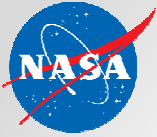# The Power of Crowd Based Challenges

NASA's Practical Toolkit for Open Innovation

NASA's Center of Excellence for
Collaborative Innovation (CoECI)
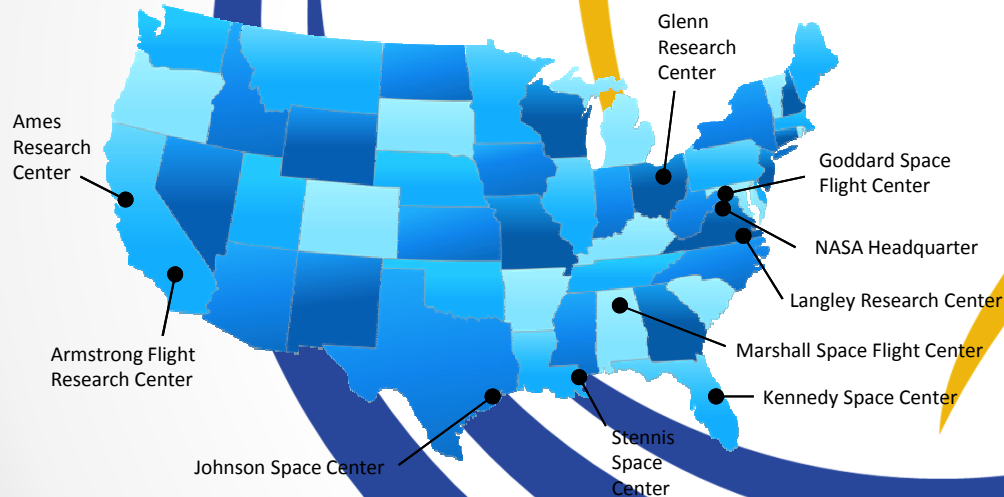
Steve Rader   steven.n.rader@nasa.gov
                         @NASA_NTL

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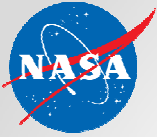
- The **Center of Excellence for Collaborative Innovation (CoECI)** was officially launched in November of 2011 at the request of the White House OSTP.
- **CoECI** works across all of NASA and with other federal agencies to _infuse crowdsourcing methods as a set of available tools_ to create innovative,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

Glenn Research Center

Ames Research Center

Goddard Space Flight Center

NASA Headquarter

Langley Research Center

Armstrong Flight Research Center

Marshall Space Flight Center

Kennedy Space Center

Johnson Space Center

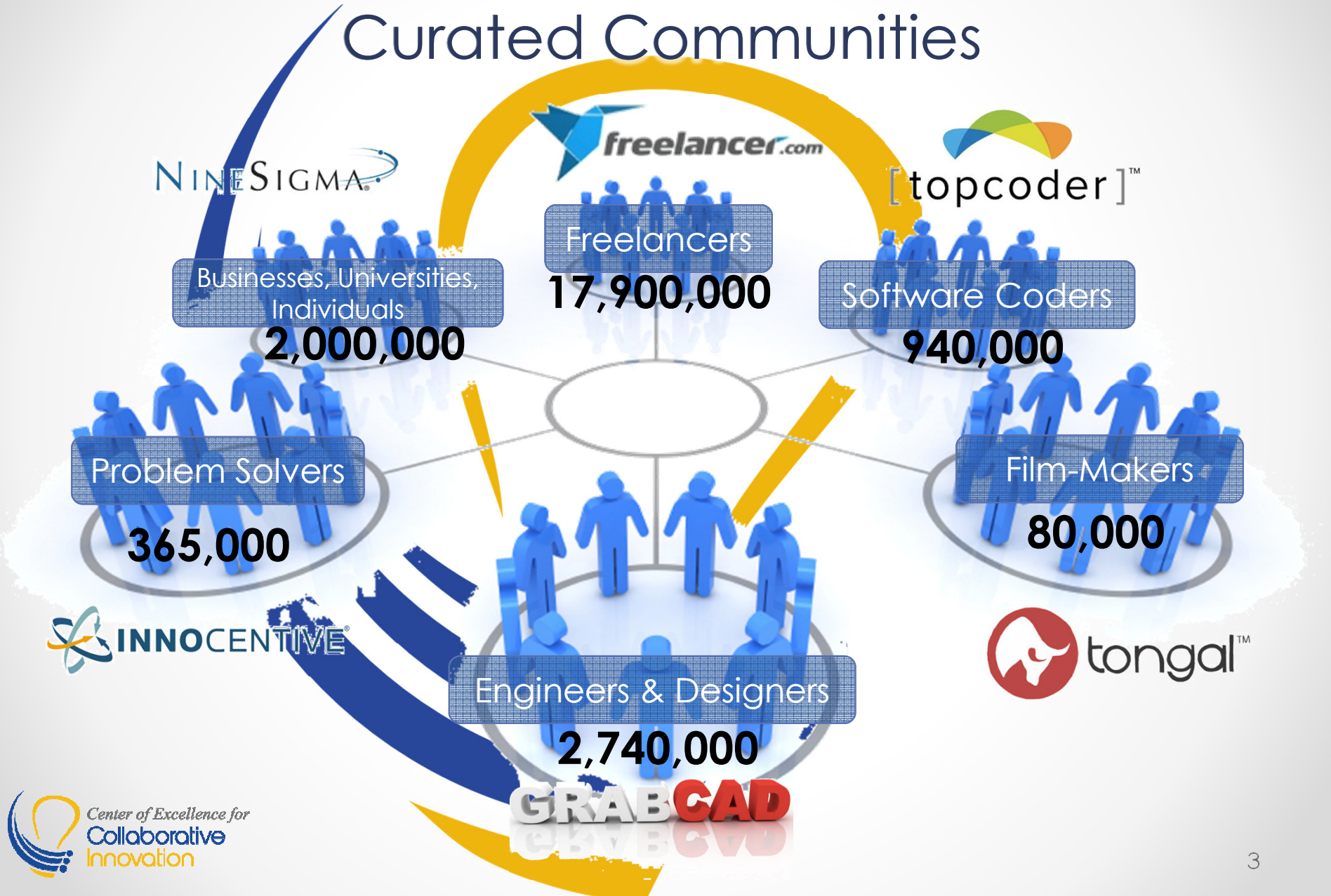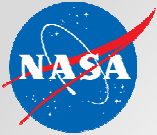Stennis Space Center

