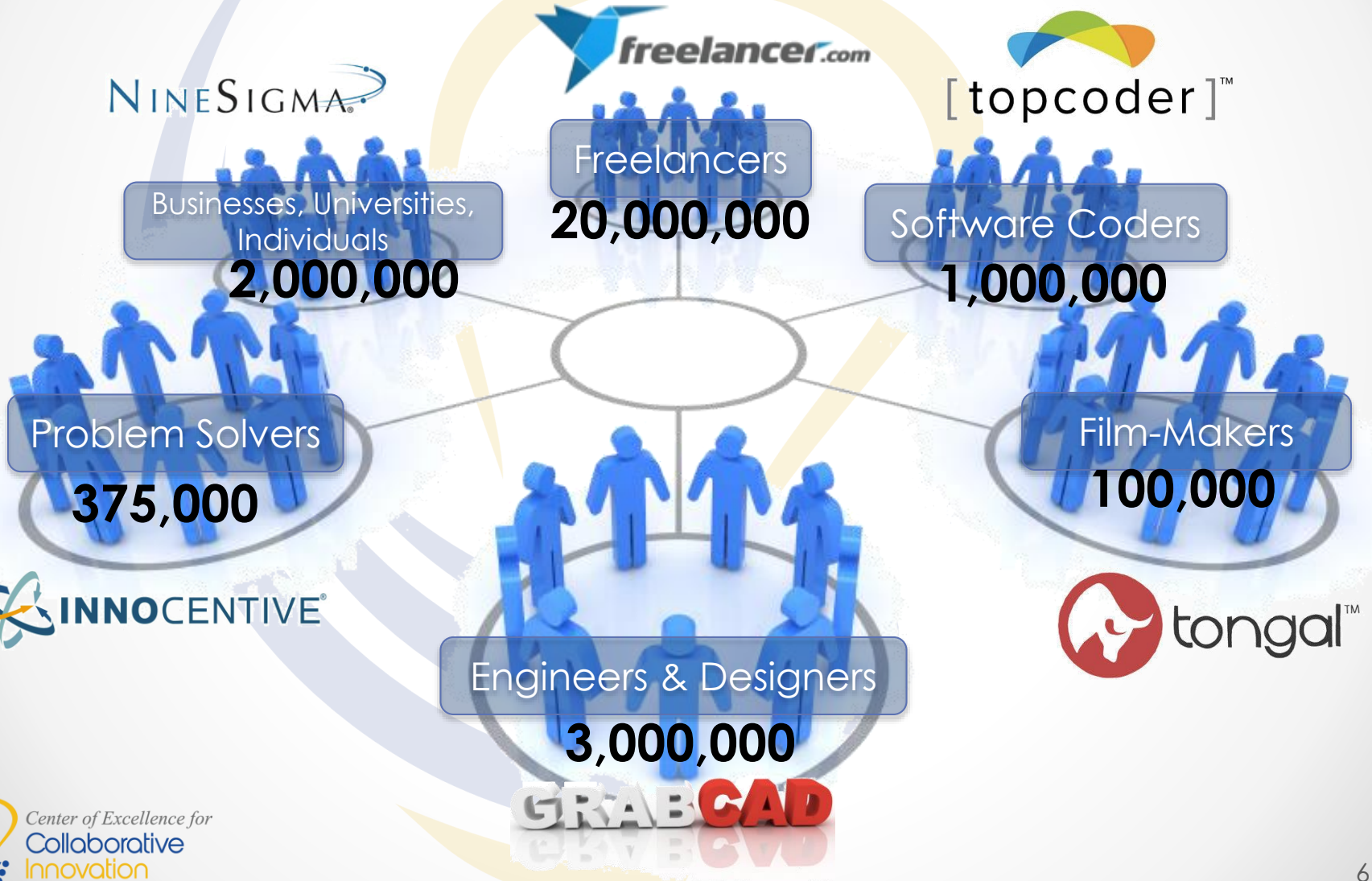
ideas, concepts, designs, or solutions that meet a previously unmet need possibly resulting in significant advances in performance.

Who Has The Expertise/ Capabilities You Need?



Networks & Communities

Curated Communities



Center of Excellence for Collaborative Innovation

Curated Communities

Resources and Tools for Members

User Agreements for Privacy and Payment

Incentives for Members to Participate

Community Building & Communication

Mechanism for Handling IP Licensing and/or Transfer

Curated communities are built around enabling people to pursue their passion and create a win-win for the company and its community members.

They provide structure and incentives.

Communities do NOT like to be exploited!

Texas A&M
“Kyle Field” Stadium
Capacity: 102,733

All of NASA Civil Servants and Contractors
60,000

InnoCentive
375,000

Technical
Problem
Solvers

Community is 6X
larger than
NASA's
Workforce

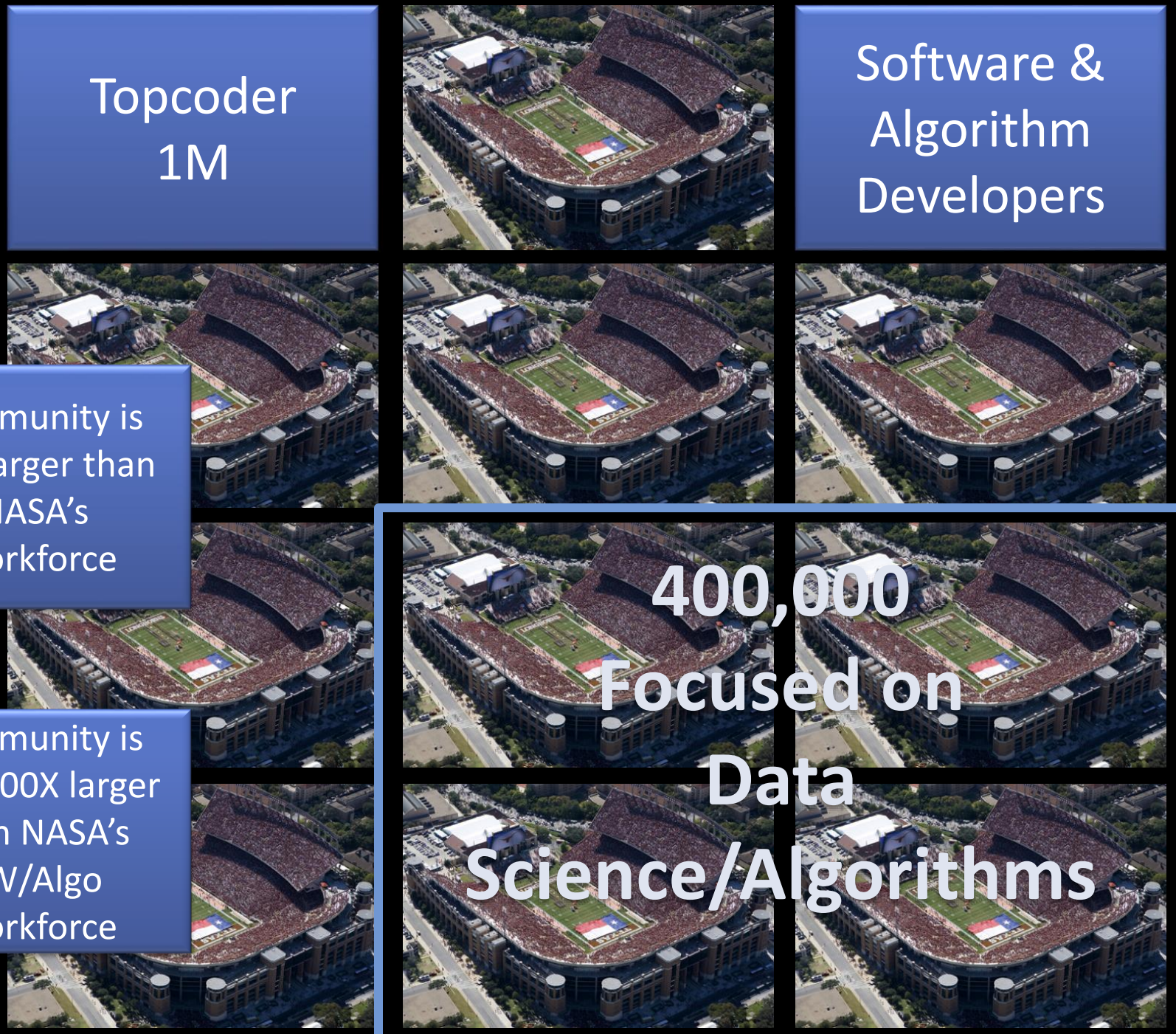
Topcoder 1M

Software & Algorithm Developers

Community is 17X larger than NASA's Workforce

Community is 200-500X larger than NASA's SW/Algo Workforce

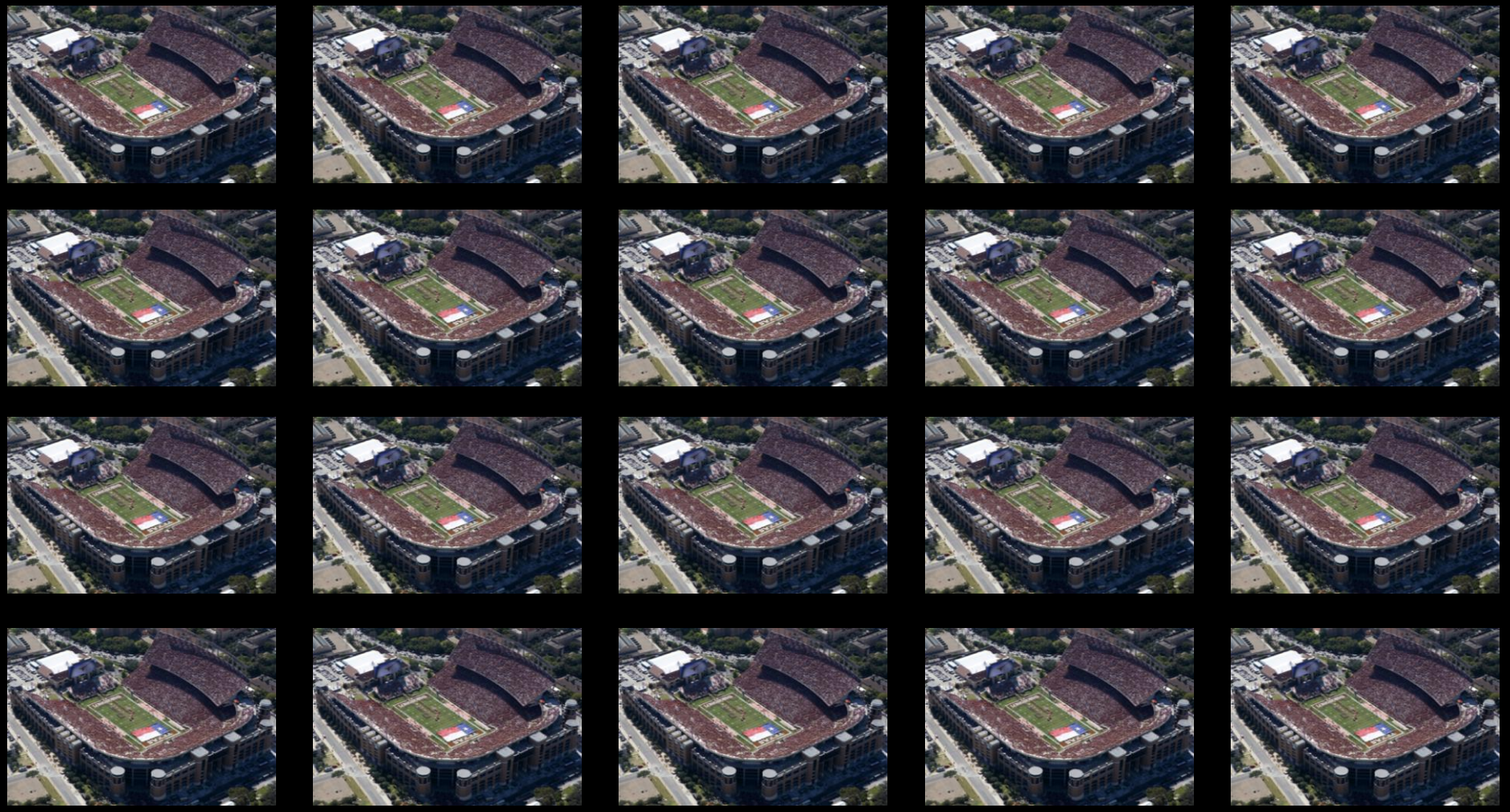
400,000 Focused on Data Science/Algorithms



NineSigma
2M

Technical
Problem Solvers
Network of Individuals,
Universities, & Companies

Community is 33X
larger than NASA's
Workforce



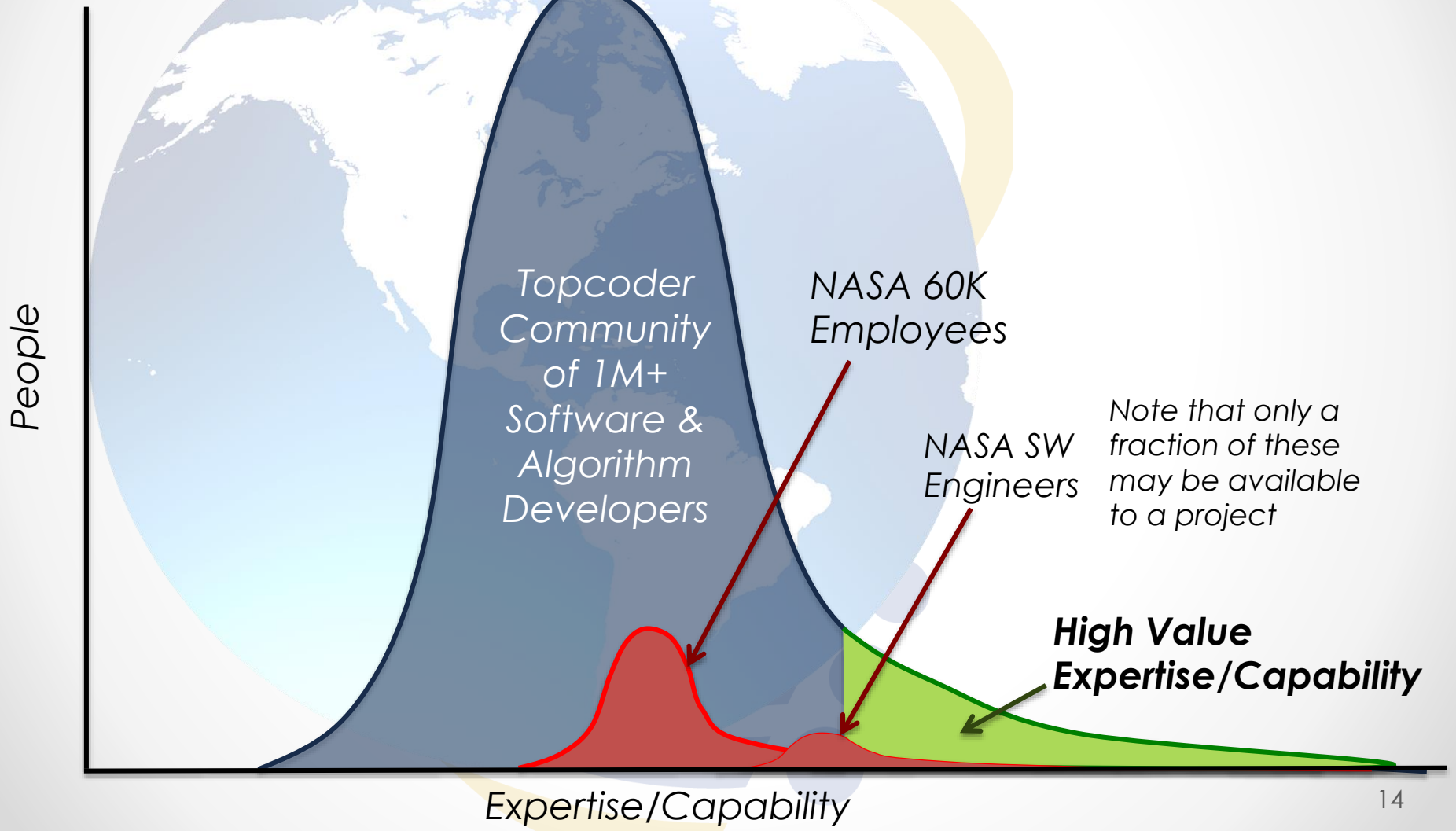

GrabCAD
3M
Mechanical Engineers and Designers
Community is 50X larger than NASA's Workforce
>500X CAD Design

Freelancer 20M

Multi-Discipline Freelancer Workers

Community is 333X larger than NASA's Workforce

Specialized Curated Communities



Formulate the Problem Statement

A well formulated problem statement
(with good success criteria)

Design the Challenge

A well designed challenge
(including setting the right prize amount)

Execute the Challenge

Knowing how to do all of these steps really helps to mitigate the issues associated with this "too many solutions" problem.

