



The Power of the Crowd to Solve Problems and Develop Systems

Center of Excellence for
Collaborative Innovation (CoECI)

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Crowdsourcing



- **Using the unique power of large communities of people (enabled by the internet) to solve problems, perform tasks, or raise money.**
- **Unique power of large communities:**
 - **Respond to a variety of incentives**
 - **Money/Prizes, Status, Experience, etc.**
 - **Provide innovative solutions**
 - **Diversity of experience and expertise provide innovative approaches**
 - **Massively parallel performance of task can be extremely fast**
 - **Can provide very high quality**
 - **Via large number of reviewers and/or thorough testing**
 - **Provide depth of expertise**
 - **The aggregate knowledge & experience of a large community is massive (often in unexpected ways).**

“No matter who you are, most of the smartest people work for someone else.”
- Bill Joy, Co-Founder of Sun Microsystems

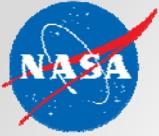


Extending Your Reach



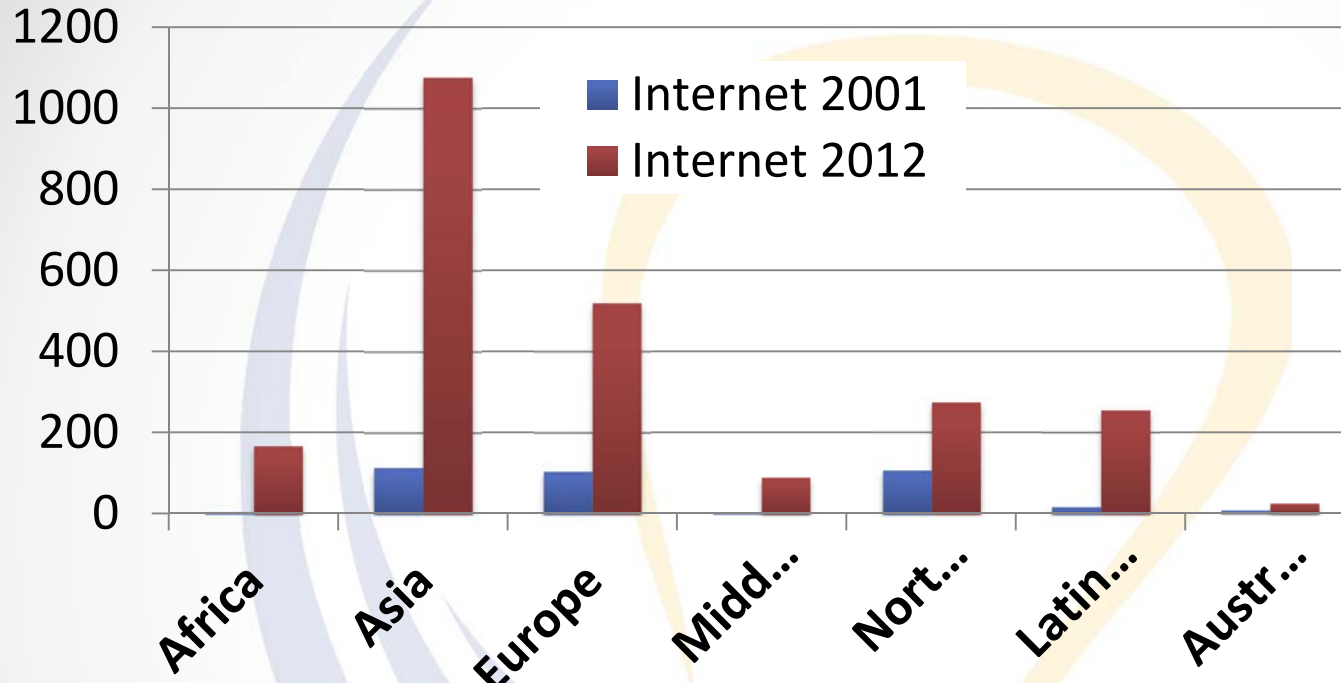
Engaging A World of On-Demand Talent to Generate Ideas & Solve Problems





The "Crowd" is Growing

Increasing Skilled/Motivated Human Capital Accessible via the Internet



Total Current Internet Users = 2.5 B

While almost 80% of N. Americans are on the internet, there are only 28% of the almost 4 billion Asian population (so far).