US Federal Agencies

- **Other NASA Crowd-Based/Challenge Programs**
  - **NASA Centennial Challenges** – Similar to X-Prize competitions
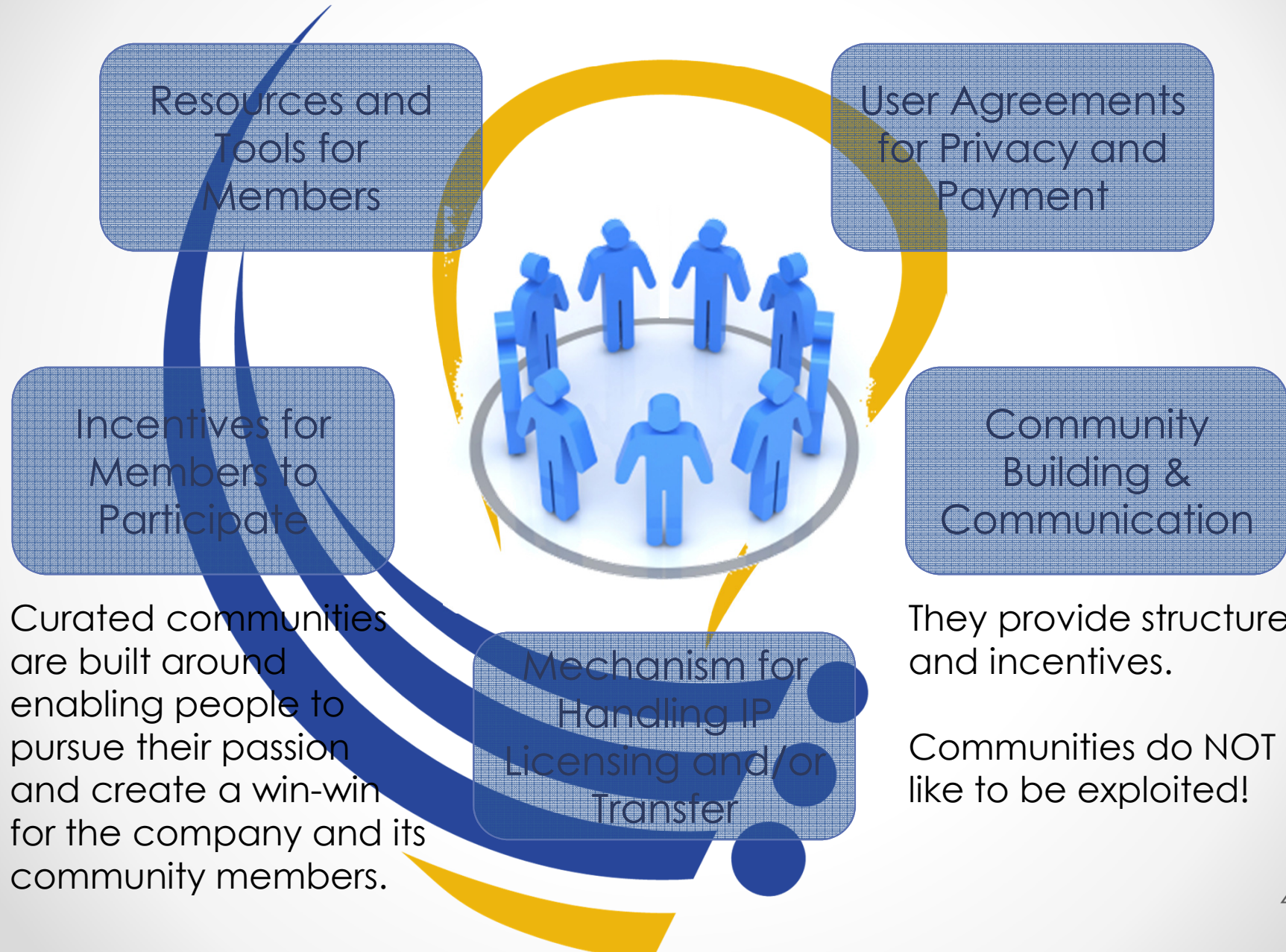 - **SpaceApps, Education & Citizen Science Challenges**

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!

Center of Excellence for Collaborative Innovation

4

Effectively Using Communities

Solve a Problem

Create an Innovative New Solution

Apply an Existing Technology
(in an innovative way)

Find an Existing Solution
(you didn't know existed)

Diverse Membership

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

Develop a Product | Provide a Service

Access Best Possible Product or Service
(competition winner)

