

Using Open Innovation as a Secret Weapon to Finding the Right Technologies and Solution in an Era of Technology Explosion and Relentless Change

Center of Excellence for Collaborative Innovation
NASA Tournament Lab

Steve Rader steven.n.rader@nasa.gov 713.447.7867

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

CoECI works across NASA and other U.S. Federal Government Agencies to assist organizations in understanding and using open innovation tools.



MAKING THE CASE TO INNOVATE

Management and Employees Must
Internalize the “Innovate or Die” Message

Significant Technical Challenges to Space Exploration



- Affordable Propulsion
 - Zero-boiloff Cryogenic Storage, In-space Refueling, Improved Solar, Safe/High Capacity/Light Energy Storage
- Long Term Human Habitation with Limited Logistics
 - High Reliability, Closed Loop ECLS, Food Storage & Production
- Communications
 - Bandwidth For Multi-spectral Imaging, Delay
- Galactic Cosmic Radiation Protection

Finding New Technologies & Solutions to Build Upon

Discovery (\$)

Finding the set of possible solutions containing value



Proof of Concept/Tech Maturation (\$\$)

Determining feasibility of realizing value



Design (\$\$\$)

Selecting optimum against requirements to realize value



Development (\$\$\$\$\$\$\$\$)

Investing in integrating the selected technology to realize the benefit.



Process is replicated, repeated, and revisited across multiple projects and systems from the architecture level down to the component level.

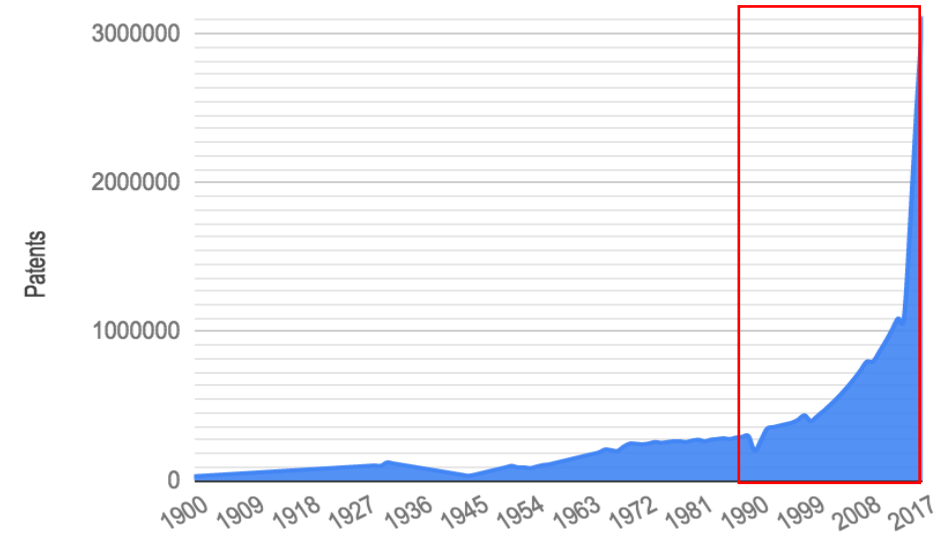
THE WORLD HAS CHANGED

Much of what worked for us in the past
will not work in the future!

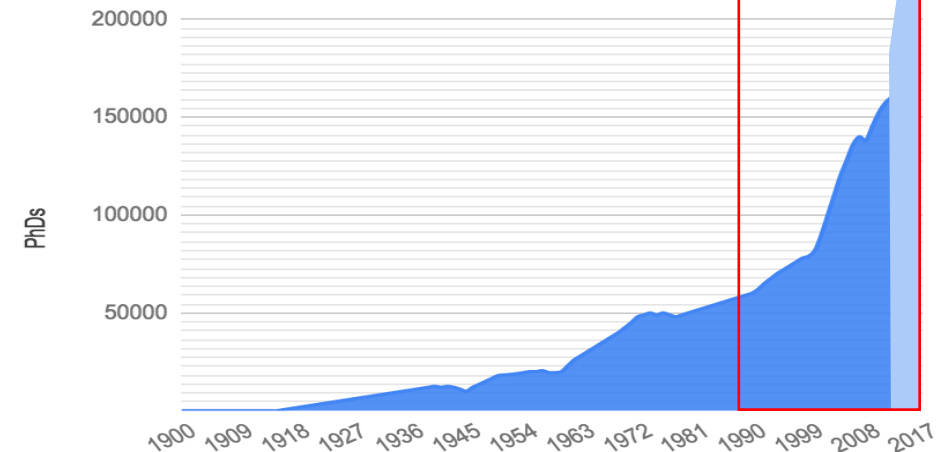
The World has Changed Significantly over the Past 20 Years

90% of All Scientists that Ever Lived
are Alive Today

Patents Worldwide over Time (1900-2017)



PhDs Granted Worldwide over Time (1900-2012)



Technology Building Blocks Accelerating the Rate of Change

Additive
Manufacturing

Photo Credit: Betatype

Materials/Nano-Coatings

CRISPR

Processors/GPUs

Blockchain

Open Software Components

Machine Learning Components

Sensors

A P I

Robotics Components

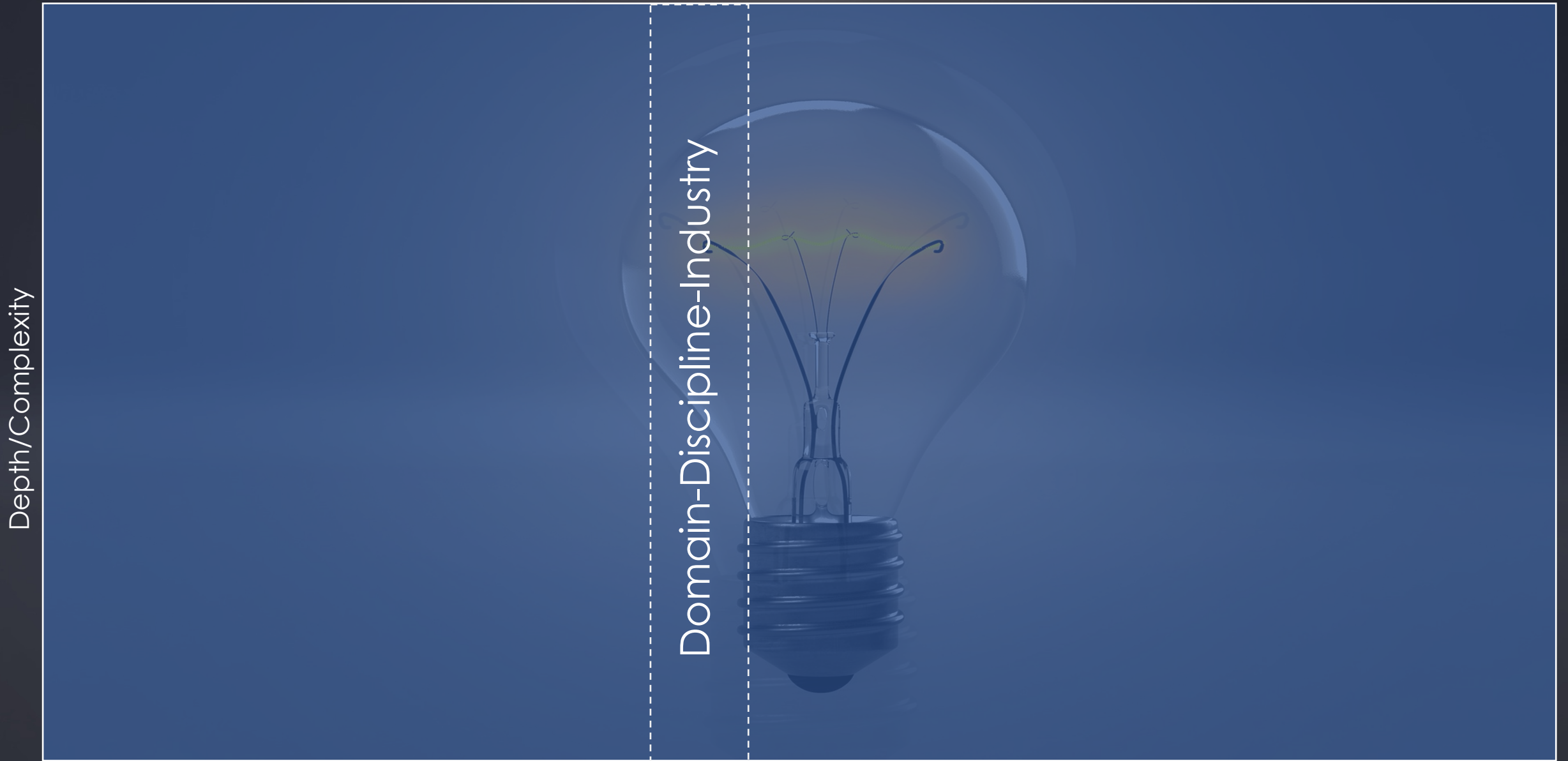
Autonomous Vehicles

Complex Manufacturing

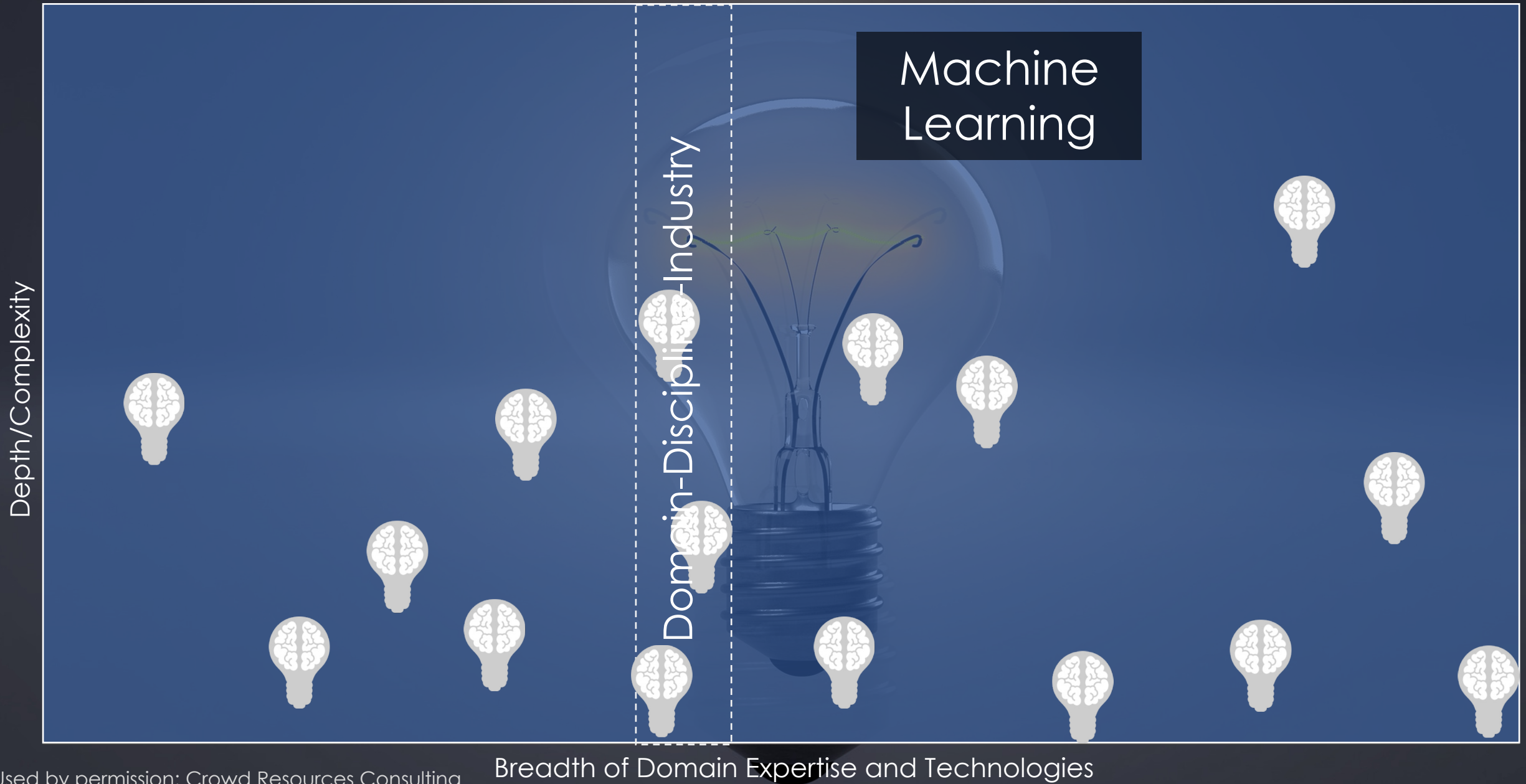
Cloud/Quantum Computing

The accelerating rate of change is driven by low cost access to powerful **technology building blocks** and tools.