Solution Filtering (optional)

Solution filtering mechanisms are offered by some platforms

Pick the Winner(s)
Evaluating

ALL of these steps can help to minimize the number of solutions you end up needing to evaluate.

Get Your Solution
IP licensing and/or transfer

Accessing the Crowd Using Challenges

Why Does The Crowd Contribute?

Earn Money (real or virtual)

Have Fun (or pass the time)

Socialize with Others

Multiple Incentives can often operate in parallel

Obtain Recognition or Prestige

(leaderboards, badges)

Do Good (altruism)

Learn Something New

Obtain Something Else

Create Self-Serving Resource

Gold Guts Good Glory

Effectively Using Communities

Center of Excellence for Collaborative Innovation

Solve a Problem

Create an Innovative New Solution

Apply an Known Existing Technology

(in an innovative way)

Find an Unknown Existing Solution or Technology

(you didn't know existed)

Develop a Product | Provide a Service

Access Best Possible Product or Service

(competition winner)

Access Very Specific Expertise

(found through competition)

Diverse Membership

Innovation from Diversity found via Challenges
(Experience, Context/Perspective, Expertise)

Expert or Domain Focused Membership

High Quality Products/Services
(via Competition to get Best in Domain)

crowdsourcing.org
The Industry Website

May 2011 · www.crowdsourcing.org

Crowdsourcing Industry Landscape

Crowdfunding

Financial contributions from online investors, sponsors or donors to fund for-profit or non-profit initiatives or enterprises.

Collective Knowledge

Development of knowledge assets or information resources from a distributed pool of contributors.

Tools

Applications, platforms and tools that support collaboration, communication and sharing among distributed groups of people.

Collective Creativity

Tapping of creative talent pools to design and develop original art, media or content.

Cloud Labor

Leveraging of a distributed virtual labor pool, available on-demand to fulfill a range of tasks from simple to complex.

Community Building

Development of communities through active engagement of individuals who share common passions, beliefs or interests.

Civic Engagement

Collective actions that address issues of public concern.

Open Innovation

Use of sources outside of the entity or group to generate, develop and implement ideas.

Crowdsourcing is Mainstream

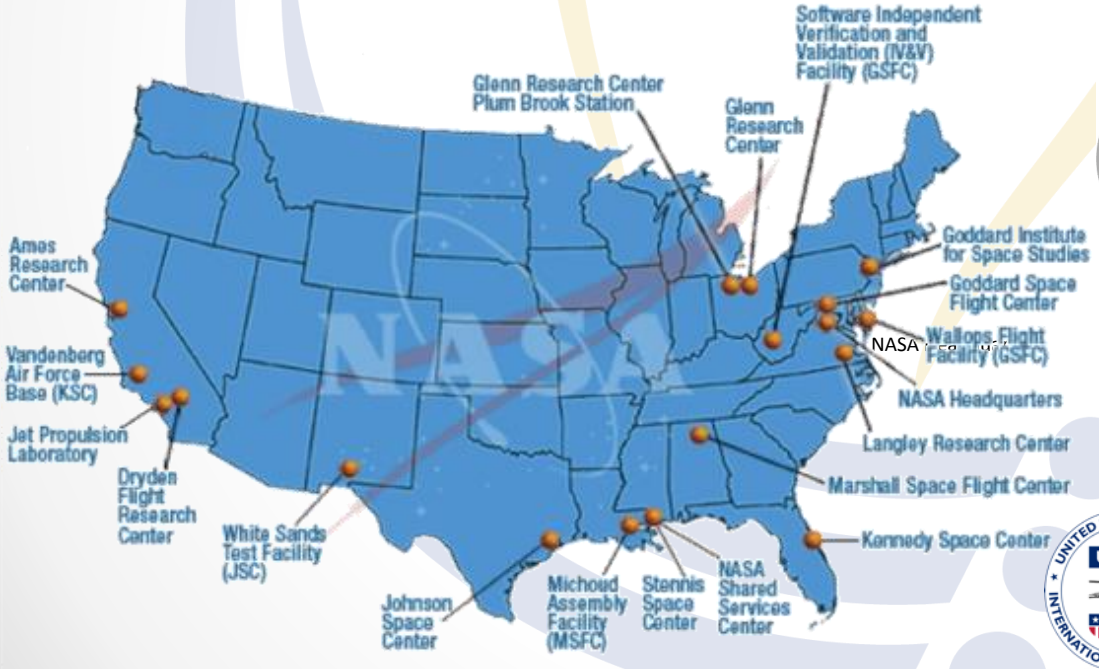
What is NASA Doing with Crowdsourcing?

USAID FROM THE AMERICAN PEOPLE

CMS CENTERS for MEDICARE & MEDICAID SERVICES

NASA's Center of Excellence for Collaborative Innovation (CoECI)

- The **Center of Excellence for Collaborative Innovation (CoECI)** was officially launched in November of 2011 at the request of the White House Office of Science and Technology Policy (OSTP).
- **CoECI** works across all of NASA and with other federal agencies to *infuse crowdsourcing methods as a set of available tools* to create innovative, efficient, and optimal solutions to real world problems.



US Federal Agencies

The Center of Excellence for Collaborative Innovation

Jason Crusan
Director CoECI
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HEOMD, NASA Headquarters

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Deputy Director CoECI
Director, Human Health and Performance
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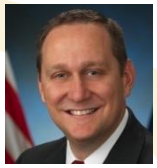

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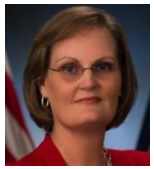
Deputy Manager CoECI
Human Health and Performance
NASA Johnson Space Center



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Stellar Solutions – NASA Headquarters

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Business/Innovation Architect
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Stellar Solutions – NASA Headquarters

Carissa Callini
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Wyle - Johnson Space Center

Michael Ching
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Jeff Doi
Information Management Specialist
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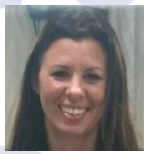
Wyle - Johnson Space Center

Robert Lewis
Web Community Manager
Human Health and Performance
Wyle - Johnson Space Center

Christine Jenkins
Technical and Business Integration
Human Health and Performance
Wyle/Stellar - Johnson Space Center



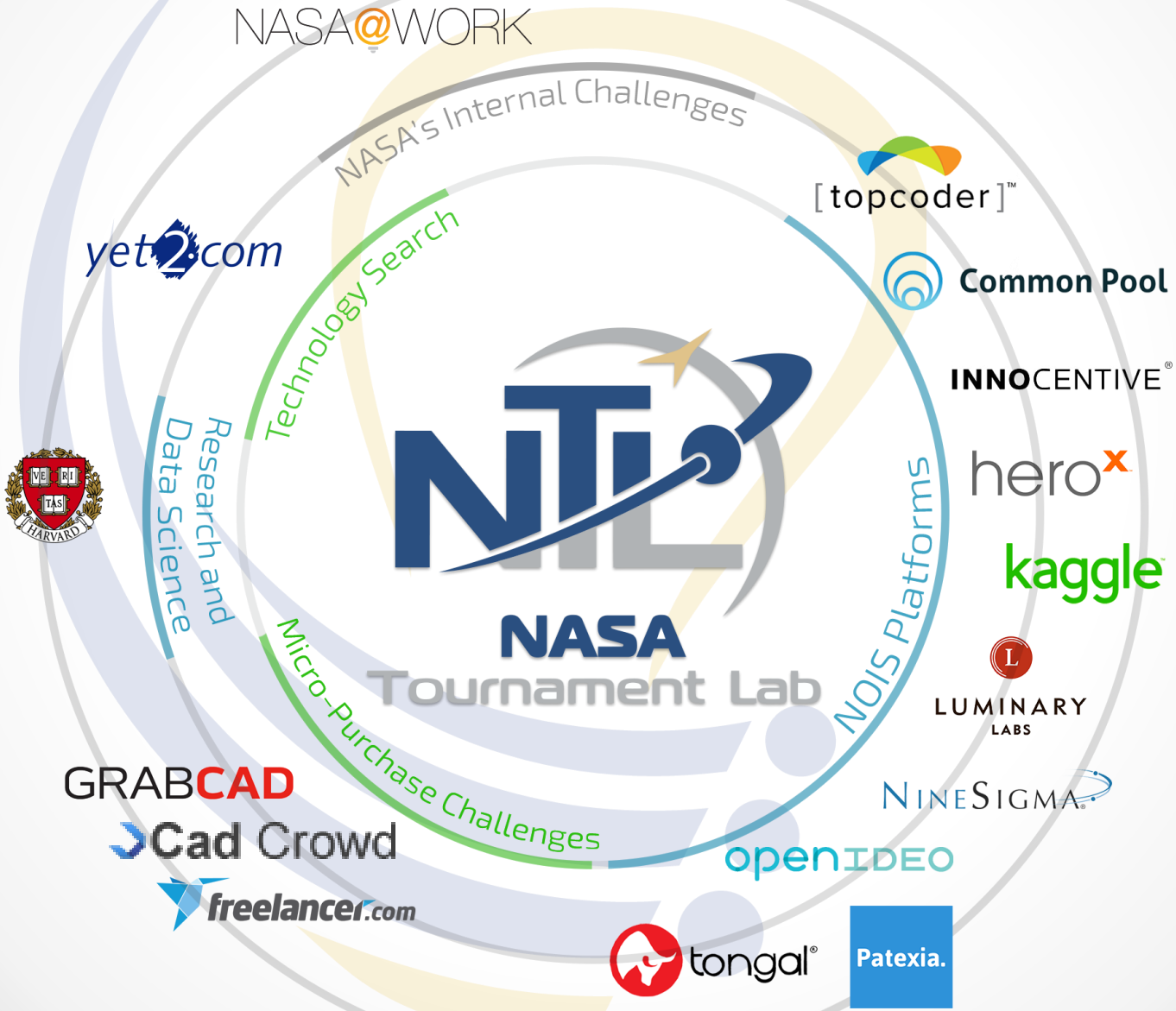
Aubrie Henspeter
Contracting Officer
Procurement
NASA Johnson Space Center

Colleen Wells
Contract Support
Procurement
NASA Johnson Space Center

	Duration	Prizes	Product	Participation
Centennial Challenges	Years	$M+	Tech Dev & Demo	
NTL Curated Community Challenges	Months	$1K-$100Ks	Ideas, Designs, Software	
Student-Focused Challenges	Months	Recognition Rewards	Vary in scope, Inspire, Educate, Partner	
Space Apps Challenge	Days/Weeks	Recognition	Software Apps	

The CoECI Toolkit

Available to ALL NASA Projects



NASA@WORK

Start with our most innovative community: NASA

NASA@WORK

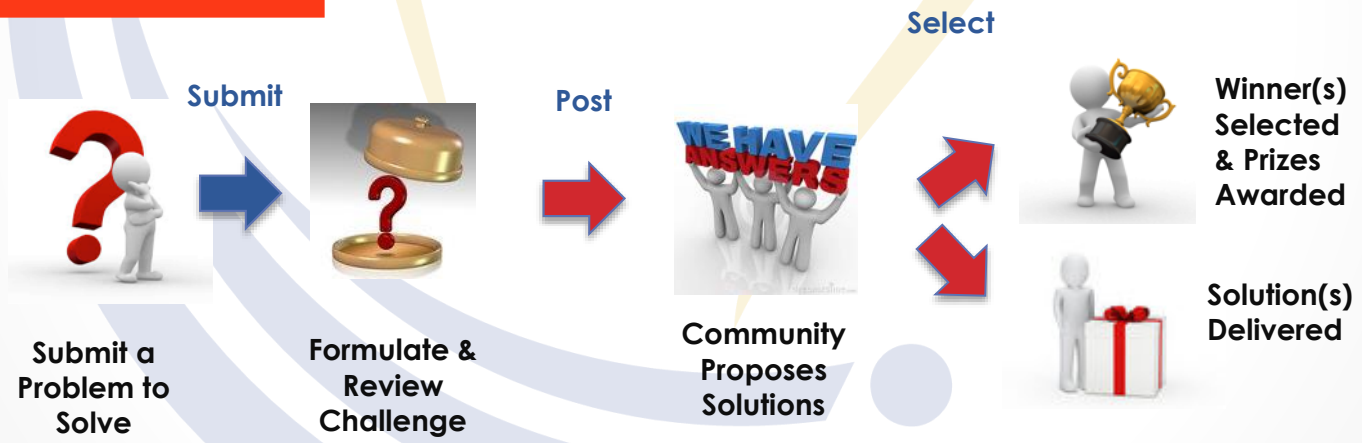
nasa.innocentive.com

Using Your NASA ID Max Login

What Is NASA@work?

- A NASA-wide platform for employees to find technical solutions, new ideas, or expertise using prize-based challenges (crowdsourcing).
- Operated by the NASA Center of Excellence for Collaborative Innovation (CoECI)
- Supported and funded by OCT

How Does It Work?



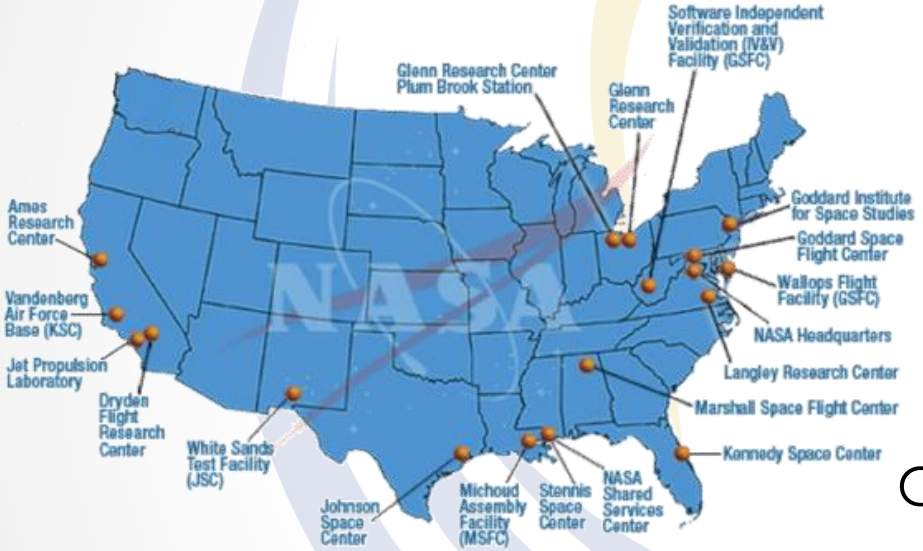
Time Investment:	30 min Challenge Owner	2-3 hrs Challenge Owner	10-15 min NASA@work Solver	1-3 hrs Challenge Owner

NASA@WORK

People that work at NASA want to make a difference!