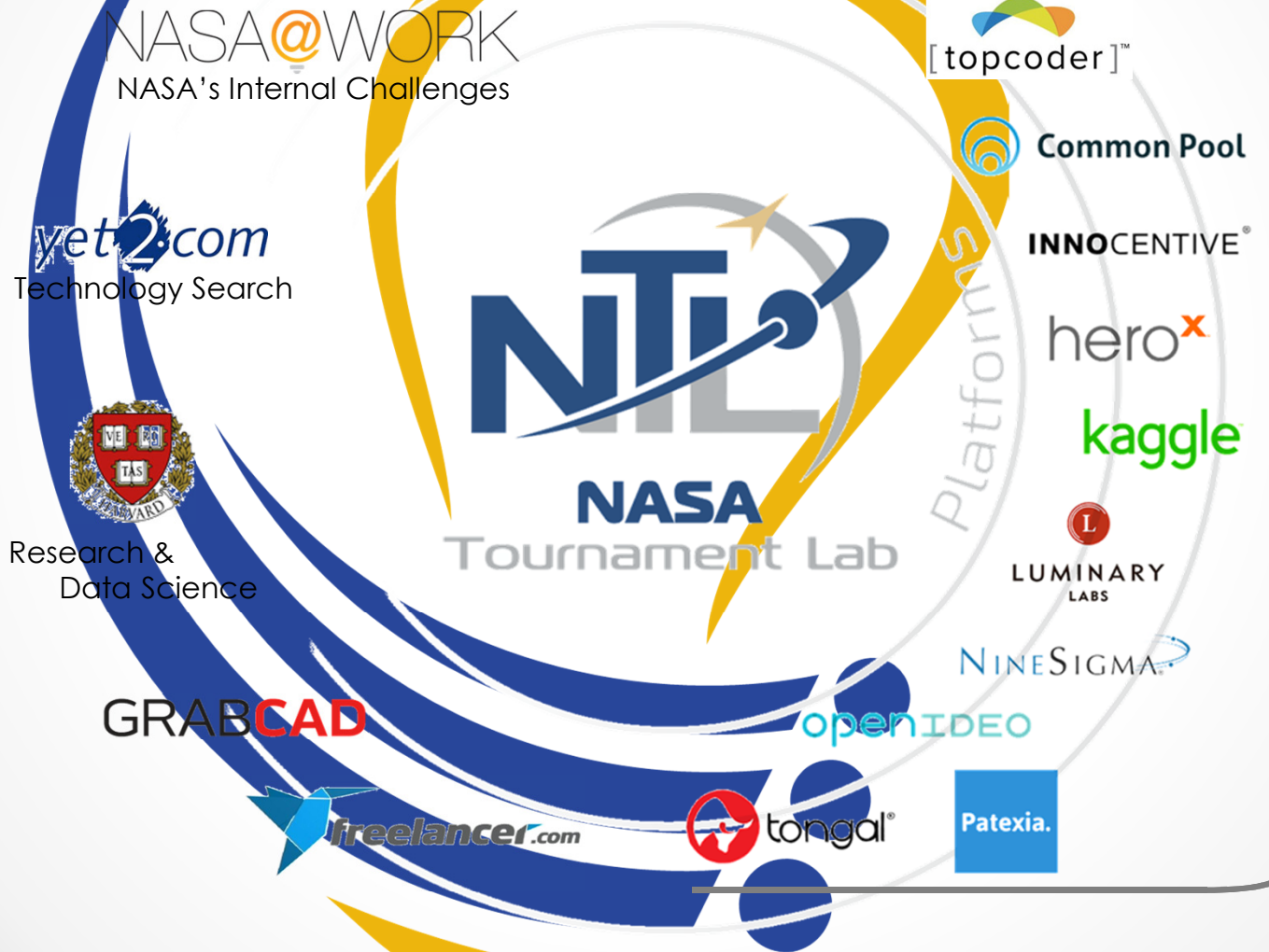**Access Very Specific Expertise**
(found through competition)

Expert or Domain Focused Membership

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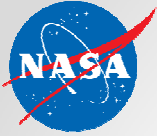(via Competition to get Best in Domain)

The CoECI Toolkit

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
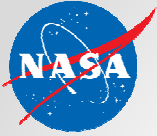
- New NASA Open Innovation Services (NOIS) Contract added new communities

- A total of 6 communities focused on Innovative Problem Solving Challenges available to NASA

INNOCENTIVE®

NINESIGMA®

LUMINARY LABS

openIDEO

hero×

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.

Swiss company with 80,000 employees, Roche operates in 150 countries and has R&D operations in Europe, North America and Asia-Pacific

Roche is a world leader in in vitro diagnostics.

Roche ran an InnoCentive challenge

"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

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

Concept for Future Lander Designs

Results

- Winner: Concept for ionospheric and atmospheric analysis of Mars via tracer element release