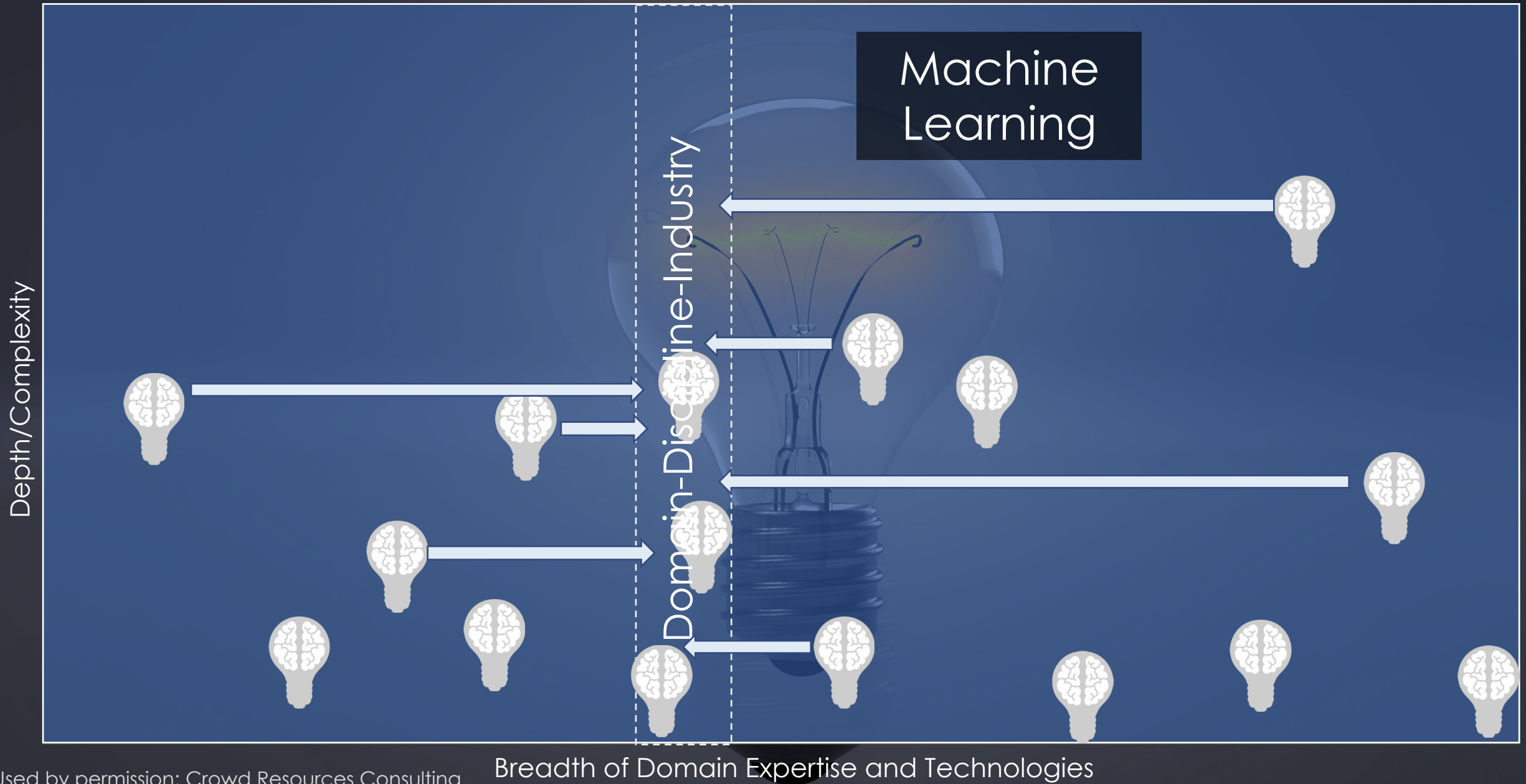
The Breadth and Depth of Skills, Expertise, and Technology



The Breadth and Depth of Skills, Expertise, and Technology



The Breadth and Depth of Skills, Expertise, and Technology



PRO

Amazing new technologies that could result in significant gains towards solving hard problems

CON

Finding these technologies & solutions across the growing number of possible sources is hard

Consequences of Not Finding the Best Tech or Expertise

Discovery (\$)

Finding the set of possible solutions

New Landscape Requires New Tools for Cost Effective Search for Both Technologies and Innovative Solutions

Proof of Concept/Tech Maturation (\$\$)

Determining feasibility of realizing value

Design (\$\$\$)

Selecting optimum against requirements to realize value

Development (\$\$\$\$\$\$\$\$)

Investing in integrating the selected technology to realize the benefit.

Missing a key technology or idea early on can have huge consequences

The Rate of Change for Knowledge and Technology is Increasing

Hard to Find Skills and Expertise

Hard to Keep Up with Tech Advances

High Risk to Remaining Competitive/Relevant

IN THE LAST 15 YEARS, 52% OF THE
FORTUNE 500 COMPANIES HAVE
GONE EXTINCT

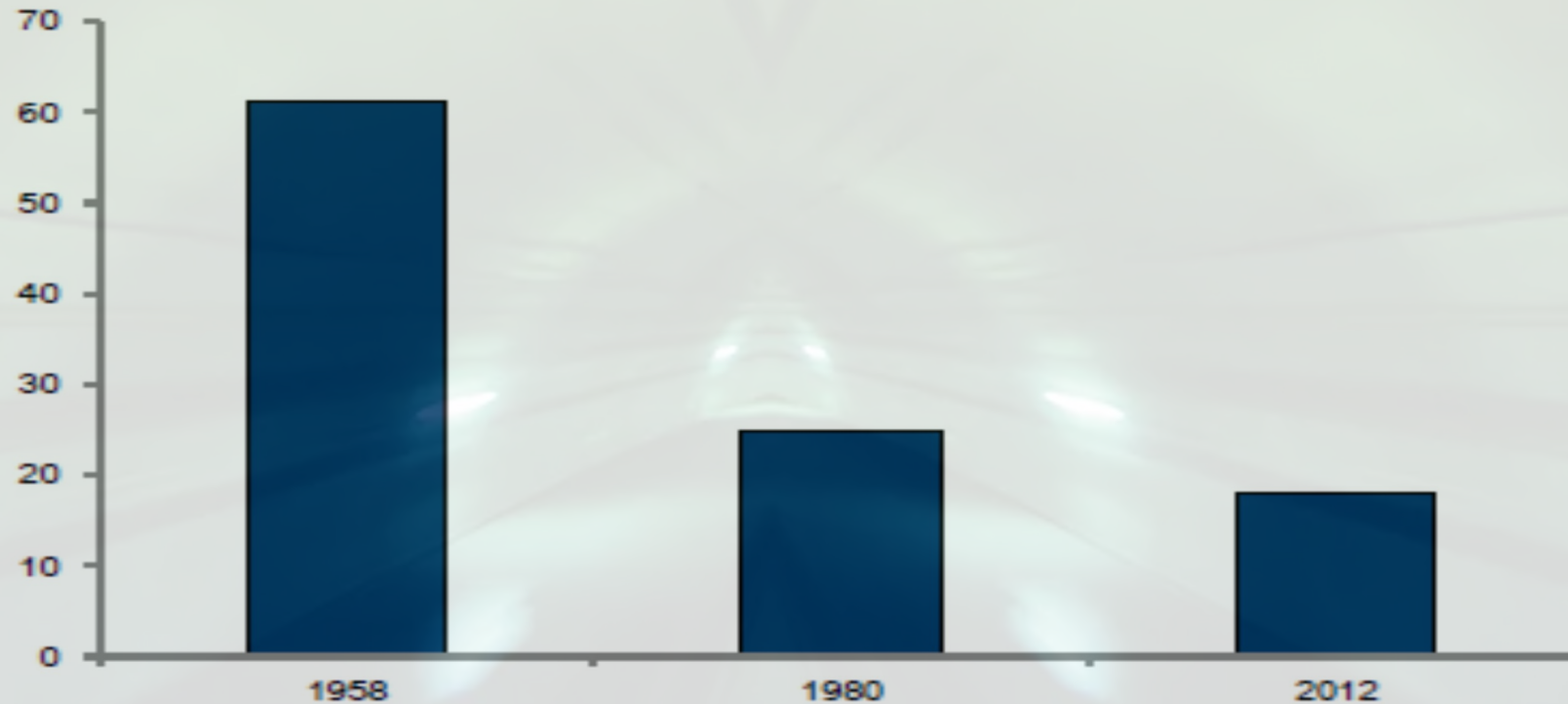


Source: Innosight



Average lifespan of an S&P 500 company

...as a result, the average lifespan of a S&P500 company is now less than 20 years, from c60 years in the 1950s

