

Implementation of Federal Prize Authority: Fiscal Year 2016 Progress Report

A Report from the
Office of Science and Technology Policy

In Response to the Requirements of the
America COMPETES Reauthorization Act of 2010

July 7, 2017



Implementation of Federal Prize Authority: Fiscal Year 2016 Progress Report

ABOUT THE OFFICE OF SCIENCE AND TECHNOLOGY POLICY

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DEPARTMENT, AGENCY, OFFICE, AND DIVISION ABBREVIATIONS

AFRL	Air Force Research Laboratory
ASPR	Office of the Assistant Secretary for Preparedness and Response (part of HHS)
BSEE	Bureau of Safety and Environmental Enforcement (part of DOI)
CDC	Centers for Disease Control and Prevention (part of HHS)
CMS	Centers for Medicare and Medicaid Services (part of HHS)
CNCS	Corporation for National and Community Service
CPSC	Consumer Product Safety Commission
CTTSO	Combating Terrorism Technical Support Office (part of DOD)
DARPA	Defense Advanced Research Projects Agency (part of DOD)
DHS	Department of Homeland Security
DOC	Department of Commerce
DOD	Department of Defense
DOE	Department of Energy
DOI	Department of the Interior
DOJ	Department of Justice
Education	Department of Education
EPA	Environmental Protection Agency
FDA	Food and Drug Administration (part of HHS)
FMC	Federal Maritime Commission
FTC	Federal Trade Commission
GSA	General Services Administration
HHS	Department of Health and Human Services
HRSA	Health Resources and Services Administration (part of HHS)
HUD	Department of Housing and Urban Development
IARPA	Intelligence Advanced Research Projects Activity

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NASA	National Aeronautics and Space Administration
NIH	National Institutes of Health (part of HHS)
NIST	National Institute of Standard and Technology (part of DOC)
NOAA	National Oceanic and Atmospheric Administration (part of DOC)
NPS	National Park Service (part of DOI)
NSF	National Science Foundation
OMB	Office of Management and Budget (part of the Executive Office of the President)
OSTP	Office of Science and Technology Policy (part of the Executive Office of the President)
SAMHSA	Substance Abuse and Mental Health Services Administration (part of HHS)
SBA	Small Business Administration
Treasury	Department of the Treasury
USAID	United States Agency for International Development
USBR	United States Bureau of Reclamation (part of DOI)
USDA	Department of Agriculture
USFS	United States Forest Service (part of USDA)
USFWS	United States Fish and Wildlife Services (part of DOI)
USGS	United States Geological Survey

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Executive Summary

On January 4, 2011, the America COMPETES Reauthorization Act of 2010 (COMPETES) was signed into law.¹ Section 105 of COMPETES added Section 24 (Prize Competitions) to the Stevenson-Wydler Technology Innovation Act of 1980 (Stevenson-Wydler), granting all agencies broad authority to conduct prize competitions to spur innovation, solve complex problems, and advance their core missions.

Prize competitions and challenges can enable Federal agencies to:

- Pay only for success and establish an ambitious goal without having to predict which team or approach is most likely to succeed;
- Reach beyond the “usual suspects” to increase the number of solvers tackling a problem and to identify novel approaches, without bearing high levels of risk;
- Bring out-of-discipline perspectives to bear;
- Increase cost-effectiveness to maximize the return on taxpayer dollars; and
- Establish clear success metrics and validation protocols that themselves become defining tools and standards for the subject industry or field

In 2010, the General Services Administration (GSA) launched Challenge.gov, a one-stop shop for the American people to learn about open innovation challenges that allow them to contribute their knowledge, creativity, and expertise to solve complex problems, improve service delivery, and advance the missions of Federal agencies. In 2016, GSA and the White House Office of Science and Technology Policy (OSTP), working with the Federal Community of Practice on Challenges, launched a new Prizes and Challenges toolkit (www.challenge.gov/toolkit) that provides a how-to-guide for launching and administering prizes, collects best practices and case studies, and contains extensive resources from the public and private sector on prizes. For historical COMPETES reports and other background on Federal challenges, visit www.challenge.gov/toolkit/resources.

This report includes a detailed description of the 63 prizes active in Fiscal Year (FY) 2016 under the prize authority provided by COMPETES (as reported by Federal agencies to OSTP) and summarizes 46 prize competitions and challenges conducted under other authorities voluntarily reported by Federal agencies to OSTP.

In FY 2016, these 109 challenges were conducted by 26 agencies. Analyzing these prize competitions shows the following characteristics of public-sector prizes, including:

- Multi-year, multi-phase challenges designed to develop and prototype complex solutions;
- Prizes that seek to accomplish multiple goals;
- Expanded partnerships with other Federal agencies, state and local governments, philanthropic foundations, and the private sector;
- Prizes that serve as one tool in a broader portfolio of actions within a program; and

¹ Public Law 111-358

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- Prize entries that pursue commercialization in the private sector.

Seventeen agencies offered prizes in FY 2016 enabled by the prize authority provided by COMPETES, including the Department of Energy (DOE), Centers for Disease Control and Prevention (CDC), Centers for Medicare and Medicaid Services (CMS), Defense Advanced Research Projects Agency (DARPA), Department of Homeland Security (DHS), Food and Drug Administration (FDA), GSA, Department of Health and Human Services (HHS), Health Resources and Services Administration (HRSA), National Institutes of Health (NIH), National Institute of Standards and Technology (NIST), National Park Service (NPS), National Science Foundation (NSF), Substance Abuse and Mental Health Services Administration (SAMHSA), Small Business Administration (SBA), Department of the Treasury (Treasury), U. S. Bureau of Reclamation (USBR), and the U.S. Department of Agriculture (USDA).

As many agencies expand their use of the prize authority provided to them under COMPETES, some agencies have continued to administer prize competitions and challenges developed under other pre-existing authorities, including agency-specific authorities, grant-making authority, and procurement authority, such as that provided by the Federal Acquisition Regulation (FAR), adding additional lessons learned and best practices regarding the use of prize competitions and challenges. In addition, agencies have used the infrastructure and expertise developed as a result of running prizes under COMPETES to operate prize competitions and challenges under other authorities as well.

Most recently, the American Innovation and Competitiveness Act² further updates the prize authority in Stevenson-Wydler. Among other things, it provides Federal agencies with the ability to partner broadly with the private sector and other government entities on incentive prizes, which could further expand the scope and sophistication of prize competitions. The new law also recognizes that incentive prizes can be comprised of cash awards or non-monetary incentives. This law also makes some important administrative updates, including changing the reporting period to every two years following this report and amending the requirement that prize competitions be announced in the Federal Register to a publicly accessible Government website, such as www.challenge.gov.

² Public Law 114-329

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Introduction

From the 1714 Longitude Prize that led to the world's first practical method to determine a ship's longitude, to the Orteig Prize that inspired Charles Lindbergh to fly nonstop from New York to Paris, to the 2016 U.S. Department of Energy (DOE) Wave Energy Prize, which demonstrated a five-fold improvement in technology that captures energy from the motion of ocean waves in just 18 months, prizes have become a standard tool that every Federal agency can use.

Inspired by the historic success of philanthropic and private-sector prizes, the Office of Science and Technology Policy (OSTP) and other Federal agencies have taken important steps to accelerate public-sector adoption of these innovative tools. In March 2010, the Office of Management and Budget (OMB) issued a memorandum that provided a policy framework to guide agency leaders in using prize competitions and challenges to advance core missions.³ In September 2010, the General Services Administration (GSA) launched Challenge.gov, a one-stop shop where entrepreneurs and citizen solvers can find and engage with public-sector prize competitions and challenges. By January 2017, Challenge.gov had featured more than 745 prize competitions and challenges from more than 100 Federal agencies, departments, and bureaus. Tens of thousands of citizen "solvers" have participated in these competitions directly on Challenge.gov, with additional entrants joining the competitions through other means. A 2014 Deloitte report⁴ found that between 2010 and 2014, "incentive prizes have transformed from an exotic open innovation tool to a proven innovation strategy" with \$64 million in total prize money⁵ being offered through Challenge.gov.

The America COMPETES Reauthorization Act of 2010 (COMPETES) further supported these efforts.⁶ Section 105 of this Act added Section 24 (Prize Competitions) to the Stevenson-Wydler Technology Innovation Act of 1980 (Stevenson-Wydler), providing all agencies with broad authority to conduct prize competitions in order to spur innovation, solve tough problems, and advance their core missions subject to the availability of funds. The COMPETES Act required OSTP to submit an annual report to the Committee on Commerce, Science, and Transportation of the Senate and the Committee on Science and Technology of the House of Representatives on the activities carried out under this prize authority during the preceding fiscal year.

Prior to the enactment of COMPETES, agencies could conduct prize competitions under multiple legal authorities. The National Aeronautics and Space Administration (NASA),⁷

³ ObamaWhiteHouse.archives.gov/sites/default/files/omb/assets/memoranda_2010/m10-11.pdf

⁴ Deloitte University Press, "The Craft of Incentive Prize Design"; Lessons from the Public Sector, 2014. dupress.com/articles/the-craft-of-incentive-prize-design

⁵ Based on 319 challenges listed on challenge.gov between 2010 and 2014.

⁶ Public Law 111-358

⁷ 42 U.S.C. § 2459f-1

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the Department of Defense (DOD),⁸ and DOE⁹ all possess the authority to directly administer prize competitions and use appropriated funds to provide the prize purse. In addition, several agencies can also choose to administer prize competitions through third-party contractors, seek outside funding for prize contests from private contributors, offer recognition prizes and awards, and elect to run prize competitions through grants and cooperative agreements. Several agencies continue to conduct prize competitions under authorities other than COMPETES. Reporting of prizes under authorities other than COMPETES is strictly voluntary and thereby, not comprehensive in this report.

GSA provides support and assistance to all Federal agencies operating prize competitions and challenges. In addition to managing the online platform Challenge.gov, the GSA program office manages a Federal community of practice of more than 700 challenge practitioners and an active listserv. The program also provides a variety of resources, research, best practices, and in 2016 launched the Prizes and Challenges Toolkit (www.challenge.gov/toolkit). Through a partnership with GSA's DigitalGov University, the program has developed a comprehensive in-person and digital training curriculum for the community, and has trained more than 2,000 people across the Federal government.

Section 24(n) of Stevenson-Wydler called on GSA to “develop a contract vehicle to provide agencies relevant products and services, including technical assistance in structuring and conducting prize competitions to take maximum benefit of the marketplace as they identify and pursue prize competitions to further the policy objectives of the Federal Government.” In response, GSA launched Sub-Schedule 541 4G, “Challenges and Competitions Services”¹⁰ in July 2011. Contractors on the schedule offer agencies options for technical assistance, prize platforms, and access to communities of individuals and teams interested in entering prize competitions. GSA continues to assist agencies in taking advantage of the available services and to inform private-sector vendors and agencies about the schedule and its benefits.

In 2011, OSTP worked with NASA to launch the Center of Excellence for Collaborative Innovation (CoECI), a NASA-led, Government-wide center of excellence to provide agencies guidance and support in implementing certain types of prize competitions and challenges. In 2015, CoECI awarded 10 contracts¹¹ under its fixed-price, indefinite delivery/indefinite quantity NASA Open Innovation Services (NOIS) procurement. That procurement was a significant milestone in the Federal Government applying a traditional procurement mechanism in a novel way to achieve an outcome that forms a foundation for expanded use of challenges across the Federal Government through 2020. NOIS provides a robust, yet competitive, mechanism to expand the number, variety, and skill sets available to continue to mature the successful use of challenges to meet agency missions.

⁸ 10 U.S.C. § 2374a

⁹ 42 U.S.C. § 16396

¹⁰ www.gsaelibrary.gsa.gov/ElibMain/sinDetails.do?scheduleNumber=541&specialItemNumber=541+4G

¹¹ 8 of the 10 awards were made to small businesses

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In addition, agencies have worked to expand their capacity and institutionalize their ability to conduct prizes in a number of different ways including (see Table 1):

- **Issuance of department-wide policy or guidance on the use of prize competitions and challenges.**
- **Establishing common contract vehicles** that leverage the work done by GSA to develop the Sub-Schedule 541 4G. Several agencies have developed agency-wide prize and challenge service contract vehicles to streamline access to vendors to support the design and implementation of prize competitions and challenges.
- **Assigning dedicated personnel to lead prize and challenge design and administration efforts** at their agencies and to provide internal support agency-wide to program managers interested in making use of prize competitions and challenges. These staff are often responsible for policy and guidance, internal and external agency communication strategies for prize competitions and challenges, the development of common contract vehicles, and consultation for specific prize and challenge designs.
- **Assigning an agency prize and challenge point of contact** that fill a variety of part-time roles including developing guidance, conducting annual reporting, and convening communities of practice.
- **Enabling a distributed networks of prize managers and points of contact within agencies**, which is not mutually exclusive to the roles above, and provides for internal mentorship and support for prize designers looking to learn from peers to increase the effectiveness of their prize programs.
- **Providing training and design support to agency staff** that builds off of support provided by GSA and provides agency-specific knowledge, resources, and best practices to maximize the approaches found most effective for that agency's mission.
- **Implementing internal communications tools and coordinated external communications** to increase awareness of prize competitions and challenges. Agencies have deployed internal communications tools to reach new users, to increase sophistication of use, and to network existing practitioners to ensure that best practices and lessons learned are shared. Agencies have also developed coordinated communications strategies for engaging with solver communities across the various prize competitions and challenges they conduct.

Table 1. Challenges and prizes infrastructure

Agency Practices	Agencies in FY 2016
Issuance of department-wide policy or guidance on the use of prize competitions and challenges	DHS, DOI, EPA, HHS, NASA, NIST, USAID, USDA
Common contract vehicles	DHS, Education, EPA, HHS, NASA
Internal communications tools	DHS, DOE, EPA, HHS, NASA
Coordinated external communications	DHS, EPA, NASA
Dedicated, central prize and challenge leads	DHS, EPA, HHS, NASA, USAID

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Agency Practices	Agencies in FY 2016
Identified agency prize and challenge point-of-contact (not dedicated full-time to prizes)	AFRL, CTTSO, DOE, DOI, DOJ, IARPA, NIST, NSF, USDA
Distributed network of prize managers and points of contact within the agency	DARPA, DOD, DOE, EPA, FTC, HHS, IARPA, NASA, USAID, USDA
Providing centralized training and design support to agency staff	DHS, HHS, NASA, NIST, USAID
Developing centers for the interagency challenges in specific topic areas	DOI

In addition to internal support, Federal agencies have also developed interagency centers for prize programs on shared topic areas. For example, in Fiscal Year (FY) 2016 the interagency Reclamation Water Prize Competition Center led by the U.S. Bureau of Reclamation (USBR) at the Department of the Interior (DOI) launched prizes that sought innovative solutions related to the several mission-critical areas including infrastructure sustainability, ecosystem restoration, and water availability. For this center, USBR forged collaborations with other Federal agencies that have a stake in these mission areas to collaboratively design, launch, and judge the prize competitions. Federal collaborators currently include the U.S. Geological Survey (USGS), the National Oceanic and Atmospheric Administration (NOAA), the U.S. Fish and Wildlife Service (USFWS), NASA, the Environmental Protection Agency (EPA), U.S. Army Corps of Engineers, U.S. Department of Agriculture (USDA), and the National Institute of Standards and Technology (NIST).

This report discusses how Federal agencies have used incentive prizes and innovation challenges¹² and highlights the prize competitions conducted in FY 2016 under the COMPETES prize authority and under all other authorities.