Over 19,000 Registered Members

(+32% of NASA's 60,000 CS & Contractor Workforce)



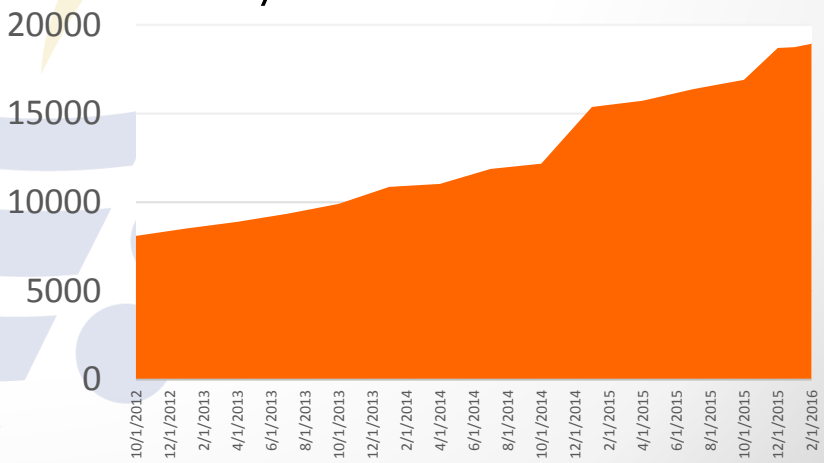
18-20 Challenges per Year

2-4 Active challenges posted at any one time

113 Challenges Posted

~80% Success Rate

Growth of the NASA@work Community since October 2012



Welcome to the NASA@work platform!

This platform is open to Civil Servants. Contractors may be able to participate with approval of their company management. If you are a contractor, read important information that you and your company need to be aware of before using this platform.

Newsflash: NASA@work August Bulletin

Create a Challenge

Suggest a Challenge

FEATURED CHALLENGES

Non-Treadmill Device that provides Treadmill Benefits for Future Mars/Exploration Missions #2147

Posted by Moore, Cherice (JSC-ER311) on Aug 10, 2015

Exercise is a major mitigation to many deleterious physiological effects of spaceflight and is required for crewed missions. In particular, treadmills have been critical in providing multiple physiological benefits to crewmembers for missions greater than approximately 30 days, including reduced degradation of:

1. Bone structural strength of lumbar spine, pelvis, femoral neck and trochanter (due to the ground reaction forces of approximately 2-3 times the person's body weight that are reacted by the bones and muscles of the lower body)
2. Cardiovascular fitness (due to the increased heart rate from aerobic exercise)

Read more...

Sep 18, 2015

Award Details >>

OPEN

50 Solutions/Replies Submitted

Engineering, Experimental Design, Hardware / Systems / Design, Human Health and System Support, Ideation, Operations, Technology Development

Edit | View Challenge | Deadline OFF | ON Following

Voting Challenge: The Write Stuff! #2179

Posted by Drake, Bret G. (JSC-XM111) on Sep 01, 2015

The initial review and evaluation of the The Write Stuff Challenge have been completed (to see the original challenge write-up, please visit: https://nasa.innocentive.com/ici/UXChallenge/show/2122). The Challenge Owner received a fantastic response and the NASA@work community now has the opportunity to vote for their favorite stories!

Sep 11, 2015

Award Details >>

OPEN

LEADERBOARD

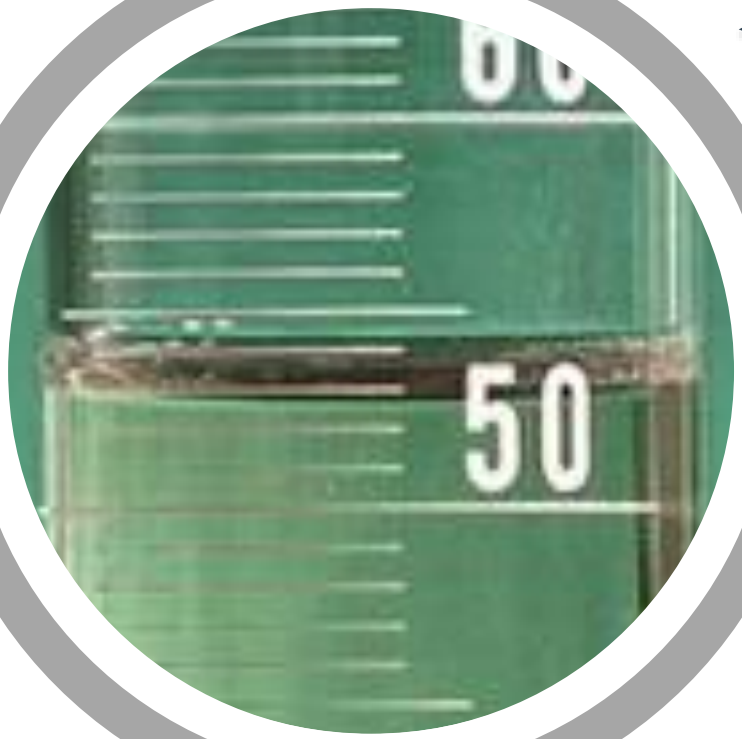
Recent winners

Arai, Tatsuya (JSC-XA111)[OCEANEERING SPACE SYSTEMS]	
Solved:	2
Posts Written:	4
DARCIE, CHRISTINA M. (JSC-EC311)	
Solved:	2
Posts Written:	4
Sims, Jerry L. (IVV-1800)	
Solved:	1
Posts Written:	1
Dorris, Karen J. (JSC-OP)[BARRIOS TECHNOLOGY LTD]	
Solved:	1
Posts Written:	3
LAUCHNER, ADAM C. (JSC-OZ)[THE BOEING COMPANY]	
Solved:	1
Posts Written:	4
Moore, Kevin (JSC-OP)[BARRIOS TECHNOLOGY LTD]	
Solved:	2
Posts Written:	17
Schneiderman, Jason S. (JSC-SK)[WYLE INTEG. SCI. & ENG.]	
Solved:	1
Posts Written:	4
Hintze, Paul E. (KSC-UBR30)	
Solved:	2
Posts Written:	3

RECENT ACTIVITY

Determining Urine Volume in Microgravity

Challenge –
Sought to identify an alternate method for real-time in-flight urine volume measurements and maintain the capability to take samples to Earth for additional analysis



60 Submissions

2 Solutions Awarded

Saved an estimated $1.3 M; 3-5 years

Center of Excellence for Collaborative Innovation

NASA@WORK

Results

- Microgravity Capillary Graduated Cylinder (working prototype) and Calorimetry
- Unknown collaboration was identified within a sister organization

Odor Control and Trash Containment for Orion

Challenge –
Find a way to control the odor from trash and waste for long duration (21 day) missions on Orion with mass and volume minimized.

29 Submissions

5 Solutions Awarded

Significantly Advanced Towards a Solution

Center of Excellence for Collaborative Innovation

NASA@WORK

Results

"We received a lot of great ideas….unique innovative ideas were submitted … Great results overall - gave us a huge head-start on this project's development." Holly Cagle – Challenge Owner

Use of Thorium Instead of Uranium

Challenge –
This challenge sought to identify any research that NASA has conducted into the use of Thorium instead of Uranium to generate nuclear power

17 Submissions

1 Solution Awarded

Also discovered Apollo-era research results

Center of Excellence for Collaborative Innovation

NASA@WORK

Results

Winning submission was “instrumental in helping KSC understand the research NASA has funded in this area” Michael Lester– Challenge Owner.

Lab Equipment Obsolescence: Cytometer

Challenge –
This challenge sought to identify cost-effective solutions to keep the Cytometer in operable use

41 Submissions

4 Solutions Awarded

Significantly Advanced Towards a Solution

Center of Excellence for Collaborative Innovation

NASA@WORK

Results

- Challenge received 4 different detailed suggested solutions that have a high chance of helping to achieve the challenge goals.
- Life extension of this hardware will save significant budget.

Display Format Development System for Deep Space Human Spacecraft

Challenge – Looking for displays for use onboard a deep space human module to be used by the crew in combination with Orion spacecraft

51 Submissions

2 Solutions Awarded

Owner impressed at the number and quality of submissions

Center of Excellence for Collaborative Innovation

NASA@WORK

Results

- Both solutions were viable and previously not known to the Challenge Owner (CO)
- Implemented several displays using the software platform that was selected

Washing Produce Grown in Space!

Challenge –
Seeking practical method solutions to sanitize produce grown on ISS.

37 Submissions

2 Solutions Awarded

Estimated cost savings of $125K

Center of Excellence for Collaborative Innovation

NASA@WORK

Results

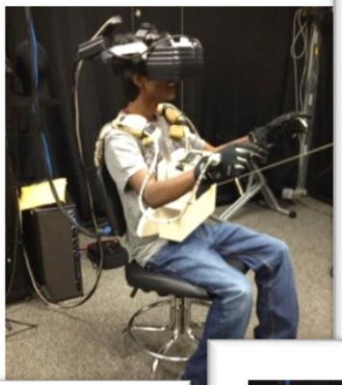
- Two solutions selected viewed as practical and effective
- One of the biggest benefits was collaborating with JSC on SBIRs activity currently in work

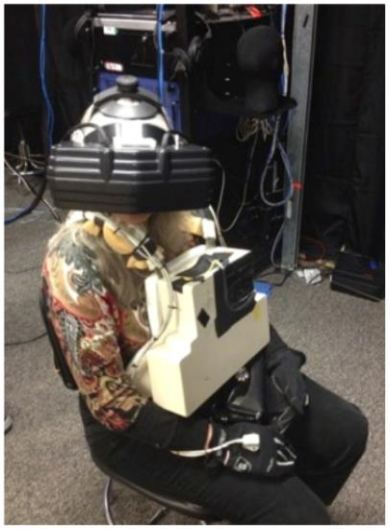
NASA@WORK

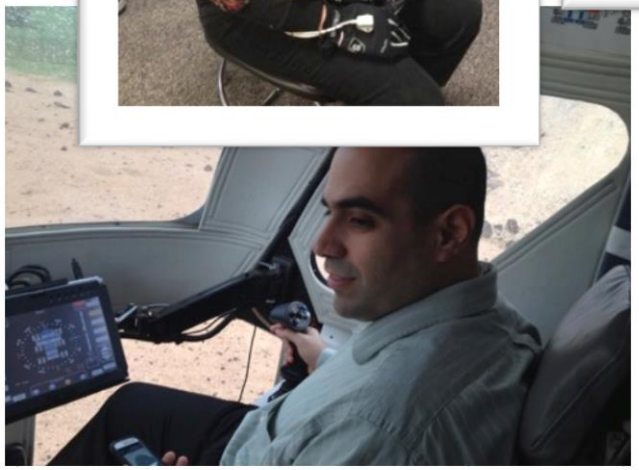
Incentive Program:

1. Cool NASA Experience
   - a cool tour for the winner at their center
2. Astronaut Autographed Item
   - personalized astronaut autograph for the winner
3. Item Flown in Space
   - an NASA@work sticker-badge that was flown in space
4. NASA External Public Recognition
   - public recognition on the NASA@work external website; tweets by multiple NASA handles
5. Recognition by Center Director and Agency Management
   - a meeting or lunch with the winner's Center Director and/or with Agency Management
6. Call from Space/Social Media Recognition from Astronaut
   - a call from space or social media recognition from an astronaut
7. Themed Award System
   - a themed award system based on how many times a winner has won on the NASA@work platform


NASA







NASA@WORK

Join by going to

http://nasa.innocentive.com

Use Your NASA ID Max Login

NASA Open Innovation Services (NOIS) Contract

- In June, 2015 NASA announced the results of the NASA Open Innovation Services (NOIS) Procurement.
- Result was 10 contracts with 10 companies who specialize in challenge management and administration in a variety of disciplines on a variety of platforms.
- Greatly expanded the kind of challenges NASA can launch as well as generating some healthy competition among the companies on contract.

Innovation & Problem Solving Challenge Results

Using Challenges with Diverse Communities to develop unique and innovative approaches to unsolved problems

NTL Innovation Platforms

- Innovative Problem Solving Communities composed of large diverse communities with a variety of expertise
- Over 5 years of experience with InnoCentive challenges
- New NASA Open Innovation Services (NOIS) Contract added new communities
- A total of 6 communities focused on Innovative Problem Solving Challenges available to NASA

INNOCENTIVE®

NINESIGMA

LUMINARY LABS

openIDEO

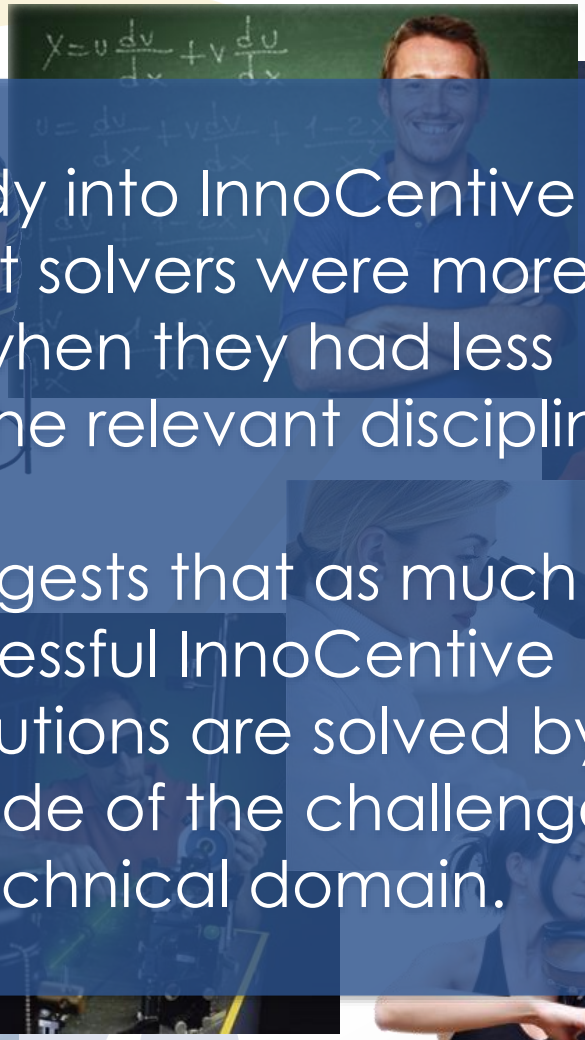
herox

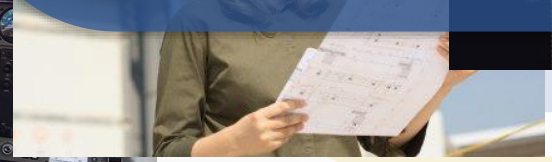
Common Pool

Diversity is the Key to Innovation

One MIT study into InnoCentive revealed that solvers were more successful when they had less experience in the relevant discipline.

Some data suggests that as much as 70% of successful InnoCentive challenge solutions are solved by individuals outside of the challenge's specific technical domain.





Roche

Diagnostics

Swiss company with 80,000 employees, Roche operates in 150 countries and has R&D operations in Europe, North America and Asia-Pacific ($8B+ in R&D annually)

Roche is a world leader in medical diagnostics.