- Honorable MetionConcept to study Mars winds using deployable micro-balloons

NTL
NASA
Tournament Lab

Center of Excellence for
Collaborative Innovation

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

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

NTL
NASA Tournament Lab

Center of Excellence for Collaborative Innovation

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 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
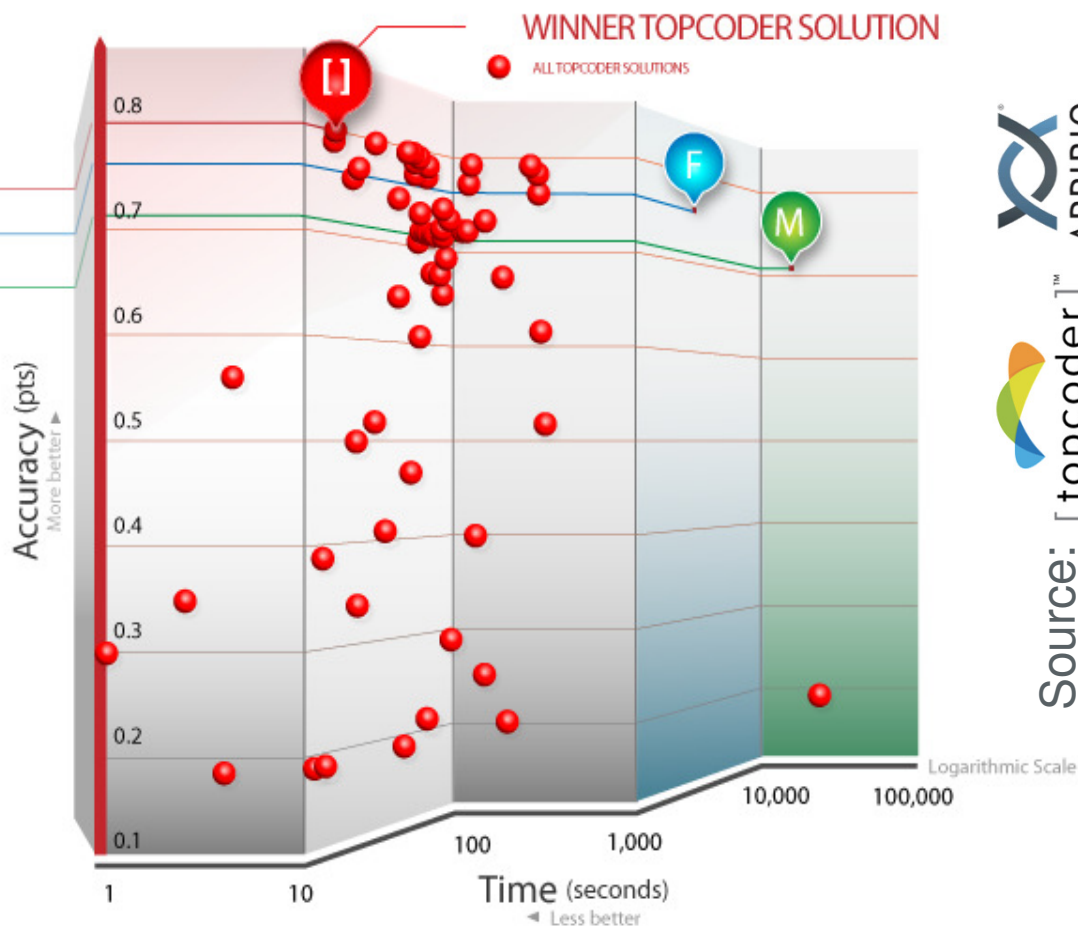
ASTEROID DATA HUNTER

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

NTL NASA Tournament Lab

Center of Excellence for Collaborative Innovation

Results

- 15% improvement over current methods
- Open Source App available for download on any laptop (20K downloads as of 9/2015)
- Maintained by Planetary Resources, Inc.