¹² For historical reports and additional information about incentive prize infrastructure across government, see www.challenge.gov/toolkit

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Section 1. Potential Benefits of Prizes in the Public Sector

The unique benefits and diverse outcomes of prizes have been well documented in the private, philanthropic, and public sectors.¹³ Specifically, prizes have enabled the Federal government to:

- **Pay only for success and establish an ambitious goal.** With a focus on proven results, prizes can empower new, untapped talent to deliver unexpected solutions to tough problems. DOE's *H2 Refuel H-Prize*¹⁴ challenged scientists and engineers to develop an on-site hydrogen generation system that uses electricity or natural gas and can be used in homes, community centers, retail sites, or similar locations to fuel hydrogen vehicles. DOE conducted the competition in two phases. In Phase 1, competitors submitted system designs, blueprints, and proposed installation locations in order to be considered for Phase 2. Originally, DOE planned to fund up to four finalist teams that met the base criteria for proceeding to Phase 2 of the competition. However, upon review of the Phase 1 proposals DOE found that only one team, SimpleFuel, met the base criteria for Phase 2 funding. SimpleFuel continued in the competition as the sole finalist and constructed their hydrogen generation system in early 2016. DOE judges performed tests on the system and analyzed the data collected during the demonstration phase in late 2016 in order to determine if the system met all of the published requirements. In January 2017, DOE announced SimpleFuel as the winner of the \$1 million H2 Refuel H-Prize.
- **Reach beyond the 'usual suspects' to increase the number of solvers tackling a problem and identify novel approaches, without bearing high levels of risk.** Prizes are one tool to tap the top talent and best ideas wherever they lie, sourcing breakthroughs from a broad pool of both known and unknown sources of innovation. For example, the DOE *Wave Energy Prize* set out to double the state-of-the-art in wave energy conversion technology in 18 months. With 92 teams registering, 20 teams qualifying in the first round, and 9 teams advancing to the finals, DOE attracted established companies, entrepreneurs, and students to solve this problem. Of the nine finalist teams, only two teams received any DOE funding in the past. The winning team, two engineers from Portland, OR who had never before worked with DOE, demonstrated a five-fold increase in the key metric for the competition. In addition, four of the top finalists successfully met the original goal of doubling the baseline performance. This prize harnessed new solvers, validated a range of new solutions, and accelerated the wave energy industry as a whole.

¹³ See e.g., McKinsey & Company, "And the Winner Is..."; Capturing the promise of philanthropic prizes, 2009, www.mckinseysociety.com/downloads/reports/Social-Innovation/And_the_winner_is.pdf and Deloitte University Press, "The Craft of Incentive Prize Design"; Lessons from the Public Sector, 2014. dupress.com/articles/the-craft-of-incentive-prize-design/

¹⁴ See Appendix B, Section B.2.2

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- **Bring out-of-discipline perspectives to bear.** Empirical research conducted at the Harvard Business School has found that breakthrough solutions to scientific challenge competitions are most likely to come from outside the scientific discipline or at the intersection of two fields of study. The Centers for Medicare & Medicaid Services (CMS) *A Bill You Can Understand Design and Innovation Challenge*¹⁵ sought to improve patient experience by making patients' medical bills easier to understand. CMS decided a national challenge presented the opportunity to support the ongoing efforts of many health care organizations by bringing in the perspective of user experience designers, developers, and entrepreneurs from the tech industry. CMS reported that many submissions came from entrants new to working with the Federal government and outside of the traditional health care space. In September 2016, CMS announced two winners of the competition. The first winner, a company that operates medical diagnostic imaging centers, designed the most concise patient bill. The second winner, a user experience design company, designed an online service that allows people to search, browse, and compare health care prices prior to selecting a provider.
- **Increase cost-effectiveness to maximize the return on taxpayer dollars.** Compared to other mechanisms, prizes can be more efficient and cost-effective approaches for identifying solutions from the private sector. Teams in prizes and challenges compete for not just the cash purse, but also the associated validation, prestige, and satisfaction that result from solving important problems. Moreover, because the purse is only paid out once the competing team or teams achieve the desired results, prize competitions can minimize agency risk. For example, the Department of Homeland Security (DHS) sought a new, innovative approach to develop an adequate buoy mooring system that would have minimal impacts on the ocean floor to update the current system. DHS chose to run the *Environmentally Friendly Replacement for Buoy Mooring Systems*¹⁶ challenge because previous research and development requests for information to the private sector did not result in a viable solution. Three phases were originally planned with a total prize purse set at \$290,000. A total of 98 submissions were received during Phase I of the competition. A viable, cost-effective, winning solution constructed from existing technology was identified during Phase I of the competition and the additional phases were canceled. The winner received a cash prize of \$10,000 and the winning solution will undergo testing in late 2017.
- **Establish clear success metrics and validation protocols that themselves become defining tools and standards for the subject industry or field.** In running a prize competition, managers sometimes develop clearer success metrics and validation protocols than current industry standards in order to evaluate solutions submitted by applicants. These new methods for measurement can create new ways to evaluate solvers and solutions head-to-head, both for the prize

¹⁵ See Appendix A, Section A.5.5

¹⁶ See Appendix A, Section A.6.2

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competition and the technology more broadly. The NIST *Post-Quantum Crypto Project*¹⁷ challenge seeks to leverage the benefit of competition (in this case, offering bragging rights and public recognition) in order to establish standards for public-key cryptographic algorithms that are resistant to large-scale quantum computers. NIST is currently accepting proposals through late 2017 and intends to select at least one algorithm providing quantum-resistant public key encryption, digital signatures, and key exchange algorithms for standardization. Proposals will be subject to three to five years of public evaluation before they are standardized.

Agency use of incentive prizes can offer these benefits as well as other advantages, such as the ability for prizes to: inspire risk-taking by offering a level playing field, credible rules, and robust judging mechanisms and give entrepreneurs and innovators license to pursue an endorsed stretch goal that otherwise may have been considered overly audacious.

Prizes are not the right tool for every problem, but, if aligned with a broader strategy and used systematically within an agency, they can be a mechanism for spurring innovation.

Section 3, Section 4, and Appendix A of this report focus on the prizes developed under the specific prize authority provided by COMPETES. Appendix B provides a brief summary of prizes conducted under other authorities. Reporting of prizes under authorities other than COMPETES is strictly voluntary and thereby, not comprehensive.

¹⁷ See Appendix B, Section B.1.1

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Section 2. Highlights and Trends from Prizes and Challenges in Fiscal Year 2016

In FY 2016, 26 agencies administered 109 prize competitions. The data analysis included in this section is focused on the 77 prize competitions that were newly announced in FY 2016 and for which agencies provided data.¹⁸ A review of all prizes active in FY 2016 reveals the following characteristics of public-sector prizes used to drive innovation:

- **Multi-year, multi-phase challenges designed to develop and prototype complex solutions.** Developing new and effective approaches often takes many years and requires multiple phases to generate early stage ideas and further develop mature solutions. For example, the Defense Advanced Research Projects Agency (DARPA) announced the *Cyber Grand Challenge* in August 2013 and teams were put through two years of scored events and qualification rounds to determine a field of seven finalists announced on July 5, 2015. The finalist teams of top computer security experts developed autonomous cyber reasoning systems that competed head-to-head at the Cyber Grand Challenge Final Event on August 4, 2016, where judges awarded \$3.75 million in prize money. Ultimately the Cyber Grand Challenge demonstrated the ability to autonomously discover unintended flaws in software, prove those vulnerabilities in other team systems, and develop patches for those flaws completely autonomously, represent a groundbreaking leap forward in automated network defense.
- **Prizes that seek to accomplish multiple goals.** The data analysis below demonstrates that FY 2016 saw an increase in the percent of new prizes that seek multiple goals. For example, the U.S. Agency for International Development (USAID)'s *All Children Reading: A Grand Challenge for Development - Tracking and Tracing Books Prize Competition* seeks innovation with four main components: a process for tracking and tracing books, associated software, associated hardware and devices, and a method for engaging/easily interfacing with users. Moreover, it is a requirement that the proposed solutions cover the whole supply chain — tracked from the point where the books are ordered to delivery in the classroom or early-learning center.
- **Expanded partnerships with other Federal agencies, state and local governments, philanthropic foundations, and the private sector.** Among other things, partnerships in prize competitions allow Federal agencies to reach new audiences, engage communities in new ways, provide expertise to the challenge administration, and ensure the long-term implementation and impact of the solutions. For example, the CMS “*A Bill You Can Understand*” *Design and*

¹⁸ The agencies self-reported the primary goals and types of solutions for each prize competition included in these data.

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Innovation Challenge has 22 partners, including financial sponsors, administrative partners, expert advisors, and outreach partners.¹⁹

- **Prizes that serve as one tool in a broader portfolio of actions within a program.** The benefits of prizes articulated in Section 1 of this report can be further enhanced when combined with a broader set of innovation activities. DOI's USBR has combined traditional research and development with prizes and challenges and technology transfer authorities to create a more impactful portfolio of agency programs. DOI's annual prize report states: "Knowledge gained from traditional [research and development] can be used to inform the design of a prize competition, and the knowledge gained from a prize competition can inform the next steps of traditional research. Prize Competition authorities provide a tool that solicit ideas, concepts, and solutions from the public. With the world connected through the internet, prize competitions are an effective tool that allows all the smart people in the world to help solve our problems."
- **Prize entries that pursue commercialization in the private sector.** Incentive prizes are a way for Federal agencies to engage the private sectors, prizes may seek to not just develop new ideas or demonstrate new technology, but to spur commercialization and stimulate a market. Several prizes result in the foundation of new companies in order to commercialize the solutions they develop. For example, the EPA *Nutrient Sensor Challenge* aims to reduce the high cost and complexity of measuring nitrogen and phosphorus levels by accelerating the development and deployment of affordable nutrient sensors. Next-generation sensors developed through the challenge should be easy to use in maintenance-free deployments of up to three months, cost less than \$5,000 to purchase, and be commercially available by 2017. In addition, USDA's *Innovations in Food and Agricultural Science and Technology (I-FAST) Pilot Program* designed a public-private partnership model to support agricultural innovations from laboratory to marketplace concept. The prize competition was structured to provide \$50,000 each to four project teams to fully participate in the National Science Foundation (NSF) I-Corps program curriculum which is designed specifically to help commercialize laboratory technology.²⁰

Agencies use prizes and challenges to achieve a variety of goals, such as improving government service delivery, finding and highlighting innovative ideas, solving a specific problem, advancing scientific research, developing and demonstrating technology, informing and educating the public, engaging new people and communities, building capacity, and stimulating markets.

The most common goals for FY 2016 challenges were *Engage new people and communities*, *Solve a specific problem*, *Find and highlight innovative ideas*, and *Develop*

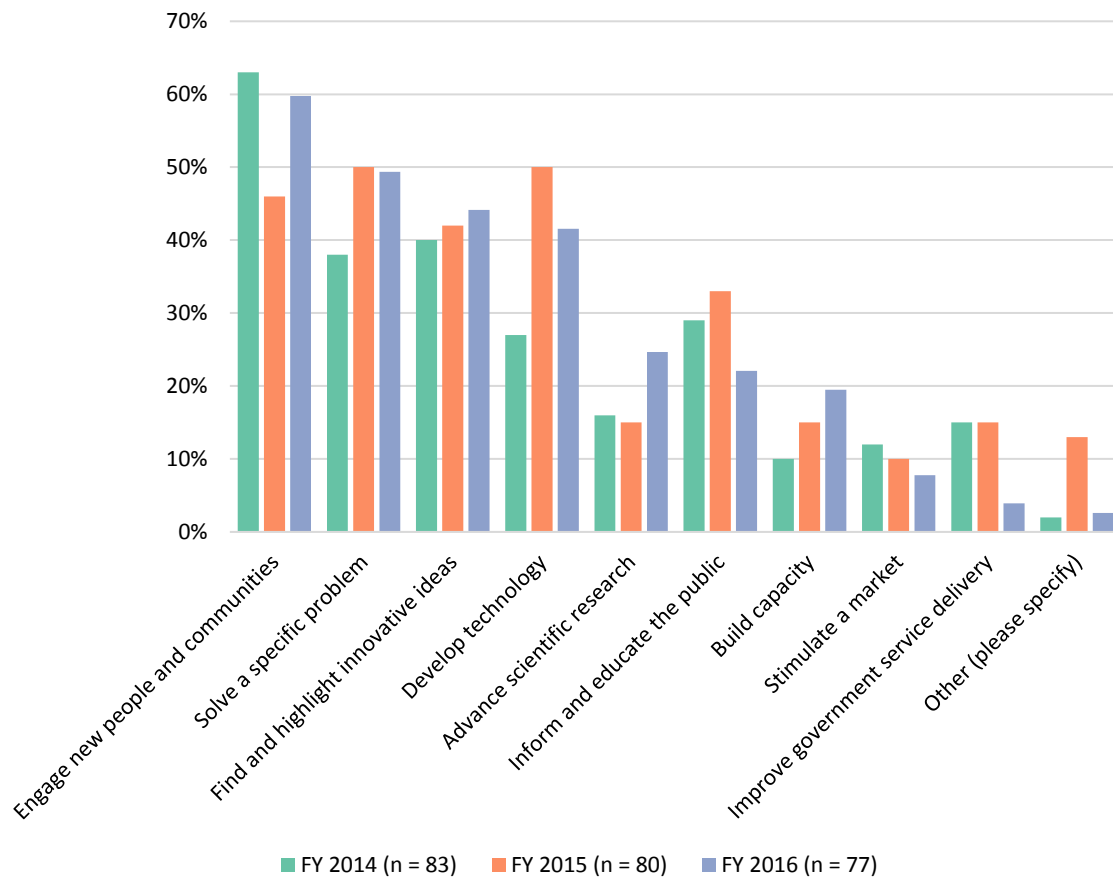
¹⁹ See Appendix A, page A-69, for a complete list.

²⁰ For additional information on I-Corps see www.nsf.gov/news/special_reports/i-corps

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technology and hardware (Figure 1).²¹ The goals of the challenges were also tracked in FY 2014 and FY 2015 so the data can begin to be compared across fiscal years. From FY 2014 to FY 2016, the biggest changes in occurrence of specific goals is an increase in the ratio of challenges that sought to *Develop technology and hardware* (15 percentage point increase) and *Solve a specific problem* (11 percentage point increase). While *Engage new people and communities* was the most sought after goal in FY2014 and FY 2016, it dipped in popularity for new challenges in FY 2015.

Figure 1. Percent of new challenges with each primary goal, FY 2014 - FY 2016²²



Note: Each challenge may have multiple goals.