| WORLD INTERNET USAGE AND POPULATION STATISTICS June 30, 2012 | | | | | | |
|---|------------------------|------------------------------|----------------------------|----------------------------|------------------|------------------|
| World Regions | Population (2012 Est.) | Internet Users Dec. 31, 2000 | Internet Users Latest Data | Penetration (% Population) | Growth 2000-2012 | Users % of Table |
| Africa | 1,073,380,925 | 4,514,400 | 167,335,676 | 15.6 % | 3,606.7 % | 7.0 % |
| Asia | 3,922,066,987 | 114,304,000 | 1,076,681,059 | 27.5 % | 841.9 % | 44.8 % |
| Europe | 820,918,446 | 105,096,093 | 518,512,109 | 63.2 % | 393.4 % | 21.5 % |
| Middle East | 223,608,203 | 3,284,800 | 90,000,455 | 40.2 % | 2,639.9 % | 3.7 % |
| North America | 348,280,154 | 108,096,800 | 273,785,413 | 78.6 % | 153.3 % | 11.4 % |
| Latin America / Caribbean | 593,688,638 | 18,068,919 | 254,915,745 | 42.9 % | 1,310.8 % | 10.6 % |
| Oceania / Australia | 35,903,569 | 7,620,480 | 24,287,919 | 67.6 % | 218.7 % | 1.0 % |
| WORLD TOTAL | 7,017,846,922 | 360,985,492 | 2,405,518,376 | 34.3 % | 566.4 % | 100.0 % |

<http://www.internetworldstats.com/stats.htm>

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The Scope of Crowdsourcing



November 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.



Crowd Creativity

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



Tools

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



Distributed Knowledge

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



Cloud Labor

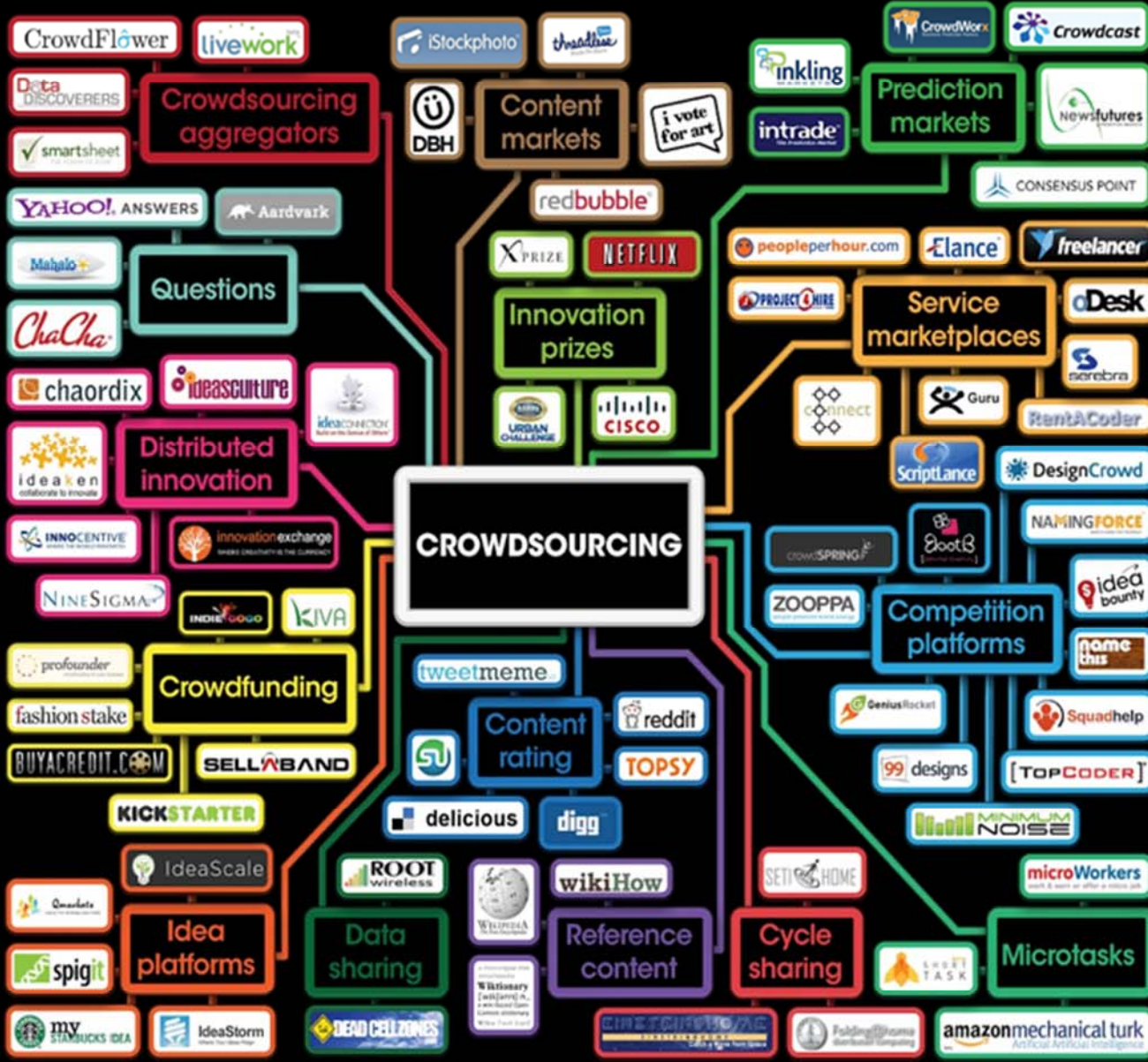
Leveraging of a distributed virtual labor pool, available on-demand to fulfill a range of tasks from simple to complex.