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

NTL
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

Using Competitions for Software Development

Conceptualization

Specification

Idea Generation

Requirement Analysis

Wireframes

Design

Storyboards

Evolution

SDLC
Software/System Development
Life Cycle - SDLC

Architecture

Testing

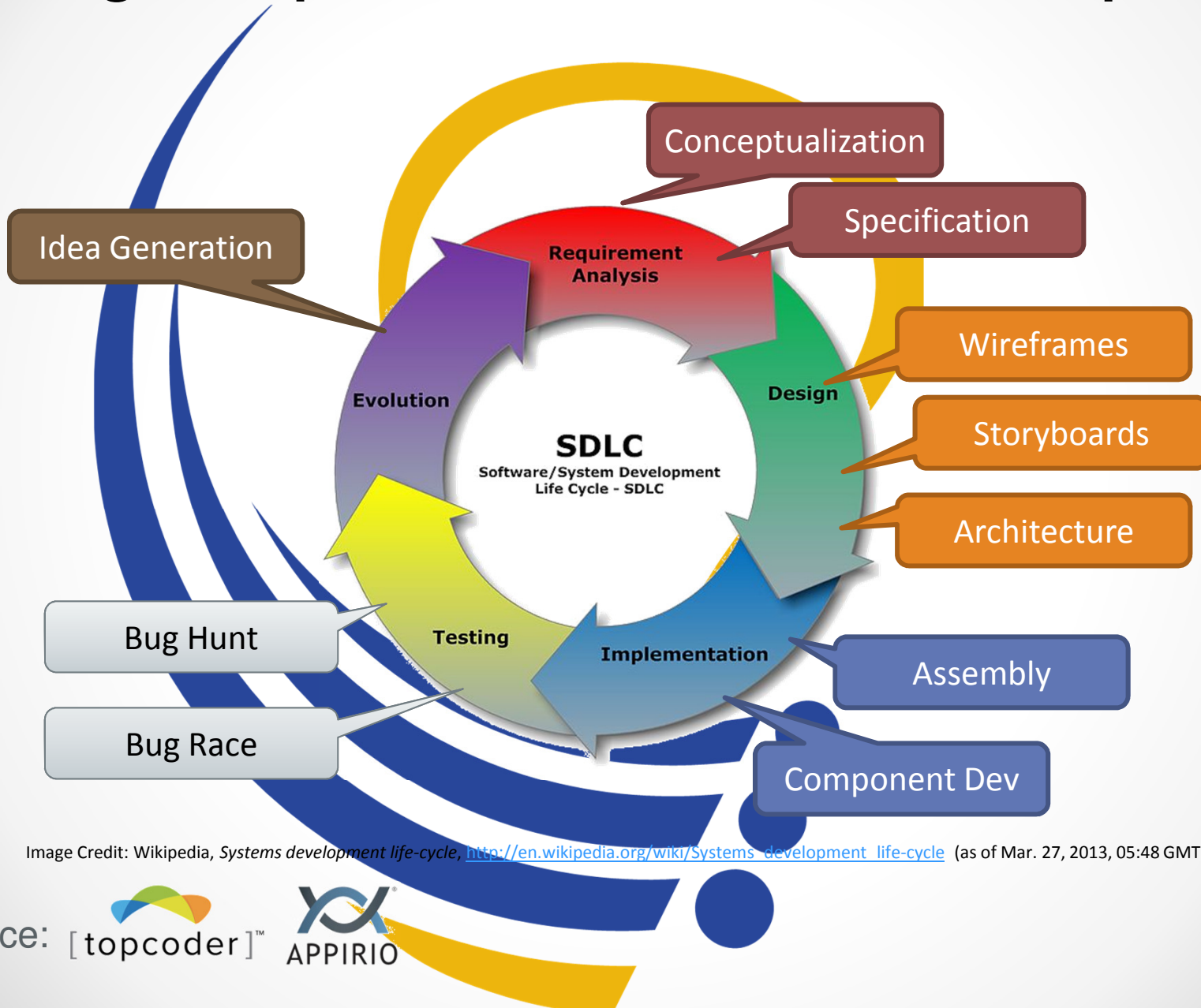Implementation

Assembly

Bug Hunt

Bug Race

Component Dev

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]™ APPIRIO

ISS FOOD INTAKE TRACKER

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

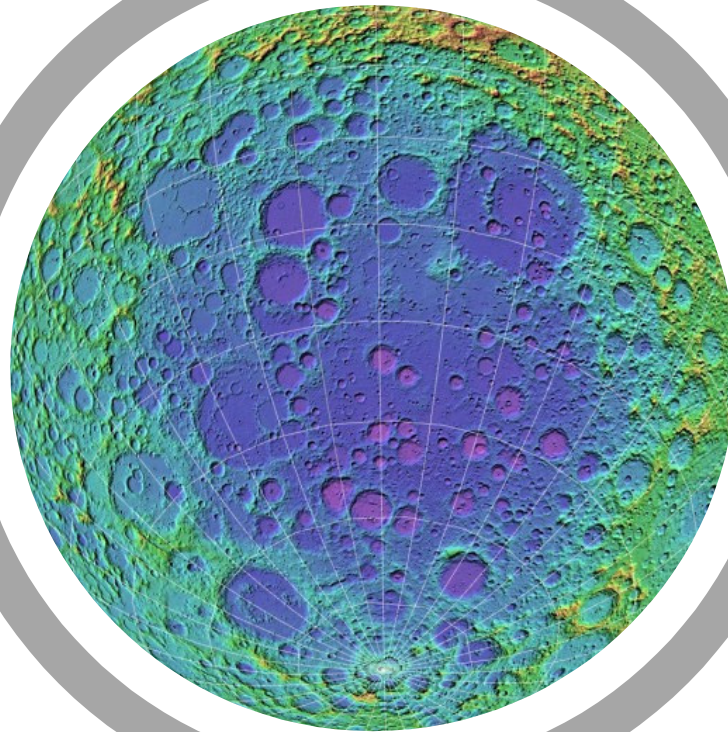Total Cost to NASA $144,600