The most common type of solution sought by FY 2016 challenges was *Ideas*, which was sought by 53 percent of the challenges (Figure 2), followed by *Software and apps* (29 percent) and *Technology demonstration and hardware* (25 percent). *Ideas* and *Technology demonstration and hardware* both increased from FY 2014 to FY 2016. Also notable is the

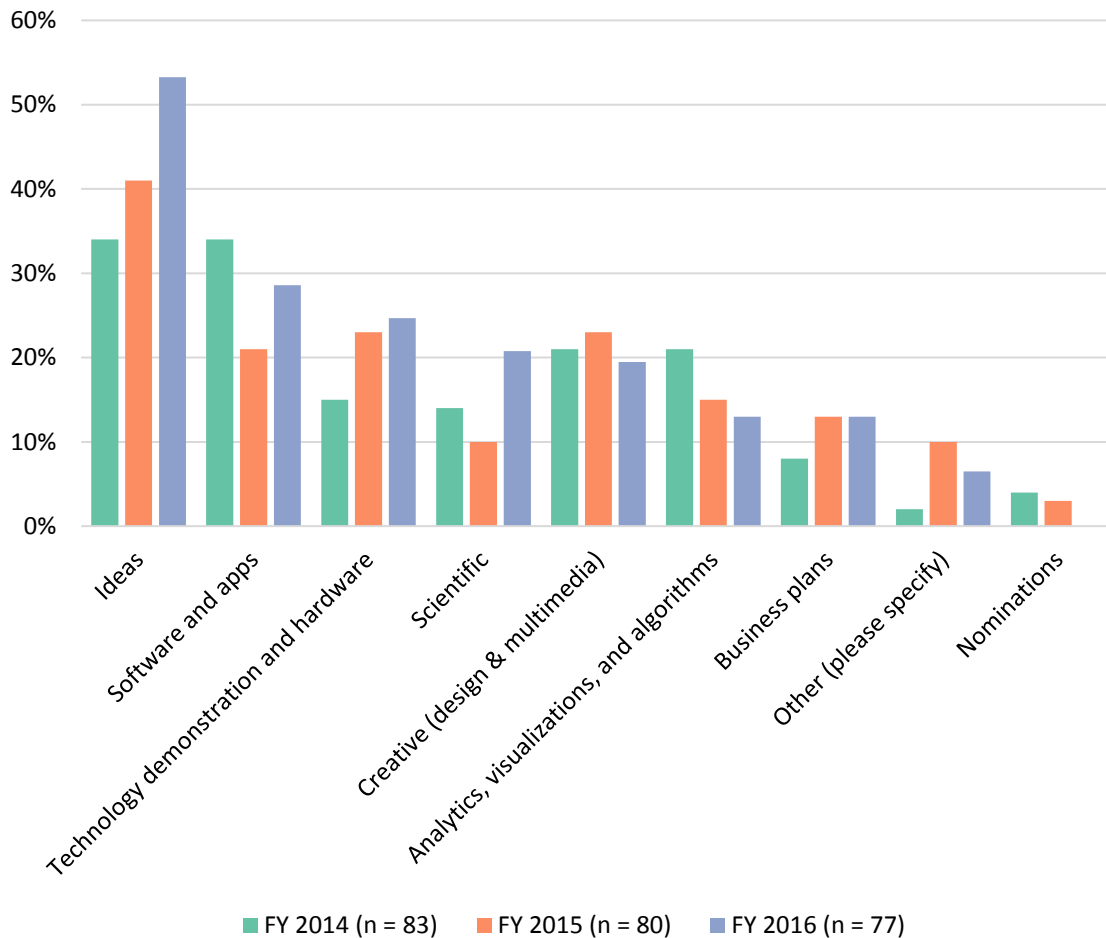
²¹ The other primary goals range from 3-25% of the total prizes.

²² Due to their independent challenge designs, the DOE JUMP Prize Competitions are considered as separate challenges for the purposes of the FY 2015 and FY 2016 reports. All 10 of the new JUMP Prize Competitions list *Solve a specific problem*, *Develop technology*, and *Engage new people and communities* as the top three primary goals.

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fluctuation in the proportion of challenges seeking *Software and apps* and *Scientific* solutions, both decreasing in FY 2015 and increasing again for prizes introduced in FY 2016.

Figure 2. Percent of new challenges with each type of solution, FY 2014 - FY2016²³



Note: Each challenge may have multiple types of solutions.

In FY 2016, the majority of new prizes (94 percent; 72 prizes) were designed to achieve multiple goals (Table 2), an increase from 81 percent in FY 2015 (65 prizes) and 78 percent in FY 2014 (64 prizes). However, the average number of goals per prize decreases from 2.85 goals/prize in FY 2015 to 2.75 goals/prize in FY 2016. The number of new prizes that sought multiple types of solutions decreased slightly from 46 percent in FY 2015 (37 prizes) to 43 percent in FY 2016 (33 prizes). However, the average number of solutions per prize increases each year from FY 2014 – FY 2016.

²³ Due to their independent challenge designs, the DOE JUMP Prize Competitions are considered as separate challenges for the purposes of the FY 2015 and FY 2016 reports. All 10 of the new JUMP Prize Competitions list *Ideas* as the only type of solution sought by the competition.

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Table 2. Prizes that seek multiple goals and solutions, FY 2014 – FY 2016

Fiscal Year	Percent of new prizes with more than one primary goal	Average goals per prize	Percent of new prizes with more than one solution type	Average solutions per prize
2014	78%	2.47	35%	1.49
2015	81%	2.85	46%	1.55
2016	94%	2.75	43%	1.79

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Section 3. Overview of Prizes Conducted Under the Authority Provided by COMPETES in Fiscal Year 2016

In FY 2016, 63 challenges run by 18 agencies were active under the COMPETES Prize Authority.²⁴ While the number of prize competitions under the COMPETES Prize Authority increased from FY 2015, the number of agencies decreased. Agencies that did not report any prizes active in FY 2016 under the COMPETES Prize Authority include: the Consumer Product Safety Commission (CPSC), the Corporation for National and Community Service (CNCS), the Department of Housing and Urban Development (HUD), the Department of Justice (DOJ), the Federal Maritime Commission, the Federal Trade Commission (FTC), and OMB. Agencies that did report prizes active in FY 2016 under the COMPETES Prize Authority include: DOE, Centers for Disease Control and Prevention (CDC), CMS, DARPA, DHS, Food and Drug Administration (FDA), GSA, Department of Health and Human Services (HHS), Health Resources and Services Administration (HRSA), National Institutes of Health (NIH), NIST, National Park Service (NPS), NSF, Substance Abuse and Mental Health Services Administration (SAMHSA), the Small Business Administration (SBA), Department of the Treasury (Treasury), USBR, and the USDA.

Table 3. Number of active prize competitions and agencies by authority, FY 2011–FY 2016

Fiscal Year	Number of active prizes under COMPETES authority	Number of Agencies offering prizes under COMPETES authority	Number of active prizes reported under all prize authorities		Number of agencies offering prizes reported under all authorities	
			Use of other authorities reported	other not reported	Use of other authorities reported	other not reported
2011	7	7				
2012	27	12	49		16	
2013	41	15	90		23	
2014	34	17	97		30	
2015	46	23	116		41	
2016	63	18	109		26	

One clear distinction of prize competitions that use the COMPETES authority is the broad partnerships that agencies are able to leverage. In FY 2016, 73 percent of COMPETES authority prizes (46 of 63) included formal partnerships, compared to 30 percent of prizes conducted under other authorities (14 of 46). In total, Federal agencies formed 288 partnerships in challenges conducted under COMPETES. In the future, Federal agencies can leverage the expanded partnership authority contained in the 2016 American

²⁴ The method for calculating these numbers was updated in the FY 2014 report from the method used in previous reports. Component agencies are counted separately if they use distinct infrastructure to operate challenges.

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Innovation and Competitiveness Act, which further updates the prize authority granted to all agencies in Section 24(n) of Stevenson-Wydler, in order to conduct prize competitions.

A review of prizes conducted under the COMPETES authority in FY 2016 reveals five major categories of formal partners:

- **Other federal agencies:** In 30 prize competitions, 12 agencies partnered with other Federal agencies in FY 2016. Partnering with other Federal agencies occurs when agencies' missions overlap and Federal employees collaborate to accomplish a specific goal. For example, in the GSA's *Government-wide Earth Day Hackathon*, GSA partnered with the White House Council on Environmental Quality (CEQ), the EPA, NIST, NOAA, and USDA to design green and sustainable projects for citizen hackers to solve. The agencies provided citizen hackers with a variety of software coding projects that when solved could improve the way each agency collects, analyzes, and displays federal data.
- **Non-profit organizations:** In 22 prize competitions, 6 agencies partnered with non-profit organizations in FY 2016. Non-profits aided in the design of prize competitions, provided judging services for prizes competitions, provided contestants expert feedback on submissions, and provided financial support for challenge competitions. In its fifth year, the *NIH Design by Biomedical Undergraduate Teams Challenge* formed a public-private partnership with VentureWell, a higher education non-profit whose mission is "to launch new ventures from an emerging generation of young inventors driven to improve life for people and the planet."²⁵ VentureWell provided the publicity for the competition, maintained an informational and entry submission portal, increased the number of prizes available to student competitors, and assisted in the evaluation of the entries.
- **Private sector:** In 22 prize competitions, 7 agencies partnered with corporate entities in FY 2016 to procure additional funding for a prize, facilitate the administration of the prize competition, and offer competitors incentives such as expert feedback and the potential to collaborate with industry partners post-competition. The most notable example of private industry collaboration is DOE's series of 13 JUMP prize competitions. Each of the JUMP prizes involved one national laboratory partner (Oak Ridge National Laboratory, Lawrence Berkeley National Laboratory, National Renewable Energy Laboratory, or the Argonne National Laboratory) and one industry partner (A.O. Smith, Building Robotics, Callida Energy, Clean Energy Trust, CLEAResult, Emerson, the Federal Energy Management Program, General Electric, Honeywell, IntelliChoice, Siemens, or the United Technologies Research Group). In each competition, the industry partner participated in the technical evaluation of submissions and provided the cash or technical support prizes for the winners.

²⁵ venturewell.org/whatwedo

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- **State and local governments:** Five prizes among three agencies partnered with state or local governments in FY 2016 to solve region-specific problems. For instance, the *Preventing Rodent Burrows in Earthen Embankments* prize led by USBR partnered with the State of Colorado Department of Natural Resources, the Boise Project Board of Control, the South Columbia Basin Irrigation District, and the US Army Corps of Engineers to design the prize competition. The prize competition produced five promising solutions to stop and prevent rodent burrows that can interrupt water delivery across the nation.
- **Academic Institutions:** Four prizes among four agencies partnered with academic institutions in FY 2016. Academic partners contributed in a variety of ways. In the *Think and Do Challenge*, DHS partnered with Kansas State University to provide further grant funding for challenge winners. CMS's "*A Bill You Can Understand*" *Design and Innovation Challenge* received guidance on patient-centered design for medical bills from experts at Harvard Medical School's Department of Health Care Policy.

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Section 4. Summary of Prizes Active in Fiscal Year 2016 Conducted Under COMPETES Authority

Agency	Name	Solution Type(s)	Primary Goal(s)	Date Open	Date Complete	Entry #s	Prize #s	Total Prize Purse	Non-Monetary Incentives
DHS	Environmentally Friendly Replacement for Buoy Mooring systems	Ideas; Hardware	Highlight ideas; Solve specific problem; Advance science; Develop technology; Educate public; Engagement	1/6/2016	2/12/2016	98	3	\$290,000	None
	Think and Do Challenge	Ideas; Business plans	Improve service delivery; Highlight ideas; Advance science; Engagement; Build capacity	9/30/2015	11/30/2015	33	2	\$100,000	Grant consideration from the State of Kansas
DOC	NIST: Federal Impact Assessment Challenge	Ideas	Highlight ideas; Engagement	9/27/2016	3/31/2017	TBD	4	\$20,000	Publication in The Journal of Technology Transfer
	NIST: Head Health Challenge III	Hardware; Scientific	Highlight ideas; Advance science; Engagement	2/2/2015	TBD	125	6	\$2,000,000	Opportunities to consult and work with NIST, Under Armour, NFL, and GE
DOD	DARPA: Cyber Grand Challenge	Software; Hardware; Analytics	Highlight ideas; Develop technology; Engagement	10/29/2013	8/4/2016	104	4	\$6,750,000	None
DOE	Catalyst Energy Innovation Prize formerly known as the SunShot Catalyst Prize	Software; Ideas; Hardware; Business plans	Highlight ideas; Develop technology; Build capacity; Stimulate market	12/11/2015	6/17/2016	7	7	\$490,000	None

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Agency	Name	Solution Type(s)	Primary Goal(s)	Date Open	Date Complete	Entry #s	Prize #s	Total Prize Purse	Non-Monetary Incentives
DOE	Cleantech University Prize	Business plans	Highlight ideas; Advance science; Develop technology	8/14/2015	3/7/2016	255	36	\$2,895,000	Entrepreneurial mentorship, interactions with private partners and suggestions for further funding
	EV Everywhere Logo Challenge	Creative	Educate public; Engagement; Stimulate market	8/13/2015	11/7/2015	89	1	\$5,000	None
	JUMP Prize Competition: Accurate, Stable Humidity Sensors for Buildings	Ideas	Solve specific problem; Develop technology; Engagement	4/12/2016	7/31/2016	15	2	\$0	Business development support, expert feedback, public recognition
	JUMP Prize Competition: Bring Your Own Controller for the Internet of Things	Ideas	Solve specific problem; Develop technology; Engagement	8/1/2016	9/30/2016	13	1	\$5,000	None
	JUMP Prize Competition: Distributed Temperature Sensing for Localized Comfort Measurement	Ideas	Solve specific problem; Develop technology; Engagement	5/22/2016	11/11/2016	9	1	\$4,350	Mentorship, technical assistance, interactions with California Technology Council, Showcase at National Clean Teach Week
	JUMP Prize Competition: Exhaust-to-Coolant Heat Exchanger Development for Engine Driven Heat Pump	Ideas	Solve specific problem; Develop technology; Engagement	2/29/2016	6/17/2016	7	0	\$0	None
	JUMP Prize Competition: FEMP Call for Innovation	Ideas	Solve specific problem; Develop technology; Engagement	5/20/2016	7/10/2016	19	1	\$0	In-kind support from Oak Ridge National Lab

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Agency	Name	Solution Type(s)	Primary Goal(s)	Date Open	Date Complete	Entry #s	Prize #s	Total Prize Purse	Non-Monetary Incentives
DOE	JUMP Prize Competition: Low-Cost Air Flow Sensor for Residential Ducted HVAC Systems	Ideas	Solve specific problem; Develop technology; Engagement	4/12/2016	7/31/2016	17	1	\$3,000	None
	JUMP Prize Competition: Low-Cost BTU Sensor for Use in Building HVAC Control Systems	Ideas	Solve specific problem; Develop technology; Engagement	9/24/2015	4/8/2016	8	1	\$5,000	Interactions with private partners, In-kind support from Oak Ridge National Lab
	JUMP Prize Competition: Low-Temperature Intrinsically Safe Defrost System	Ideas	Solve specific problem; Develop technology; Engagement	9/24/2015	4/8/2016	7	1	\$3,000	Interactions with private partners
	JUMP Prize Competition: Mean Radiant Temperature Sensing for Improved Thermal Comfort Building	Ideas	Solve specific problem; Develop technology; Engagement	4/12/2016	11/11/2016	12	4	\$7,000	Mentorship, technical assistance, interactions with California Technology Council, Showcase at National Clean Teach Week
	JUMP Prize Competition: Residential Energy Efficiency Applications for Smart Phones	Ideas	Solve specific problem; Develop technology; Engagement	5/20/2016	8/31/2016	27	6	\$6,750	Mentorship, commercialization assistance
	JUMP Prize Competition: Thermal Energy Storage in Residential Gas or Electric Water Heaters	Ideas	Solve specific problem; Develop technology; Engagement	9/24/2015	4/8/2016	14	1	\$5,000	Interactions with private partners, In-kind support from Oak Ridge National Lab