Open Innovation

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

CROWDSOURCING LANDSCAPE Beta v1



| Common Crowdsourcing Tasks and Examples | |
|---|----------------|
| 3D object design | Thingiverse |
| Advertising | idea bounti |
| Business ideas | crowdfunder |
| Clothing | Anadine |
| Consumer research | ClickAdvisor |
| Crisis information | Ushahidi |
| Data analysis | SETI@HOME |
| Fact checking | PolitiFact.com |
| Graphic design | 99 designs |
| Human reading | crowd |
| Investigative reporting | theguardian |
| Journalism | seed |
| Lending | 500 |
| Mapping | OpenStreetMap |
| Movie reviews | IMDb |
| Music | MusicMatch |
| Observation | GALAXY ZOO |
| Patent research | PatentCrowd |
| Philanthropy | Indiegogo |
| Political activism | MoveOn.org |
| Product design | MUJI |
| Proofreading | Proofreading |
| Scientific problems | fold.it |
| Software | OpenStreetMap |
| Software development | RentACoder |
| Software testing | oTest |
| Stock picking | Stockcrowd |
| Tagging | Google |
| Translation | facebook |
| Trends | Trendwatch |
| TV programming | current |
| Word of mouth | BzzAgent |
| Writing and editing | oDesk |

For details, analysis, and discussion go to:
www.crowdsourcingresults.com

Advanced Human Technologies
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Why Does The Crowd Contribute?



- Crowd Incentives



- Earn Money (real or virtual)
- Have Fun (or pass the time)
- Socialize with Others
- Obtain Recognition or Prestige (leaderboards, badges)
- Do Good (altruism)
- Learn Something New
- Obtain Something Else
- Create Self-Serving Resource



- Multiple Incentives can often operate in parallel

- Well formulated crowd-based platforms actively work to:

- Build a community of users that are **passionate enthusiasts** (around the platform's focus: photography, software coding, 3D modeling, design, etc.).
- **Get a "Win-Win"** by providing a variety of incentives so that the community members get real benefit while providing benefit to the platform.

Crowdsourcing & Human Computation Labeling Data & Building Hybrid Systems

by Matthew Lease, Assistant Professor at University of Texas at Austin on May 03, 2013

<http://www.slideshare.net/mattlease/crowdsourcing-human-computation-labeling-data-building-hybrid-systems>



EXEC.



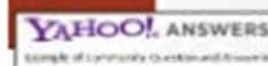
Crowdsourcing models



- Micro-tasks & citizen science
- Co-Creation
- Open Innovation, Contests
- Prediction Markets
- Crowd Funding and Charity
- “Gamification” (*not* serious gaming)
- Transparent
- cQ&A, Social Search, and Polling
- Physical Interface/Task

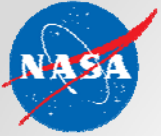


mobileworks



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What is NASA doing with this?



- The Center of Excellence for Collaborative Innovation (CoECI) is working across NASA and other federal agencies to infuse crowdsourcing methods as set of available tools for engineers and scientists on projects where applicable.
- CoECI has the contracts in place with multiple vendors and works with both users and vendors (formulation, management, performance metrics).

- Current platform vendors for NASA challenge owners

- **NASA@Work** (over 10,000 registered solvers across the NASA centers)
- **InnoCentive** (over 300,000 solvers from around world)
 - *NASA Innovation Pavilion*
- **Harvard-TopCoder** (over 600,000 competitors from around the world)
 - *NASA Tournament Lab (NTL)*
- **yet2.com** (tech scout - network of technical experts for potential collaboration)



NASA Innovation Pavilion



- **Grand/Centennial Challenges** – Similar to X-Prize competitions (HQ challenges office)



NASA@work Challenges (28 of 28 total)

SORT By: in FILTERS - By Status: [1](#) [2](#) [Next Page](#)

How can satellites measure into the ocean?

Challenge Status: EVAL (\$200 USD)

Challenge 1051



This Challenge is to stimulate a discussion of novel ideas for next-generation satellite technology regardless of implementation details. Currently, sea surface height, temperature, color, and salinity are measured from space. We are seeking novel ideas for mechanisms or technologies that can be measured by satellites in addition to these. Either a surface parameter not already measured, or proper mechanism to collect data from below the ocean's surface (e.g., dissolved oxygen levels) are especially valuable, but we are interested in novel ocean surface measurements, too.