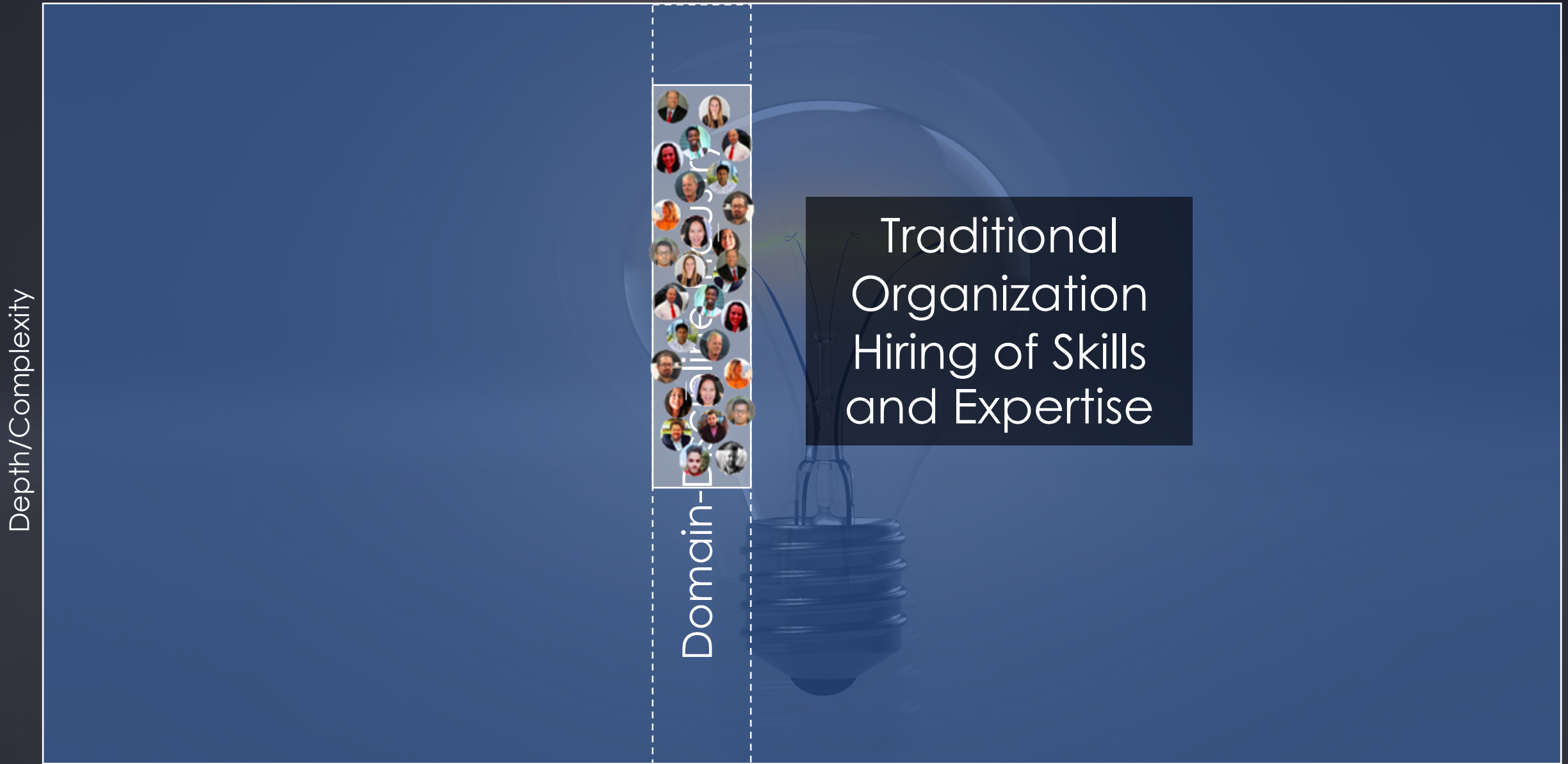


Source: Credit Suisse

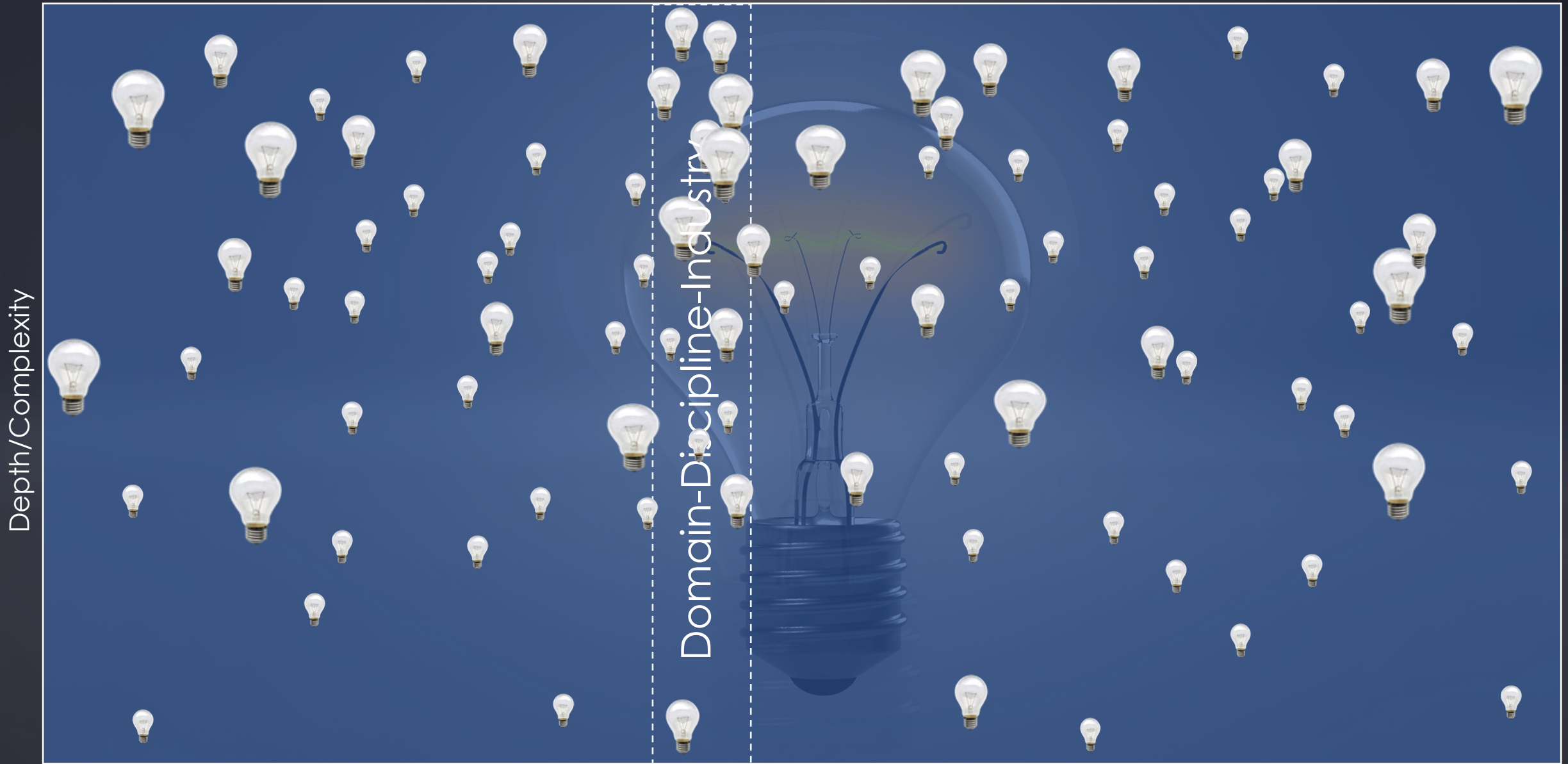
WHY OPEN INNOVATION

Workforce must understand that open innovation is not only effective, but especially able to address the innovation problem.

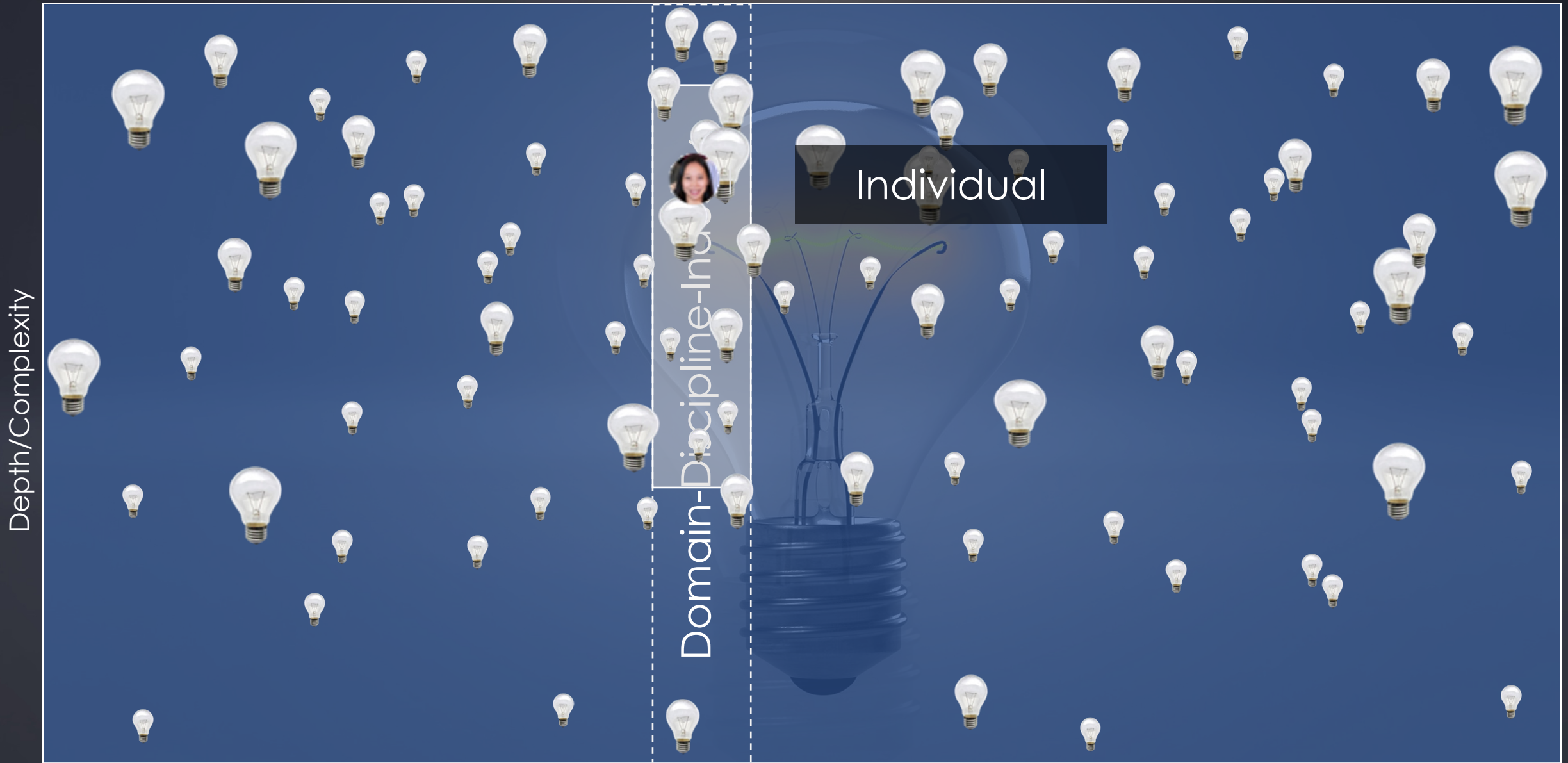
The Breadth and Depth of Skills, Expertise, and Technology



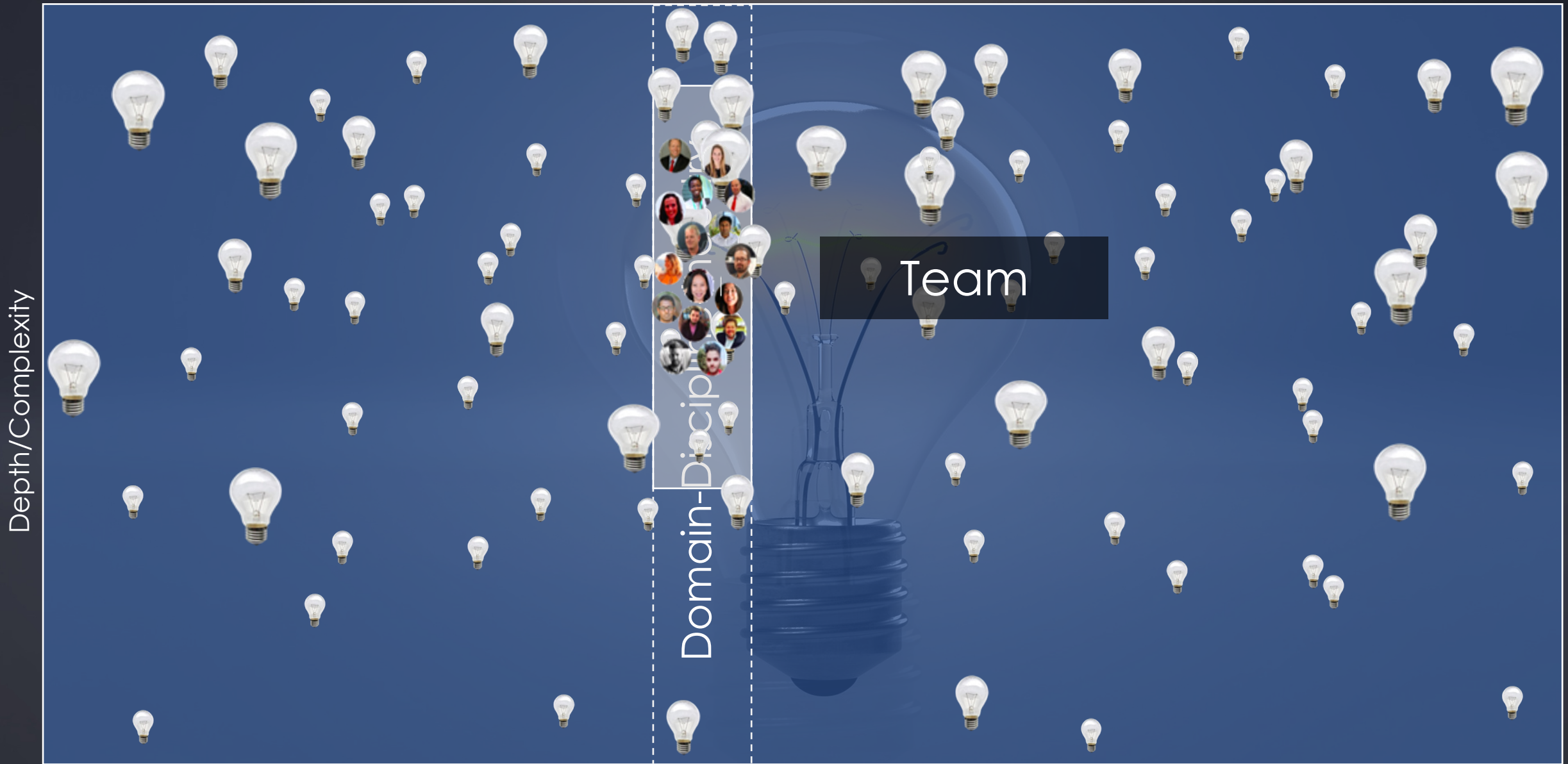
The Breadth and Depth of Skills, Expertise, and Technology



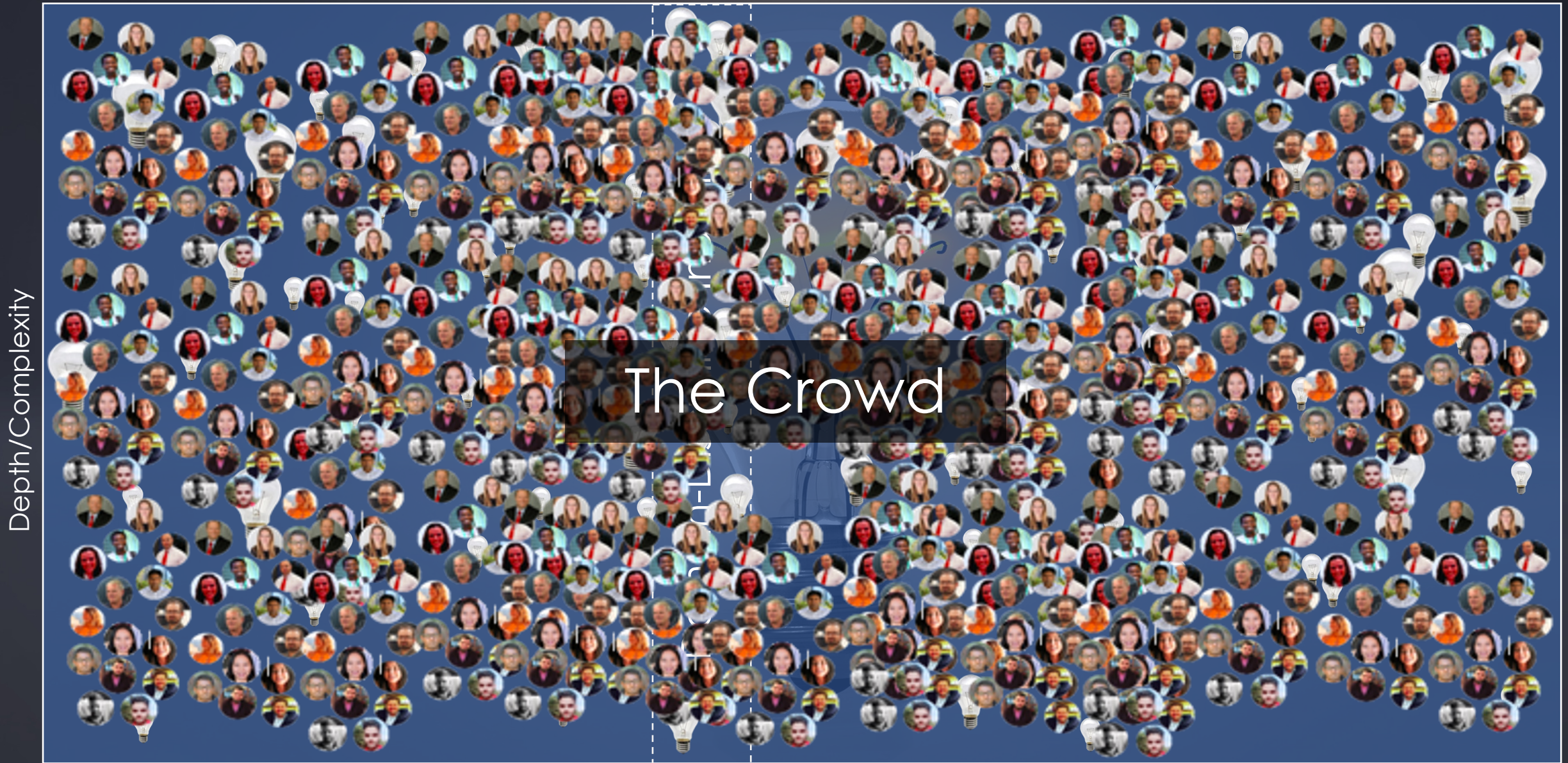
The Breadth and Depth of Skills, Expertise, and Technology