Roche ran an InnoCentive challenge:

A $20,000 prize to develop a better means of measurement in an automated chemical analyzer

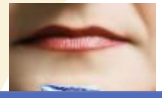
"In 60 days, Roche was able to **solve a problem** that it and its partner have been tinkering with and optimizing for the **last 15 years.** The solutions provided actually mirrored the entire history of Roche's R&D programme. **All of the solutions Roche had tried** came in. "

Julian Birkinshaw, MLabnotes, University of London Business School

InnoCentive: Current Industry Challenges

Seeking New Technologies for Denture Adhesives

Enel Challenge: Portable Communication System for Tunnels and Confined Spaces



HeroX	30 open challenges (50+ total)	38M members
NineSigma	27 open challenges (2500+ total)	2M members
InnoCentive	23 open challenges (2000+ total)	375K members
The Common Pool	14 open challenges (30+ total)	100K members
Luminary Labs	11 open challenges (15+ total)	100K members
OpenIDEO	6 open challenges (40+ total)	85K members
Patexia	1 open challenge (170+ total)	12K members

Over 100 industry and government innovation challenges are in progress right now*.

*As of May 13, 2016

Challenge: Fast Current Switch in Plasma Device

Estuary Systems

Portable Roof Damage Detection

NON-INVASIVE MEAUREMENT OF INTRA-CRANIAL PRESSURE

Challenge - Non-invasive method or technology to measure the absolute intracranial pressure (i.e., the pressure of the interior of a human's head).

Total Cost to NASA$35,000

Challenge Award $15,000

Resulted in Partnerships

INNOCENTIVE

NTL NASA Tournament Lab

Center of Excellence for Collaborative Innovation

Results

- UCLA's ICP Algorithm was selected as winning solution; Also identified via a Tech Scouting effort
- Being considered as addition to active flight study pending accuracy validation

MARS BALANCE MASS

Challenge - Ideas to find dual purpose for balance mass that is jettisoned from Mars landers to balance the aircraft during entry and landing

Total Cost to NASA$50,000

Challenge Award $25,000

INNOCENTIVE

NTL NASA Tournament Lab

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Concept for Future Lander Designs

Results

- Winner: Concept for ionospheric and atmospheric analysis of Mars via tracer element release
- Honorable Mention: Concept to study Mars winds using deployable micro-balloons

STRAIN MEASUREMENT OF KEVLAR WEBBING

Challenge - Solve a 3-year-old problem for how to test Kevlar webbing for its durability in the trying conditions in space.

Total Cost to NASA
$40,000

Challenge Award
$20,000

72 Submissions from 19 Countries

INNOCENTIVE

NTL NASA Tournament Lab

Center of Excellence for Collaborative Innovation

Results

3 Awards for similar solutions - winning solutions were quick, simple & easy to test

"So simple, so elegant how could we NOT have thought of this ourselves."

Tom Jones, Deputy Project Manager, Research Lunar Surface Systems

GALACTIC COSMIC RAY

2 Challenges -
To develop concepts for protection of humans from Galactic Cosmic Rays (GCR).
To develop specific magnetic field or material layer configurations to improve GCR protection.

Total Cost to NASA (per challenge)$32,000 & $48,000

Challenge Awards $12,000 & $0

Pay for Performance - No Solution, No Prize

INNOCENTIVE

NTL NASA Tournament Lab

Center of Excellence for Collaborative Innovation

Results

- No concepts or solutions were found that the GCR team was not already aware of and working
- Validated the GCR team's approach to addressing this very difficult issue

TEST METHODS FOR ASSESSING WEAR FOR SPACE SUIT TEXTILES

A challenge seeking proposals for test methods or procedures to assess wear/damage to candidate space suit textile materials

Total Cost to NASA$40,000

Challenge Awards 3 x $5,000

23 Submissions from 7 countries

NineSigma
Accelerating the Innovation Cycle

NASA Tournament Lab

Center of Excellence for Collaborative Innovation

Results

- Three different test methods were awarded with quite different approaches.
- One Team from University of Akron, one from a graduate student, and one from a metal worker.
- Winning solution provided a quick and easy test method that yields clear and concise results.

CONVERTING IN SITU MATERIALS

A challenge seeking systems that can convert in situ materials into interlocking structural elements for construction that can support exploration on a planet.

Total Cost to NASA$40,000

Challenge Awards 3 x $5,000

Winning solution from a world recognized leader in the field

NineSigma
Accelerating the Innovation Cycle

NASA Tournament Lab

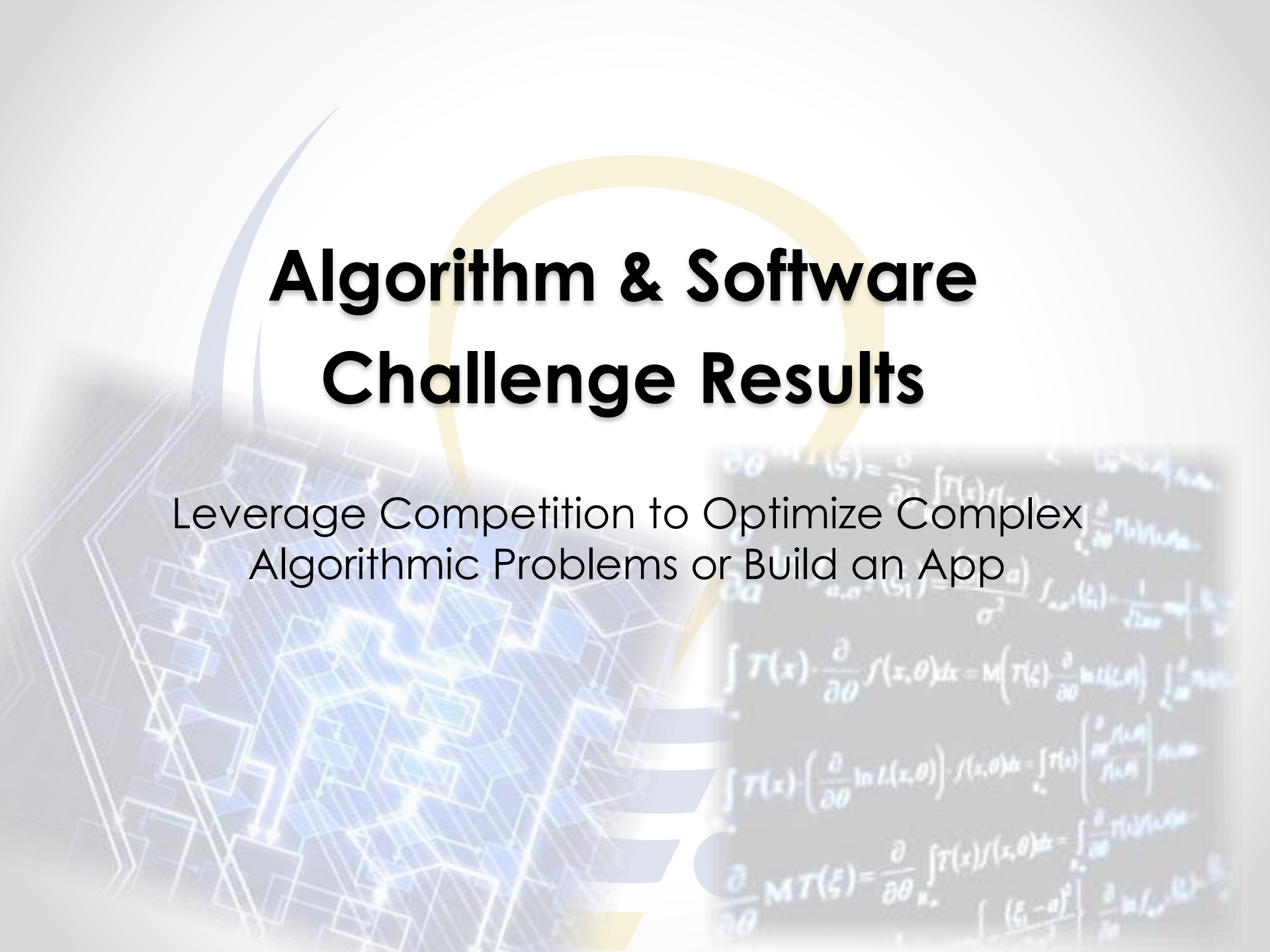
Center of Excellence for Collaborative Innovation

Results

- 3 winning concepts/technologies were selected
- Submissions were all very detailed with supporting math and chemistry data
- A wide range of approaches were submitted (63 submissions total)

Algorithm & Software Challenge Results

Leverage Competition to Optimize Complex Algorithmic Problems or Build an App



NTL Algorithm & Software Platforms

- Data Science and Software Development Communities composed of large communities with both specialized expertise and diversity.
- Over 5 years of experience with Appirio (TopCoder) challenges
- Services available include:
  - Big data/data science algorithm development and machine learning
  - Software Application Development (full life cycle)

kaggle

[topcoder]™

NTL NASA Tournament Lab

INNOCENTIVE®

NINESIGMA®

Common Pool

Winning solution performs 120x faster

Improve on NIH MegaBlast algorithm for nucleotide sequence alignment

The Challenge

Improve on NIH MegaBlast algorithm for nucleotide sequence alignment

4.3 hours
$2M+
Multi-year
Development

47 min.
$120K
1 year
Development

16 sec.
$6K Prize
14 Day
Challenge

Active Software & Algorithm Contests

TopCoder Contests

GE - Customer Training Management Tool Wireframe Challenge (UX)

Kaggle Contests

Draper Satellite Image Chronology

Topcoder members	80 open challenges (40,000+ Total)	1M
	23 Design *57 Development* *2 Data Science*	
Kaggle	16 open allenges (215 total)	300K members

Almost 100 government and industry algorithm & software challenges are in progress right now*.

*As of May 13, 2016

Response REST API (Coding)

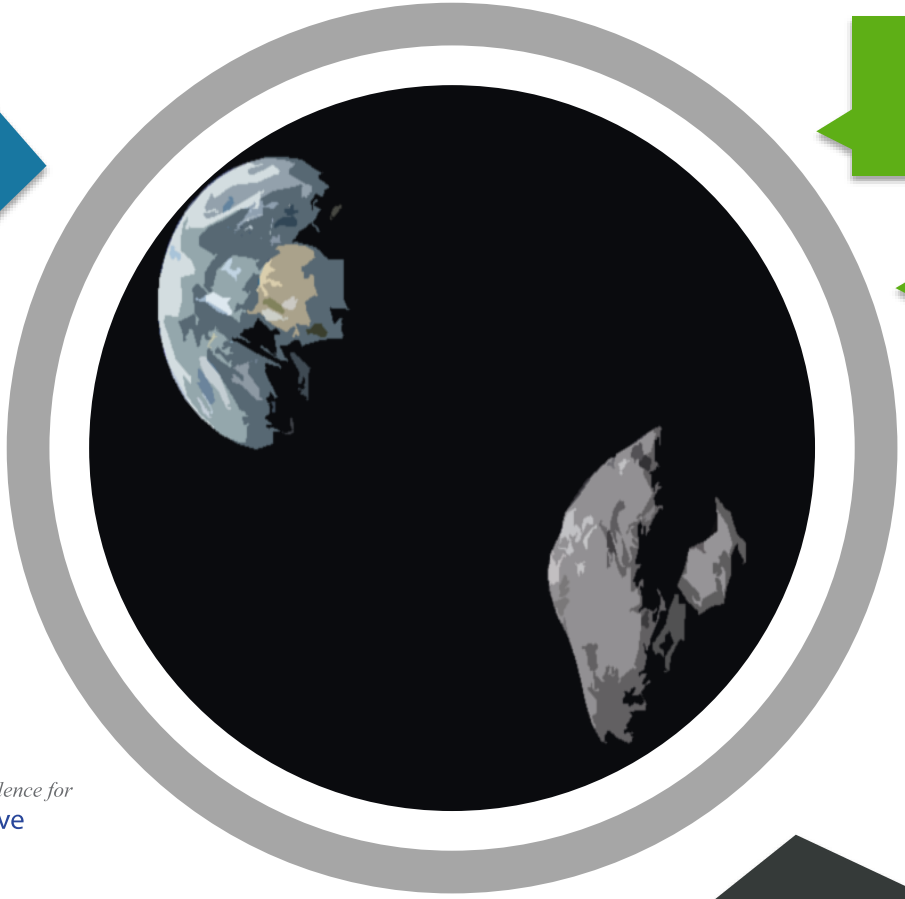
Titanic: Machine Learning from Disaster

The Gates Foundation - Binary to Text Software Performance Challenge in C (Algorithm)

Facial Keypoints Detection

ASTEROID DATA HUNTER

Challenge - Create an algorithm to detect moving objects using Catalina Sky Survey (CSS) data



Total Cost to NASA$186,980

Challenge Award $71,370

15% Improvement

[topcoder]™

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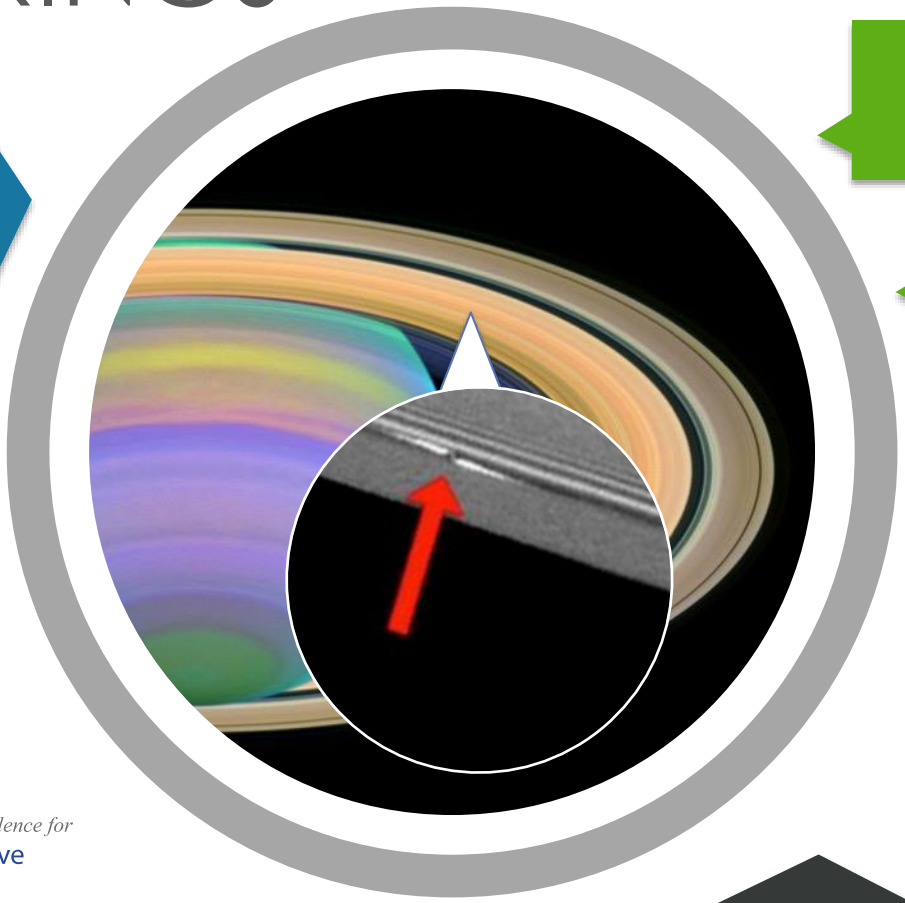
Center of Excellence for Collaborative Innovation

Results

- 15% improvement over current methods
- Open Source App available for download on any laptop (9000 downloads as of 3/2016)
- Maintained by Planetary Resources, Inc.