Tags: Computational, Design, Electrical, Engineering, Ideation, Technology Development

DEADLINE EXTENDED: Oct 27, 2011 [Discuss this Challenge \(12\)](#)

Challenge Posted: Sep 01, 2011

Tele-possibilities: Understanding and Enhancing our Mobile Work and Telepresence Technologies

Challenge Status: EVAL (\$200 USD)

Challenge 1055

Challenge Owner: [McLarney, Edward L. \(LARC-B7\)](#) - [Edit](#)[This Challenge](#)

- **10,000+** Registered **Solvers** from all NASA Centers
- **50+ Challenges awarded** since its start (as a pilot) in late 2010.
- Initial program provided \$200 awards.
- With sequestration, program changed to utilize **alternative prizes** (tours, astronaut autographs, items flown in space, tweet from space, etc.)
- Can be used to help formulate challenge to be posted on Innocentive platform.



NASA@work GSFC Example: Radiation Protection



The Challenge:

***Alternate in design/material approach for
electron radiation protection***

The Participation:

3 Participants from 2 Centers

12 Discussion Posts

The owners were searching for new material systems/approaches for shielding electronics equipment and personnel from ionizing radiation, specifically electrons.

Alternate approach in design/material for electron radiation protection

The Solution:

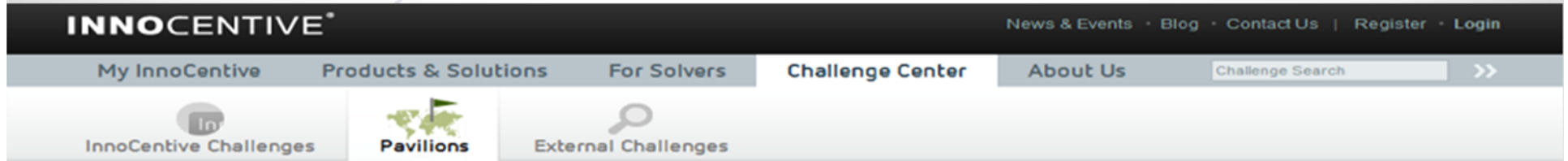
- The solvers from Goddard provided a very detailed description on the use of Tungsten Dust to provide the protection.
- The solver from Johnson proposed a solution from a 1967 reference document that given technology advances is possible to manufacture today.

Challenge Owner Feedback:

“It was useful to tap into historical knowledge. A newer person like myself may not know what happened back in the 1960's in this area. In this sense, InnoCentive is also useful as a knowledge capture and dissemination mechanism.”

“It is a great way to knowledge share. I would participate again.”

NASA Innovation Pavilion on InnoCentive



NASA Innovation Pavilion



[NASA Pavilion Home](#)

[NASA Challenges](#)



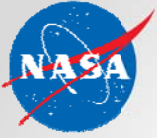
Global Appeal-

2900 solvers

80 Countries



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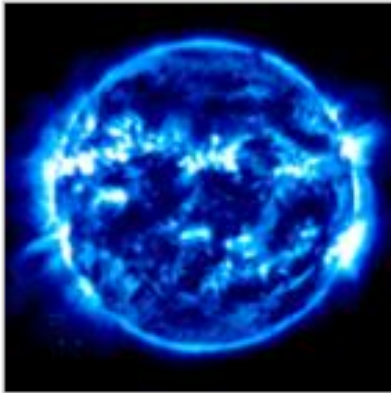


External Crowd Sourcing Pilot Results



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

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NASA Challenge: Data-Driven Forecasting of Solar Events

TAGS: Engineering/Design, Computer Science/Information Technology, Math/Statistics, NASA, RTP

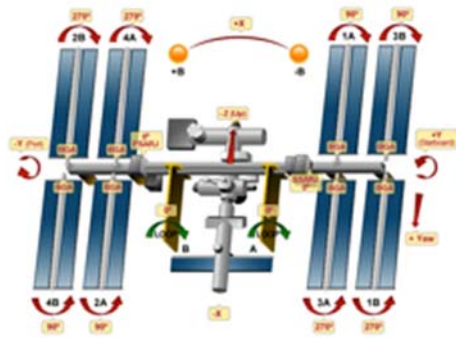
STATUS: Awarded | ACTIVE SOLVERS: 579 | POSTED: 12/22/09

- Important for protecting health during space flight
- Previous work to extend prediction capability beyond 1-2 hours not successful
- Challenge:
 - 4-24 hour prediction
 - 2 sigma confidence interval
- Result:
 - 8 hour prediction
 - 85% accuracy
 - 3 sigma confidence interval
- Solution submitted by retired Radiofrequency engineer

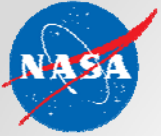


[TOPCODER]

Enterprise Open Innovation



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TOPCODER IN ONE SLIDE



- An atomized approach to Challenges.
- Rooted in:
 - Algorithm contests to recognize the best and fastest developers.
 - Software engineering for enterprise development.
- TopCoder fronts an established Community that operates on a well-defined process.