The Breadth and Depth of Skills, Expertise, and Technology



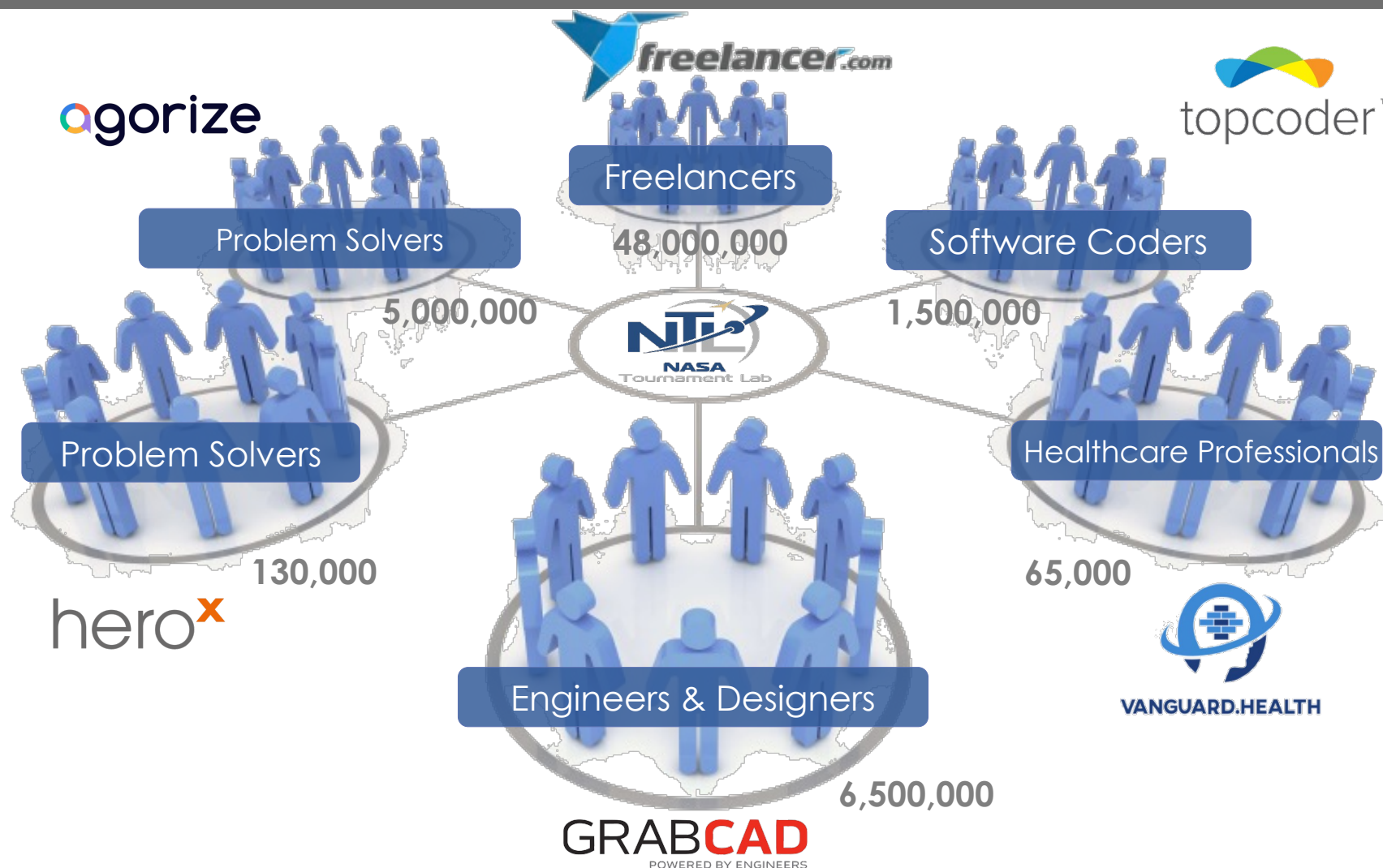
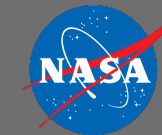
The Breadth and Depth of Skills, Expertise, and Technology



“Open Innovation” is an Effective Tool to Keep Pace with Accelerating Change

Open Innovation or crowdsourcing platforms are bringing together and curating large numbers of people from all over the world with all types of backgrounds, skills, and expertise to provide valuable products and services.

Curated Communities



Crowd Facing:

Company draws in members from around the world around a passion and/or interest.

Customer Facing:

Company mobilizes the skills and expertise of their curated community members to provide value to customers.

Communities leverage passion and diversity to provide value to organizations.

Crowds Provide Access to High Value Expertise/Skills

"Most of the bright people don't work for you – no matter who you are."

- Bill Joy, Co-Founder of Sun Microsystems



Crowds Provide Access to High Value Expertise/Skills



Crowds Cut Across a Broad Set of Technical Disciplines

Physics/Mech Eng

Biotech/Genom

Materials/Nano

Electrical Eng

Math/Data Science/ML

Multispectral Sensing

Computing

Automation

Power Gen/Storage

Solutions many times
come from knowledge,
perspectives or
technologies from other
technical domains

...

The Breadth and Depth of Skills, Expertise, and Technology

Depth/Complexity

Study data of successful InnoCentive challenge solutions showed...

70% of successful challenge solutions are solved by individuals outside of the challenge's specific technical domain.

"75% of successful solvers already knew the solution to the problem."

*Dr. Karim Lakhani **

- *Jeppesen, Lars Bo and Karim R. Lakhani. Forthcoming. Marginality and problem solving effectiveness in broadcast search. Organization Science 20. Published Version <http://orgsci.journal.informs>.

Breadth of Domain Expertise and Technologies

Using Crowds to Solve Problems

Depth/Complexity

But HOW Can You Find the
“Right” Expert or the Existing
Solution from Some Other
Domain Using the Crowd?

Breadth of Domain Expertise and Technologies

Accessing Crowd VALUE Using Challenges

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

Solution Filtering (optional)

Solution filtering
mechanisms are

Pick the Winner(s)

Evaluating

offered by
some
platforms

Get Your Solution

IP licensing and/or transfer

Well designed challenges posed to a curated community have proven very effective for discovering new and existing (but unknown) solutions and technologies.

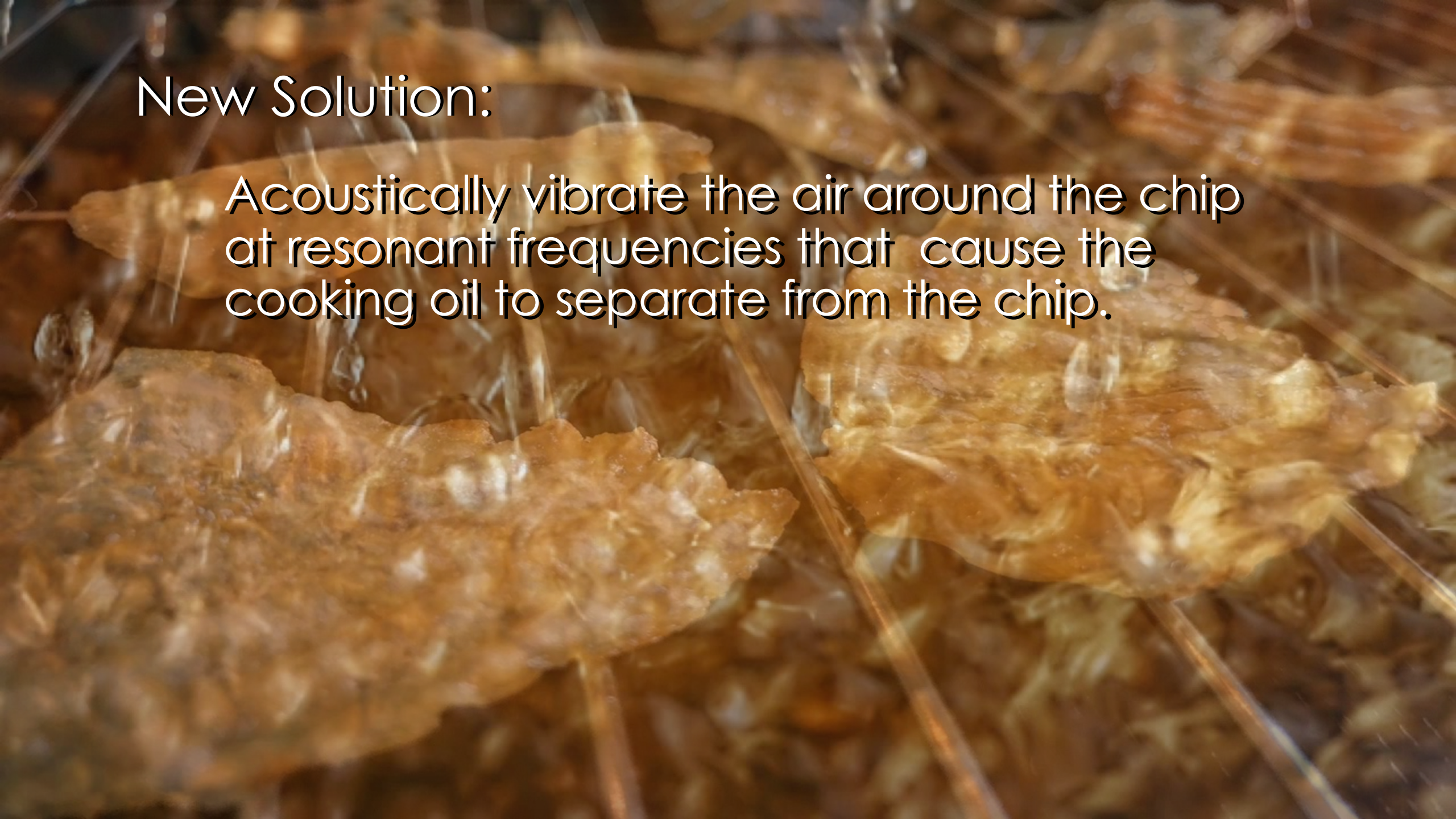
The Problem - Generalized For a Broader Crowd

Remove grease and soft fluid
from skin to achieve crisp texture

Existing Solution

Mechanically vibrate the crisps to shake off the cooking oil.



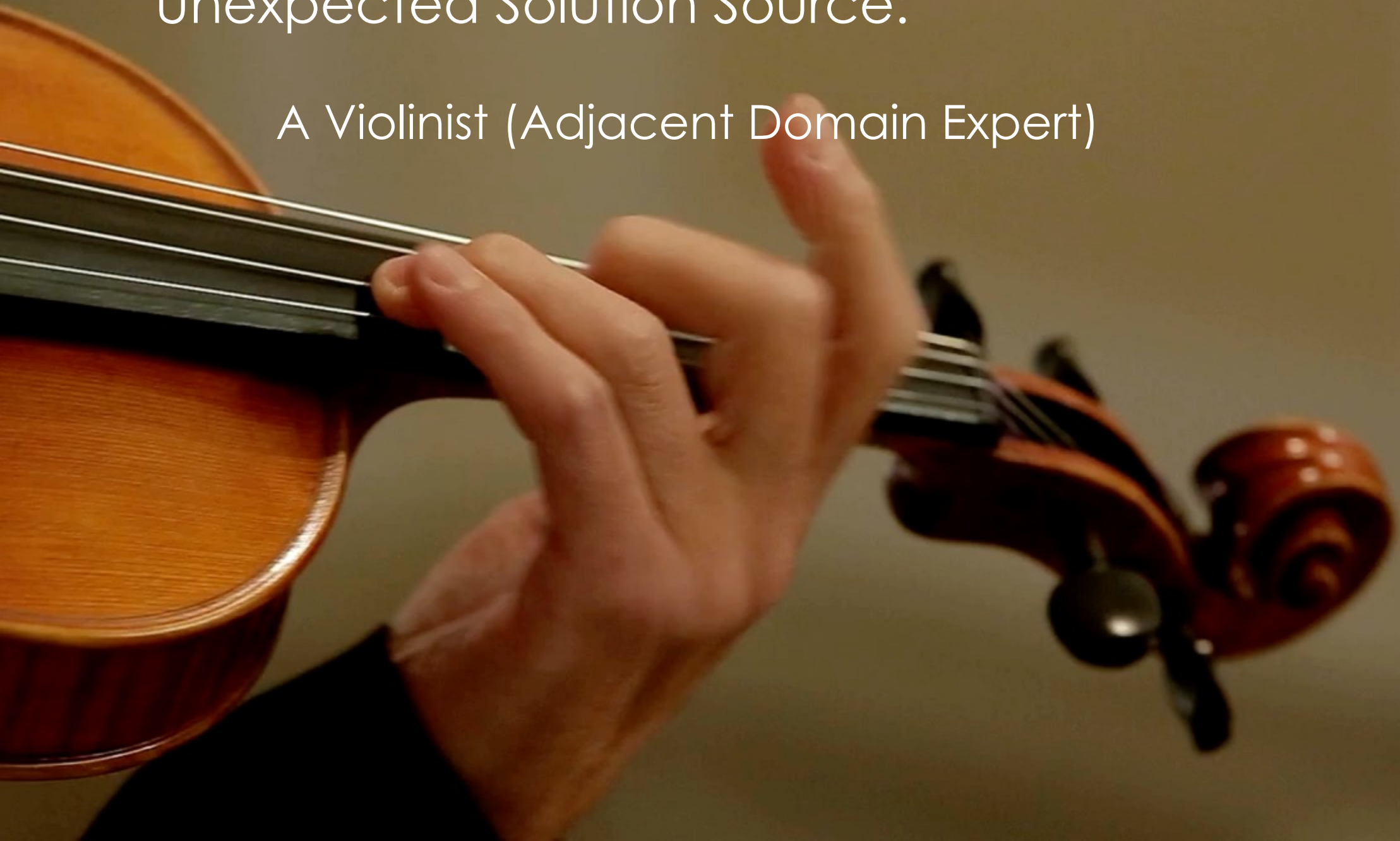


New Solution:

Acoustically vibrate the air around the chip at resonant frequencies that cause the cooking oil to separate from the chip.