PLANETARY DATA SYSTEMS CASSINI RINGS

Challenge – Find anomalies and features of interest in the rings of Saturn using an algorithm that are not otherwise detectable by a computer due to false-positives



Total Cost to NASA$100,000

Challenge Award $28,400

Detects 81% of known anomalies in the rings of Saturn

[topcoder]™

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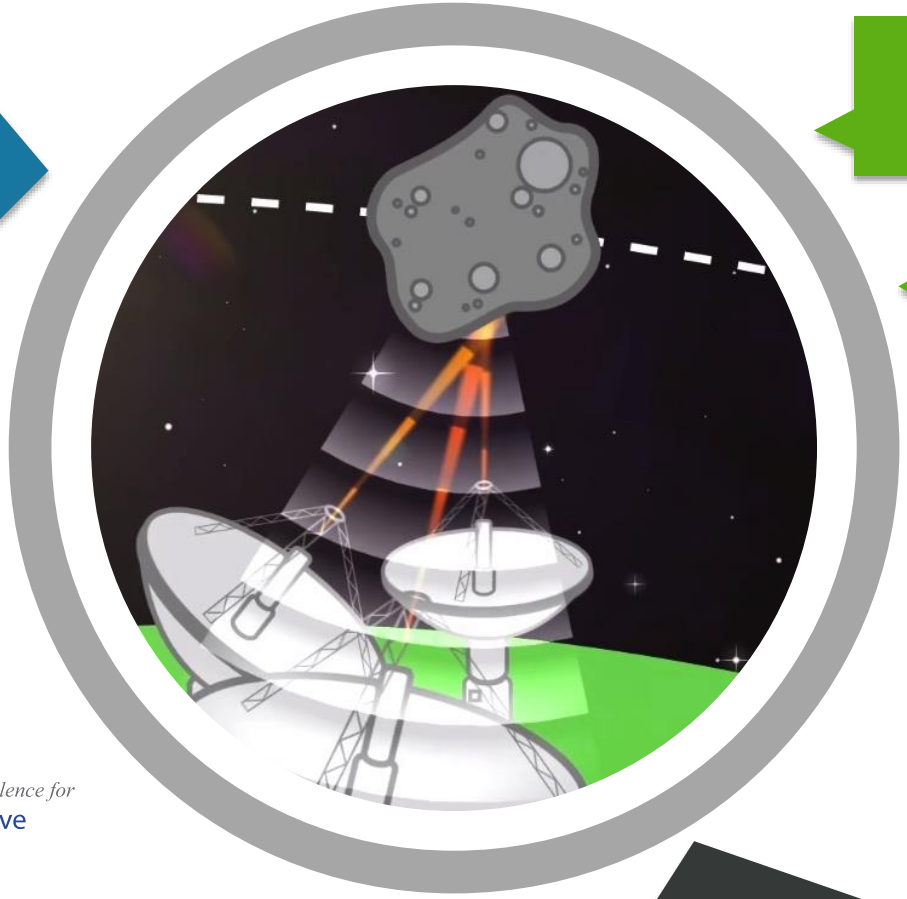
Center of Excellence for Collaborative Innovation

Results

- Algorithm improves understanding of ring phenomena, ring structure and can potentially find new moons
- Solution found 81% of known anomalies and 4 new not previously identified propellers (propellers are created by moons hidden in the rings)

ASTEROID TRACKER

Challenge - Optimize the use of an array of radar dishes when tracking Near Earth Objects



Total Cost to NASA$61,386

Challenge Award $36,288

1-2 FTE Cost Savings

[topcoder]™

NASA Tournament Lab

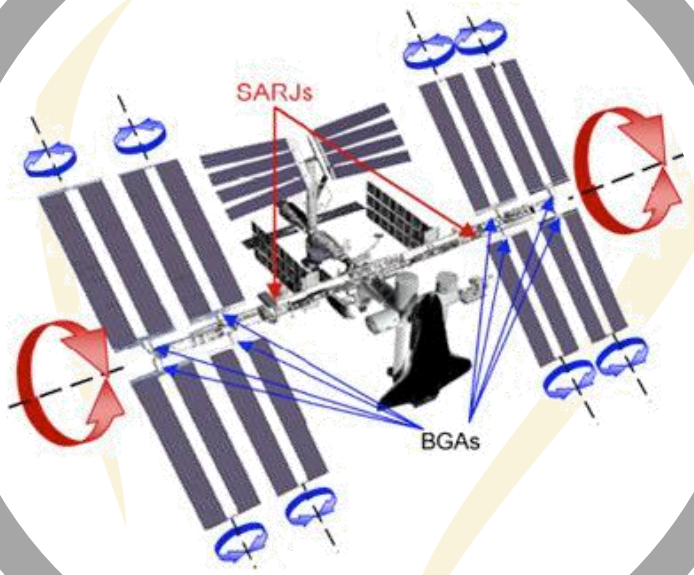
Center of Excellence for Collaborative Innovation

Results

- Provides time based allocation of dishes to various target asteroids
- Delivered as Open Source software under an Apache 2.0 license

ISS LONGERON

Algorithm for power optimization for the International Space Station to maximize power production while minimizing impact to solar array structure



Total Cost to NASA$80,000

Challenge Award $40,450

459 Participants& 2000+ submissions

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Results

- Resulting algorithm performs comparably with current ISS tools (but developed for a fraction of the price)
- Algorithm actually performs better on edge cases.

Using Competitions for Software Development

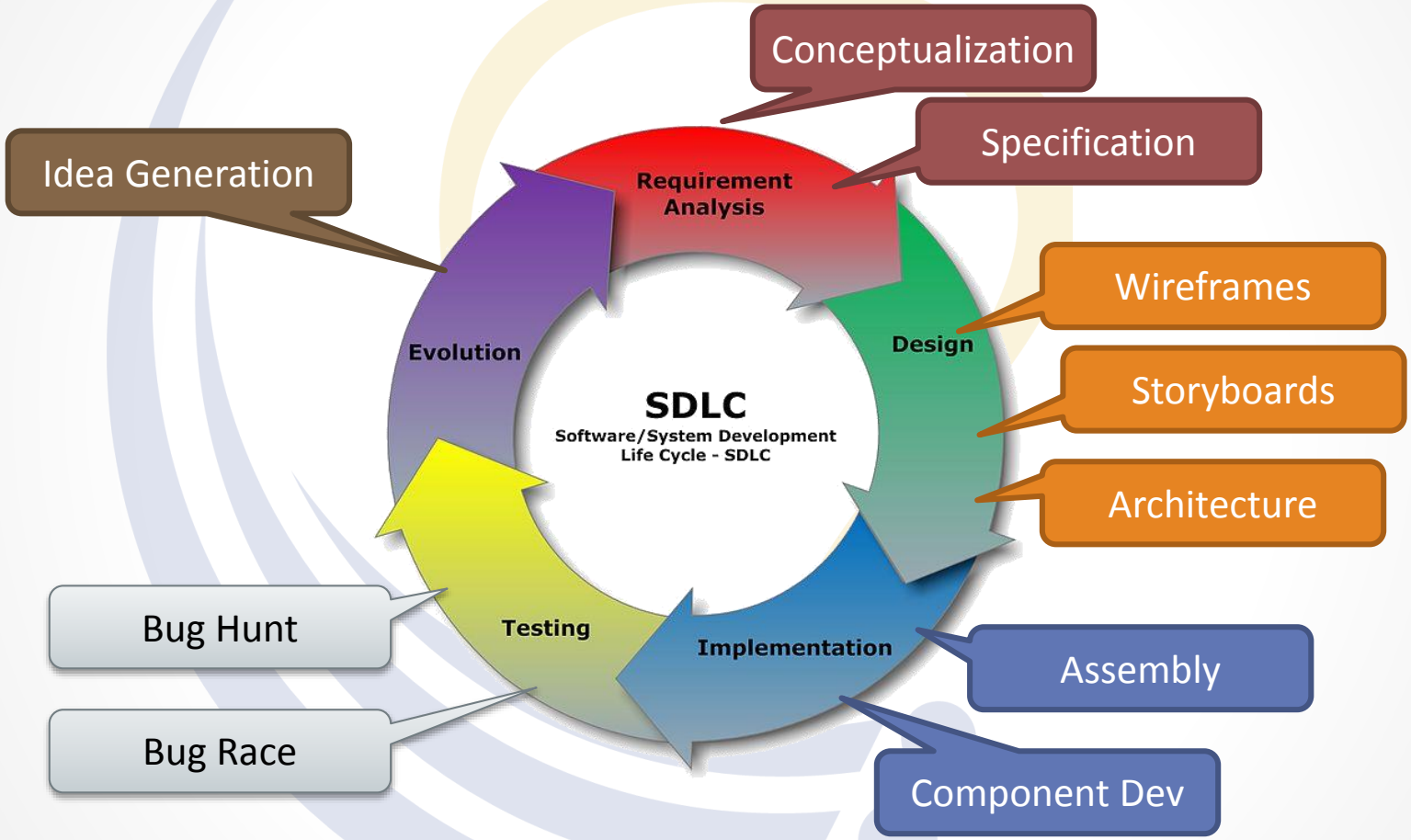
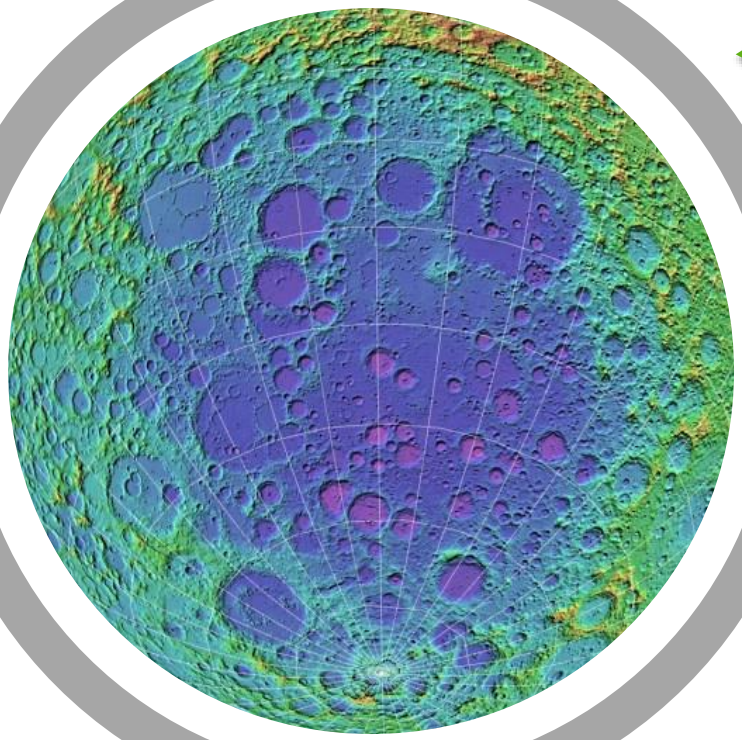


Image Credit: Wikipedia, *Systems development life-cycle*, http://en.wikipedia.org/wiki/Systems_development_life-cycle (as of Mar. 27, 2013, 05:48 GMT).

Source: [topcoder]™

LUNAR MAPPING AND MODELING PORTAL

Challenge – develop an application that takes raw images from the Lunar Reconnaissance Orbiter (LRO) and turns them into rich visualization layers



Total Cost to NASA$81,724

Challenge Award $12,625

Image processing time reduced from 19 to 3 hours

[topcoder]™

NASA Tournament Lab

Center of Excellence for Collaborative Innovation

Results

- Online tool processed LRO images into hi-res geo-referenced mosaic
- Reduced processing time from 19 to 3 hours
- Additional reduction in time by adding additional nodes

ISS FOOD INTAKE TRACKER

Challenge - Create an iPad application for ISS crewmembers to easily enter their dietary intake

Total Cost to NASA$144,600

Challenge Award $36,288

More Detailed Food Log plus Bar Code Scan

[topcoder]™

NTL NASA Tournament Lab

Center of Excellence for Collaborative Innovation

Results

- Will provide NASA scientists a better understanding of nutrition to help mitigate negative physiological effects of spaceflight
- Scheduled for operational use starting in June 2016

DTN Challenge Series

The NASA-wide DTN team has utilized crowd-based challenges to access innovative solutions to hard problems and extend their development team's capabilities

8 Challenges over 2 years

Total Spent $331,630

Used to develop actual flight software

NASA Tournament Lab

Center of Excellence for Collaborative Innovation

Results

- SW Implemented: LTP Auth, Astro Email, Neighbor Discovery
- Innovation: Security Key Architecture, Killer App
- User Interface: DTN Dashboard
- Interface Testing/Validation: DTN2 implementation of DTPC
- Graphics: Series Infographics/DTN Logo

DTN Security Key Architecture

Challenge – Develop a conceptual architecture for exchange of security keys in a disrupted and/or delayed network. There was no known method for achieving this.

Total Cost to NASA$86,985

Challenge Award $26,045

Solved a Previously Unsolved Problem

NTL NASA Tournament Lab

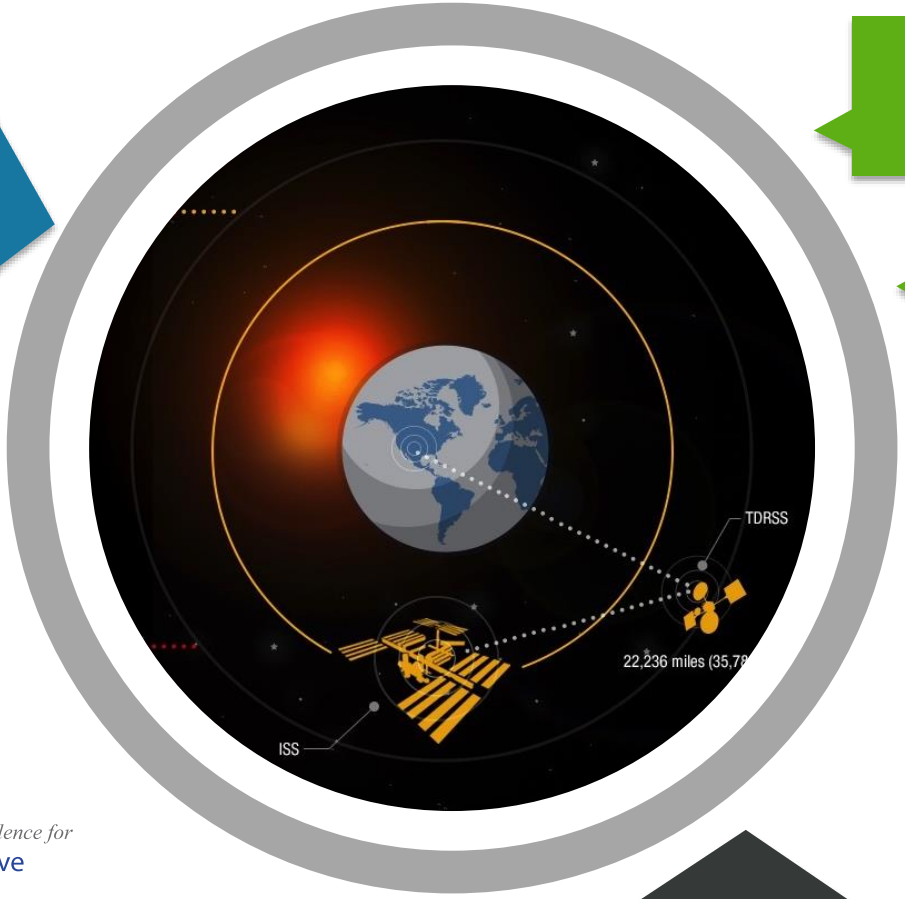
Center of Excellence for Collaborative Innovation

Results

- Resulting architecture successfully solved the problem by applying a variation of the Byzantine Generals' problem (typically used for distributed computing).