= Enterprise Open Innovation



Crowdsourcing & Open Innovation



Micro-tasks/Crowdsourcing

- Cost Savings
- Faster Results
- Free-Up Your Internal Resources
- Focus on Higher Value Tasks

Efficiency & Bandwidth Expansion



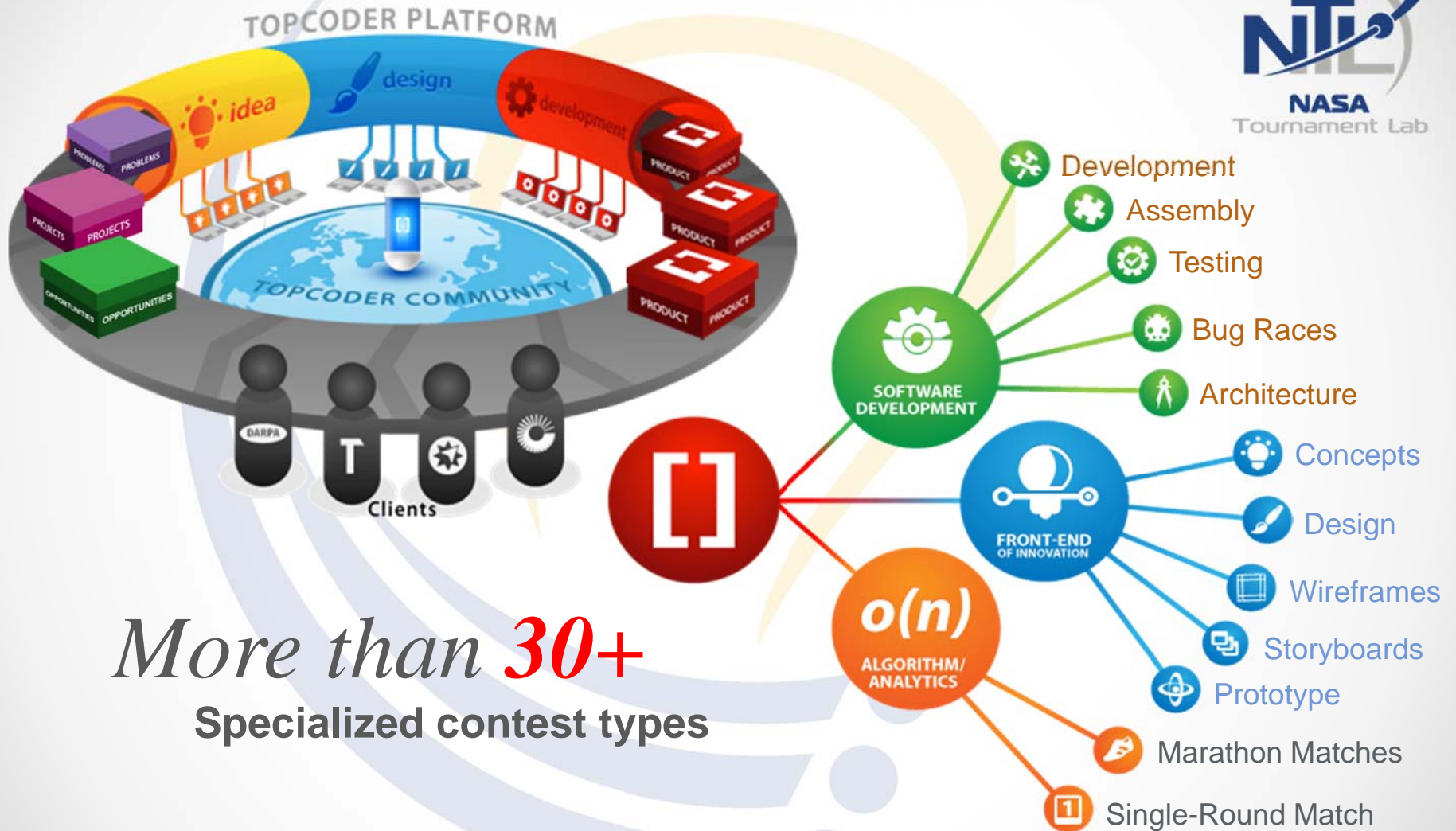
Open Innovation

- New Products
- Breakthrough Discoveries
- Extreme Value Outcomes
- Community Building and Engagement

“Top Line” Gains



INNOVATION AS A PROCESS: EOI



More than 30+
Specialized contest types

What Customers are Building

Web & Mobile Apps



Websites, E-Commerce Platform & Strategic Assets



Legacy System Integration & Cloud Utility Tools



Analytics



Comcast Case Study

- 500+ people from 21 different countries working on Comcast's next generation consumer applications
- Work performed over an 18 month period
- Applications developed for set top boxes, iPad, iPhone,
- Working on highly confidential new products entering into new markets