Unexpected Solution Source:

A Violinist (Adjacent Domain Expert)



An Case for Augmenting the Traditional R&D Approach



Roche

Results: Existing technology found to solve the problem

15 years of
proprietary
research
replicated in a
single 60-day
public
challenge

Case Study: Julian Birkinshaw, MLabnotes, University of London Business School

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Improving Pipeline Bundle Inspection

subsea 7

Subsea7 was seeking to improve pipeline inspections.

NineSigma Challenge Result: Found a technology a fraction of the size that performs inspections over **100x faster** that will be much less expensive to operate.

This new technology was poised to transform the industry.

NINESIGMA

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

ADDRESS THE CONCERNS

Make sure and have a solid approach for sensitive topics like protecting intellectual property and software security.

Intellectual Property (IP) and Open Innovation

Who owns the solutions to challenges?

How can I protect my company sensitive information & IP?

How are crowd member ideas/designs protected?

Can I have crowd members sign an NDA?

How can I protect my organization from potential bad actors?

Intellectual Property (IP)

The IP position is almost always determined by the challenge owner

Solver Maintains Full IP

Used for stimulating the market, max participation

Solver License IP to Challenge Owner:

Typical Win-Win

Solver Provide Solution under Open Source License

Similar to license

Solver Transfers IP to Challenge Owner

Used for minor products/ideas, minimum participation

Platforms normally have a process for protecting and transferring IP.

Approaches for Protecting Sensitive Information

Stay anonymous or use a proxy challenge owner.

Narrow the scope you challenge to only address a component of the larger problem such that the overall context is not visible.

Remove contextual language from the challenge such that the context of the information is unknown.

This has the added benefit of making the problem more accessible to solvers outside of your domain.

Require NDA's, background checks, and/or limit participants to a known/verified group.

Require identification verification.

Seal or hide all submissions from competitors/public.

Methods for Protecting Sensitive Challenges: Contextual Obscuration

A challenge was posted to find a way to track a specific bison in Yellowstone National Park using only images posted on social media.



The challenge owner was the CIA who needed to find a way of tracking Russian actors in Crimea but needed to keep the actual problem secret.

An innovative solution was found and deployed without detection.

Software Security

Given international crowd participation with limited visibility into participant details/background, crowd-sourced solutions must mitigate risks to government software and IT infrastructure.

Participants are not granted access to secure systems.

Only source code is accepted for delivery. Binary code is not accepted.

Source code is independently reviewed for quality/security.

The crowd is used to find bugs/security issues in the source code/design.

This is very difficult for a bad actor to deal with.

All source code is scanned using static analysis vulnerability detection software.

Option exists to employ registered “white hat hacker” community to test deployed systems for vulnerabilities.

IMPLEMENTING TOOLS & PROCESSES

Organization must provide the tools and support processes/resources to put the concept into practice.

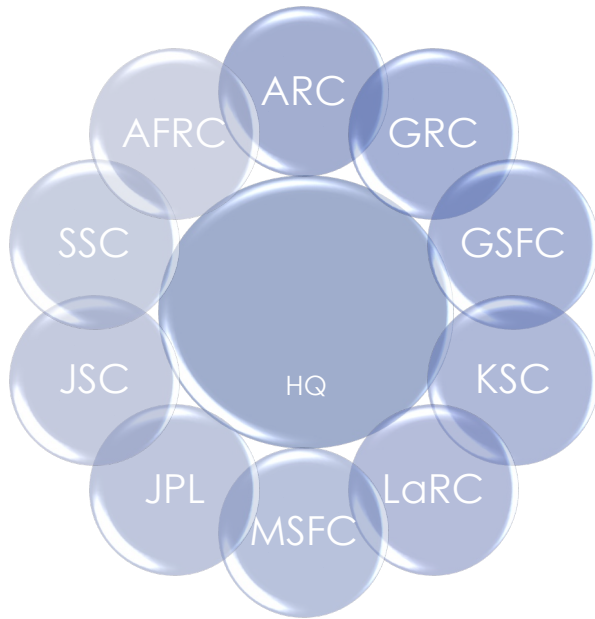
NASA's Center of Excellence for Collaborative Innovation



Across NASA Centers & Programs

Public Facing - Worldwide

Across US Federal Agencies



27 Organizations across
15 Agencies To Date

Provides Access to Open Innovation (OI) Platforms Worldwide
Contracts/Mechanisms
Processes/Support
Education/Outreach
Research

Part of NASA's Space Technology Mission Directorate (STMD)
Prizes and Challenges Program
Provides services across NASA & other Federal Agencies
Virtual Office hosted within Johnson Space Center's
Human Health & Performance Directorate

The NASA Tournament Lab “Toolkit”

Contracts and Resources for Crowd-Based Projects



Working with
Organizations
Outside of NASA:

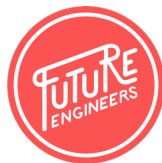
Other **federal agencies** may use the NOIS2 and OITS contracts via an Inter-Agency Agreement (IAA) as an assisted procurement.

Any **non-government organization** may also partner with NASA to fund and run a public prize competition using the COMPETES Act-based agreement.

External Technology Search via Open Innovation Technology Search (OITS) Contract



K-12 Challenge Platform via Future Engineers SBIR Contract



External Crowd Platforms via NASA Open Innovation Services (NOIS) 2 Contract



External Crowd Platforms via Micro-Purchase or P-Card Transactions

Internal Crowd Platform via NASA Internal Innovation and Collaboration Environment (NIICE) Contract



Research Studying Crowd-based Programs via Cooperative Agreement



Authorities
the NTL uses to
execute projects:

Procurement Authority: Purchasing a solution from a company who uses crowd-based methods to provide that solution (selectable IP options).

COMPETES Act Authority: Purchasing services from a company to help execute a challenge using COMPETES Act (The gov't administers the prize and the winner maintains IP rights)

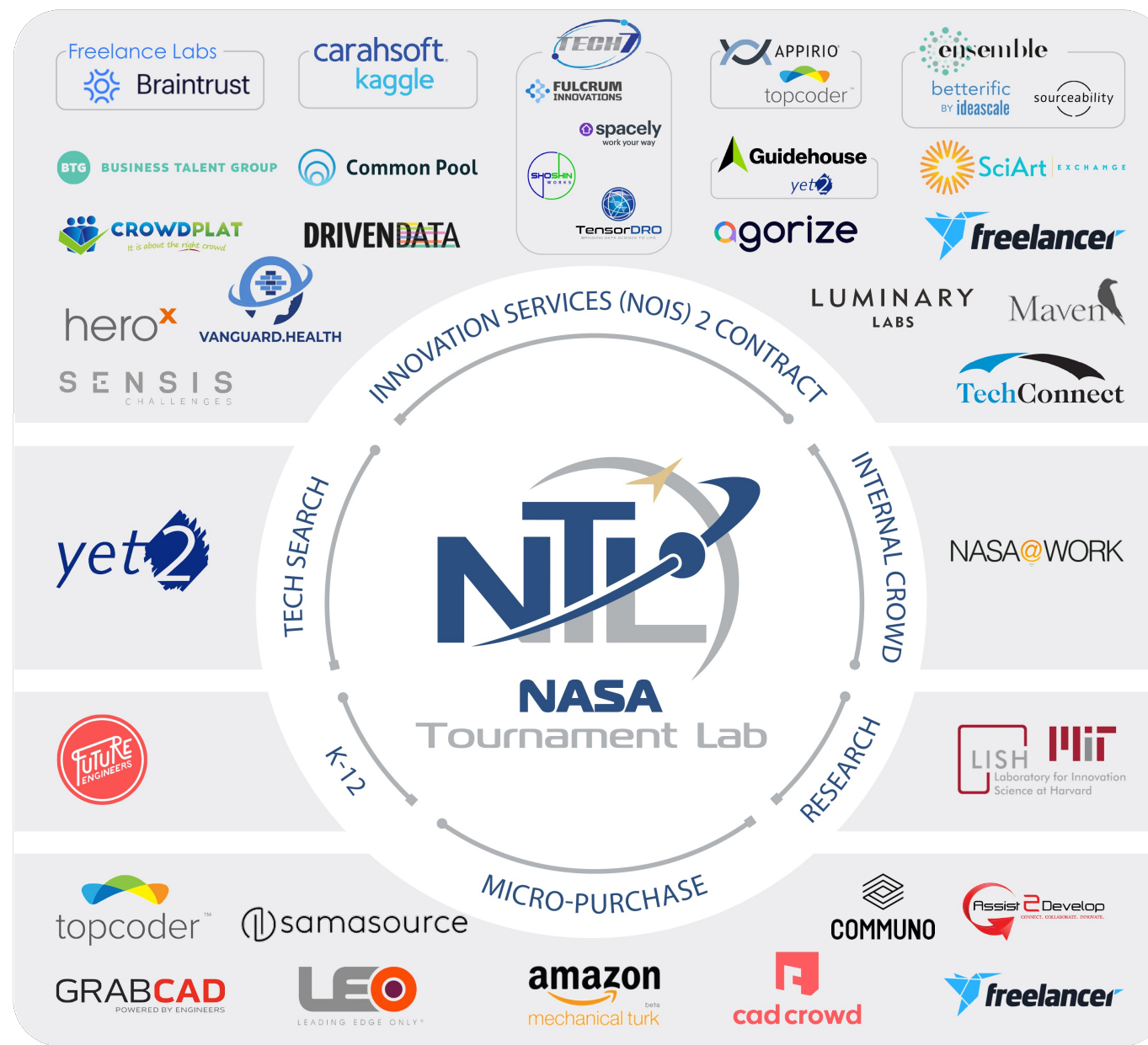
The CoECI team provides facilitation and assistance to organizations using the NTL Toolkit or developing innovation initiatives/programs within their organizations.

The NASA Tournament Lab “Toolkit”

Curated Crowds Available for NASA Challenges & Tasks



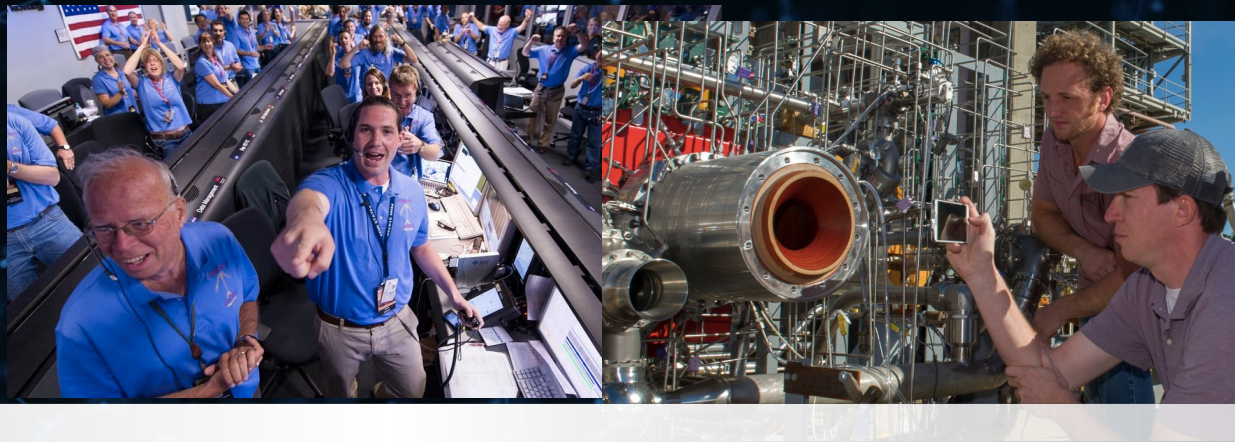
Access to 40
Open
Innovation
Firms &
Communities



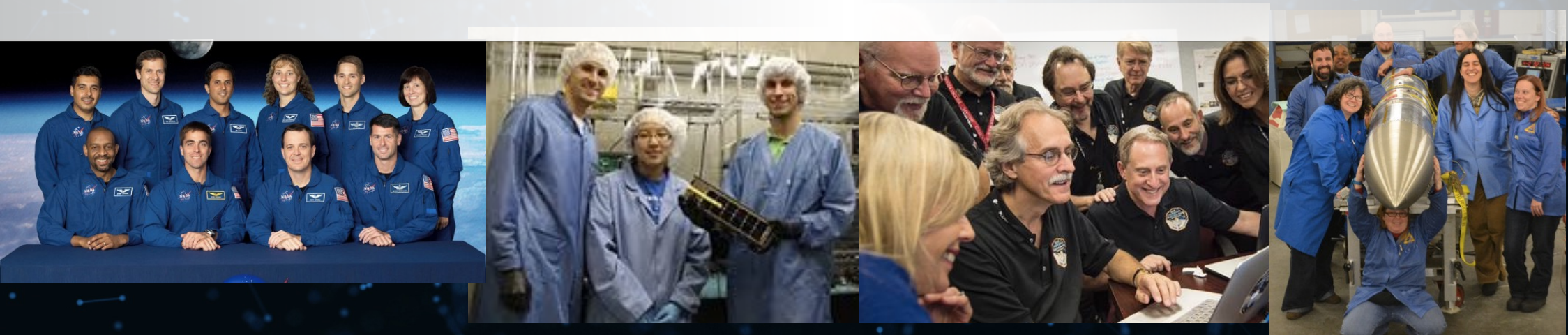
Representing
over 100
Million
People
Worldwide

The CoECI Toolkit

NASA's Internal Crowd



NASA@WORK



[WELCOME](#)[HOW TO PARTICIPATE](#)[FAQ](#)[SUCCESSES](#)[PAST CHALLENGES](#)

Search Active Ideas

NASA@WORK

With open innovation, we can dissolve the boundaries that separate our different disciplines and look to our own community to help us build a better NASA.