DTN ASTRONAUT EMAIL

Challenge – Fix ISS crew email issue caused by communications time delay by adding Disruption/Delay Tolerant Network (DTN) protocol to ISS email software suite.



Total Cost to NASA$142,500

Challenge Award $52,213

Cost was 75% of est NASA dev. costs

[topcoder]™

NASA Tournament Lab

Center of Excellence for Collaborative Innovation

Results

- Enables large file transfer between ISS and the Earth
- Flight certification in process for use on ISS
- Provides a long term solution for email for deep space human exploration missions

DELAY TOLERANT PAYLOAD CONDITIONING

Challenge – Validate the DTN2 implementation of the DTPC protocol and provide interoperability testing against the ION implementation.

Total Cost to NASA$18,100

Challenge Award $8,356

Test and validation of SW against specs

[topcoder]™

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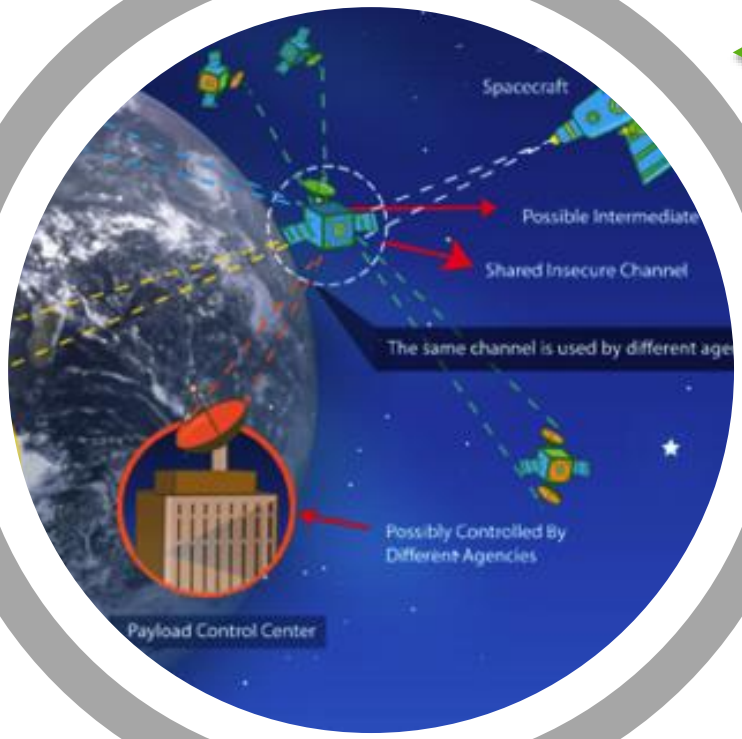
Results

- Produced 66 test scenarios
- Produced 20 test cases
- Successfully demonstrated DTPC interoperability between DTN2 and ION

LTP Authentication

Challenge – Implement the Lidlicker Transport Protocol's Authentication specifications for the ION DTN implementation



Total Cost to NASA$92,300

Challenge Award $52,385

Code Integrated into ION Code Base

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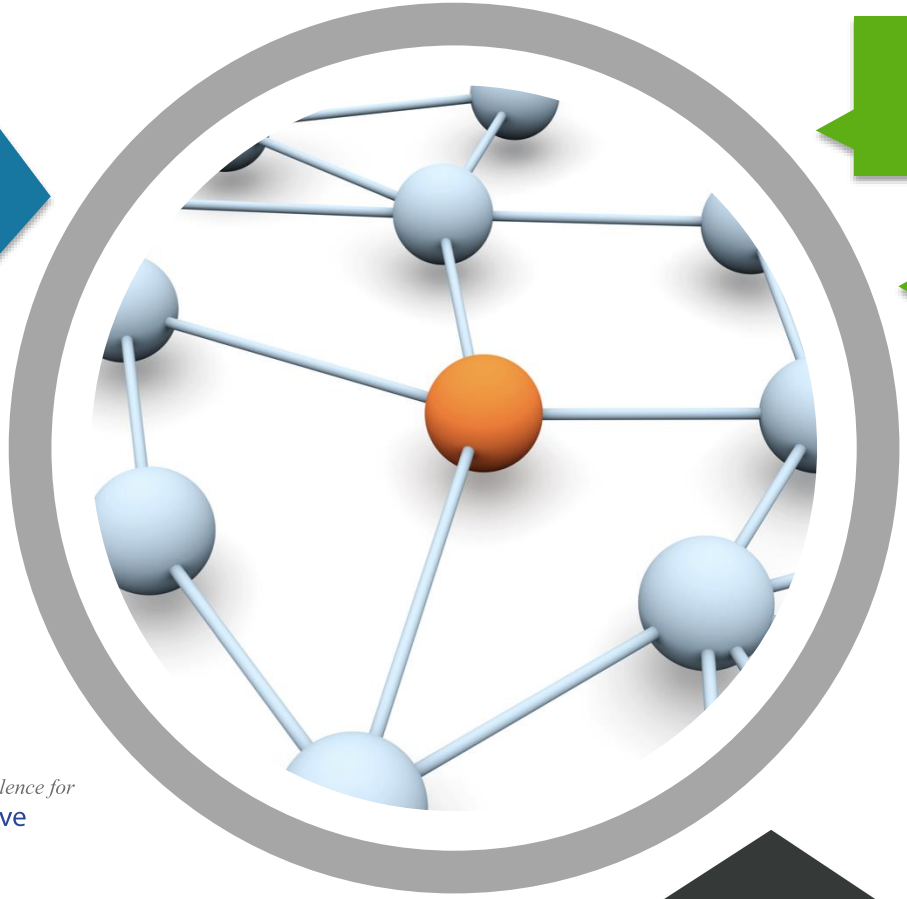
Center of Excellence for Collaborative Innovation

Results

- 2,780 Lines of software code
- Very complete test cases with reusable products (VMs).
- Discovered issues with specifications (valuable to CCSDS.
- Considered a significant win for the team.

DTN Neighbor Discovery

Challenge – Update the DTN ION implementation to include the IP Neighbor Discovery (IPND) protocol specification



Total Cost to NASA$104,129

Challenge Award $45,573

Code Integrated into ION Code Base

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Center of Excellence for Collaborative Innovation

Results

- IPND was successfully implemented and integrated into the ION code base in just 5 months.
- ION is now compatible with DTN2 and IBR.
- Enables the future addition of dynamic routing for DTN.

DTN Dashboard

Challenge – Develop a user interface that can be used to do network management functions for a scalable DTN network.

Total Cost to NASA$23,549

Challenge Award $14,832

Selected the best features from 12 UI designs

[topcoder]™

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Results

- Designed a UI that is easy to use, intuitive and provides capabilities to help manage DTN networks.
- The UI is extremely intuitive and provides the capability to monitor and manage remote nodes in a DTN

SOLUTION MECHANISM GUIDE

Challenge - Create an online tool that allows users to answer a series of questions to pinpoint solution mechanisms to best fit their project needs.

Total Cost to NASA$56,500

Challenge Award $37,474

Cost Effective

[topcoder]™

NASA Tournament Lab

Center of Excellence for Collaborative Innovation

Results

- User and administrative interfaces based on tailorable content management schema
- Delivered as Open Source software under an Apache 2.0 license
- Results exceeded initial expectations – tool currently internally deployed on NASA's network and deployed in the Human Health and Performance Directorate

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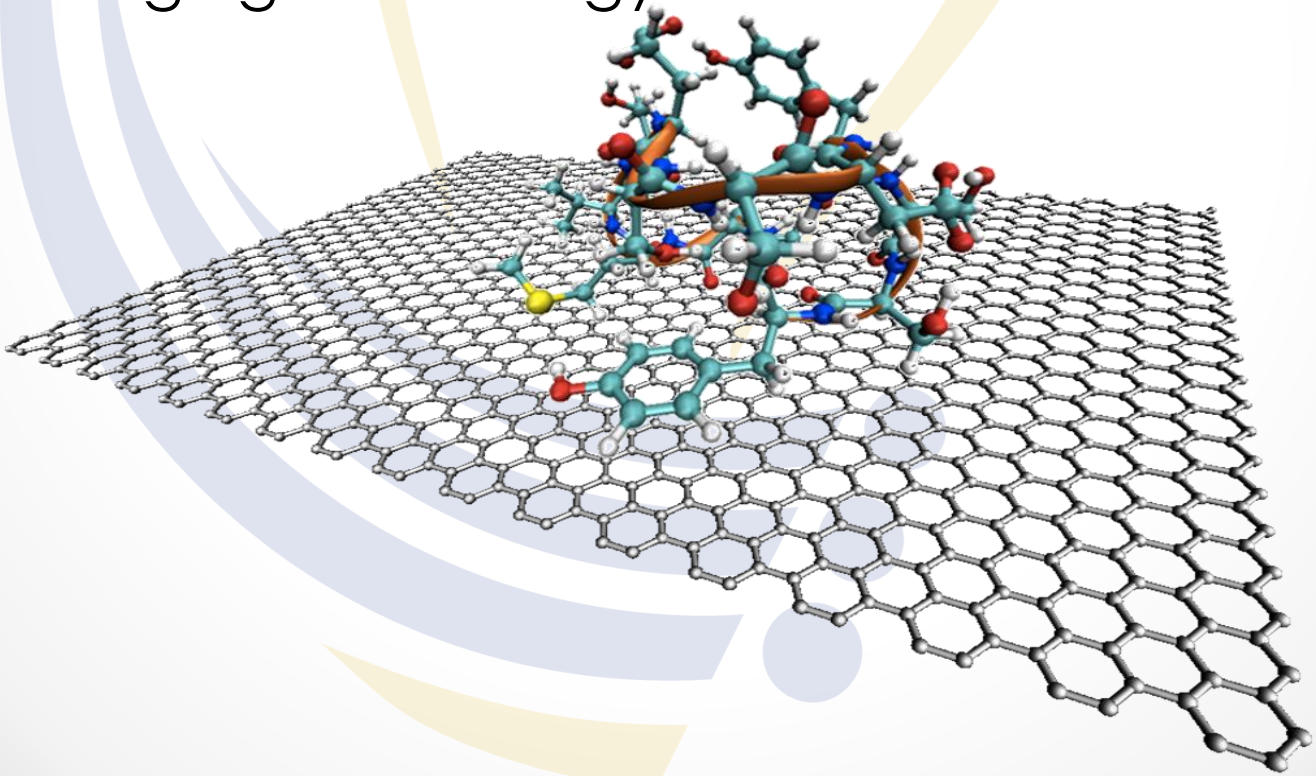
Center of Excellence for Collaborative Innovation

Searching for Technologies

Using New Methods to Search for New and Emerging Technology to Meet NASA's Needs



Yet2.com

Technology Searches

Provides a "matching" service that finds technologies and solutions from industry, academia, and/or individuals for a given need/challenge.

Includes a 130,000 member community and links to over 16,000 commercial entities.

Very effective (and cost effective) in searching for existing products or development efforts.

NASA Tournament Lab

Center of Excellence for Collaborative Innovation

INTRACRANIAL PRESSURE MONITOR

A technology search challenge to find emerging technologies that could help measure intracranial pressure non-invasively.

Budget
$20,000

4 month schedule

Winning solution from a world recognized leader in the field

yet2.com

NTL NASA Tournament Lab

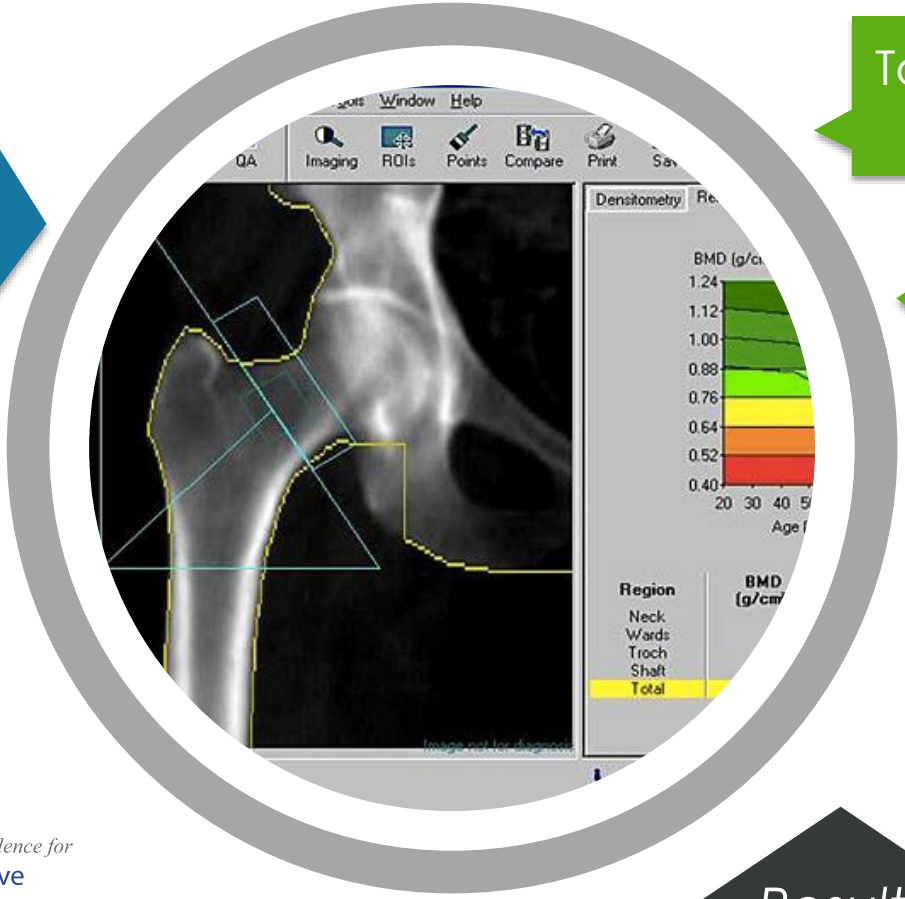
Center of Excellence for Collaborative Innovation

Results

- 3 high interest solutions identified (1 resulting in a partnership)
- "Much more than (they) expected! Very pleasantly surprised that this process exposed so many potential solutions with such wide breadth and depth." – Challenge Owner: J. Villereal

BONE DENSITY MEASUREMENT

A technology search for clinically-useful tech. sensitive to assess the microstructure of "spongy" bone that is found in the marrow cavities of whole bones



Total Cost to NASA $20,000

3 month schedule

Worldwide search across industry, academia, and gov't

yet2com

NTL NASA Tournament Lab

Center of Excellence for Collaborative Innovation

Results

- 51 technology leads identified via the search
- Challenge owner was pleased with the contacts made through the scouting effort.
- 5 active leads resulted from the search.

MONITORING WATER AND BIOCIDES

A search for tech to monitor microorganism content of stored potable water in real time & report the water's status to assure its continued potability for as long as a year.

Budget
$20,000

3.5 month schedule

Over 2000 hits of interest from organizations around the world

yet2.com

NASA Tournament Lab

Center of Excellence for Collaborative Innovation

Results

- 61 technology leads identified via the search (over 2000 hits). 8 active leads resulted from the search.
- Challenge owner was Impressed with information received from effort.
- Found it far more affordable than an SBIR effort and as valuable.