Challenge Award $36,288

NTL NASA Tournament Lab

Center of Excellence for Collaborative Innovation

More Detailed Food Log

Results

- Will provide NASA scientists a better understanding of nutrition to help mitigate negative physiological effects of spaceflight
- Final updates in work for upload to ISS December 2015

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

NTL 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

Micro-Purchase Challenges

Leveraging Low Cost Competition to Access Diverse, Innovative Design Space
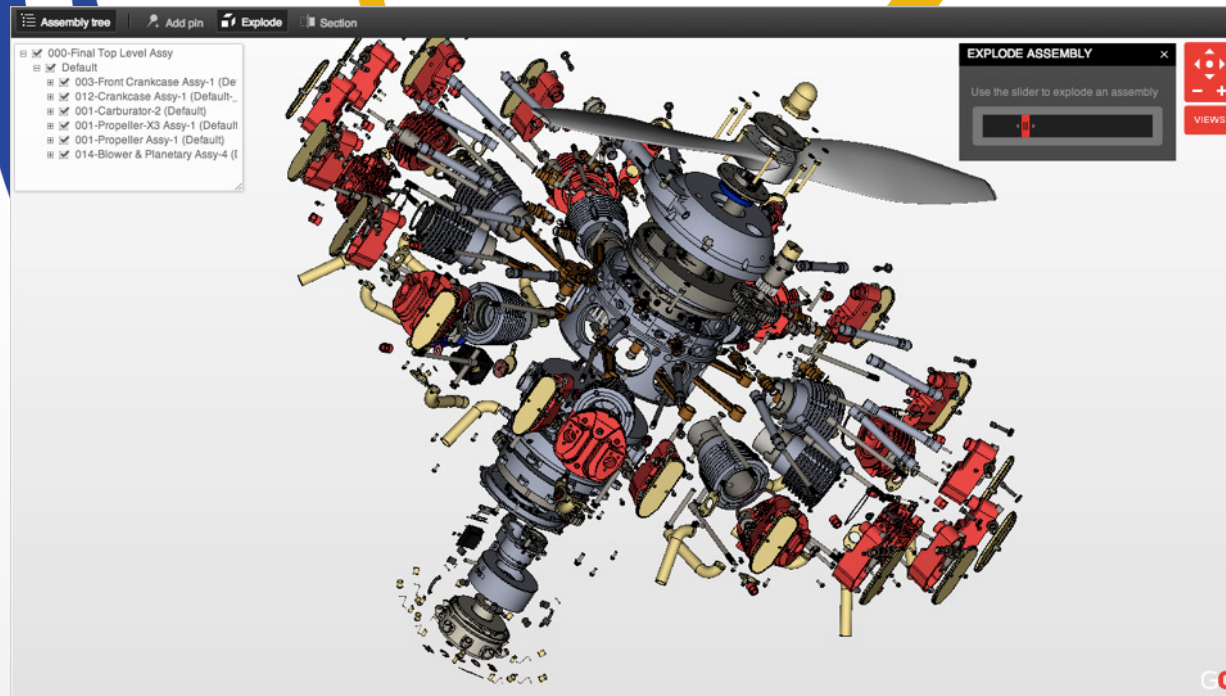
NASA Handrail Clamp Assembly Challenge
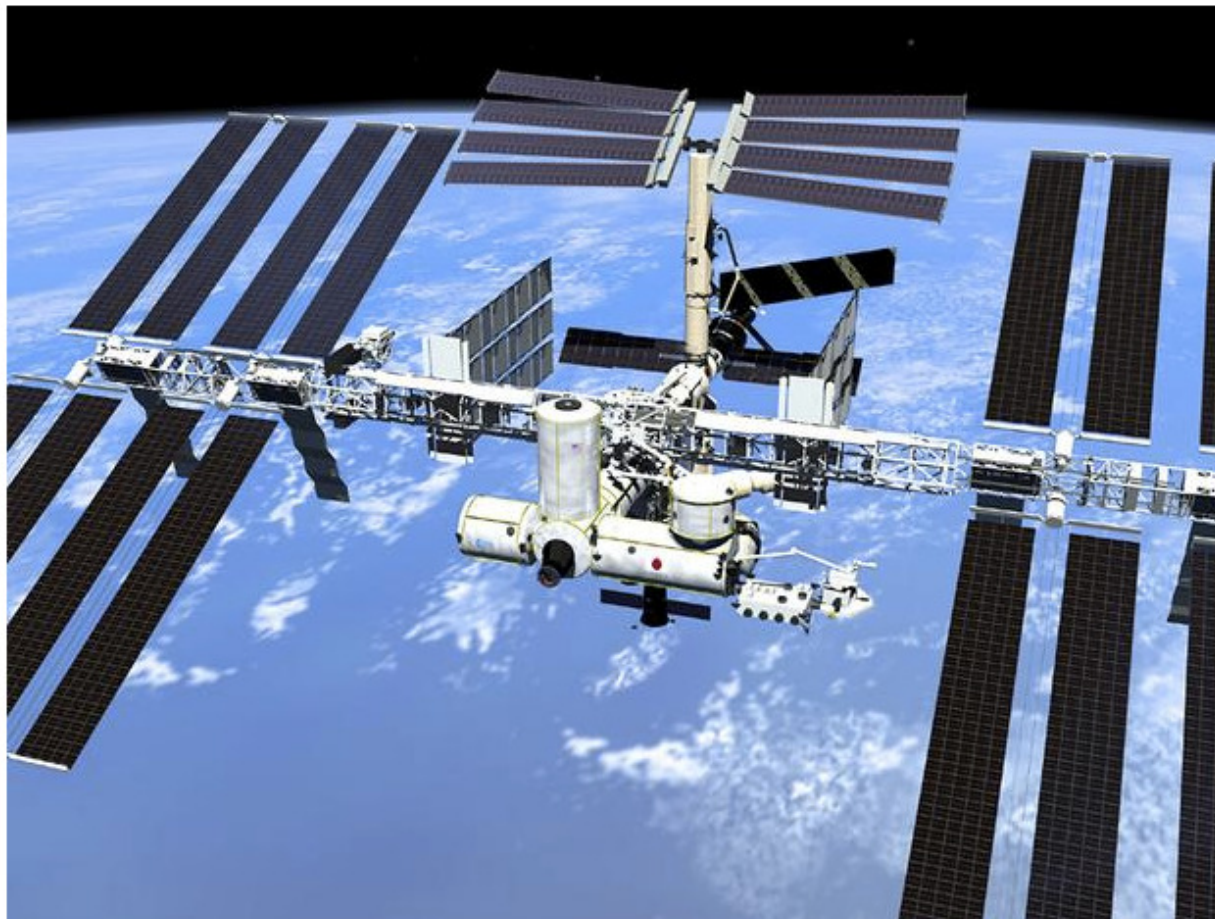
Description | Entries 321