 Copilots  Winner Countries

13

PROJECTS

184

CONTESTS

8

COPILOTS

4933

TOTAL
REGISTRATION

557

UNIQUE
REGISTRANTS

185

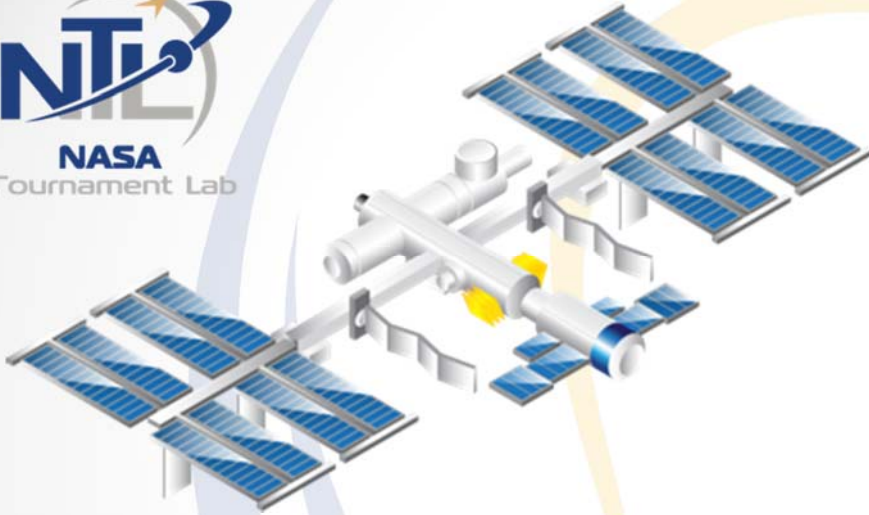
UNIQUE
SUBMITTERS

21

WINNER
COUNTRIES



NTL: Open Innovation On-Demand for NASA

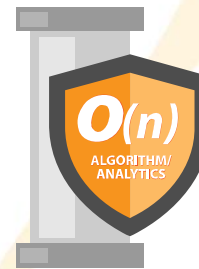


FIT (Food Intake Tracker) iPad Application



The application can identify the Astronaut, track all dietary intake (food and beverages), and provide a timestamp of when the food was consumed on space.

Pipeline Protection Detection Algorithm



A detection algorithm to spot the presence of wheeled vehicles in proximity to a pipeline with the ability to distinguish between a security threat - an unauthorized vehicle - and a non-threat such as wild-life or a downed tree limb.

Planetary Data System (PDS) APIs and Mobile apps



Develop and deploy an API to homogenize search results across a federation of 13 PDS nodes. Demonstrate the value of the API with a suite of mobile consumer apps.