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Agency	Name	Solution Type(s)	Primary Goal(s)	Date Open	Date Complete	Entry #s	Prize #s	Total Prize Purse	Non-Monetary Incentives
DOE	JUMP Prize Competition: Ultra High Efficiency Compressors for AC Applications	Ideas	Solve specific problem; Develop technology; Engagement	2/29/2016	6/17/2016	9	1	\$0	None
	JUMP Prize Competition: Ultra High Efficiency DX System for Supermarkets	Ideas	Solve specific problem; Develop technology; Engagement	2/29/2016	6/17/2016	3	0	\$0	None
	SunShot Prize Race to 7-Day Solar	Software; Hardware; Other	Improve service delivery; Highlight ideas; Develop technology; Engagement; Stimulate market	3/4/2015	8/14/2015	5	24	\$10,000,000	Recognition
	Wave Energy Prize	Hardware; Other	Solve specific problem; Develop technology; Engagement	4/27/2015	7/15/2015	66	3	\$2,250,000	Tank testing, WEC-Sim and MathWorks software, recognition
DOI	NPS: Memorials for the Future	Ideas	Educate public; Engagement; Other	4/11/2016	8/8/2016	300	4	\$60,000	Public exhibition in the Hall of Nations at the JFK Center for the Performing Arts
	USBR: Detecting the Movement of Soils Within Earthen Dams, Canals, Levees, and their Foundations	Ideas	Solve specific problem; Engagement; Build capacity	3/31/2016	5/10/2016	29	5	\$20,000	None
	USBR: Downstream Fish Passage at Tall Dams	Ideas	Solve specific problem; Engagement; Build capacity	3/31/2016	5/10/2016	44	4	\$20,000	None
	USBR: Preventing Rodent Burrows in Earthen Embankments	Ideas	Solve specific problem; Engagement; Build capacity	8/29/2016	10/11/2016	75	5	\$20,000	None

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Agency	Name	Solution Type(s)	Primary Goal(s)	Date Open	Date Complete	Entry #s	Prize #s	Total Prize Purse	Non-Monetary Incentives
DOI	USBR: Quantifying Drift Invertebrates in River and Estuary Systems	Ideas	Solve specific problem; Engagement; Build capacity	10/7/2015	11/16/2015	24	5	\$30,000	None
GSA	Digital Innovation Hackathon Fall 2015	Software	Highlight ideas; Solve specific problem; Engagement	10/16/2015	10/16/2015	16	3	\$15,000	None
	Government-wide Earth Day Hackathon	Software	Highlight ideas; Solve specific problem; Engagement	4/22/2016	4/22/2016	10	4	\$15,000	None
HHS	ASPR: "MRC Serves!" Video Challenge	Creative; Ideas	Highlight ideas; Educate public; Engagement	8/4/2016	9/11/2016	12	3	\$0	Travel to the 2017 Preparedness Summit in Atlanta, GA
	ASPR: My Preparedness Story: Staying Healthy and Resilient Video	Creative; Ideas	Highlight ideas; Educate public; Engagement	1/4/2016	3/28/2016	94	4	\$3,500	Recognition
	Consumer Health Data Aggregator Challenge	Software	Solve specific problem; Engagement; Stimulate market	3/1/2016	11/7/2016	30	6	\$175,000	Expert feedback, recognition
	CDC: CDC 2015 Million Hearts Hypertension Control Challenge	Ideas; Hardware; Analytics; Other	Highlight ideas; Educate public; Engagement	8/8/2015	10/31/2015	26	18	\$0	Recognition
	CDC: Healthcare-Associated Venous Thromboembolism Prevention	Ideas	Highlight ideas; Educate public; Engagement	11/2/2015	1/10/2016	19	8	\$80,000	Recognition
	CMS: "A Bill You Can Understand" Design and Innovation Challenge	Software; Creative; Ideas; Hardware; Analytics	Highlight ideas; Solve specific problem; Engagement	5/9/2016	8/10/2016	84	2	\$10,000	Recognition, expert feedback, user feedback
	CMS: Merit Based Incentive Payment System (MIPS) Mobile Challenge	Software; Creative; Ideas	Develop technology; Educate public; Engagement	5/3/2016	8/15/2016	31	6	\$75,000	Public Recognition

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Agency	Name	Solution Type(s)	Primary Goal(s)	Date Open	Date Complete	Entry #s	Prize #s	Total Prize Purse	Non-Monetary Incentives
HHS	FDA: The 2016 FDA Naloxone App Competition	Software	Highlight ideas; Solve specific problem; Engagement	9/23/2016	11/7/2016	TBD	TBD	\$40,000	None
	HRSA: Bridging the World Gap Challenge	Software; Ideas; Hardware	Solve specific problem; Develop technology; Educate public	11/9/2015	8/11/2016	90	15	\$225,000	Expert feedback, recognition, mentorship, interactions with stakeholders, live broadcast Demo Day
	Move Health Data Forward Challenge	Software; Hardware; Business plans	Highlight ideas; Solve specific problem; Develop technology	5/10/2016	9/8/2016	28	10	\$250,000	Recognition
	NIH: \$100,000 for Start a SUD Startup	Ideas	Highlight ideas	6/13/2016	9/16/2016	17	10	\$100,000	Recognition, Expert assistance
	NIH: A Wearable Alcohol Biosensor Challenge	Hardware	Advance science; Develop technology; Stimulate market	3/2/2015	12/1/2015	8	2	\$300,000	Expert feedback, testing
	NIH: Addiction Research There's an App for that	Software	Highlight ideas; Advance science; Develop technology	11/3/2015	4/29/2016	20	3	\$100,000	Recognition
	NIH: Antimicrobial Resistance Rapid Point-of-Need Diagnostic Test Step 1	Scientific	Highlight ideas; Advance science; Develop technology	9/8/2016	1/9/2017	TBD	TBD	\$50,000	Recognition
	NIH: Climate Change and Environmental Exposures Challenge	Software; Analytics	Educate public; Engagement; Build capacity	10/1/2015	2/2/2016	11	4	\$30,000	Expert feedback, recognition, published in the White House Climate Resilience Toolkit

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Agency	Name	Solution Type(s)	Primary Goal(s)	Date Open	Date Complete	Entry #s	Prize #s	Total Prize Purse	Non-Monetary Incentives
HHS	NIH: Design by Biomedical Undergraduate Teams	Hardware; Business plans; Analytics	Highlight ideas; Develop technology; Build capacity	3/1/2016	5/30/2016	72	6	\$75,000	Recognition
	NIH: Follow that Cell	Scientific	Highlight ideas; Advance science; Develop technology	8/11/2014	3/30/2017	33	5	\$500,000	Sponsored travel to 3rd annual Single Cell Analysis PI Meeting
	NIH: Innovative Tools to Increase Public Awareness and Knowledge of Sickle Cell Disease Undergraduate Challenge	Software; Creative	Highlight ideas; Educate public; Engagement	11/30/2015	4/6/2016	19	4	\$21,000	Recognition
	NIH: Open Science Project	Software; Hardware; Analytics; Scientific	Highlight ideas; Advance science; Engagement	10/20/2015	2/29/2016	96	6	\$80,000	Expert feedback, recognition
	NIH: Pill Image Recognition Challenge	Software; Analytics	Solve specific problem; Advance science; Develop technology	4/4/2016	5/31/2016	11	3	\$45,000	Recognition
	NIH: Up for a Challenge Stimulating Innovation in Breast Cancer Genetic Epidemiology	Analytics; Scientific	Highlight ideas; Advance science; Engagement	6/15/2015	2/25/2016	15	3	\$50,000	Recognition, invitation to publish in PLoS genetics
	Provider User Experience Challenge	Software	Solve specific problem; Engagement; Stimulate market	3/1/2016	11/7/2016	41	7	\$175,000	Expert feedback, recognition
	The Simple Extensible Sampling Tool Challenge	Software	Solve specific problem; Educate public	9/29/2016	5/15/2017	TBD	TBD	\$40,000	Recognition

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Agency	Name	Solution Type(s)	Primary Goal(s)	Date Open	Date Complete	Entry #s	Prize #s	Total Prize Purse	Non-Monetary Incentives
HHS	Use of Blockchain in Health IT and Health-Related Research	Ideas	Highlight ideas; Educate public; Engagement	7/5/2016	9/8/2016	77	15	\$45,000	Invitation to present their papers at the NIST/ONC Blockchain in Healthcare Workshop
	SAMHSA: Opioid Recovery App Challenge	Software; Creative	Solve specific problem; Develop technology; Engagement	3/4/2016	3/27/2016	15	8	\$32,500	Recognition
NSF	Community College Innovation Challenge	Software; Ideas; Hardware; Scientific	Highlight ideas; Advance science; Develop technology	10/15/2015	2/15/2016	20	10	\$41,590	Professional development workshop, present projects on Capitol Hill, expert feedback, recognition
	Generation Nano	Creative; Ideas; Hardware	Advance science; Educate public; Engagement	11/19/2015	2/2/2016	115	4	\$3,000	Recognition, trip to the USA Science and Engineering Festival, signed materials from comic creator, Stan Lee
Treasury	2016 Community Development Financial Institutions (CDFI) Fund Prize Challenge	Ideas	Highlight ideas; Solve specific problem; Build capacity	6/16/2016	7/29/2016	64	8	\$1,000,000	None
USDA	E.A.T. School Lunch UX Challenge	Software	Improve service delivery; Highlight ideas	12/1/2015	3/1/2016	44	14	\$50,000	Recognition
	Innovation in Food and Agricultural Science and Technology (I-FAST)	Ideas; Hardware; Business plans; Scientific	Highlight ideas; Advance science; Develop technology	5/26/2016	9/2/2016	6	4	\$200,000	None
SBA	Growth Accelerator Fund Competition—2016	Creative; Business plans	Educate public; Stimulate market	5/4/2016	6/3/2016	417	85	\$4,250,000	None

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Agency	Name	Solution Type(s)	Primary Goal(s)	Date Open	Date Complete	Entry #s	Prize #s	Total Prize Purse	Non-Monetary Incentives
SBA	InnovateHER Competition—2016	Ideas; Business plans	Develop technology; Educate public;	8/4/2015	12/2/2015	74	3	\$70,000	None
	Lean for Main Street Training Challenge	Business plans	Highlight ideas; Build capacity	1/11/2016	2/11/2016	38	5	\$125,000	Participation in NSF I-Corps

Appendix A. Agency Prizes and Challenges Active in FY 2016 Under the America COMPETES Reauthorization Act of 2010

This Appendix provides a complete summary of all prizes and challenges conducted in FY 2016 under the prize authority provided to agencies in COMPETES and does not include any of the multiple prize competitions conducted under other authorities.

A.1 Department of Agriculture

A.1.1 E.A.T. School Lunch UX Challenge²⁶

Summary: The U.S. Department of Agriculture’s (USDA) National School Lunch Program and School Breakfast Program offer free and substantially reduced-price school meals to children from low income households. However, due to issues with reporting, calculating, and processing, many applications contain errors that result in incorrect eligibility determinations for children. USDA Food and Nutrition Service (FNS) currently does not offer a web-based application. The E.A.T. School Lunch UX Challenge asked contestants to develop a working web-based application that satisfied a set of minimum FNS-specified requirements. A total of 44 unique solutions were received. At the end of the contest, FNS partnered with the Presidential Innovation Fellows to help finalize what will be its first web-based model application. The final product, which was released in late 2016, takes inspiration from the best contest submissions and contains features that reflect lessons from USDA and other research into the nature and causes of applicant error.

Solution Type: Software and apps

Primary Goals: Improve government service delivery; and find and highlight innovative ideas

Results: Contestants submitted 44 entries. Thirty met the submission and eligibility criteria to compete for prizes. Individuals submitted 16 entries; teams submitted 21; small corporations, nonprofits, and other legal organizations submitted 3 entries, and large corporations and other organizations submitted 4. First prize was awarded to a team of four individuals with experience in design and software development. That team also won awards for “Best Creative Design Aesthetic” and “Best Behavioral Design Elements.” The contest’s second place winner was a team of two students. That team also won the “Student Award.”

Problem Statement: The U.S. Department of Agriculture’s (USDA) National School Lunch Program and School Breakfast Program offer free and substantially reduced-price school meals to children from low income households. Traditionally, households applied for free or reduced-price benefits by submitting paper or web-based/online applications to their schools. Millions of

²⁶ lunchux.devpost.com

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applications are filed every year, and nearly nine million low income children were certified to receive benefits in school year 2015-16 through these applications.

However, due to issues with reporting, calculating, and processing, many applications contain errors that result in incorrect eligibility determinations for children. Food and Nutrition Service (FNS) research indicates that certification error due to mistakes by households and school districts in filling out and processing applications is the single biggest source of improper payments in the school meal programs. FNS offers a prototype paper application on its website, and thousands of school districts have adopted or modified that application for their own use. Many districts also offer web-based applications. To date, however, FNS has not offered its own web-based prototype. Web-based applications have the potential to reduce applicant error by providing prompts and feedback to the user during the application process. For example, web-based applications can be designed to:

- Guide applicants through a process that prompts for all reportable income types;
- Alert applicants to missing information; and
- Prompt applicants to inform the accuracy of a final household income total.

Without its own web-based prototype, FNS has not had any influence on the content of the web-based applications developed by States and local school districts.

The E.A.T. School Lunch UX Challenge asked contestants to develop a working web-based application that satisfied a set of minimum FNS-specified requirements. The contest challenged individuals and teams with expertise in UX design, programming, and the behavioral sciences to reimagine what a web-based school meal application could look like and how it should function. The contest was FNS's first step in developing a forward-looking, web-based application that limits the burden on applicants, facilitates access to program benefits for eligible children, and strengthens its program integrity by reducing applicant errors.

Proposed Goals: The immediate goal of the contest was to develop working web-based application prototypes for free and reduced-price school meal benefits. Its broader purpose was to advance the state-of-the-art in web-based school meal application design to reduce program error while protecting and facilitating access to program benefits by eligible children.

Measures of Success: Contestants submitted 44 applications, all of them unique. Most satisfied the minimal integrity promoting concepts outlined in the contest rules and others went further. As a group, contestants demonstrated that a more integrity-focused application is fully compatible with good user-focused design.

At the end of the contest, FNS partnered with the Presidential Innovation Fellows to help finalize what will be its first web-based model application. The final product, to be released in late 2016, takes inspiration from the best contest submissions and contains features that reflect lessons from USDA and other research into the nature and causes of applicant error.

By its very public nature, the FNS's America COMPETES Act contest generated interest among several of the large vendors that develop and market software systems to school districts. Informal

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feedback from some of these vendors suggests that the private market will quickly adopt the key integrity features of the FNS model once it is released.

A short list of the best contest entries includes a few submitted by small and large corporations and nonprofits that do not currently market their own applications to school districts. Although it remains to be seen, these firms may decide to enter the market for school district software. Market stimulation was not among the initial goals of the contest, but may prove to be an unintended benefit.

The challenge succeeded in generating interest in FNS's web-based application initiative, and gave people a place to voice their ideas, concerns, and solutions. Individuals made 17,872 visits to the contest website over the course of the contest. Registered contestants sent over 1,000 messages through a Slack (team collaboration) channel set up on the website to facilitate communication by participants and encourage the formation of teams.

Participants: FNS and contest host Devpost, Inc. (Devpost) marketed the contest to individuals, teams of individuals, and corporations and nonprofit organizations of all sizes who have an interest in human behavior, UX design, interaction design, information design, and front-end software development.

The contest was open to U.S. citizens and permanent residents who were at least 18 years old at the time of entry. The contest was also open to corporations (including not-for-profit corporations and other nonprofit organizations), limited liability companies, partnerships, and other legal entities that were incorporated in, and maintained a primary place of business in the United States. Corporations, nonprofits, LLCs, partnerships and other legal organizations with fewer than 50 employees ("Small Organizations") were eligible for a cash prize. Similarly structured organizations that employed 50 or more people were eligible only for a non-cash "Large Organization" recognition award.

The challenge brought together 105 participants.

Timeline: Submissions for the challenge opened on November 30, 2015 and closed on March 1, 2016. Winners were announced March 31, 2016.