PRIZE
$2,000 total prize pool

DEADLINE
4 days

TOTAL ENTRIES
321

Who's in the jury?

Niki Werkheiser
NASA In-space Manufacturing Project Manager

Quincy Bean
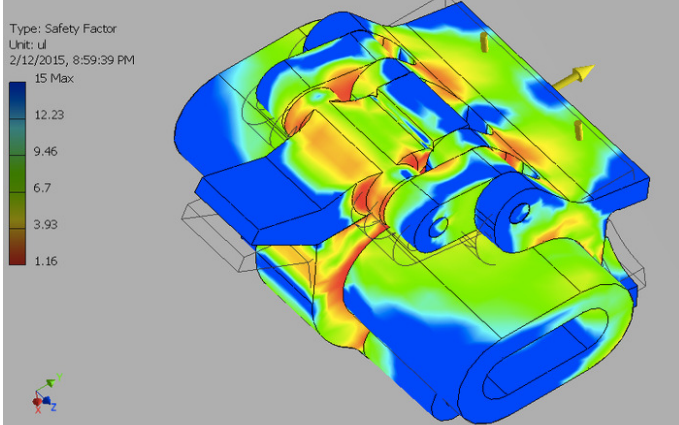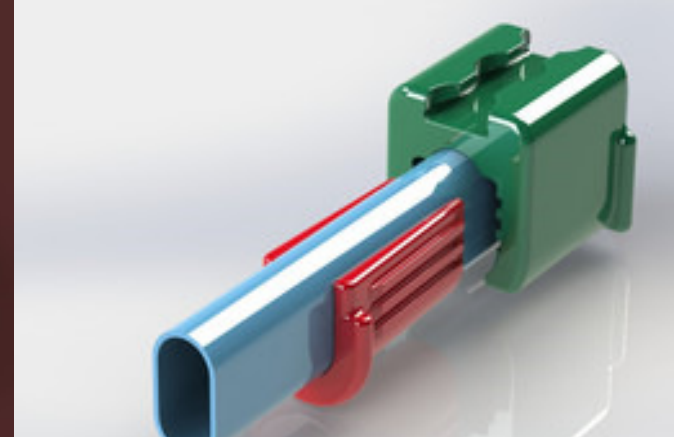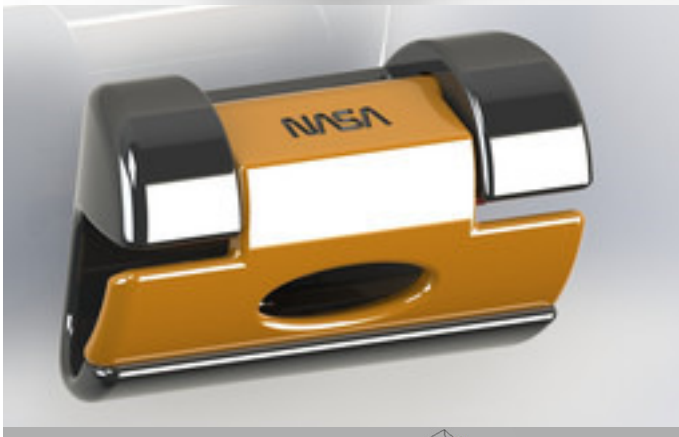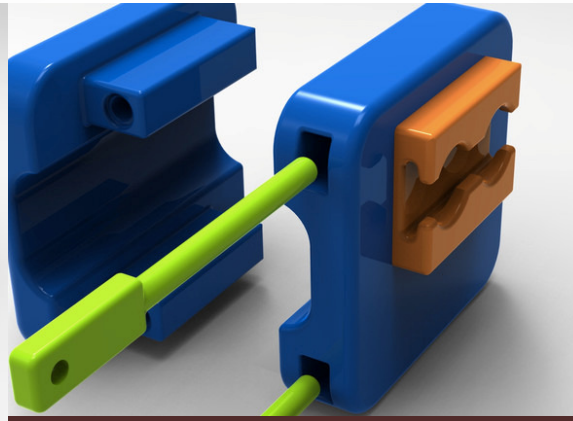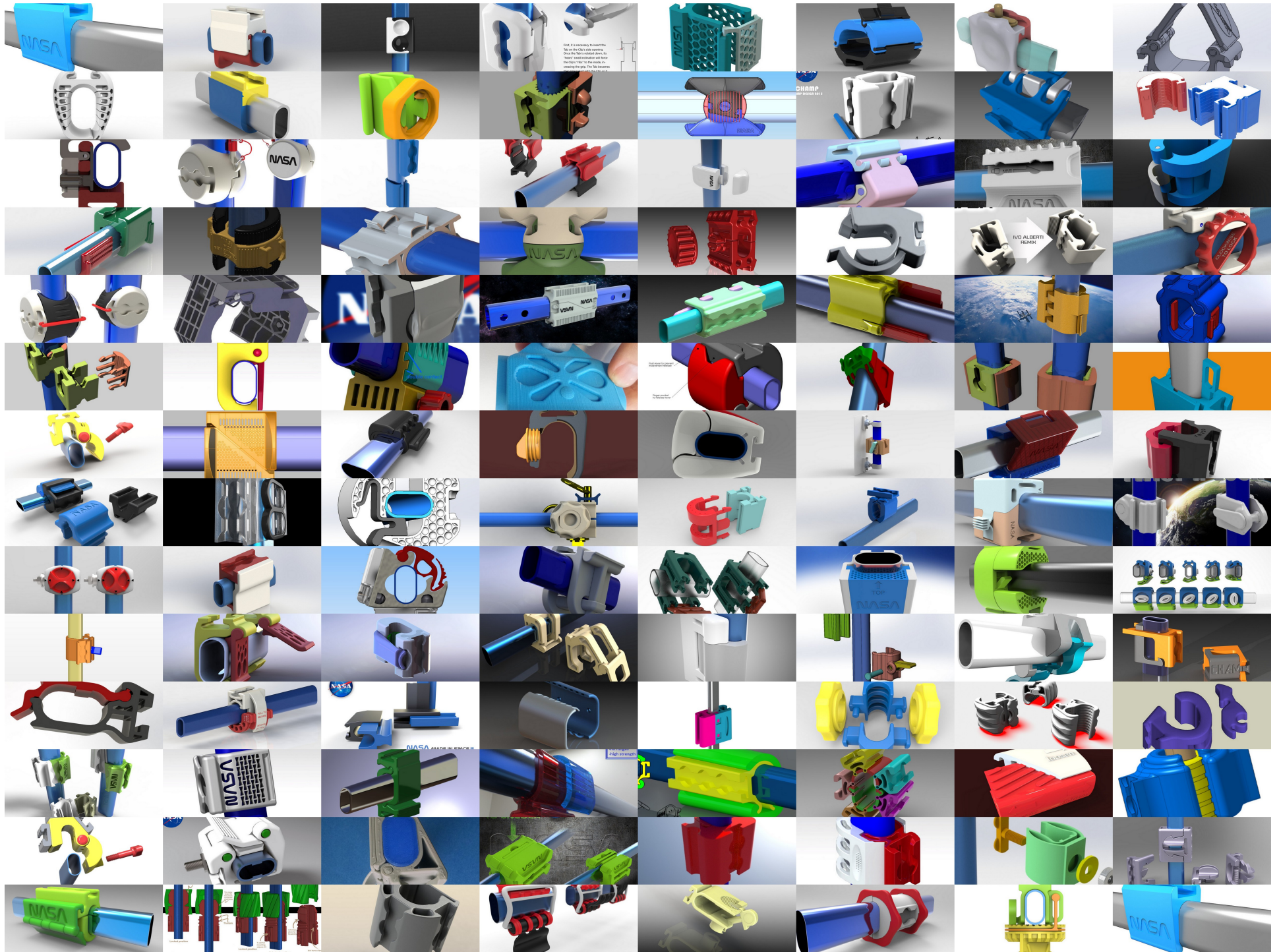NASA In-space Manufacturing Principal Investigator

Drew Hood
NASA Exploration EVA Tools

GrabCAD 30 Day challenge for $3000: 492 CAD Designs Submitted

Micro-Purchase Challenges Pilot

$10K in pilot challenges with Freelancer community of 16M+ members using micro-task challenges under $3K (using gov't purchase card) – 22 challenges total.
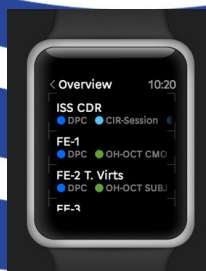
Completed 15 CAD challenges for Robonaut and NASA@Work with positive results with prizes in $50-$200 range.