The ISS Longeron Challenge



4000+ Registrants



450+ Submissions

\$30,000

Total Prizes



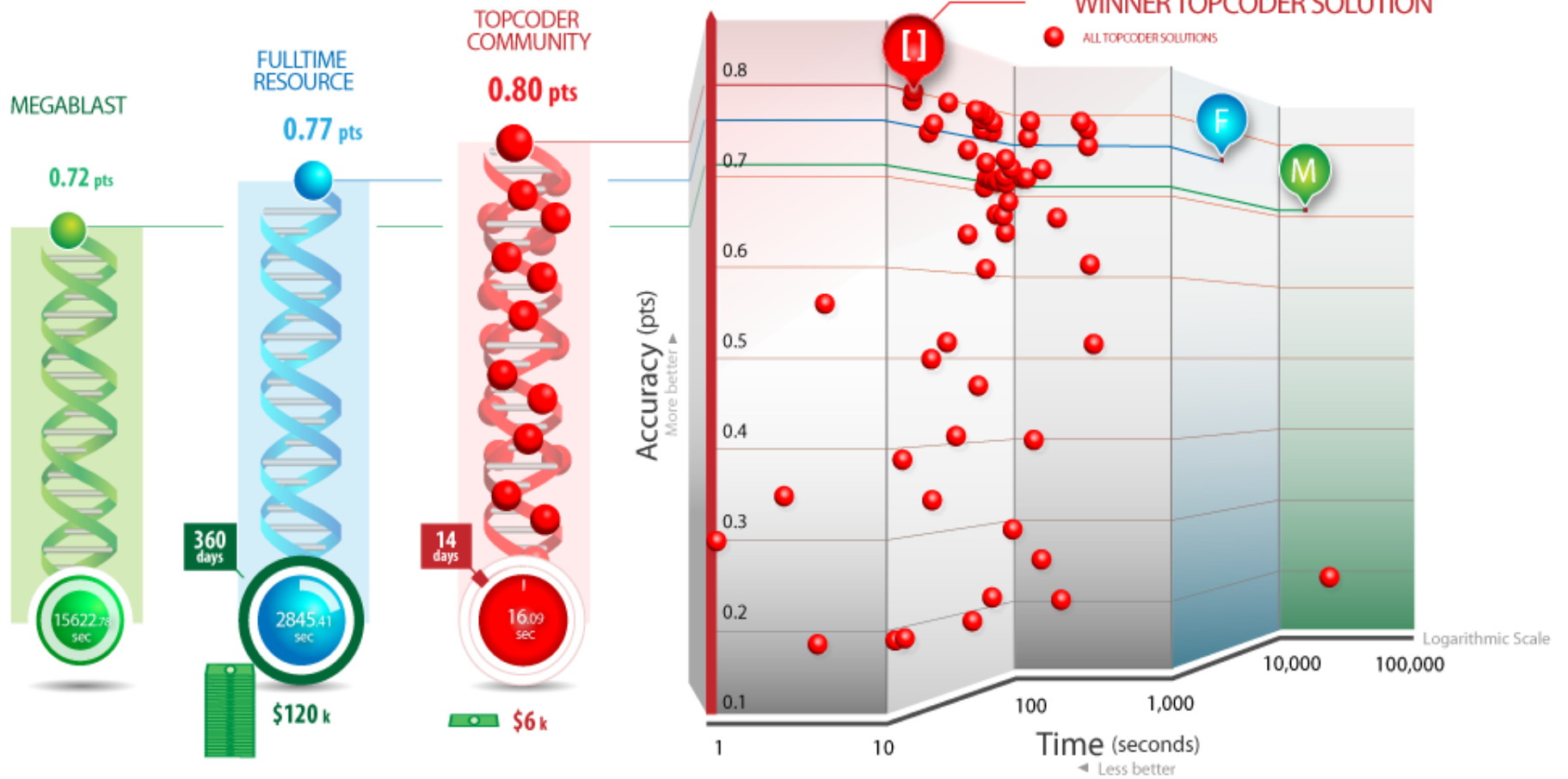


Case Study

Winning solution performs 120x faster

Improve on NIH MegaBlast algorithm for nucleotide sequence alignment

ANTIBODY SEQUENCE ANNOTATION



122

CODERS SUBMITTED

654

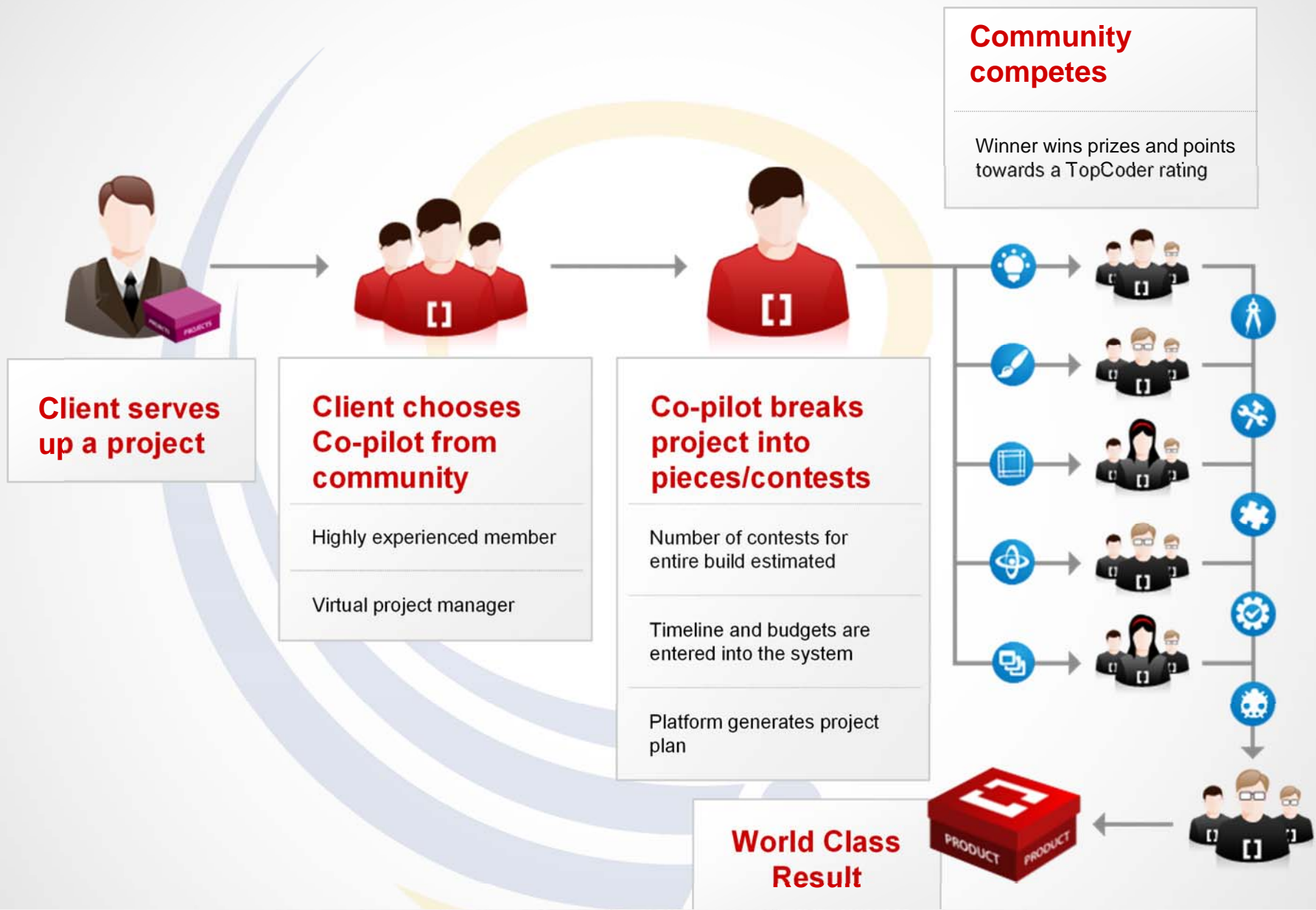
SOLUTIONS

89

DIFFERENT APPROACHES TO SOLVE PROBLEM IDENTIFIED

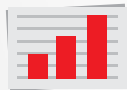
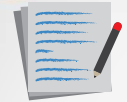
5

WINNING COUNTRIES
RUSSIA, FRANCE, EGYPT, BELGIUM & US





Massively Parallel Production of Innovative Assets



Assets



Client

Copilot



Competitors



Architecture

Assembly

Testing

UX Idea Gen

Rapid Prototyping

Big Data Challenge

Optimization Algo

Storyboard

Wireframes

Concept



[TOPCODER]

www.topcoder.com

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Yet2.com: External Talent Scout



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 **Crystalline, anti-corrosive waterproofing material works within the cement matrix** -- Finalist, Clean15. Originally developed to protect nuclear and defense facilities, this material works with the matrix of cement and water to create crystals that block the pores and capillaries in concrete.

Tech Need Challenge™ Can you solve these technology needs?


 **Seeking Next-generation topical warming innovations that produce heat on the skin** -- Heat is comforting and therapeutic. This organization wants to create physical heat or the feeling of heat for use with a variety of their actives.

 **Seeking: Algorithms for multi-criteria decision making/multi-objective decision making to optimize parameters for hybrid computer models** -- The most effective input parameter configurations must be identified to perturb this complex simulation model toward desirable states.

Technology Marketing Report™

 **Cleaning Agents & Materials**
The Technology Marketplace Report is a list of selected technologies from our database.