Solicitation and Outreach: FNS and its partner Devpost developed marketing and outreach materials that included an agency press release, blog posts, Twitter, and email messages for release throughout the contest. Critical to the marketing plan was Devpost's outreach to its network of registered participants from past contests. Both FNS and Devpost contacted a long list of individuals in government and the private and non-profit sectors at the outset of the contest. These organizations and individuals are primarily from the technology and design worlds or have an interest in the agency's mission.

Devpost and FNS encouraged participation in the contest via:

- Featured placements on the Devpost homepage and Hackathon listings page throughout the challenge submission period;
- Featured placement in 18 weekly Devpost newsletters over 9 weeks;

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- University outreach via personal email to more than 60 computer science, interaction design, UX design, digital media, information design, and human-computer interaction programs at research universities and tech training boot camps across the U.S.;
- Influencer outreach via personal email to 60 design thought leaders and 80 Meetup and student club organizers;
- Targeted outreach via personal email to more than 1,300 college hackers who participated in Devpost's autumn 2015 hackathon season;
- PR outreach to design and development-focused blogs, newsletters, and podcasts;
- Weekly/bi-weekly targeted emails to the registrants, providing reminders on important dates, tips on getting started, introduction of new resources, and webinar invitations and recaps (including 23 updates and 3 rounds of personal email correspondence with all 420 registrants);
- Development and co-hosting of 3 webinars to provide detailed background and open Q&A for participants;
- Daily support of participating designers to answer technical questions and questions on contest rules;
- Moderating a challenge discussion board and Slack channel, and answering submitter questions one-on-one;
- Additional exposure through secured promotional partnerships with Usability.gov and Citizen Onboard;
- Press/publicity: [UX Notebook](#), [Usability.gov blog](#), [SCVNews.com](#); and
- Twitter:
 - Total number of impressions across all Tweets: 50,468
 - Total number of ReTweets across all Tweets: 33
 - Total number of Likes across all Tweets: 36
 - Total number of Expands across all Tweets: 43
 - Total number of Link Clicks across all Tweets: 100
 - Total number of Replies across all Tweets: 3

Incentives: FNS used appropriated funds to award \$50,000 in prizes. The top prize was \$20,000. The contest offered a second prize of \$10,000, and a third prize of \$5,000. To generate additional interest, the contest offered five honorable mentions of \$2,000 each, and \$1,000 prizes for best student submission, most popular submission, and each of three technical achievement categories.

Evaluation and Judging: Three FNS officials and two individuals from outside the government served as judges. FNS judges were career individuals in the agency's Child Nutrition Programs. The contest's external judges were from the world of human centered and UX design. Judging criteria included UX design and appeal, the effectiveness and efficiency of behavioral prompts to reduce applicant mistakes, inclusion of FNS-specified required elements, the quality of program code and documentation, and the extent of demonstrated user testing and debugging. A discussion of evaluation and judging can be found in the *Federal Register* notice located at www.gpo.gov/fdsys/pkg/FR-2015-11-30/pdf/2015-30313.pdf.

Partnerships: No partnerships were utilized.

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Resources: FNS contracted with Devpost, Inc. to administer the contest and consult with FNS on contest rules. FNS personnel took the lead in much of the contest planning, preparation of the materials that appeared on the contest website, development of an outreach plan, and drafting communication materials. FNS’s contract with Devpost totaled \$92,000, excluding the \$50,000 in prize money. FNS contributed personnel time worth an estimated \$30,000.

Results: Contestants submitted 44 entries. Thirty met the submission and eligibility criteria to compete for prizes. Individuals submitted 16 entries; teams submitted 21; small corporations, nonprofits, and other legal organizations submitted 3 entries, and large corporations and other organizations submitted 4.

FNS asked contestants to report their years of experience as software developers at the time of registration. They reported the following:

Participants	Years of Development Experience
6	0-1
10	2-4
5	5-8
7	9+
8	not developers
9	did not respond

Nine teams identified themselves as “student” teams. Under contest rules, students must have:

- Been enrolled in at least nine credits or three courses, or the equivalent at the time of entry (or must have been enrolled in such credits or courses within the past three months); or
- Graduated in the three months prior to the date of entry from either a secondary school or functional equivalent, or an accredited post-secondary institution (e.g., university, community college, technical college).

The contest offered eight general prizes (first, second, third, and five honorable mentions) plus a prize for the best student entry, three prizes for best execution in specific categories, a popular choice award, and a non-cash large organization recognition award. With the exception of large organizations, all contestants were eligible to win more than one prize.

FNS awarded first prize to a team of four individuals with experience in design and software development. That team also won awards for “Best Creative Design Aesthetic” and “Best Behavioral Design Elements.” The contest’s second place winner was a team of two students. That team also won the “Student Award.”

Individuals and teams invested in sometimes impressive research and testing. Several contestants tested their applications with parents of school age children. At least one team tested their application with a high ranking official at a major U.S. public school district. A number of contestants made their applications mobile-friendly, a feature not required by contest rules. A few of those contestants cited research that found greater access to smartphones than desktop computers among low income households.

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A.1.2 Innovations in Food and Agricultural Science and Technology (I-FAST)²⁷

Summary: The I-FAST Pilot Program is a public-private partnership that will help create a stronger national ecosystem for innovation that couples scientific discovery with technology development to address agricultural and societal needs and support from laboratory to marketplace concept. The USDA-NIFA I-FAST prize competition was structured to provide \$50,000 each to four USDA-NIFA funded project teams to fully participate in the NSF I-Corps™ program curriculum. Selected USDA-NIFA I-FAST project teams will have the opportunity to concurrently participate in the educational programs with NSF I-Corps awardees.

Solution Type: Ideas; technology demonstration and hardware; business plans; and scientific.

Primary Goals: The goals are to identify valuable product opportunities that can emerge from NIFA supported academic research. The NSF I-Corps™ is a program specifically designed to broaden the impact of select, basic-research projects by preparing scientists and engineers to focus beyond the laboratory. The final goal of this opportunity is to facilitate technology transfer of innovations that can make an impact in the U.S. marketplace and global economy.

Results: Four teams were selected to enter into the ongoing I-FAST Pilot Program. The team from the University of Houston, Texas developed a toolkit to educate and improve produce handling practices. The team from the University of Illinois developed two software packages that allow crop advisors to work with farmers on improving their nitrogen fertilizer management strategies. The team from Lincoln University developed a pathogen detection biotechnology test kit to determine if E. coli has contaminated food. The team from Cornell University developed a microtensiometer sensor that will help producers optimize their irrigation needs.

Problem Statement: A majority of NIFA grant funding is provided to academic institutions to focus on developing research in the areas of farm efficiency and profitability, ranching, renewable energy, forestry (both urban and agroforestry), aquaculture, rural communities and entrepreneurship, human nutrition, food safety, biotechnology, and conventional breeding. USDA-NIFA will partner with the National Science Foundation (NSF) Innovation Corps (I-Corps) to provide entrepreneurship training to USDA-NIFA grantees under this Innovations in Food and Agricultural Science and Technology (I-FAST) Pilot Program. The goals are to identify valuable product opportunities that can emerge from NIFA-supported academic research. The NSF I-Corps™ is a program specifically designed to broaden the impact of select, basic-research projects by preparing scientists and engineers to focus beyond the laboratory. Leveraging experience and guidance from established entrepreneurs and targeted curricula within the NSF I-Corps™ program, USDA-NIFA I-FAST grantees will learn to identify valuable product opportunities that can emerge from USDA-NIFA supported academic research. The I-FAST Pilot Program is a public-private partnership that will help create a stronger national ecosystem for innovation that couples scientific discovery with technology development to address agricultural and societal needs and support from laboratory to marketplace concept. The USDA-NIFA I-FAST prize competition was structured to provide \$50,000 each to four USDA-NIFA funded project teams to fully participate in the NSF I-Corps program curriculum. Selected USDA-NIFA I-FAST project

²⁷ nifa.usda.gov/program/innovations-food-and-agricultural-science-and-technology-i-fast-prize-competition

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teams will have the opportunity to concurrently participate in the educational programs with NSF I-Corps™ awardees. Over a 12-month period USDA-NIFA supported teams in the I-FAST Pilot Program will learn what is required to achieve an economic impact with their particular innovation. The final goal of this opportunity is to facilitate technology transfer of innovations that can make an impact in the U.S. marketplace and global economy.

Proposed Goals: Innovations and technologies development at the academic laboratory scale is often stalled and cannot move out of the academic arena. USDA-NIFA implemented the I-FAST Pilot Program as a means to provide valuable entrepreneurship training to university post-doctoral graduate students and others with a desire to start a business focused on the technology that was funded by NIFA in the laboratory. USDA-NIFA hopes that the four teams that complete the I-FAST Pilot Program will apply for a USDA Small Business Innovation Research (SBIR) grant to continue the growth of the innovation/technology into a commercial market.

Specifically, the USDA/NIFA sought to find and highlight innovative ideas, advance scientific research, and develop technology through the contest.

Measures of Success: The four I-FAST Teams began a six-week training program through the NSF I-Corps™ in late October and are expected to complete the training in December 2016. Measures of success for the program include their ability to: (i) identify a commercial market for the innovation/technology that USDA-NIFA invested in; (ii) develop a Phase I SBIR proposal to maintain the commercialization path of the innovation/technology that USDA-NIFA invested in; (iii) create jobs and new small businesses under the program and; (iv) employ clear opportunities for USDA-NIFA funded research to move into commercial markets.

Participants: The I-FAST Competition was open to teams (“Teams” or “Participants”) comprised of individuals from academic/university institutions that had received a prior award from NIFA (in a scientific or engineering field relevant to the proposed innovation) that were currently active or that had been active within five years from the date of the I-FAST Team's proposal submission. The lineage of the prior award extended to the Principal Investigators, Co-Principal Investigators, Senior Personnel, Post-Doctoral Students, Professional Staff, or others who were supported under the USDA-NIFA award. Prior awards could range from students, single-investigators, to large distribution centers. A full description of the eligibility requirements can be found in the *Federal Register* notice located at www.gpo.gov/fdsys/pkg/FR-2016-05-25/pdf/2016-12265.pdf.

The challenge brought together a total of 18 participants.

Timeline: Submissions for the pre-application phase opened on May 26, 2016 and closed on July 22, 2016. The submission period for the full application phase opened on August 8, 2016 and closed on September 2, 2016. Winners were announced on September 23, 2016.

Solicitation and Outreach: On May 25, 2016, in Vol. 81, No. 101, pp. 33204 to 33207, of the *Federal Register*, USDA published the *Announcement of Requirements and Registration for U.S. Department of Agriculture (USDA) Innovations in Food and Agricultural Science and Technology (I-FAST) Prize Competition*.²⁸ A press release was issued November 1, 2016 by NIFA. Social

²⁸ www.gpo.gov/fdsys/pkg/FR-2016-05-25/pdf/2016-12265.pdf

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media tools including Twitter and Facebook were also used. In addition, there was a Memorandum of Understanding (MOU) entered into between NSF and USDA-NIFA.

Incentives: USDA-NIFA used funds from the USDA SBIR program under its 3% Administration Fund which allows for funds to be used for new programs in the areas of technology transfer and commercialization. SBIR funding is obtained by taxing a required percentage of the extramural Research/Research & Development (R/R&D) appropriations received by USDA annually. The Prize Purse is \$200,000. The competition is structured to provide \$50,000 each to four USDA-NIFA funded project teams to fully participate in the NSF I-Corps™ program curriculum. This program did not provide any non-monetary incentives. The program is ongoing and USDA-NIFA obligated \$200,000 for the Teams to expense against. Since the funding is from the USDA SBIR accounts, it is not appropriated funds, but is provided under a taxing authority under the Small Business Act. From this percentage, the USDA SBIR 3% Administration Fund mentioned above is determined. At this time it is unclear if there will be any unobligated funds once the program is completed.

Evaluation and Judging: USDA-NIFA screened all entries for eligibility and completeness. Entries from Teams that did not meet the eligibility requirements or failed to include required submission elements were not evaluated or considered. Eligible and complete entries were judged by a fair and impartial panel of individuals from USDA-NIFA and NSF (the “Judging Panel”). A full description of the evaluation and judging requirements can be found in the *Federal Register* notice located at www.gpo.gov/fdsys/pkg/FR-2016-05-25/pdf/2016-12265.pdf.

Partnerships: USDA-NIFA entered into a Memorandum of Understanding (MOU) with the National Science Foundation (NSF) with the focus on sharing a common interest in conducting technology transfer of U.S. Government-funded research that is ready for commercial applications and providing a societal impact. USDA-NIFA's mission is to invest in and advance agricultural research, education, and extension to solve societal challenges. The National Science Foundation – Innovation Corps (I-Corps™) is a set of activities and programs that educates research scientists and engineers to extend their focus beyond the laboratory to facilitate the technology transfer of U.S. Government-funded research to commercial markets. The MOU established a framework between USDA-NIFA and the NSF I-Corps™ to include participation by USDA-NIFA funded research projects through the pilot I-FAST program. Selected I-FAST Teams will have the opportunity to concurrently participate in the educational programs with NSF I-Corps™ awardees. Based on the outcomes of the initial pilot program, the Parties will evaluate the benefits and feasibility of further collaboration and expansion of the I-FAST program. I-FAST Teams will strive to maintain core elements of the I-Corps™ model. I-FAST will be managed by USDA-NIFA with guidance from, and in collaboration with, NSF program directors. For the Pilot Program, eligibility is limited to academic principal investigators that received a USDA-NIFA competitive grant. The proposal and selection process was structured to closely mimic that in use by NSF, with identical team structure requirements.

Resources: USDA-NIFA used funding provided under the USDA SBIR 3% Administration Fund to implement this program. USDA-NIFA managed the competition in-house and did not use a third-party vendor, contractor or partner.

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Results: The following four teams (including the innovations/technology that was funded) were selected to enter into the ongoing I-FAST Pilot Program. Each clearly demonstrated the ability to participate in the requirements of the I-FAST Pilot Program and had prior USDA-NIFA funded innovations/technologies ready to move into commercial markets.

University of Houston Houston, Texas	Developed a behavioral-based, affordable educational toolkit with monitoring and augmented reality technology system that will educate and improve employee fresh and fresh-cut produce handling practices. Using this toolkit will ensure food safety is learned and that knowledge is transferred into practice.
University of Illinois Champaign, Illinois	Developed two software packages that allow crop advisors to work with farmers to run on-farm, whole-field agronomic trials, using the data for recommendations to farmers' profitable nitrogen fertilizer management strategies. This will make it possible for crop advisors working with farmers to inexpensively run large-scale, on-farm agronomic trials and create management input strategies.
Lincoln University Jefferson City, Missouri	Developed a pathogen detection biotechnology test kit to determine if E. coli 0157:H7 has contaminated food. This kit would terminate the risk of farmers supplying E. coli contaminated food to customers, processing facilities, distributors, and retailers.
Cornell University Ithaca, New York	Developed a Micro-Electro-Mechanical Systems (MEMS) microtensiometer sensor to monitor minute-by-minute readings of both plant water and soil stresses. This monitoring system will help producers optimize their irrigation needs by maintaining the precise level of water that provides the optimal yield or quality for the crop.

A.2 Department of Commerce

A.2.1 NIST: Federal Impact Assessment Challenge²⁹

Summary: The Federal Government invests over \$135 billion in research and development annually. Many of the technologies developed by Federal researchers are transferred to the private sector through formal agreements or through informal exchanges. This challenge asks participants to describe a federally developed technology that has been transferred to the private sector and the demand environment (e.g., who is using the technology), and uses data to present an assessment of the economic and societal impacts that resulted from the technology that was transferred from the Federal agency. A \$20,000 total prize purse was the incentive for this competition. There will be a total of four awards at \$5,000 each.