[Run a Challenge](#)

NASA's Internal Crowd

Over 30,000 NASA Civil Servants and Contractors

Over 190 challenges to date

91% of challenges are successful

90% of solutions implemented/planned

88% of NASA@WORK challenges that provided cost estimates showing cost savings averaging 82% (total savings identified to date \$8.7M) over traditional methods.

No cost to projects to run a challenge

Offers a set of non-monetary awards

Very effective for enterprise knowledge sharing/discovery

NASA@WORK

Determining Urine Volume in Microgravity



Robert Pietrzyk from JSC's Human Health & Performance Directorate needed improved solutions for measuring urine volume in microgravity.

He ran a NASA@WORK challenge seeking solutions.

Results: Found an working prototype saving \$1.3M & 3-5 years of development.

The working prototype was developed for another purpose in a lab that was only 300 yards from the group seeking the solution.

Searching for Technologies

Using Crowd-based
Networks to Find
Technologies Invisible to
Most Internet Searches



Lunar Surface Innovation Initiative



"The technology search was rapid and comprehensive. It was also global, which increased the odds of finding the right type of technology we were looking for. It is very possible their findings will meet requirements for a lunar surface experiment! I'm so happy this tech search capability exists."

-- MSFC\Jennifer Edmundson

Technology Searches:

- Lunar Dust Mitigation
 - 12 promising technologies found of 82 identified
- Lunar Surface Manufacturing
 - 6 promising technologies found of 69 identified
- Acceptable Materials for the Lunar Environment
 - 8 promising materials found of 72 identified
- Lunar Dust Filters
 - 1 promising technology found of 53 identified



Cost Per Search: \$30,000



Innovation & Problem Solving Challenges

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





Exploring Hell: Avoiding Obstacles on a Clockwork Rover

He used a HeroX challenge to seek out new and innovative approaches.

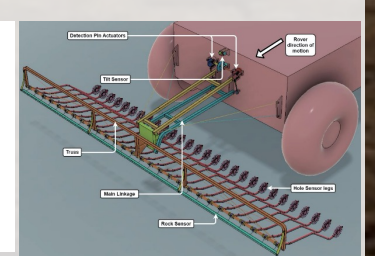
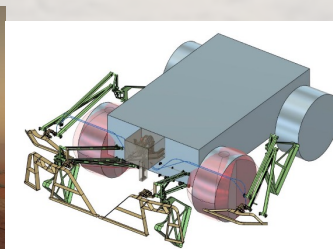
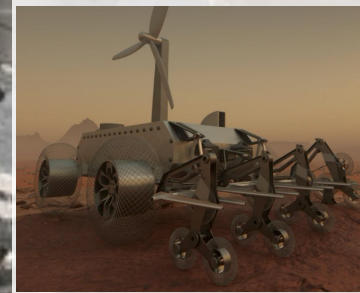
Jonathan Sauder PhD, Senior Mechatronics Engineer from JPL, needed an innovative obstacle avoidance sensor for a mechanical clockwork Venus rover.



The longest any spacecraft has survived on the surface of Venus is just over 2 hours — a record set by the Soviet Union's Venera 13 probe in 1981. The last spacecraft to land on Venus was in 1985 and it survived only 52 minutes.

Proposed solutions were required to last 6 months or longer on the Venus surface.

Winning Solutions



572 Submissions Total Cost: \$66,750

Exploring Hell: Avoiding Obstacles on a Clockwork Rover



Just one of 572 submissions.

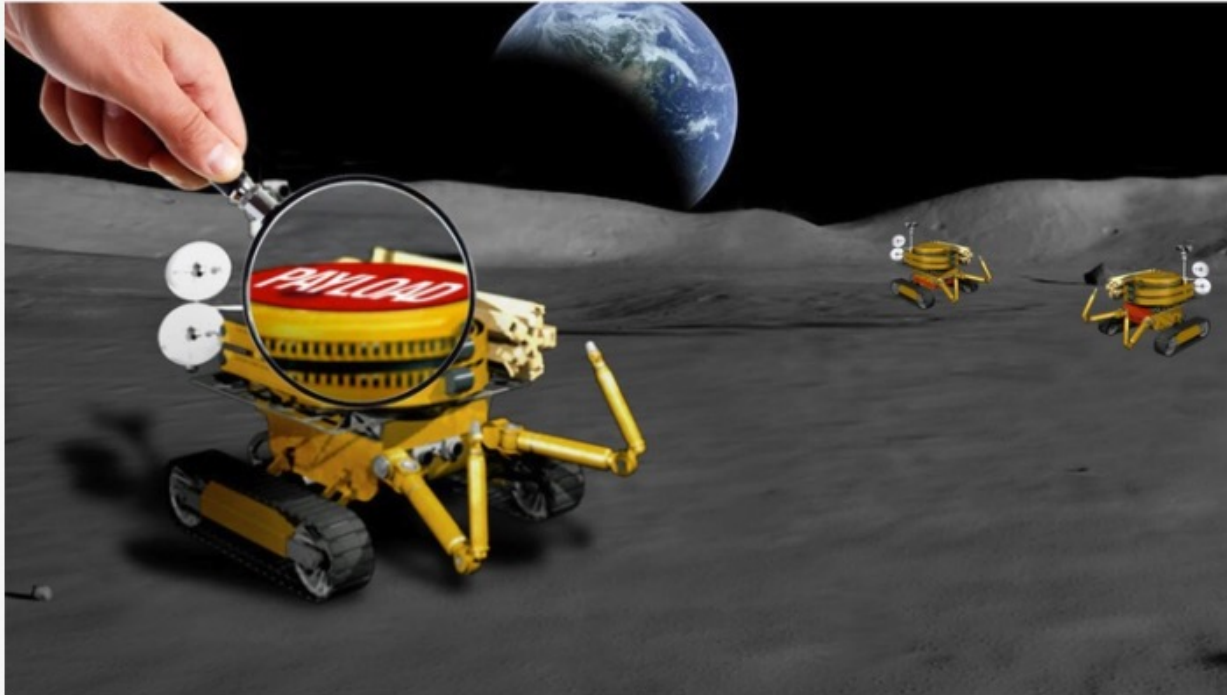


NASA Tournament Lab

49,776

Share

Follow (1.7K)



Honey, I Shrunk the NASA Payload

Give a tiny bot a new set of tools to explore the moon. Share your ideas for a mini payload to make lunar exploration more effective.

Government

Science

Space

Stage:
Judging Closed

Prize:
\$160,000

FOLLOW CHALLENGE

- Payloads need to be similar in size to a new bar of soap to fit cleanly inside the rover (maximum external dimensions: 100mm x 100mm x 50mm).
- This ideation challenge will award \$160,000 total in prizes across two categories. This ideation challenge is expected to be followed by new challenges to prototype, test, and deliver these miniaturized payloads.
- This larger effort will generate a maturation pipeline of next-generation instruments, sensors, and experiments that can be used for lunar exploration over the next few years.



NASA Tournament Lab

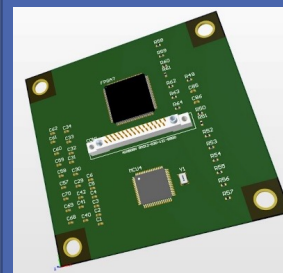
14 Winners Awarded: July 14, 2020

49,776

Share

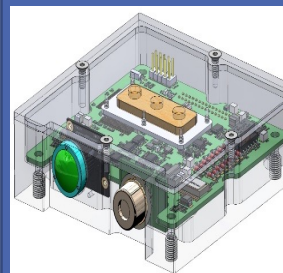
Follow (1.7K)

Honey, I Shrunk the NASA Payload



1st Place Resources Potential

The Puli Lunar Water Snooper



1st Place Lunar Environment

Sun Slicer – Miniaturized XRAY Spectrometer

Category 1: Lunar Resource Potential

- | | |
|--------------|--|
| First Prize | Puli Lunar Water Snooper by Puli Space Technologies Team |
| Second Prize | Permittivity Analysis of Regolith using SansEC by Nova Rover Payload Team |
| | KSat Stuttgart e.V. MICU 3D mineral seeker by KSat Team |
| | M-EL VIS, Locating and Mapping Lunar Volatiles by Curtis Purrington |
| Third Prize | Adaptable science box: Magnetometer+Rad detector by Space Initiatives Inc |
| | LAMPER by Amin Aminiaei |
| | Moon soil resources from seismic waves by Drive Me Through the Moon Team |
| | Raman-based Mineral Classification Payload (RMCP) by Top Raman NASA Payload Team |
| | M.E.G.A.M.A.N. by Big Brain, Little Payload Team |

Category 2: Lunar Environment

- | | |
|--------------|---|
| First Prize | Sun Slicer – Miniaturized XRAY Spectrometer by Team Sun Slicer |
| Second Prize | LEA (Lunar surface Energetic neutrals Analyzer) by Bhardwaj Shastri |
| Third Prize | Novel Fibber Bragg Grating seismometer by John Draganov's team |
| | Lunar Radiation Characterization by Christian Haughwout |
| | Laser Based Dust Detector for the Lunar Surface by Ryan Smith |

Data Science/Algorithm Challenges

Using Challenges with Expert Communities to Develop/Improve Algorithms.



Asteroid Data Hunter



Victoria Friedensen from NASA HQ needed to improve NASA's ability to detect asteroids.

She used a challenge on Topcoder to find a solution.

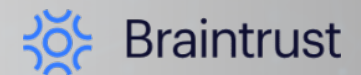
Results: Downloadable app and algorithm that provides a 15% Improvement in asteroid detection over current method for asteroids in the main belt of Asteroids that orbit between Mars & Jupiter



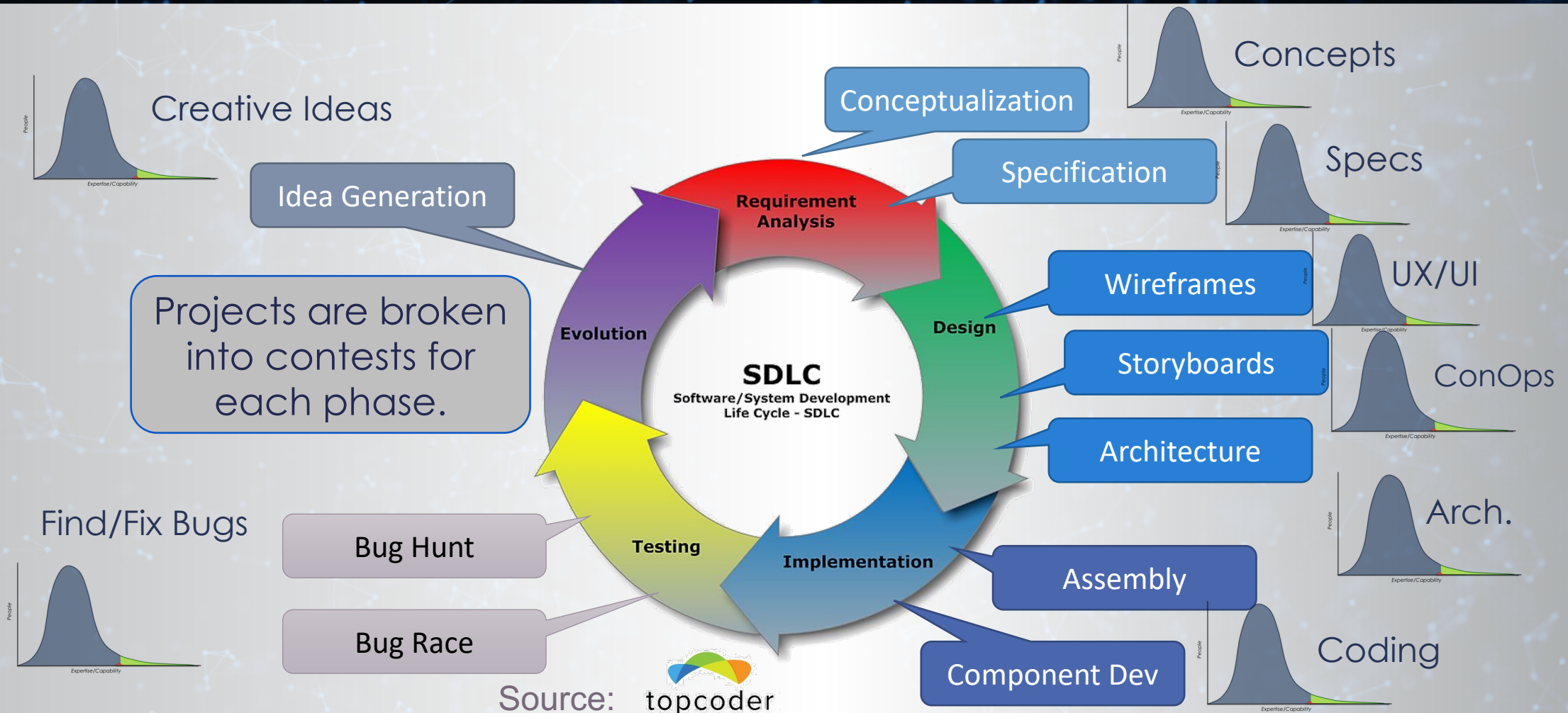
1241 Registrants
625 Solutions Submitted
Total Cost: \$188,000

Software Challenges

Using Challenges with Expert Communities to
Develop Software Solutions.