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Stream yet2.com's Dec. 9 Webinar: yet2.com presents the finalists in the Clean 15

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 **Global Calendar**



External Talent Scout Pilot Results



| <i>Technical Need</i> | <i>No. of total replies/leads</i> | <i>No. of hits (initial interest)</i> | <i>Active leads</i> |
|--|-----------------------------------|---------------------------------------|---------------------|
| Bone Density Measurement | 51 | 793 | 5 |
| Monitoring of Water and Biocides | 61 | 2003 | 8 |
| Radioprotectants | 28 | 475 | 6 |
| Exoterrestrial Life Differentiation | 31 | 1596 | 1 |
| Food Packaging/Protection | 29 | 173 | 5 |
| Portable Imaging | 34 | 581 | 5 |



Current & Future Plans



- Currently working several AES/Engineering related NTL projects:
 - Disruptions Tolerant Networking (DTN) – Pathfinders in progress
 - Key Management Challenge (pathfinder)
 - DTN2 DTPC Interoperability Test Challenge pathfinder)
 - LTP Authentication Challenge (pathfinder)
 - List of several additional challenges planned after pathfinders.
 - KaBOOM Phased Array Uplink (Planned)
 - Asteroid Identification – Crowd trained machine learning for image processing (Planned)
 - QuakeFinder – Developing algorithms to detect earthquakes from magnetometer data.
 - Preparing to release a BAA for crowdsourcing vendors
 - Applied research examining full scope of crowdsourcing applications.
 - Planning to expand the number/types of crowd/challenge vendors.

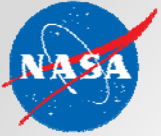


Closing Thoughts



Crowdsourcing provides a new toolset for problem solving and system development.

- This toolset is large and varied.
- Crowdsourcing is NOT free labor.
- When applied correctly, crowdsourcing CAN access amazing innovation.
- When applied correctly, crowdsourcing CAN provide cost effective solutions.
- Crowdsourcing engages the public and allows them to participate directly in the development of the space program!



Questions?