Solution Type: Ideas

Primary Goals: Find and highlight innovative ideas; engage new people and communities. The objective of this challenge is to identify and measure economic and societal impacts that result

²⁹ www.federalregister.gov/documents/2016/09/27/2016-23239/announcement-of-requirements-and-registration-for-national-institute-of-standards-and-technology

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from the transfer of federally developed technologies. The challenge should find and highlight innovative ideas and engage new people and communities.

Results: Submission for the challenge opened September 27, 2016 and is open through March 31, 2017. As of October 25, 2016, there are seven challenge followers.

Problem Statement: Every year the Federal Government invests over \$135 billion in research and development. Almost one-third of these funds support intramural research—by Federal researchers within Federal laboratories—covering a wide range of technologies with applications in aerospace, biotechnology, chemical engineering, communications, electronics, and much, much more. Many of the technologies developed by Federal researchers are transferred to the private sector through formal agreements (e.g. patents, licenses, or cooperative research and development agreements) or through informal exchanges (e.g. publications, conference presentations, or collaborations). Without doubt these Federal investments have yielded extraordinary long-term impacts, creating new knowledge and ultimately new industries.

Despite the proliferation of Federal research and the profound effect that many federally developed technologies have upon our everyday life, more effort is needed to assess the impact of these technologies—as emphasized in President Obama’s 2011 Memorandum *Accelerating Technology Transfer and Commercialization of Federal Research in Support of High-Growth Businesses*.

This memorandum called on Federal agencies to establish performance goals, metrics, evaluation methods, and implementation plans to improve the effectiveness of Federal technology transfer activities. The President's charge stimulated agency interest in studies that assess the impact of technologies transferred from Federal laboratories. In an effort to encourage research in this area, the Technology Partnerships Office of the National Institute of Standards and Technology (NIST) and the *Journal of Technology Transfer* present a Federal Impact Assessment (FIA) Challenge for researchers to develop impact studies of Federal technology transfer activities. Participants are required to write a paper that describes a federally developed technology that has been transferred to the private sector and the demand environment (e.g., who is using the technology), and uses data to present an assessment of the economic and societal impacts that resulted from the technology that was transferred from the Federal agency. Successful papers will describe a novel approach to capturing the impact of federally funded technology(ies), present a comprehensive scope of impacts, and present a high-quality, well-reasoned, and compelling argument for capturing the impact of the federally funded technology(ies).

Proposed Goals: The objective of this challenge is to identify and measure economic and societal impacts that result from the transfer of federally developed technologies. The challenge should find and highlight innovative ideas, and engage new people and communities.

Measures of Success: The competition began in late September 2016 and is currently ongoing. It is too early to identify success measures.

Participants: This challenge is primarily directed at students and researchers who are interested in studying the economic or societal impacts of federally developed technologies, but is open to

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anyone (or any organization) that meets the eligibility requirements described in the Rules.³⁰ Participants do not need to be a technology expert or economist, but should have an appetite for research and some familiarity with methods of impact analysis. Teaming is encouraged because of the scope and diversity of potential technology transfer studies, from understanding the technology to tracking its transfer and assessing its impact.

Eligibility requirements were listed in the Rules as stated in the *Federal Register* notice. Specifically:

- The FIA Challenge is open to all individuals over the age of 18 that are residents of the 50 United States, the District of Columbia, Puerto Rico, the U.S. Virgin Islands, Guam, the Commonwealth of the Northern Mariana Islands, and American Samoa, and to for-profit or non-profit corporations, institutions, or other validly formed legal entities organized or incorporated in, and which maintain a primary place of business in, any of the preceding jurisdictions. An individual, whether participating singly or with a group, must be a citizen or permanent resident of the United States.
- Federal employees are not eligible to participate. Any individuals or legal entities that have received Federal funds for the development of any part of a submission are ineligible. Any other individuals or legal entities involved with the design, production, execution, distribution, or evaluation of the FIA Challenge are also not eligible to participate.
- A Participant shall not be deemed ineligible because the Participant consulted with Federal employees or used Federal facilities in preparing its submission to the FIA Challenge, if the employees and facilities are made available to all Participants on an equitable basis. Note that while Federal employees may provide information to Participants, they are not obligated to respond to information requests within the time frame of this Challenge. The task of gathering information for this Challenge in a timely manner is the sole responsibility of the Participant.
- To be eligible to win a Cash Award, a Participant (whether an individual or legal entity) must have registered to participate and must have complied with all requirements under the COMPETES Act.
- Multiple entries are permitted. Each entry will be reviewed independently. Multiple individuals and legal entities may collaborate as a group to submit a single entry, in which case all members of the group must satisfy the eligibility requirements, and a single individual from the group must be designated as an official representative for each entry. That designated individual will be responsible for meeting all entry and evaluation requirements. Participation is subject to all U.S. Federal, State and local laws and regulations. Individuals entering on behalf of or representing a company, institution, or other legal entity are responsible for confirming that their entry does not violate any policies of that company, institution or legal entity.

³⁰ Rules are stated in the *Federal Register* notice, see www.federalregister.gov/documents/2016/09/27/2016-23239/announcement-of-requirements-and-registration-for-national-institute-of-standards-and-technology.

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Timeline: Submissions opened September 27, 2016 and will close March 31, 2017.

Solicitation and Outreach: N/A

Incentives: NIST Technology Partnerships Office is offering \$20,000 for four prizes of \$5,000 each. Participant(s) who submitted a paper that is among the top four papers ranked by the Judges will receive \$5,000 each and an invitation to have the Paper considered for publication in a special issue of *The Journal of Technology Transfer* (“Journal”), or another issue as determined by the Journal’s editorial board. This journal provides an international forum for the exchange of ideas that enhance and build an understanding of the practice of technology transfer. In particular, it emphasizes research on management practices and strategies for technology transfer.

Evaluation and Judging: The evaluation and judging is in process and not yet complete. Submissions to the challenge will be completed in May 2017.

Partnerships: NIST is partnering with *The Journal of Technology Transfer* for this Challenge. The Journal is providing the winners an opportunity for their submissions to be considered for publication in a special issue of *The Journal of Technology Transfer* (“Journal”), or another issue as determined by the Journal’s editorial board.

Resources: This Challenge is still underway. Thus far, the Challenge Manager Mike Walsh has dedicated some of his time to establishing the Challenge, working with relevant NIST offices (i.e., Program Coordination Office, Office of Chief Counsel). NIST is using the free web platform provided by GSA to host the Challenge.

Results: This challenge is still in progress, so it is too early to report results.

A.2.2 NIST: Head Health Challenge III: Advanced Materials for Impact Mitigation³¹

Summary: The National Football League (NFL), Under Armour, General Electric (GE), and the National Institute of Standard and Technology (NIST) established a joint effort to advance the state-of-the-art in advanced materials for impact mitigation. Five teams were identified in the First Round of the challenge and each received a \$250,000 prize purse. Over the coming year, the teams will further develop their materials in consultation with the Challenge partners. In early 2017, the judges will again come together to select one Grand Prize winner to receive up to \$500,000.

Solution Type: Technology demonstration and hardware; scientific

Primary Goals: The goal of Head Health Challenge III is to spur creation of innovative impact absorbing materials that will result in increased protection for athletes, the warfighter, and civilians. NIST is supporting its mission by establishing new material performance tests to advance measurement science in this area. In particular, NIST hopes to fill a measurement need—identified

³¹ www.headhealthchallenge.com

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through interactions with the Challenge partners—in assessing material response to shearing and rotational impacts, which account for a considerable percentage of brain injuries.

Specifically, the goals associated with this challenge were to find and highlight innovative ideas, advance scientific research, and engage new people and communities.

Results: This Challenge is still in process. One hundred twenty-five abstracts were submitted initially when the contest began, with a range of backgrounds. The five First Round winners announced in December 2015 represent a spectrum of expertise and sectors. They include four companies and one academic institution.

Problem Statement: The National Football League (NFL), Under Armour, General Electric (GE), and the National Institute of Standard and Technology (NIST) established this joint effort to advance the state-of-the-art in advanced materials for impact mitigation. Head Health Challenge III seeks to stimulate the development of a range of materials that provide excellent energy absorbing and energy-dissipating properties. The National Football League, Under Armour, GE, and NIST are working in partnership on this Challenge, which is offering up to \$2 million in prizes. The Challenge kicked off February 2, 2015 with an invitation for participants to submit an abstract that described a novel material that met specific performance criteria related to maximizing energy absorption while minimizing momentum transfer. Technical experts evaluated the abstracts and in April 2015 the authors of the top-rated abstracts were invited to submit a more detailed proposal along with samples of the material for testing. Considering the results of mechanical tests performed by NIST and the attributes of the overall proposal, a panel of judges identified five teams to be recognized with a First Round Award of \$250,000 each. These winners were announced December 15, 2015. In 2016 the teams further developed their materials in consultation with the Challenge partners. In early 2017, the judges will again come together to select one Grand Prize winner to receive up to \$500,000.

Proposed Goals: The goal of Head Health Challenge III is to spur that creation of innovative impact absorbing materials that will result in increased protection for athletes, the warfighter, and civilians. NIST is supporting its mission by establishing new material performance tests to advance measurement science in this area. In particular, NIST hopes to fill a measurement need – identified through interactions with the Challenge partners – in assessing material response to shearing and rotational impacts, which account for a considerable percentage of brain injuries.

Measures of Success: This Challenge is still underway. Initial assessment of success measures shows positive indicators. For example, the five first round finalists submitted innovative materials that appear to be new strategies for impact absorption. These include 3D-printed lattices, innovative textiles, and designed multilayers—structures that absorb energy both because of their architecture and their inherent materials properties. NIST testing and data has allowed the participants to continually improve their designs over the last year.

Participants: NIST and our Challenge partners understood that the materials experts who could produce better materials were from a hugely diverse set of communities, from aerospace to automotive to sports medicine. A national prize competition would gain the attention of this diverse set of scientists and engineers. This prize seeks to advance the research and technology

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development in this field by tapping into a diverse network of materials scientists and others with an interest in answering this call to action.

The Head Health Challenge III follows the eligibility guidelines outlined in the COMPETES Act (i.e., entrants must be U.S. citizens or permanent residents over the age of 18, and validly formed legal entities in the U.S.; entrants could not be NIST employees or guest researchers, or Federal employees or entities acting in their official capacity; or anyone affiliated with the Challenge sponsors). Because of the demanding material performance requirements and the obligation to provide a sample of the material if invited to submit a full proposal, many of the participants are practicing materials scientists and engineers.

A total of 125 individuals (or teams) entered the challenge. Fifty-five full proposals were received, and twenty-one materials were selected for testing by NIST. Five first-round winners were identified.

Timeline: Submissions for the challenge opened February 2, 2015 and closed March 13, 2015 for abstract submissions. The challenge sponsors issued invitations for full proposals in April 2015, and material testing occurred at NIST during July and August 2015. First-round winners were announced in December 2015. In 2016, the winning teams refined their materials to compete for the \$500,000 grand prize that will be announced in early 2017.

Solicitation and Outreach: The Head Health Challenge III used a combination of social media, email, press releases, and partnerships with outside organizations to reach potential solvers. The Head Health Challenge III follows two previous challenges that were issued by NFL, Under Armour, and GE as part of a larger program to support head health. This continued programmatic set of competitions helped build awareness of the Head Health Challenge III. The Challenge was announced during a press conference in Phoenix, AZ, held in conjunction with Super Bowl XLIX. Video segments and interviews on news programs (both local and national) helped generate awareness of the Challenge and shed light on this important issue. The Challenge platform host, NineSigma, shared information about the Challenge with its community of innovators. In addition, NIST reached out to representatives of the top materials science and engineering programs in the nation, and generated interest through membership of the Materials Research Society and the American Chemical Society.

Incentives: Up to \$2 million in prizes is being offered in conjunction with the Head Health Challenge III. This includes First Round awards of \$250,000 each (the judges identified five teams to receive this award). The First Round winners will compete for a grand prize of \$500,000.

The First Round awards were issued by the NFL, Under Armour, and GE. NIST will issue the \$500,000 Grand Prize to the winner when announced in early 2017.

Evaluation and Judging: Evaluation and judging is still in process.

Partnerships: The NFL, Under Armour, and GE partnered with NIST in the design and execution of this Challenge. The Challenge was hosted by NineSigma under contract with NFL, Under

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Armour, and GE. Each of the four partners is contributing funds for the prize awards. Other findings will be determined after conclusion of the Challenge.

Resources: In FY 2016, NIST invested \$500,000 to support its role in the Head Health Challenge III. These funds supported personnel and technical equipment. NIST materials scientists and engineers developed material performance tests, and NIST acquired new equipment to perform these tests on the submitted materials. By the end of FY 2016, the NIST testing team completed two rounds of measurements of the performance of First Round winners' materials and provided performance data and analysis to them. These rounds of testing data provided guidance to the five First Round winners to improve their materials over the year, in order to compete for the Grand Prize to be announced in early 2017.

Results: This Challenge is still in process. One hundred twenty-five abstracts were submitted initially when the contest began, with a range of backgrounds. The five First Round winners announced in December 2015 represent a spectrum of expertise and sectors. They include four companies and one academic institution.

A.3 Department of Defense

A.3.1 DARPA: Cyber Grand Challenge³²

Summary: The DARPA Cyber Grand Challenge (CGC) tests the abilities of a new generation of fully automated cyber defense systems. CGC teams created automated systems to compete against each other to evaluate software, test for vulnerabilities, and generate and apply security patches to protected computers on a network. Three teams won prize money at the final tournament. CGC autonomous systems are now transitioning to government partners to be put to use in studying software in the national interest. At the completion of the event in August 2016, CGC cash prizes totaled up to \$6.75 million.

Solution Type: Software; technology demonstration; and analytics, visualizations, algorithms

Primary Goals: Find and highlight innovative ideas; develop technology; and engage new people and communities

Results: Three teams won prize money at the final tournament. CGC autonomous systems are now transitioning to government partners to be put to use in studying software in the national interest. At the completion of the event in August 2016, CGC cash prizes totaled up to \$6.75 million.

Problem Statement: The Department of Defense (DOD) maintains information systems using a software technology base comprising commercial off-the-shelf (COTS) operating systems and applications. This COTS technology base is common to DOD, industry, and the Defense Industrial Base, and the continual discovery of potential vulnerabilities in this software base has led to a constant cycle of intrusion, compromise discovery, patch formulation, patch deployment, and

³² archive.darpa.mil/CyberGrandChallenge_CompetitorSite

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recovery. This defensive cycle is performed by highly trained software analysts; it is their role to determine software function, and identify and remove novel threats. Manual analysis of code and threats is a detailed process, often requiring skilled analysts to spend weeks or months analyzing a problem. The size of the technology base contributes to the difficulty of manually discovering vulnerabilities.

At present, program analysis technologies are able to assist the work of human software analysts. These technologies include dynamic analysis, static analysis, symbolic execution, constraint solving, data flow tracking, fuzz testing, and a multitude of related technologies. In the Defense Advanced Research Projects Agency (DARPA) Cyber Grand Challenge (CGC), competitors improved and combined these semi-automated technologies into unmanned cyber reasoning systems that could autonomously reason about novel program flaws, prove the existence of flaws in networked applications, and formulate effective defenses. The performance of these automated systems was evaluated through head-to-head tournament-style competition.