Using Competitions for Software Development



Each contest taps into the **best** of the portion of the community that has expertise for that phase.

ISS Astronaut Food Intake Tracker (FIT) iPad App



Dr. Scott Smith and Sara Zwart from JSC's Nutritional Biochemistry Lab needed a better way to collect crew nutrition data on ISS.

They used a NASA@WORK challenge followed by a Topcoder challenge to find a solution.



Results: iPad App currently in use by ISS crew with significant improvement in the capture of crew nutrition data.

Total Cost*: \$99,000

*Total Dev Cost w/ Add'l flight reqmts: \$225,000



NASA

ISS FIT (Food Intake Tracker) iPad App

NASA needed an improved way to track the dietary intake of astronauts aboard the International Space Station (ISS). The application would help NASA combat health risks their astronauts face, like bone density loss (osteoporosis). The solution needed to be sleek, simple, and yes... work in space. Crowdsourcing helped deliver the ISS FIT (Food Intake Tracker) iPad application.

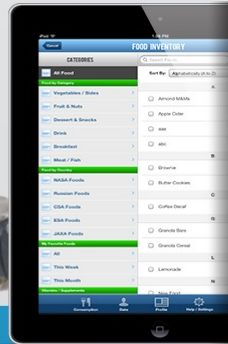
It starts with Project Atomization

Breaking a complex project into the smallest buildable elements helps attract hyper-specialists from the Topcoder Community. Their expertise was needed to solve for extremely specific features of this application like:

Intuitive user interface for the diverse, international crew aboard the ISS

Universal barcode compatability to track food from multiple space agencies

Interactive data entry to allow astronauts to record food intake manually, by voice, or by photo



Projec Kickoff



21
Crowdsourced
Challenges



1
Copilot
managed the project and helped
facilitate the challenges

ROADMAP



8
Months
of work from project
kickoff to completion



55
Unique
Submitters
from around
the globe



6
Unique
Challenge
Types
spanning ideation
through testing



20
Unique
Winners
illustrating true
global collaboration

WINNERS

99
Submissions
received from competitors
around the globe

\$99.8K

Project Budget
included prize money
and project fees

The iPad app is now being
used aboard the ISS.

Project Completion



Crowd Results using a Government Credit Card (< \$10,000)

Micro-Purchase Challenges

50 Projects to date including: Software, CAD designs, Graphics, & Video



GRABCAD

samasource

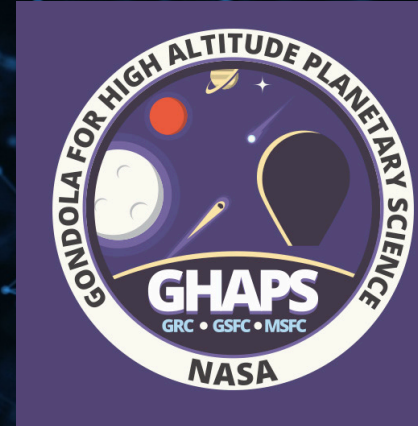
amazon mechanical turk
Artificial Intelligence

COMMUNO

cOutsource

NASA Project Graphic Contests

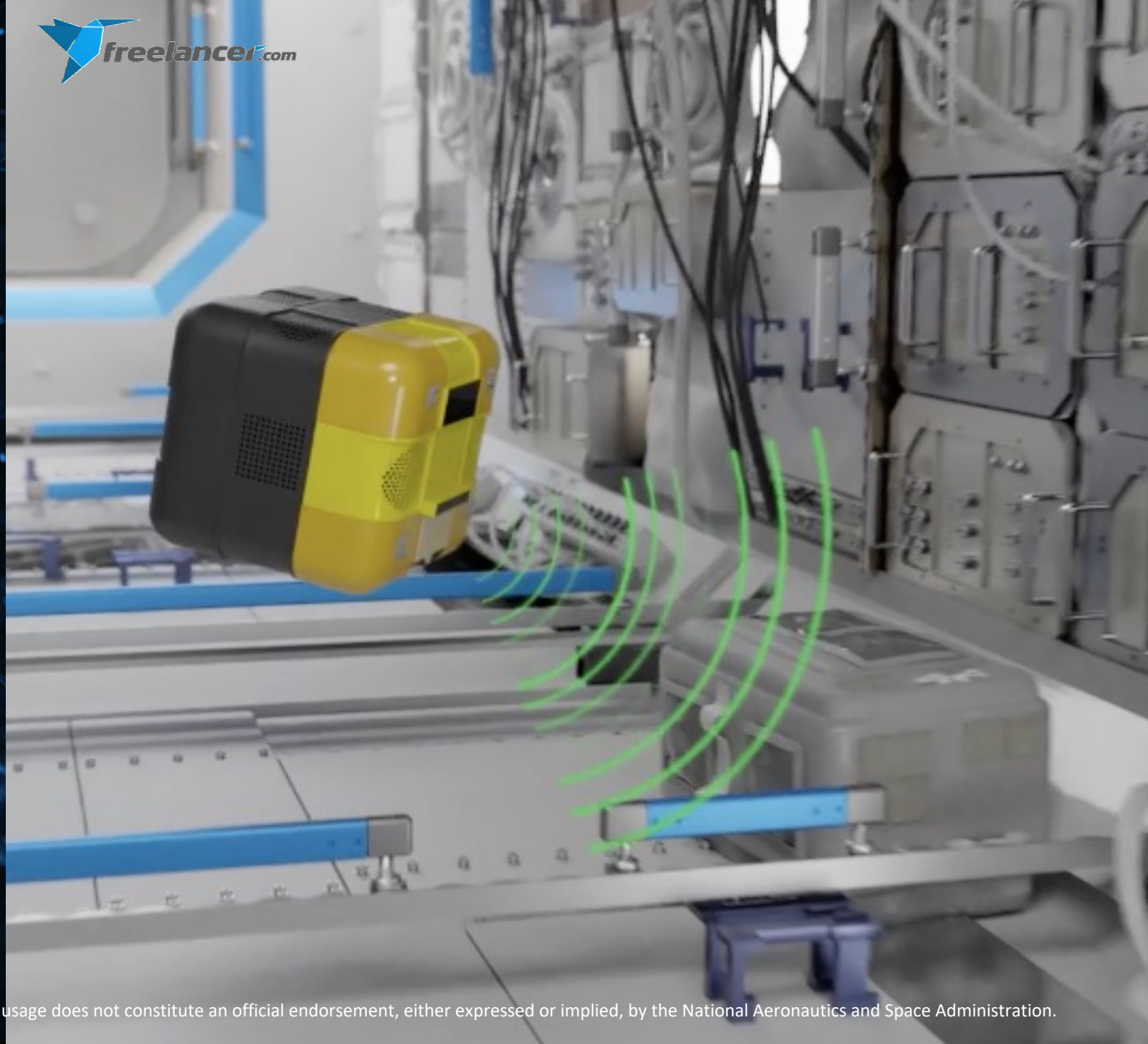
8 NASA projects now
identify their project
using Freelancer
contest produced
graphics



RFID-Enabled Autonomous Logistics Management (REALM) Video Contests

\$1500 storyboard
challenge followed by a
\$3000 video production
challenge developed a
3 minute fully CGI
explanation of REALM.

<https://youtu.be/0bcWA-HnSSY>





Machine Learning Training

Currently working with LaRC on pilot data labeling for ML project related to flaw detection in complex composites lay-down/layering using a P-Card.

Also exploring a pilot project for data labeling of crew health data (PII) to see if Samasource's security measures meet NASA's needs.



Includes Challenges (Public Prize Competitions), Crowd Microtasks, Freelancer Projects, and Challenge Services.



Ideas	Conceptual Designs	System Designs	Demos/ Prototypes	Engineering Models	Software	Algorithms/ Data Science	Graphics	Video	Engagement	Services/ Other	Technology Search
107	83	17	3	26	48	33	39	24	35	9	63

82 NASA@WORK	37 NASA@WORK	17	2 Common Pool	17	30	25	26 NASA@WORK	9	35 NASA@WORK	1 Common Pool	49
7	12		1 LUMINARY LABS	6 GRABCAD POWERED BY ENGINEERS	5 NASA@WORK	1	8	7		1	14 NASA@WORK
5	7 hero ^x			1 hero ^x	5	1	4	6 NASA@WORK		3	
5 hero ^x	6 LUMINARY LABS			2	5	1 NASA@WORK		1		2	
2 LUMINARY LABS	5 NINE SIGMA				1	1 DRIVEN DATA		1 hero ^x		1 yet2	
2	3										
	2										
	1										

475
Projects

95% Were
Successful

80% Have
Cost Savings

45% Average
Cost Savings

\$35M Estimated
Cost Savings

Includes challenges in formulation and in progress.

The NASA Tournament Lab

Open Innovation (OI) Products and Services



Products and Services Provided by: Crowd-Based Prize Competitions/Challenges | Freelance Experts/Workers | Micro-Tasking | OI Program Support



Ideas	Conceptual Designs	System Designs	Demos/ Prototypes	Engineering Models	Software	Algorithms/ Data Science	Graphics	Video	Engagement	Crowd Program	Technology Search
\$40,000 - \$100,000	\$75,000 - \$150,000	\$200,000 - \$1,000,000	\$400,000 - \$5,000,000+	\$500 - \$20,000	\$5,000 - \$1,000,000+	\$80,000 - \$2,000,000	\$200 - \$2,000	\$2,000 - \$1,000,000	\$30,000 - \$200,000	\$100,000 - \$1,000,000	\$10,000 - \$60,000
2 - 3 mo.	3 - 4 mo.	4-12 mo.	6 - 18 mo.	3 - 30 days	3 - 12 mo.	3 - 12 mo.	3 - 30 days	1 - 6 mo.	1 - 6 mo.	3 - 12 mo.	2 - 4 mo.



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“OPEN” is the Future and “INNOVATION” is No Longer Optional

Crowds, gig-workers, freelancers are a rapidly growing resource with **increasing capabilities**

Curated communities are attracting **passion** and building **expertise** and **skills**

Open methods are **extremely effective** for accessing valuable innovations

Those that fail to innovate will be **left behind**

Significant Technical Challenges to NASA's Mission



**GIANT
LEAPS
START
HERE**

If we are serious about leading in Space Exploration, we must use new tools if we hope to access the necessary technologies, ideas, and innovations we require.



Questions?

190 NASA@WORK Challenges to Date

Non-Treadmill Device for Future Exploration
Display Format for Deep Space Human Spacecraft
Determining Urine Volume in Microgravity
Satellite Assembly Demonstration Concepts
Use of Thorium Instead of Uranium
Packing Foam Alternatives Challenge
Group On-Call Notification Alternatives
Lab Equipment Obsolescence: Cytometer
Reduce Waste in Space
Advanced Exercise Concepts for Long Missions
Inflight Calcium Isotope Measurement Device
Durable/Permanent Anti-Fog for the EMU Helmet
Data Exchange to Support Conf Room Booking
Design Info Accessible to Students & NASA Users
Onsite Vehicle and Parking Lot Monitoring System
Improve Training & Reducing Cost
Energy Savings at the Employee Level
Efficient Method to Collect Dietary Data
RID Repository - Seeking New Tools
Washing Produce Grown in Space!
Tele-possibilities
Lunar Regolith-Tolerant Valve
How Can Satellites Measure in the Ocean?
Securely Attaching to Terrain Surfaces in a Low-G
Gamification Knowledge Sharing Challenge
Identifying Collaboration Tools
Automated Entity and Entity Relationship
Extraction
Non-Invasive Measurement of Intracranial Pressure
Mars Pioneering
Odor Control and Trash Containment for Orion
Center Mobile Application
Applications for Flexible Electronics
Astronaut Trash Receptacle Interface

V&V of Agile Developed Software
Website Management for Everyone
Identify Sensors for Lunar Landers
Creating Gantt Charts from MS Project
Robust Wireless Network Architecture
Uses of Energy from Nuclear Thermal Propulsion
NASA's Safety & Mission Assurance Rqmts
Protection of the Human from GCR
Infrared Pulsed Laser Beam Diagnostic Tool
Drug Stability Analysis Capabilities
Track Participant Progress Online
Mars EVA Gap Challenge
Future Detector Planes
Impedance Match Coating for Mid-Far IR Absorption
Emergency Egress Guidance System
Castable Polymers for Ultrasound Transmission
Enterprise Add-On or Service for OCR
Manufacturing in Space
Mathematical Model for Mars Dust Storm
Impact of Gender on Spaceflight Tech
Logistics Carriers for In-Space Consumables
Biomarker Identification
Measurement of ISS Node 3
Analytical Tools to Predict Flare Plumes
VR Simulation of Post-flight Disorientation
Help Improve NASA's Open MCT
Phase-Independent Injector for Gas Chromatograph
Energy Storage Device
Active Tintable Electronic Coatings
Radiation Blanket Origami
How do we Predict the Future?
In-Space Inspection Sensors
Effective Use of Electric Vehicles
Data Architecture for IRD