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Micro-Purchase Design Challenges

Leveraging Low Cost Competition to Access Diverse, Innovative Design Space

Cad Crowd

GRABCAD

freelancer.com

3D PRINTABLE ISS HANDRAIL CLAMP

Challenge to develop a design for an ISS handrail clamp that could be 3D printed and still withstand the loads and stresses required.

Challenge Budget
$3,000

Challenge Prize
$2,000

492
submissions
in 30 days

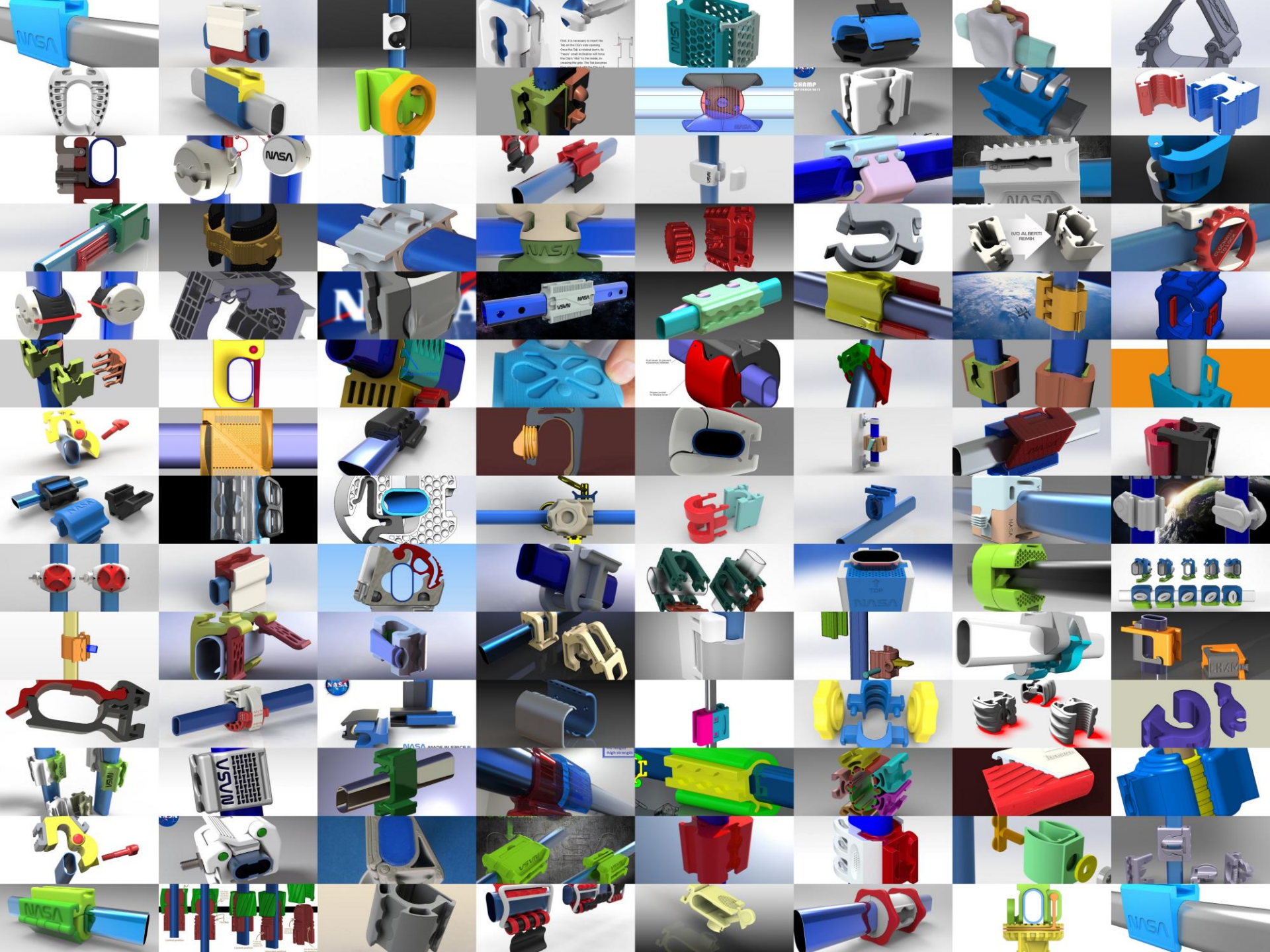
GRABCAD

NASA Tournament Lab

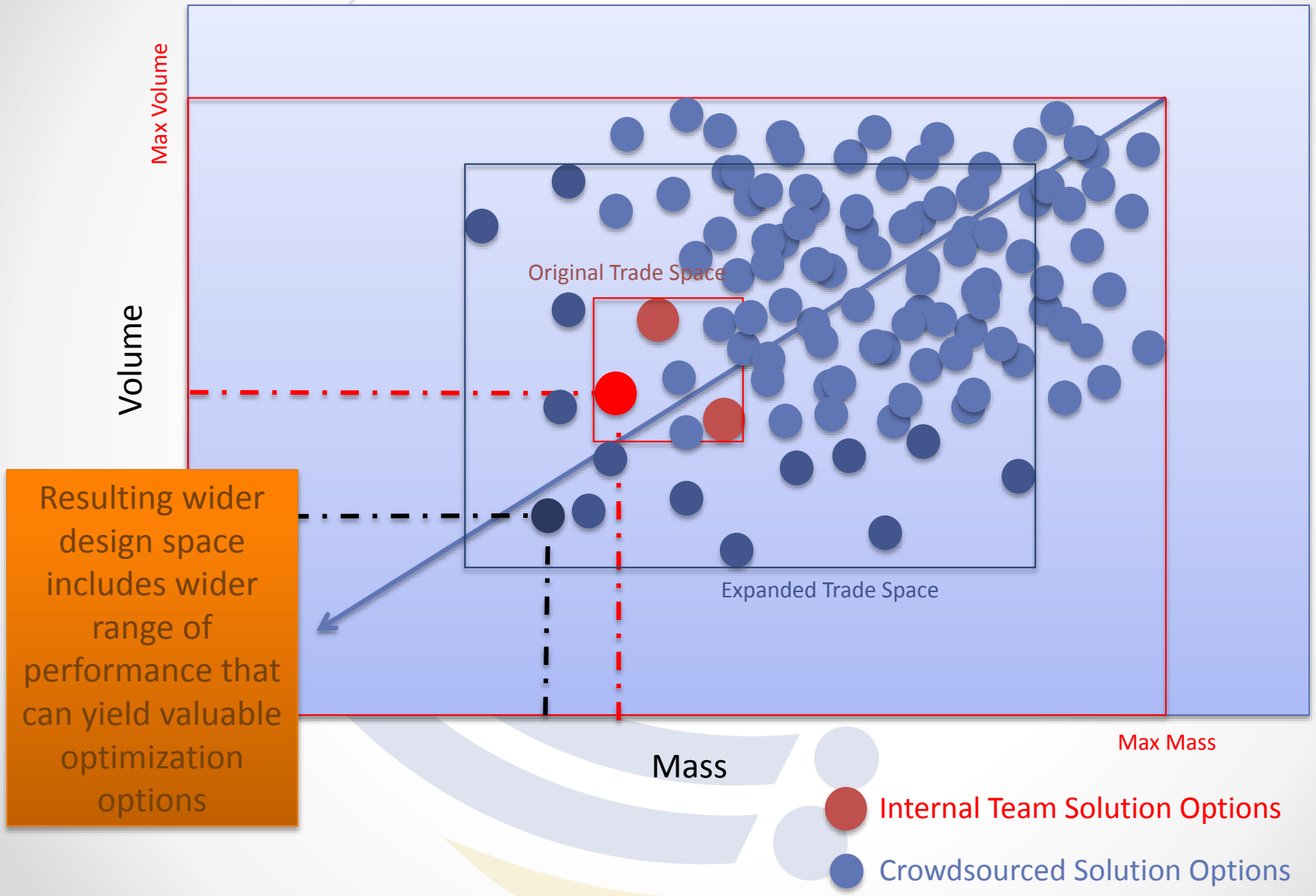
Center of Excellence for Collaborative Innovation

Results

- Selected 5 winning designs from 492 diverse and innovative mechanical designs demonstrating a wide range of approaches.
- Winning designs evaluated for best approaches for in-space printing.



Typical Hardware Design Space (Performance Box)



GRABCAD GE Design Improvement

GE asked the GrabCAD Community to redesign a **jet engine bracket** via 3D Printing methods.

The original bracket weighed 2,033 grams.

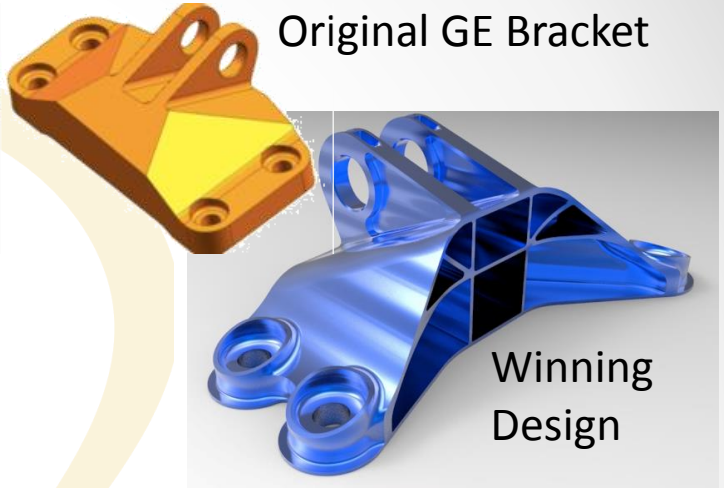
The winner, M Arie Kurniawan, was able to **slash its weight by nearly 84%** to just 327 grams (0.72 pounds.)

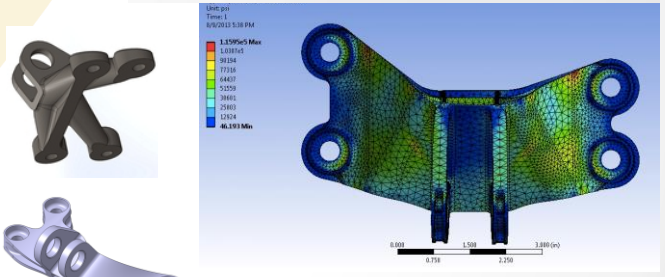
Phase I: 640 Entries for 10 $1,000 prizes.

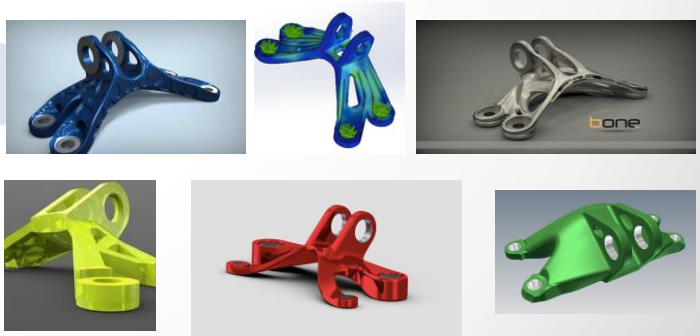
GE Aviation **3D printed the 10 shortlisted designs** at its **additive manufacturing** plant from **a titanium alloy** on a direct metal laser melting (DMLM) machine.

Phase II awarded a total of $20,000 for the top 8 designs that passed testing.

The GE Global Research (GRC) engineers strapped each bracket to an MTS servo-hydraulic testing machine and exposed it to axial **loads ranging from 8,000 to 9,500 pounds**. **Only one of the brackets failed** and the rest advanced to a torsional test, where they were exposed to torque of 5,000 inch-pounds.

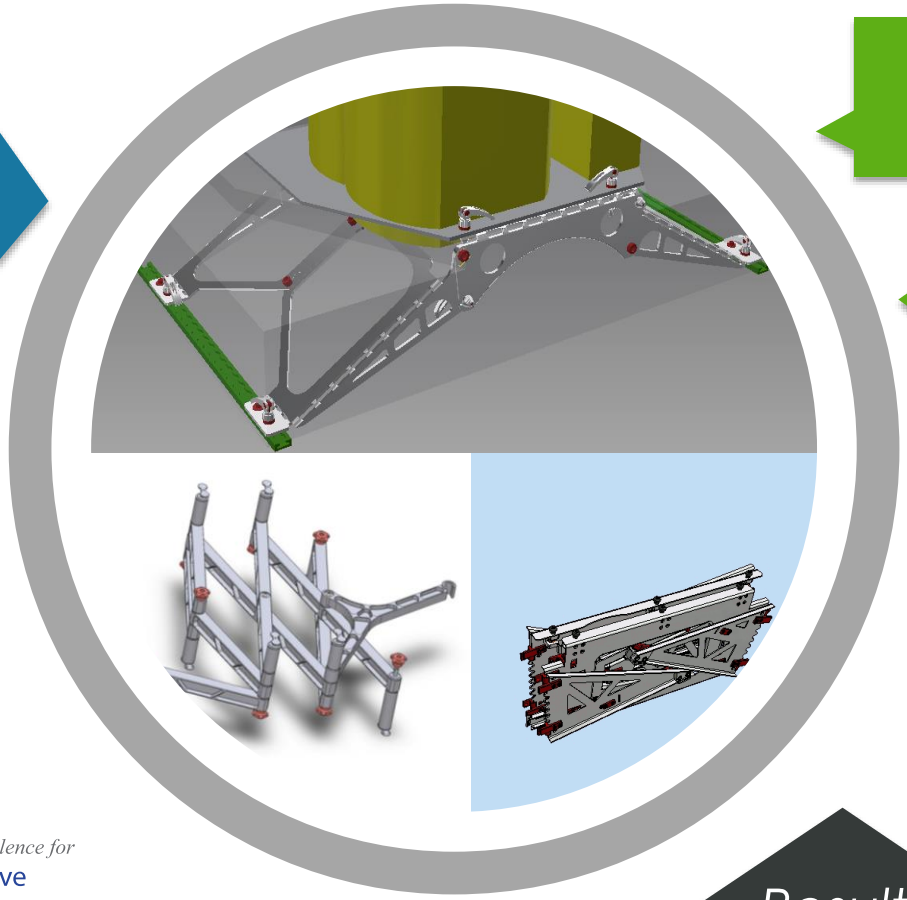






EXPERIMENT ATTACHMENT SYSTEM

Challenge to develop a structure to attach an experiment to an ISS rack with structural, stowage, and crew assembly constraints.