Proposed Goals: The goal of the DARPA CGC was to engender a new generation of autonomous cyber defense capabilities that combined the speed and scale of automation with reasoning abilities exceeding those of human experts. Entrants were asked to field autonomous systems to compete head-to-head in an isolated network testbed environment. The autonomous systems' performance was measured using the same competition rating metrics used to quantify the performance of human analysts. The results quantify the systems' ability to reason and mitigate novel software flaws. The ultimate goal was a demonstration of autonomous system performance that exceeded human performance.

Measures of Success: The prototype systems created for CGC have proven the feasibility of a new generation of autonomous cyber defense capabilities that combine the speed and scale of automation with reasoning abilities exceeding those of human experts. In the final event, competitor systems were confronted with real-world network security problems of known difficulty gathered from the history of the computer security field. By comparing the performance of these systems against the abilities of human experts to solve these challenges, the efficacy of prototype automation was measured.

Participants: DARPA provided two parallel paths for participation in CGC: the Proposal Track and the Open Track. Proposal Track teams were selected competitively on the basis of proposals submitted in response to a broad agency announcement (DARPA-BAA-14-05). Open Track teams were selected based on applications deemed qualified to compete per Title 15 U.S.C. § 3719 and CGC rules. Eligibility requirements can be found in the CGC Rules Section 2.1 (see www.darpa.mil/cybergrandchallenge).

Utilizing prize authority under the America COMPETES Act made it possible to work with academic institutions and affiliated teams, large commercial interests not involved in defense contracting, small businesses, small teams of experts, and individuals, most of whom had not worked with DOD before.

Timeline: Announced on October 29, 2013, applications were due on November 2, 2014. The first event was held on December 1, 2014 and the second was on April 16, 2015. The CGC trials ran

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through March and April of 2016, with the CGC Final Event (CFE) on August 4, 2016. Winners were announced August 17, 2016.

Solicitation and Outreach: The CGC encouraged the most capable and innovative companies, institutions, and entrepreneurs active in the computer security field to produce breakthroughs in capability and performance. The DARPA CGC was announced through several methods including publication in *Federal Register*, web features, websites, national media, social media outlets, and conference presentations. The CFE was attended by more than 5,000 people, with another 15,000 viewing via live webcast. Major press outlets attended the event and have written numerous articles about CGC.

Incentives: Cash prizes totaling \$6.75 million were awarded per Title 15 U.S.C. § 3719 and CGC rules. Because DARPA is the sole sponsor of the CGC, no private funds were contributed to the program. Nonmonetary prizes were not offered.

Following the CGC Qualifying Event (CQE) on June 3, 2015, seven competitors qualified as finalists; four from the Open Track each received \$750,000 in prize money, and three from the Proposal Track each received \$750,000 in additional funding. At the CFE, cash prizes were awarded to the first place (\$2 million), second place (\$1 million), and third place (\$750,000) winners.

Cash prizes were drawn from the Program Element (PE) and project as follows:

PE	Project	Title	FY14	FY15	FY16
0602303E	IT-05	Cyber Grand Challenge (CGC)	\$ 0.00M	\$ 3.00M	\$ 3.75M

Evaluation and Judging: To ensure objectivity in judging and evaluation at the CFE, custom automated scoring software was utilized to provide quantitative measurements for the DARPA CGC Program Manager to make the final prize determinations. Prior to the announcement of official prize winners, independent verification of the automated scoring was performed to ensure the reproducibility and integrity of the prize determination. This was accomplished through the use of multiple clean room scoring implementations of a single specification, which provided confidence that no adversarial malfeasance or accidental errors occurred during the competition.

Partnerships: DARPA funded various entities within DOD (e.g., Space and Naval Warfare Systems Command, Air Force Research Laboratory, and Naval Postgraduate School) and federally funded research and development centers (e.g., Massachusetts Institute of Technology Lincoln Laboratory) for contracting and specialized technical support in conducting the CGC competition. To raise awareness of state-of-the-art automated cybersecurity competition, DARPA entered into a cooperative R&D agreement with the DEF CON Hacking Conference, and the CFE was co-located with the DEF CON 24 Conference.

Additionally, the cyber reasoning systems (CRS) created for CGC are transitioning to various Government partners for their use in furthering the CGC mission of the autonomous study of software in the national interest. These Government transition partners include the Air Force

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Research Laboratory, U.S. Cyber Command, Army Cyber Command, Naval Postgraduate School, and the Department of Homeland Security.

Resources: The DARPA CGC was organized by Government staff members and support contractors managing logistics, security, infrastructure, administration, information technology services, planning, execution, production, visualization, and software development. The CGC was not executed by a single entity; rather a cross-disciplinary team of experts from across the United States was assembled to build the software base of the Challenge and develop its automated scoring mechanisms and software platform.³³ Visualization experts from the computer gaming industry were contracted to build novel visualization capabilities for CGC. Datacenter experts performed the physical build of the CRS hardware and supporting infrastructure to include power, cooling and staging.

Funds were drawn from the Program Element (PE) and projects as follows:

PE	Project	Title	FY14	FY15	FY16
0602303E	IT-05	Cyber Grand Challenge (CGC)	\$10.438M	\$16.832M*	\$ 9.864M*
0602303E	IT-03	Cyber Grand Challenge (CGC)	\$0.000M	\$ 6.233M	\$11.329M

**includes cash prizes*

Results: The DARPA Cyber Grand Challenge created the first-ever, all-machine hacking tournament for fully automated network defense systems, demonstrating a leap forward in autonomous cyber reasoning capability. Over the course of two years, teams were put through scored events and qualification rounds to determine a field of seven finalists announced on July 5, 2015. The finalist teams of top computer security experts developed autonomous cyber reasoning systems (CRSs) that competed head-to-head at the CGC Final Event (CFE) on August 4, 2016, where \$3.75 million in prize money was awarded. The competition drew teams of top experts from a wide range of computer security disciplines including reverse engineering, formal methods, program analysis, and applied computer security competition.

CGC teams were tasked with creating automated systems that could competitively evaluate software, search for vulnerabilities, generate and apply security patches to protected computers on an isolated test network, evaluate the efficacy of defenses, and prove the existence of vulnerabilities by network scanning. Competitors successfully created cyber reasoning software that automatically detected and fixed intended and unintended flaws in never-before-seen software at machine speed.

Scores from the CFE are provided below. The CGC scoring and forensic infrastructure performed as designed, and the results were independently verified prior to final award announcements on August 7, 2016.

³³The Cyber Grand Challenge software platform is available as open source software at github.com/CyberGrandChallenge

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Place	Team	Affiliation	Location	Track
1 st	ForAllSecure	ForAllSecure, Inc.	Pittsburgh, PA	Proposal
2 nd	TECHx	GammaTech, Inc University of Virginia	Ithaca, NY Charlottesville, VA	Proposal
3 rd	Shellphish	University of California at Santa Barbara	Santa Barbara, CA	Open
4 th	Deep Red	Raytheon SIGovs	Arlington, VA	Open
5 th	CodeJitsu	University of California at Berkeley Syracuse University	Berkeley, CA Syracuse, NY	Proposal
6 th	CSDS	University of Idaho	Moscow, ID	Open
7 th	disekt	disekt	Athens, GA	Open

Throughout the 9-hour final event, teams' CRSs evaluated 82 challenge binaries during 96 rounds of competition, fielding 296 successful proofs of vulnerability and creating 585 patches for vulnerable challenge binaries. The sheer volume of data analysis and software programming performed by these autonomous systems greatly exceeds the ability of human experts in terms of scale and speed.

The capability developed for and demonstrated during CFE to autonomously discover unintended flaws in software, prove those vulnerabilities in other team systems, and develop patches for those flaws completely autonomously represents a groundbreaking leap forward in automated network defense. As an example, the total life cycle from a zero-day exploit to a successfully fielded patch in the CGC finals occurred in 15 minutes (versus the 312 days a typical zero-day attack lasts³⁴ plus 24 days it takes to patch in the real world³⁵). In addition, one team was able to find and prove a flaw in an analog of the famous "crackaddr" loop satisfaction bug; this level of software analysis has been considered the domain of human experts until now. Finally, subsequent to winning CGC, the Mayhem CRS participated in the human DEFCON Capture the Flag tournament, where it discovered and patched a vulnerability in 22 minutes and created a 2-step exploit in 105 minutes of a challenge binary that was considered by human competitors to be too hard to exploit. In sum, the technology demonstrated at CGC is poised to ignite an automation revolution in computer security.

A.4 Department of Energy

A.4.1 Catalyst Energy Innovation Prize³⁶

Summary: The Catalyst Energy Innovation Prize, formerly known as the SunShot Catalyst Prize, is an open innovation program in the Energy Department's (DOE) Office of Energy Efficiency

³⁴ S. Frei. *Security Econometrics: The Dynamics of (In)Security*, September 7, 2009.

³⁵ L. Bilge and T. Dumitras. *Before We Knew It: An Empirical Study of Zero-Day Attacks in the Real World*, users.ece.cmu.edu/~tdumitra/public_documents/bilge12_zero_day.pdf, August 8, 2012.

³⁶ catalyst.energy.gov

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and Renewable Energy and aims to catalyze the rapid creation and development of products and solutions that address near-term challenges in the U.S. solar and energy efficiency marketplaces. Through a series of contests, Catalyst helps commercial companies bring mature solar technologies to the field by facilitating collaboration with the Energy Department's tools, data assets, and other resources, in order to help lower the costs of financing and acquisition of customers for entry to the market. The program transfers business plans to energy startups with products in 90 days. All competitors are continuing from the Incubation contest in 2015.

Solution Type: Software and apps; ideas; technology demonstration and hardware; and business plans

Primary Goals: Find and highlight innovative ideas; develop technology; build capacity; and stimulate a market

Results: Three of seven participating teams received the highest available award, and all teams received awards to continue with their development.

Problem Statement: Solar is a relatively new industry that is growing rapidly, but continued growth will be dependent on several issues including cost competitiveness and ability to seamlessly integrate to the grid and operate with other energy related technologies such as energy storage, demand response appliances, and electric vehicles. Through the Catalyst prize program, communities of innovators use software, data, algorithms, and automation to drive down non-hardware soft costs—financing and customer acquisition—that today make up significant costs. Since its inception, the Catalyst Energy Innovation Prize (formerly known as the SunShot Catalyst Prize) has helped hundreds of innovators bring solar solutions to the marketplace. Catalyst's prize challenge framework introduces the business community to the vast array of tools, capabilities, data assets, and additional resources developed by the Department of Energy (DOE) and the national laboratories. Catalyst's open, fast-paced innovation cycle allows crowd-sourced engagement and frequent partnerships with the nation's growing networks of technology mentors, incubators, and accelerators.

In 2015, the Catalyst program was expanded to include the Building Technologies Office (BTO), with the goal of leveraging the Catalyst innovation cycle to develop innovative startups around low energy building design and operation software. In 2016, BTO supported the Catalyst program with mentoring services and funding for two of the seven total progress round teams.

Proposed Goals:

- Support new entrants into the solar plus "founder's club" and buildings software innovation community;
- Bring non-traditional entrepreneurs and human capital into solar and building efficiency industries;
- De-risk technology development for applicants by providing rapid prototyping services; and
- Provide pre-seed stage prize funding, integrating well with other Catalyst and BTO funding opportunities including Catalyst's Incubator program and BTO Small Business Innovation Research (SBIR) grants.

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Measures of Success: For 2016, success was measured by how successful the competing teams were in completing their milestones, growing their business, and their ability to attract private funding. Over the past year, the program's success was also measured in terms of the number of online platform participants; the number of problem statements submitted online; the number of videos submission of the business innovation contest; the number of engaged incubators and accelerates; and finally, the total dollar value of added private funding to the teams supported throughout the Catalyst program. In 2016, Catalyst and BTO evaluated the Catalyst program from its inception and conducted a number of interviews with participants before final awards were granted. The findings of this internal evaluation are highlighted in GAO report published in October 2016.³⁷

Participants: For 2016, participation was restricted to continuing teams from the Incubation contest in 2015. Seven teams participated.

Timeline: This progress round started December 11, 2015 and ended June 17, 2016, with progress awards announced July 12, 2016.

Solicitation and Outreach: Outreach activities were primarily limited to recruitment of program participants during the earlier Ideation and Business Innovation stages of the Catalyst cycle in 2015. In 2016, Catalyst and BTO press releases announced the progress round awardees.

Incentives: In addition to cash incentives, the teams continued to have access to DOE staff and NREL staff to help provide mentoring support and entrepreneurial training as needed for six months.

Evaluation and Judging: For the Incubation Evaluation Criteria for the progress round, DOE will evaluate submissions by applicants based on the contestant Score Card performance and the extent of progress that has been shown during this six-month assessment period. Specifically, DOE will evaluate each of the five or more performance metrics provided by each team based on the grading scale of A, B, C, or D as further described below.

- Grade A means the team met or exceeded their stated score card metric or met similar goals taking into account reactions to market changes.
- Grade B means the team made significant progress towards meeting the goal or will likely hit their goals based on current performance.
- Grade C means that teams made enough progress towards hitting their goals.
- Grade D means the level of progress made by the team does not indicate a likelihood of future success.

DOE will also evaluate each team's performance on the following two questions based on the same grading scale.

- Did the contestant demonstrate substantial progress to building a viable business in the solar and building efficiency industries as outlined in their Seed Round submission?

³⁷ www.gao.gov/assets/690/680425.pdf

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- Did the contestant increase their assets by at least \$1 million (e.g. revenue exceeded \$1 million, closed equity investors)?

If a team's most occurring grade is A, the team will receive the full \$70,000. If the most occurring grade is a B the team will receive \$50,000. If the most occurring grade is a C, the team will receive \$20,000, and if the most occurring grade is a D, then the team will receive no additional funds.

Partnerships: For 2016, there were no new partnerships. In previous years, DOE has partnered with NREL and Topcoder.

Resources: In 2016, DOE has provided staff time and support from NREL as needed.

Results: For 2016, seven teams (5 Catalyst and 2 BTO) were participating in the growth round of the Incubation Contest with an eligibility to receive up to \$70,000 per team. Three teams received \$70,000 awards, two teams received \$50,000 awards, and two teams received \$20,000 awards.

A.4.2 Cleantech University Prize³⁸

Summary: The Cleantech University Prize (Cleantech UP) is designed to inspire clean energy innovation across the country by creating businesses from best in-class technology research, while inspiring and cultivating America's next generation of entrepreneurs to drive those businesses forward. Cleantech UP is a national business plan competition, designed to build a network of student-focused business creation contests across the country. 137 teams competed in the 2016 Cleantech UP regional collegiate competitions. Twenty-four teams were then invited to compete in the National Competition, with eight of those teams winning DOE-sponsored prizes at the regional collegiate competitions. At the National Competition, three teams won DOE-sponsored prizes.

Solution Type: Business plans

Primary Goals: Find and highlight innovative ideas; develop technology; engage new people and communities

Results: 137 teams competed in the 2016 Cleantech UP regional collegiate competitions. Twenty-four teams were then invited to compete in the National Competition, with eight of those teams winning DOE-sponsored prizes at the regional collegiate competitions. At the National Competition, three teams won DOE-sponsored monetary prizes. These three winners were Heila Technologies, from the Massachusetts Institute of Technology; XStream Trucking, from Stanford University; and NovoMoto, from the University of Wisconsin-Madison. Heila Technologies developed a universal control hub that automatically monitors and manages disparate microgrids at places like company campuses, military bases, and rural villages, for optimal performance. XStream Trucking developed a technology that eliminates the gap between a semi-trailer and its cab, thereby reducing drag and fuel consumption of trucks at high speeds. NovoMoto developed technology that aims to incorporate solar power, control and monitoring software, and local

³⁸ www.cleantechup.org

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partners to provide renewable, sustainable electricity to communities in sub-Saharan Africa. The startups from the competition have seen enormous success. In the past year, companies have been acquired, secured joint development agreements with major corporates, attracted crowdfunding and traditional investment, and been accepted into prestigious incubators and accelerators.