Gateway Program Graphic Challenge
"Explore as One" Video & Graphics Challenges
The Write Stuff – Mars Ops Concepts
NASA NHPC Banner Design
KSC Recycling Bin Report
Review and Inputs to Mentoring Material
Design NASA Innovation of Excellence Coin
Solutions to NASA Goddard's Contribution
New Technology Demonstration Prize Competitions
Incentives for NASA@work that Count
Peer to Peer Coaching and Counseling Program
Human Systems Integration (HSI) Metrics
Creating an Innovation Incubator
Maintain Social Interactions while Teleworking
Office of the Future- How WILL we work?
Mgmt Engagement in Employee Resource Groups
Collaborative Innovation Video
Improve Accessibility at a NASA Center
EVA 50th Anniversary Logo Design Challenge
Identifying Barriers to Going Paperless
Mars Video Challenge
NASA Examples of Solutions to Environ. Sustainability
Design EVA's 50th Anniversary Theme
Reed Solomon Encoding Tutorial
Tech Petting Zoo
Seeking Exploration Graphics Challenge
Communicating about Asteroid Grand Challenge
Seeking Ideas for Telemedicine
Showcase your Technology
Hometown Graphics Challenge
Crosswalk Design
Seeking Function Ideas for a Mobile Application
Failures on the Path to Progress
Seeking 'Cool NASA Experience' PoCs

50 Technology Searches to Date

Clothing Refresh Technology Search
In-Space Fabrication Lab Tools
Lander Automotive Sensors
Lander LIDAR
Radiation Hardened GPUs
EVA Heads-In Display
Orion Emergency Breathing Mask
Non-Invasive Meas. of Intra-Cranial Pressure
Monitoring Water and Biocides
Portable Diagnostic Scanning
Food Packaging/Protection
Bone Density Measurement
Exotrestrial Life Differentiation
Solid State Power Amplifiers (SSPA)
Magnetic Field Computational Design
Radioprotectants

Orion Emergency Breathing Mask
Flexible Electronics
Lunar Surface Dust Mitigation
JSC Tech Transfer Office Technology
Monetization
Reliable Manufacturing Processes for Lsi
Materials for the Lunar Environment
Artemis Camera Search
FOD Scheduling & Training Mgmt System
HLS Food System Search
Abrasion Resistant Filter Media for Lunar
Approaches to Sanitization and Sterilization
Water Conservation in Cooling Towers
Trust for Autonomous Systems
Aircraft/Spacecraft Voice Comm Systems



~70 Technical Solution Projects to Date

Reducing Galactic Cosmic Rays Impacts

Flexible Sealing Device

Mars Balance Mass

Recycling in Space

EVA Textile Test Methods

In-Situ Construction Materials

Bio-Inspired Advanced Exercise Concepts

Sky for All - Advanced Air Traffic Control

Space Poop Challenge

CubeSat Challenge

Galactic Cosmic Ray Mitigation Concepts

PDS White Spot Detection Development

Big Data Challenge-Cross Cutting

Big Data Challenge-Energy

Big Data Challenge-Earth Science

System Architecture Study

Simple Microgravity Laundry System

Medical Consumables Tracking

Earth Science Climate Resilience

Next Generation Animal Tracking

Strain Measurement of Vectran And Kevlar Webbing

New Ways to Use, Visualize, and Analyze OpenNEX Data

NASA Climate Modeling - New Sources of Observational Data

Improved Barrier Layers - Keeping Food Fresh in Space

Compact Aerobic & Resistive Exercise Device

Coordination of Sensor Swarms for Extraterrestrial Research

Augmenting the Exercise Experience with Audio-Visual Inputs

Non-Invasive Measurement of Intra-Cranial Pressure

Software Applications using NASA's DTN Protocol

Mars Space Pioneering: Achieving Earth Independence

USAID How to Identify Enablers of Mass Atrocities

USAID Safe Ways to Capture Evidence of an Atrocities

USAID Seeking Secure Communications During a Crisis

NSF-Hearables

NIST Virtual Public Safety Test Environment

NIST Differential Privacy

DHS U.S. Coast Guard Ready for Rescue

DHS Detection of Opioids in Mail Systems

DHS Hidden Signals

VA Game Controller Adaptations for Differently-Abled Veterans

VA Gun Safety Matters

32 Algorithm/Data Science Projects to Date

Vehicle Recognition
Detecting Crater Impact
ISS Longeron Modeling & Power Optimization
Robonaut Computer Vision
Collective Minds & Machines Exploration
USPTO Algorithm
USAID Indicators of Vulnerability
EPA ToxCast Prediction Challenge
EPA Cyano Predictive Modeling
Asteroid Tracker
Asteroid Data Hunter
Quest for Quakes
Robonaut 2 Tool Localization
PDS Cassini Rings Challenge

Data-Driven Forecasting of Solar Events
REALM Location Tracking Algorithm
NMIO Detecting Illegal Fishing
DHS Passenger Screening Algorithm
USSOCOM Urban 3D Challenge
Detection of Nuclear Threats in Urban Areas
HF Geolocation Algorithm Challenge
DOI Sub-Seasonal Climate Forecasting
DOI Streamflow Forecasting
CDC Maternal Morbidity and Mortality Data
CDC Text Classification Marathon
NIST PSCR Data De-Identification NOAA
NGA Geocentric Pose
NOAA Magnetic Field Prediction

40+ Software Development Projects to Date

Android Electrocardiography (ECG)
Solution Mechanism Guide
Astronaut Smartwatch App UI/UX
Astronaut Smartwatch Application
NASA Enterprise Search Portal
NBL Torque Training Display
REALM User Interface
Planetary Data Systems Storyboard
Planetary Data Systems Mobile Apps
Open MCT Notebook
ISS Food Intake Tracker (FIT) iPad App
DTN Astronaut Email
DTN Dashboard
DTN Neighbor Discovery Protocol
DTN LTP Authentication
DTN Delay Tolerant Payload Conditioning
DTN Update Wireshark Dissectors for BP,
LTP, & TCPCL, SBSP, CFDP, AMP, TCPCLv4,
& BPv7

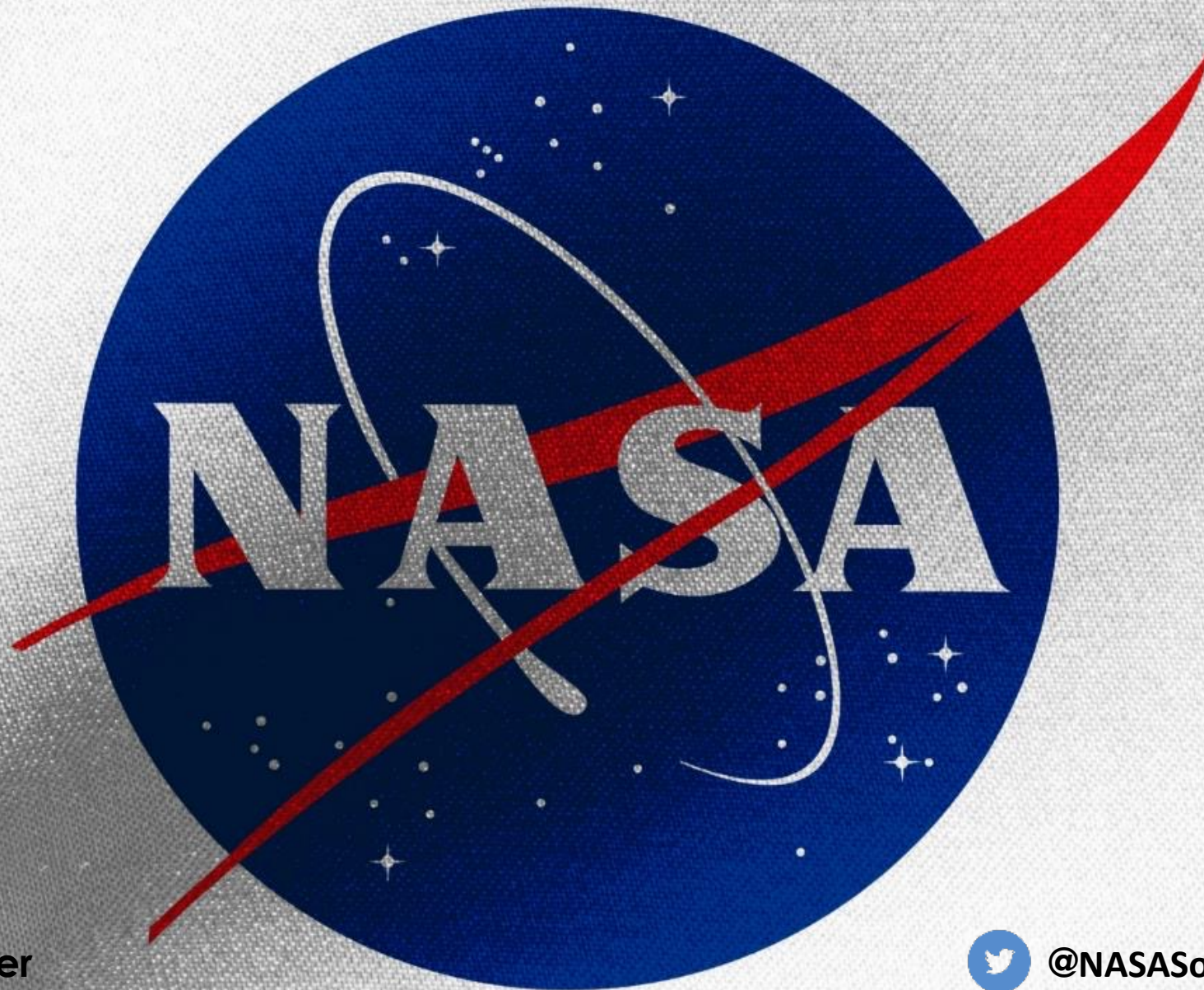
Build an App to Utilize OpenNEX Climate & Earth Science Data
Improving NASA Enterprise Search Capabilities
Partnership Agreement Maker User Interface Updates
Lunar Mapping and Modeling Portal Image Processing
Cold Stowage Asset Planning Tool (Excel Replacement)
Finding Post-Apollo Artificial and Natural Impacts on the Moon
Unmanned Aircraft Systems Ground Control Station Software
Develop a Template/Production Process for an HTML-Based Newsletter
AVAIL Search Optimization Topcoder Open Challenge

VA Synthetic Patient Data
VA Veterans Online Memorial
DOE Open Wave Analysis and Response Program
CMS Healthcare Fraud Prevention Partnership Data Exchange Network
CMS Medicaid Provider Screening and Enrollment Portal
CMS Open Payments
OPM Service Credit System Project
FAA Notice to Airmen (NOTAM) API

100+ Micro-Purchase Projects to Date

Astronaut Smartwatch App Interface Design
Astronaut Smartwatch Application Development Task
NASA Handrail Clamp Assembly Challenge
NASA Experiment Attachment System (EAS) Challenge
Improved UI/UX for MagicDraw for Building Space Architectures
Model Based Systems Engineering Architecture Model Challenge
HRP Animate Storyboard Clips Task
Animate the NASA Tournament Lab Logo
Animate the NASA@WORK Logo
Develop 3D Models for Robonaut Simulation (14)
Design a Patch for NASA Evolutionary Xenon Thrust - Commercial (NEXT-C)
Design a Patch for Delay/Disruption Tolerant Networking (DTN) Project
Design a Banner for the NASA Human Health and Performance Center
Design Patch for NASA's Gondola for High Altitude Planetary Science (GHAPS)
Design a Patch/Graphic for NASA Center for Climate Simulation (NCCS)
Design a 3D Printable Award for NASA@WORK
Design the Program Integration Branch Graphic
AMS: ISS-TEA Project Graphic
Gateway Program Graphic Identifier
In-Space Manufacturing Logo Challenge
Astrobee Challenge Series - Robotic Arm Architecture Contests
NBL Torque Training Display Concept
NBL Torque Training Display Concept
Robotic Systems User Interface Theme/Brand

Software Applications using NASA's DTN Protocol
DTN Update Wireshark Dissectors (2)
DTN Imagery or Animation Challenge
DTN ION Training Course Development Challenge
ISM: Refabricator Mission Patch/Graphic Challenge
Origami/Folding Concept for Radiation Shield Packing/Deployment
REALM - Patch/Graphic Challenge
REALM Project Overview Animated Video Storyboard
REALM Project Overview Animated Video
3D CAD Models/Animations of Three Different Radiation Shielding Concepts (2)
Exploration Medical Graphic Challenge
Design the 3D Printing Heat Shield Project Graphic
Design the Advanced Exploration Systems (AES) Modular Power System AMPS Graphic
Training Image Description Machine Learning
Design the Navigation Doppler Lidar (NDL) Graphic
DTN ION Training Course Development Task
Astrobee Video Edits for Architecture Study Contest Series (2)
Human Rated Spacecraft 3D Printing Process Animation (model generation phase)
Design the Human Factors Engineering Lab (HFEL) Graphic
Sample Return Regolith Sorter Design Challenge
Machine Learning Image Classification Micro-Purchase Task
Develop a Template and Production Process Instructions for HTPL Newsletter
HRP Communications Animation Storyboard
HRP Animate 10-20 Second Clip Contest



@SteveRader



@NASASolve