Completed 5 logo challenges in $100-$200 range.

Received concepts for DTN Apps and Astronaut Smartwatch Apps.

LOGISTICS REDUCTION
Logo for LR Project

NEXT-C NASA EVOLUTIONARY XENON THRUST – COMMERCIAL
Logo for GRC's NEXT-C Project

D T N DELAY/DISRUPTION TOLERANT NETWORKING
Logo for DTN Project

Banner for NHHPC

3D Models for Robonaut Project

Astronaut Smartwatch App Concept

Pilot Results and Lessons Learned Study Complete October 2015

NASA@WORK

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?

Submit

Post

Select

Submit a Problem to Solve

Formulate & Review Challenge

Community Proposes Solutions

Winner(s) Selected & Prizes Awarded
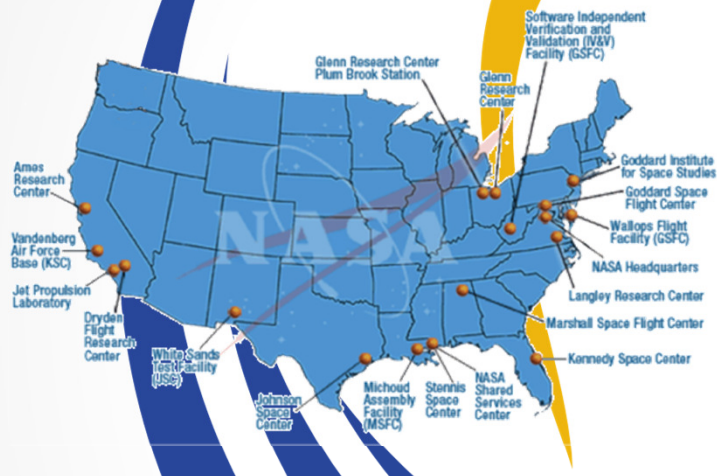
Solution(s) Delivered

How Can NASA@work Be Used?

- Generate new ideas, concepts
- Collect new and creative input
- Survey NASA for knowledge or expertise
- Refine a challenge prior to external crowdsourcing

27

NASA@WORK

Over 18,000 Registered Members

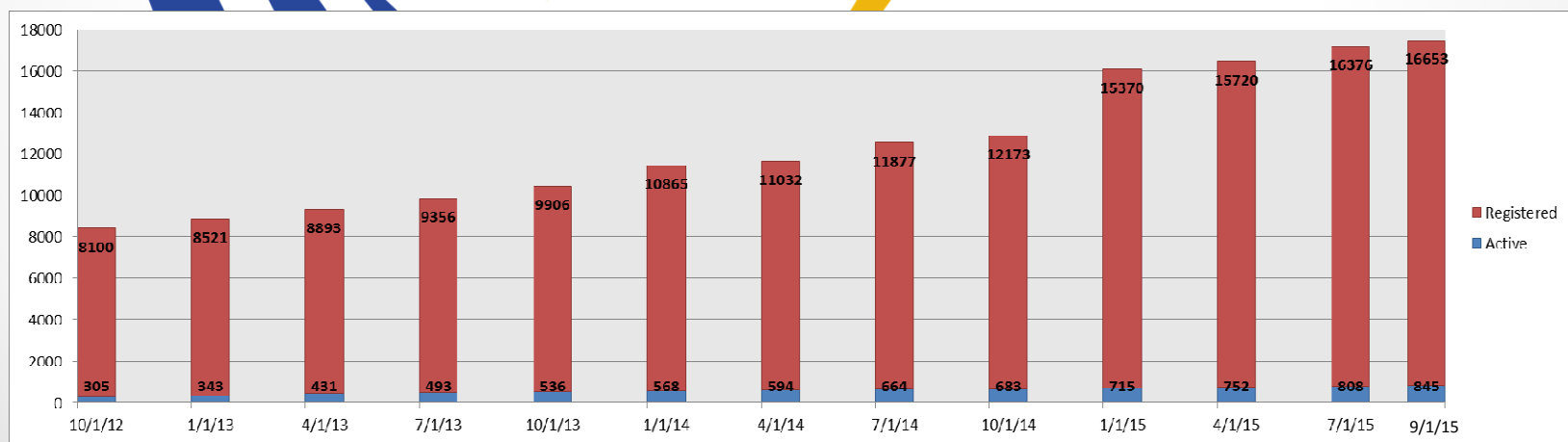(30% of NASA's 60,000 CS & Contractor Workforce)

People that work at NASA want to make a difference!

15-20 Challenges per Year

2-4 Active challenges posted at any one time

New challenge posts every ~2-3 weeks

Registered	8100	8521	8893	9356	9906	10865	11032	11877	12173	15370	15720	16376	16653
Active	305	343	431	493	536	568	594	664	683	715	752	808	845

Growth of the NASA@work Community since October 2012

28

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

Substantial cost savings

Center of Excellence for **Collaborative Innovation**

NASA@WORK

Results

- Microgravity Capillary Graduated Cylinder (prototype available from Engineering) and Calorimetry
- Unknown collaboration was identified within JSC in Engineering Directorate

How You Can Leverage the Power of the Crowd?

NASA@WORK

Register

Participate in a Challenge

Launch a Challenge

Free - Weeks

NOIS

Platforms: APPIRIO, Common Pool, INNOCENTIVE, hero x, kaggle, LUMINARY LABS, NineSigma, openIDEO, tongal, Patexia

Run an Innovative Problem Solving Challenge

$30-60K, 3-6 mo.

Run a Software or Algorithm Challenge

Cost & Duration Depend on the Challenge

yet2.com

Run a Tech Search

$20K, 4-6 mo.

freelancer.com GRABCAD

Run a Micro Challenge

<$3K, 2 mo.
Gov't Purchase Card

Request a Challenge Workshop

http://www.nasa.gov/coeci