Total Cost to NASA$3,500

Challenge Prize $3,000

50 submissions in 30 days from 23 countries

GRABCAD

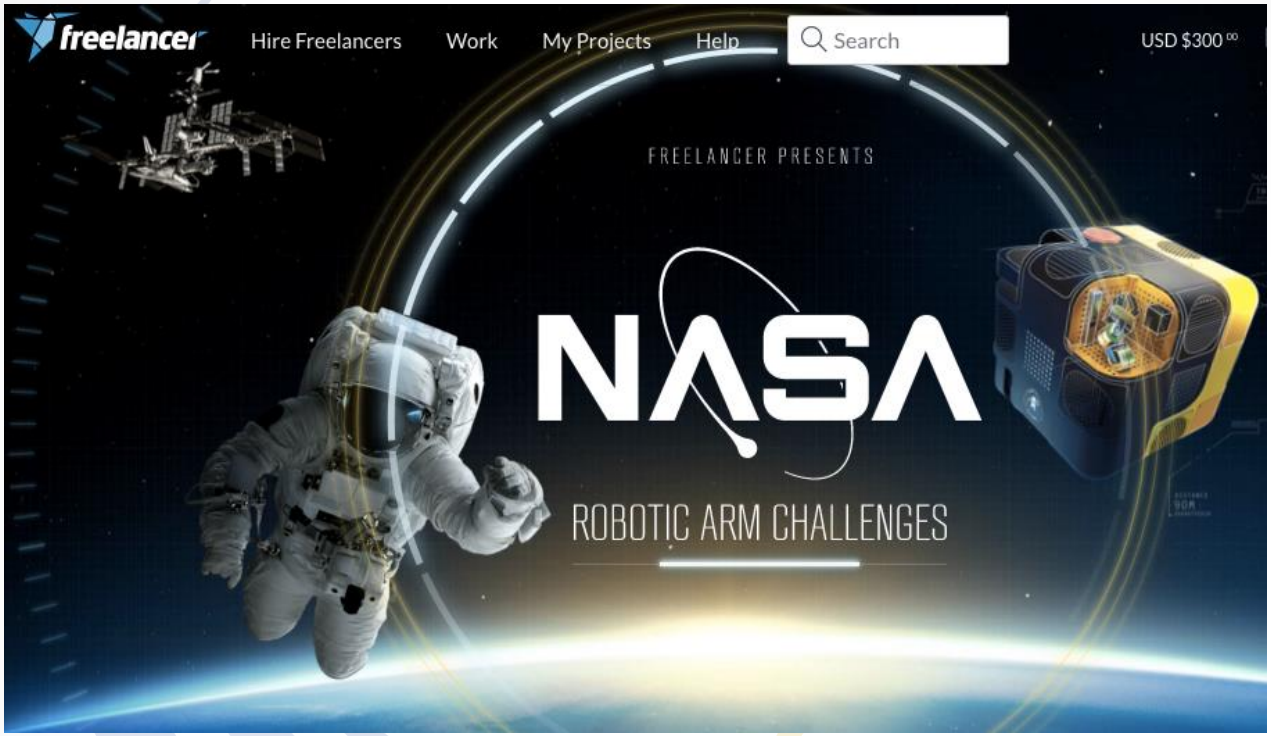
NASA Tournament Lab

Center of Excellence for Collaborative Innovation

Results

- Selected 5 winning designs from 50 diverse and innovative mechanical designs demonstrating a wide range of approaches.
- Designs included manufacturing considerations and stress analysis.
- Winning designs will be used to inform final ISS design.

Pilot Project



- Freelancer.com is a community of over 18M members who do a variety of freelancer work.
- Challenges provide them a way to build their portfolio.
- They charge very little overhead (2.3%) for contest.
- CoECI ran a set of pilot challenges to see if there was value in these challenges ($10K for the pilot challenges) using a Gov't P-Card.

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ROBONAUT SIM TOOLS MODELING

Challenge to develop 3D CAD models of 14 different Robonaut testing tools (from photos) to be used in a testing simulation.

Challenges Budget
$1,100

Challenge Prizes
5x$50, 5x$75,
3x$100, 1x$150

Almost 300 submissions across 14 10 day challenges

freelancer.com

NTL NASA Tournament Lab

Center of Excellence for Collaborative Innovation

Results

- Most challenges resulted in an acceptable submission by day 3.
- Demonstrated the power of the NASA brand and the desire of skilled people from around the world to contribute to NASA projects.
- In-house development estimated to be 3-10 times more expensive.

PROJECT LOGOS/GRAPHICS

Challenge to develop graphics and logos for various projects that reflect the project based on information provided about the project.

Challenges Budget $1127

Challenge Prizes 1x$100, 2x$150, 2x$200, 1x$300

Over 1900 submissions across 6 challenges

freelancer.com

NTL NASA Tournament Lab

Center of Excellence for Collaborative Innovation

Results

- Evaluation showed $200 prize optimal for around 200 submissions.
- Showed how individual submissions can be customized via feedback to freelancers.
- Demonstrated NASA brand power and the desire of skilled people from around the world to contribute in a meaningful way to NASA projects.

DTN KILLER APP IDEATION

NASA's DTN project ran an Ideation challenge to find a idea for a smartphone app that could help infuse DTN protocols into terrestrial uses.

Image from Google: Similar "Signal Finder" Android App

DTN
DELAY/DISRUPTION TOLERANT NETWORKING

Total Cost to NASA$512

Challenge Prize $500

67 submissions received over 30 day challenge

freelancer.com

NTL NASA Tournament Lab

Center of Excellence for Collaborative Innovation

Results

- Winning Concept was an Offline Coverage Mapping App.
- Demonstrated use of a public crowdsourcing platform with very low cost overheads to reach a larger global community.
- Winner was a Physicist from Chicago who joined Freelancer just to participate in this challenge (found on challenge.gov).

ASTRONAUT SMARTWATCH UI CONCEPT

Challenge to develop a UI concept for a smartwatch app that integrated ISS crew tools from the crew timeline, communications status, C&W, and timers.

Total Cost to NASA$1535

Challenge Prize $1500

245 submissions received over 30 day challenge

freelancer.com

NTL NASA Tournament Lab

Center of Excellence for Collaborative Innovation

Results

- Winning Concept was from two User Interface experts from Canada.
- Challenge got significant worldwide news coverage (CNET, Time, Wired, Bloomberg, Forbes, etc (over 50 news outlets)).
- Winning concept was used as the starting point for demo software dev.

ASTRONAUT SMARTWATCH APP

A task on Freelancer.com where the recruited freelancer bid $3000 to build the smartwatch app based on the UX concept contest.

Total Cost to NASA$3,029

Task Schedule 5 months

Fully functioning prototype app on a Gov't P-Card

NineSigma
Accelerating the Innovation Cycle

NTL NASA Tournament Lab

Center of Excellence for Collaborative Innovation

Results

- Fully functional implementation of crew timeline, caution & warning messages, communications status, and timers.
- Included a web based data emulator in the delivery.
- Hardware (Samsung Gear2) required custom OS programming.

Active Design & Multimedia Contests

GrabCAD Contests

Sense the Pressure Challenge by Microtechnologies

Modular Prosthetic

Freelancer Contests

UI/UX of IOS & android mobile app

YouTube Ad

GrabCAD	4 open challenges (160+ Total)	3M members
CAD Crowd	5 open challenges (45+ Total)	10K members
Freelancer	1077 open challenges (9M+ Total)	19M members
Tongal	47 open challenges (500+ Total)	100K members

Over 1100 government and industry design & multimedia challenges are in progress right now*.

*As of May 13, 2016

Westin Hotels Video

CAD Crowd Contests

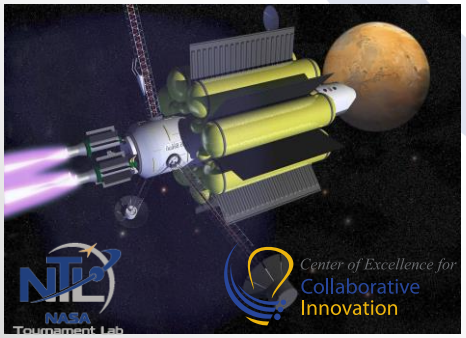
Design a stand for a virtual Reality Headset

ATG's Automotive Concepts 2016 - 2

Allstate Host Advantage Video

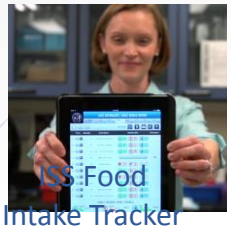
How Could This Make a Difference to NASA?

- Imagine how NASA could advance its systems if we actively **set aggressive design goals** and used challenges to see how far we could get?
  - Component **mass** and/or **volume** reduction
  - **Power** reduction
  - Algorithm **performance** (speed, accuracy, efficiency)
  - New ideas, approaches, & methods
- What if we took our Failure Effects & Modes Analysis (FEMA) and analyzed them for our least reliable components **and set challenge goals to improve them** (bringing up the overall system reliability)?
- What if we **decomposed systems/operations based on risk** to find those defined issues that might have an solution in the crowd?



Hunter

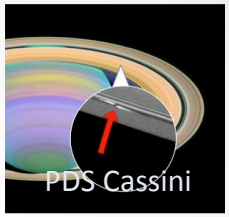
Tracker



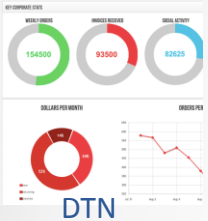
Intake Tracker

Pressure

Email



Authentication



DTN
Dashboard

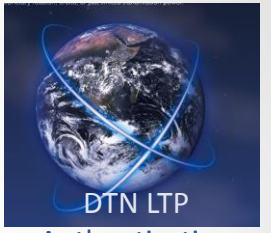
Interoperability


DTN Neighbor
Discovery

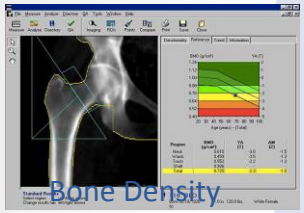
Algorithms

Mechanism Guide

ISS Handrail
Clamp



Authentication


Bone Density
Measurement

Astronaut
Smartwatch

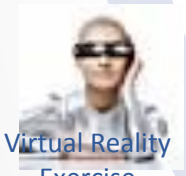
It Already Is Making a Difference!

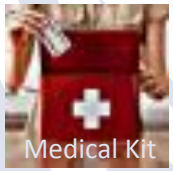
NASA Tournament Lab

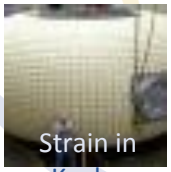

ISS Solar Array
Pointing

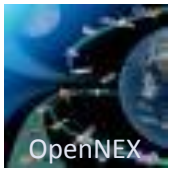
Micro Purchase
Pilot CAD/Graphics


Solar
Prediction


Virtual Reality
Exercise


Medical Kit
Tracking

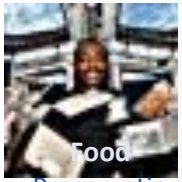

Strain in
Kevlar

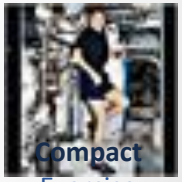

OpenNEX
Climate Data


Water
Monitoring

Mars
Pioneering


Bio
Inspired
Exercise


Food
Preservatio
n


Compact
Exercise

CoECI's Crowdsourcing Experience

249 Challenges Total Completed or in Progress (with 10 more in formulation)

InnoCentive

21 Innovation:
7 Ideation*
13 Theoretical
1 Reduction to Practice

1 Video

**3 USAID*

NineSigma

3 Innovation

1 Consultation Task

HeroX

2 Innovation

1 Video

Harvard / topcoder

17 Algorithms*

22 Software** ***

3 Ideation

6 Graphics/Design

***USPTO, USAID, 2 EPA*
****2 CMS, OPM, DOE*
***** APPLAUSE*

yet2.com

13 Tech Surveys*

**1 EPA*

NASA@WORK

126 Challenges

tongal

4 Videos

GRABCAD

2 Eng. Design

freelancer.com

3 Ideation

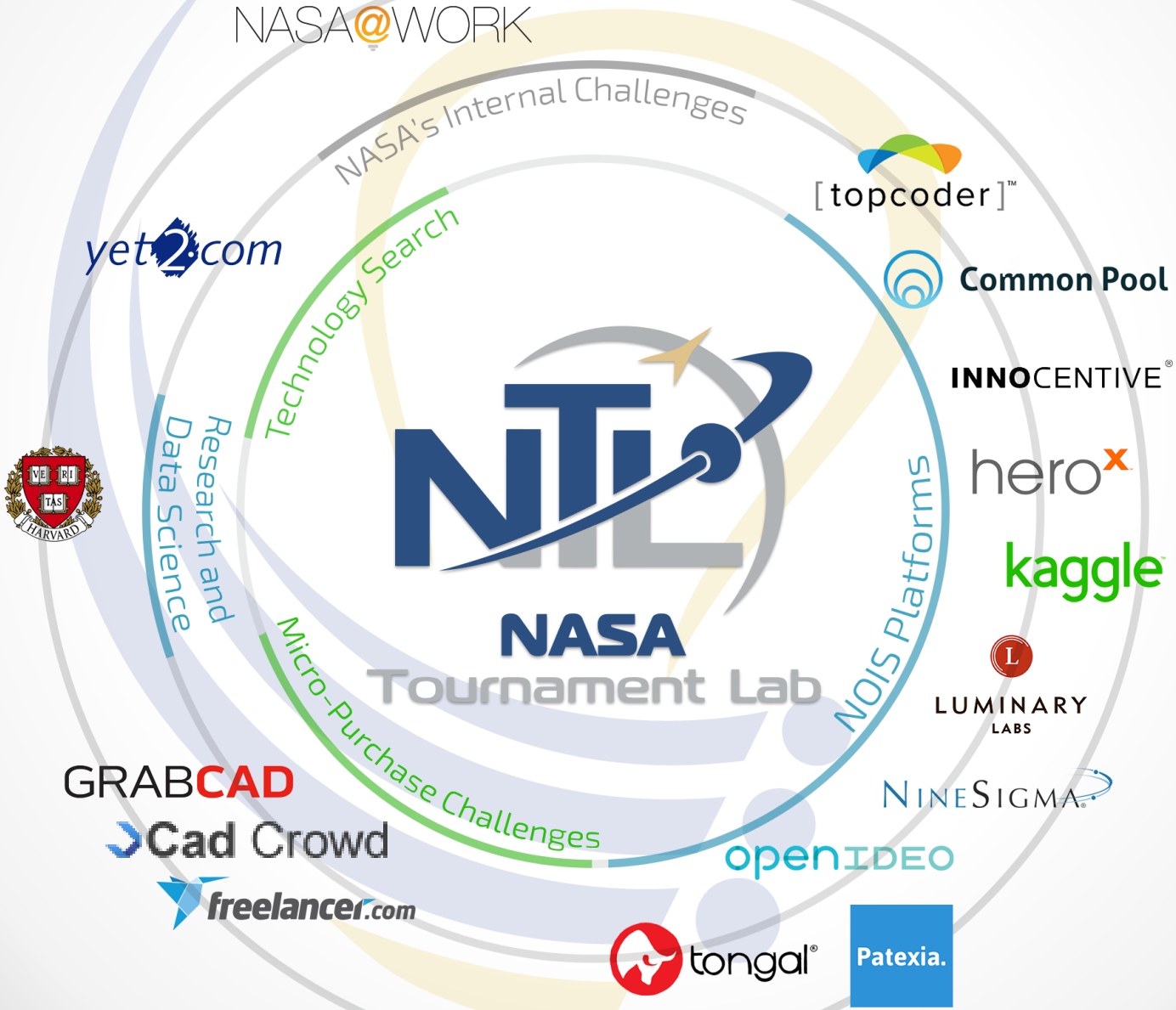
15 CAD Modeling

10 Graphics

Plus 1 SW dev task and 30 Architecture tasks

The CoECI Toolkit

Available to ALL NASA Projects



How You Can Leverage the Power of the Crowd?

Request a Challenge Workshop

NASA@WORK

Register

Participate in a Challenge

Launch a Challenge

Free - Weeks

NOIS

Run an Innovative Problem Solving Challenge

$30-60K, 3-6 mo.

NASA Tournament Lab

Platforms

topcoder, Common Pool, InnoCentive, hero, kaggle, Luminary Labs, NineSigma, openIDEO, tongal, Patexia

Run a Software or Algorithm Challenge

Cost & Duration Depend on the Challenge

yet2.com

Run a Tech Search

$21.4K, 4-6 mo.

freelancer.com

GRABCAD

Run a Micro Challenge

<$3.5K, 2 mo.
Gov't Purchase Card

http://www.nasa.gov/coeci

The *NEW* NASA Tournament Lab

www.nasa.gov/coeci