Problem Statement: Start-ups and innovative technologies are critical to the growth of the clean energy economy in the United States and abroad. However, persistent gaps exist between innovative technology developers and entrepreneurs. Because of significant barriers to creating clean energy technology start-ups, there is a dearth of participants entering the energy entrepreneurship pipeline. Traditionally, the nation’s institutions of higher education—where there is a strong ecosystem for entrepreneurs and start-ups—have fostered the high-tech innovation pipeline. At least 450 colleges and universities across the United States have entrepreneurship programs, but they also have a demonstrated need for Federal support.

Cleantech UP aims to inspire clean energy innovation across the country by creating businesses from best in-class technology research, while inspiring and cultivating America’s next generation of entrepreneurs to drive those businesses forward. Cleantech UP awards prizes to the teams with not just the best technology, but the premier teams developing early-stage companies to turn technology into products ready for the commercial markets. By working with the private sector, through in-kind sponsorship, cash prizes, and having the business and investor community serve as judges and mentors, the competition brings together the communities in a way that could not be done through a grant alone.

Participants are required to present business plans at the Cleantech UP collegiate competitions and the National Competition. All business plan proposals must fall within DOE’s Office of Energy Efficiency and Renewable Energy (EERE) mission and technology portfolio, as defined in the Funding Opportunity Announcement (FOA):

“The Office of Energy Efficiency and Renewable Energy works to strengthen the United States’ energy security, environmental quality, and economic vitality in public-private partnerships. It supports this goal through (1) enhancing energy efficiency and productivity; and (2) bringing clean, reliable and affordable energy technologies to the marketplace.”³⁹

Business plans must fall within EERE’s purview, but they may be based upon technical or service-based solutions or products.

Acceptable technology areas are represented by EERE’s ten program offices:

1. Building Technologies
2. Advanced Manufacturing
3. Vehicle Technologies
4. Federal Energy Management Program
5. Weatherization and Intergovernmental
6. Biomass Program
7. Geothermal Technologies

³⁹ www.eere.energy.gov

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8. Fuel Cells Technologies
9. Solar Energy Technologies
10. Wind and Hydropower Technologies

Proposed Goals: Cleantech UP goals include:

- Catalyze clean energy start-up formation on college campuses;
- Support novel training and educational opportunities that equip the next generation of energy entrepreneurs and innovators across the country;
- Establish a national-level training program and competition for America's top clean energy student entrepreneurs; and
- Create a sustained and diverse community to support student entrepreneurs.

Measures of Success: EERE has had success in supporting initiatives to spur student entrepreneurship. Cleantech UP builds on its precursor, the DOE National Clean Energy Business Plan Competition (NCEBPC), by leveraging growing interest in energy entrepreneurship to expand student engagement in clean energy technologies. Student entrepreneurship prizes are critical catalysts for early-stage company formation and serve an important role in supporting innovation. The prize incentive draws talented entrepreneurs and technology developers, and the prizes help capitalize early stage development by providing funding. However, companies that enter competitions are usually at their earliest stage of development, and many students who participate in competitions require additional business and technology commercialization training. Using prizes as a catalyst for company formation has been a tested and proven model, demonstrated through quantitative and qualitative evidence. By enabling open competition, the best technologies in all categories are eligible for consideration, rather than creating a single technology-focused grant.

In addition to administering prizes, Cleantech UP also provides students with critical opportunities for academic enrichment around entrepreneurship principles. Students are exposed to clean energy entrepreneurship training, allowing them to develop the business and commercialization skills they need to move clean energy technologies from discovery to market. Cleantech UP increases student entrepreneurs' participation—both in quantity and quality—in clean energy, and closes the existing gap in early-stage training.

Since the competition started, participants have formed more than 240 ventures, created over 200 jobs, and raised more than \$160 million in follow-on funding, helping to grow the clean energy economy and develop innovative and sustainable technologies.

Participants: Cleantech UP targets student entrepreneurs and technologists launching clean energy ventures. The program was launched to inspire and promote entrepreneurship, connecting DOE with a large group of leading entrepreneurs and innovations in the energy space. As a program whose goals include the development of the next generation of entrepreneurs, Cleantech UP requires that students be highly involved in each competition's management and execution. In order to participate in the Cleantech UP competition, at least 50% of any participating team's formal team members must be actively enrolled in an accredited U.S. university or college. Formal team members are defined as those individuals eligible to directly receive prize money or services awarded by the competition. Students are required to present business plans at the Cleantech UP

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collegiate competitions and the National Competition. Three hundred and seventy-nine individuals participated from 137 teams.

Timeline: Specific dates varied across individual regional prizes, but submissions opened late 2015/early 2016, and were due late 2015/early 2016 dependent on the prize. Winners were announced early/mid 2016.

Solicitation and Outreach: Cleantech UP used multiple media methods to disseminate information broadly about the National Competition and its winners. This included social media, traditional press, energy.gov through the EERE and Secretary's blog, and challenge.gov. Blog posts highlighting each winner after each regional competition were released, and connected to social media, including Facebook and Twitter. The lead-up to the national event also included blog posts and broad distribution. To attract entrants, each region executed their own outreach strategy.

Incentives: Cleantech UP has several prizes associated with the entire competition. DOE directly sponsors the eight regional collegiate competition prizes of \$50,000 for each regional competition. The prizes were distributed by regional organizers. The funding was allocated through a cooperative agreement, awarded in 2015. Some regional competitions had other prizes, sponsored by a variety of private and non-profit organizations.

The top three teams from each of the eight regional Cleantech UP collegiate competitions are invited to compete at the National Competition. The National Competition prizes which amounted to \$150,000 were sponsored by the DOE.

In addition to cash prizes, student teams are able to access energy entrepreneurship and commercialization training, which includes instruction and guidance in preparation for the National Competition and supplemental curriculum that focuses on the creation and development of student businesses in cleantech.

Evaluation and Judging: A general framework for the Cleantech UP National Competition judging criteria is outlined in a policy memo that has remained constant since the program's inception. The Cleantech UP judging criteria among the regional collegiate competitions must be approved by DOE in advance of the competitions. The submissions for the National Competition are the regional winners from each competition.

At the regional level, each competition determines selection independently, with the guidelines instructed through the eligibility requirements. Independent reviewers hailing from multiple sectors, including finance, business, and non-profits, serve as judges at the application and competition stages. While the regions can determine their own judging criteria, their criteria are subject to DOE approval.

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Solutions/Products (30%)	<p>Value Proposition Teams will be judged on the value their solution/product can deliver to their customers. The value of the solution/product might include:</p> <ul style="list-style-type: none"> • Offering and benefits • Exclusivity • Nature and degree of pain customers currently experience • Willingness to pay <p>Teams will be judged on whether their value proposition is superior to every alternative being considered. Teams should outline their target customers’ needs and wants and explain how their product meets those requirements.</p> <p>Differentiation Teams will be judged on clear and convincing description of the market differentiation for their solution/product. Descriptions should include comparisons to direct competitors and indirect substitute products.</p> <p>Barriers to Competition Teams will be judged on their ability to identify and capitalize on barriers against others who seek to imitate their success (i.e., through intellectual property, first movers’ advantage, compelling marketing, and/or strategic partnerships).</p> <p>Teams with technical solutions/products should briefly describe their IP position and/or their IP strategy, including the degree to which they control or are in the process of gaining control of a protectable intellectual property or service.</p> <p>Technical Feasibility Teams will be judged on the extent to which their solution/product is technically feasible. The technical feasibility should be addressed independently of market feasibility.</p> <p>To demonstrate feasibility, teams should discuss:</p> <ul style="list-style-type: none"> • Technology research (e.g., document searches, discussions with experts, etc.); • Proof of concept (e.g., basic technology tests, design concept tests, prototype development, etc.); • Product development assessments; and
Go-To-Market Strategy (30%)	<p style="text-align: center;">Feasibility of Go-to-Market Plan</p> <p>Teams will be judged on the feasibility of achieving market adoption and successful deployment of the technology, including likely success in accessing:</p> <ul style="list-style-type: none"> • Manufacturing resources; • Financing requirements; • Personnel; • Regulatory environment; and • Marketing resources <p>Teams should discuss any barriers (e.g., restrictions, monopolies, unreasonable costs, scarcity, energy, equipment, technology, material, process or personnel) that might limit access to required factors of production/implementation. Teams should discuss how they will overcome excessive capital requirements, financing obstacles, regulatory hurdles, marketing challenges or other non-IP barriers.</p> <p>Customer Access and Traction Teams will be judged on their ability to demonstrate to the best of their ability evidence of customer valuation/validation.</p>

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	<p>Presentations should include a description of the customer research design used to support market assessments.</p> <p>Teams should identify potential early- and late-adopters of their solution/product and prove they can secure customers.</p> <p>Scalability Teams shall prove to the best of their ability that their business is scalable.</p> <p>Proof of scalability will be based on:</p> <ul style="list-style-type: none"> • Total addressable market size; • Plans to achieve economies of scale; • Investments staging; • Production strategy; and • Customer recruitment/management
Team Plan (20%)	<p>Quality Teams will be judged on how well they are positioned to successfully carry out their business plan. Expertise and backgrounds for the team members should be commensurate with the needs of the business plan</p> <p>Successful teams will prove their:</p> <ul style="list-style-type: none"> • Relevant experience in all aspects of the project; • Diversity of expertise and backgrounds (i.e., technological, entrepreneurial, business and policy); • Ability to engage appropriate outside expertise; and <p>Teams must execute a strong pitch while conveying creativity, confidence and competency.</p> <p>Commitment Teams will be judged on their commitment to the enterprise.</p> <p>Members must exhibit a high level of enthusiasm for and demonstrable dedication to the company and their partners.</p> <p>Chemistry Teams will be judged on whether they possess the right competencies for their plan and ability to blend those skills to achieve synergies.</p> <p>Gaps and Action Plans Teams will be judged on gaps that currently exist in their organization and their action plan to fill the gaps.</p> <p>Descriptions should explain the gaps between their present and desired future states. Teams should articulate the risk associated with any inadequacies and discuss mechanisms to eliminate the gaps.</p>
Impact on EERE Mission (20%)	<p>Teams will be judged on how their solution/product will strengthen the economy, protect the environment and reduce dependence on foreign oil.</p> <p>Presenters should identify which of the eleven areas⁴⁰ of the EERE’s mission space will benefit from their solution/product. Teams will be judged on credibility of quantitative assessment of their solution/product’s impact in the clean energy space (i.e., increasing efficiency, improving transmission, increasing clean energy generation, reducing greenhouse gas emissions) as well as its impact in terms of relevance, significance, scale and sustainability.</p>

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Partnerships: For the National Competition and the regional collegiate competitions, the National Hub and the regional organizers partnered with a variety of private sector and non-profit organizations for in-kind support, monetary contributions, judges, facility use, and marketing and outreach. DOE encourages these partnerships to support the regional collegiate competitions and the National Competition.

Resources: To execute the national and regional prizes, the DOE released a competitive solicitation to determine the administrators of the prizes in 2015, establishing a Cleantech UP Hub and eight collegiate competitions.

The Cleantech UP Hub is a national center for student-focused clean energy entrepreneurship training and education. This Cleantech UP Hub:

- Develops a premier clean energy entrepreneurship training program, including instruction in commercialization and preparation for the Cleantech UP National Competition;
- Strengthens and expands the clean energy student entrepreneurship community;
- Facilitates a learning platform for best practices in clean energy entrepreneurship education across the Cleantech UP network;
- Organizes an annual National Competition—the culmination of the regional Cleantech UP collegiate competitions—and awards \$100,000 in cash prizes from DOE along with in-kind awards and services from DOE and other sponsors.

At the 2016 Cleantech UP National Competition, a total of \$100,000 in DOE prize money was awarded: \$50,000 for first place, \$30,000 for second place, and \$20,000 for third place. The first place team also received an additional DOE National Lab Voucher for lab access and services equivalent to \$50,000 in value.

Each collegiate competition supports the earliest development of teams and their training by:

- Establishing and running an annual regional competition, to include recruiting applicants, mentors, evaluators, judges, and other competition partners, developing a prize competition structure, developing an outreach and marketing plan, promoting the event, and collecting metrics;
- Establishing team development and training;
- Awarding up to \$50,000 in prizes at each DOE-supported regional collegiate competition.

Results: Since its inception, Cleantech UP catalyzed the launch of companies, attracted attention and private sector support for competitions, and created jobs. The startups from the competition have seen enormous success. In the past year, companies have been acquired, secured joint development agreements with major corporates, attracted crowdfunding and traditional investment, and been accepted into prestigious incubators and accelerators.

137 teams competed in the 2016 Cleantech UP regional collegiate competitions. Twenty-four teams were then invited to compete in the National Competition, with eight of those teams winning

⁴⁰ The eleven areas that makeup EERE's mission space include Renewable Energy (Solar, Wind, Water, Biomass, Geothermal, Hydrogen and Fuel Cells) and Energy Efficiency (Homes, Buildings, Vehicles, Manufacturing, and Government).

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DOE-sponsored prizes at the regional collegiate competitions. At the National Competition, three teams won DOE-sponsored prizes.

The winners of the June 2016 Cleantech UP National Competition were:

1. Heila Technologies, from the Massachusetts Institute of Technology, won first place for developing a universal control hub that automatically monitors and manages disparate microgrids at places like company campuses, military bases, and rural villages, for optimal performance.
2. XStream Trucking, from Stanford University, won second place for their technology that eliminates the gap between a semi-trailer and its cab, thereby reducing drag and fuel consumption of trucks at high speeds.
3. NovoMoto, from the University of Wisconsin-Madison, won third place for their technology that aims to incorporate solar power, control and monitoring software, and local partners to provide renewable, sustainable electricity to communities in sub-Saharan Africa.

The winners of the 2016 Cleantech UP regional collegiate competitions were:
Berkeley Cleantech University Prize (Berkeley CUP)

1. Nelumbo, from UC Berkeley, won the Berkeley CUP for developing a hydrophobic coating that provides 25-30% greater efficiency to air conditioning.
2. Cuberg, from Stanford, developed high-performance solid-state batteries that store double the energy of the best batteries currently on the market.
3. OPUS 12, from Stanford, won third place for developing a technology that recycles carbon dioxide into chemicals and fuels using an electrochemical process.

Allegheny Region Cleantech UP Collegiate Competition (Allegheny CUP)

1. DR-Advisor, from the University of Pennsylvania, won the Allegheny CUP for developing a data-driven demand response recommendation system that builds predictive models based on historical data, while also learning from the actions of the building operator.
2. Manta Biofuel, from the University of Maryland, won second place for developing a renewable, carbon neutral, and cost-competitive algal crude oil that does double duty to replace fossil fuel crude oil.
3. Waven Technology, from Carnegie Mellon University, tied with Manta Biofuel for second place for improving the capture and conversion of wave energy to electricity with a novel technology that is both affordable and reliable.

Clean Energy Trust Clean Energy Challenge

1. NovoMoto, from the University of Wisconsin-Madison, won first place at the Clean Energy Trust Challenge for their sustainable social enterprise that aims to provide clean, renewable, and sustainable electricity to communities in sub-Saharan African countries.

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2. Hazel Technologies, from Northwestern University, won second place for their technology which utilizes biotechnology to reduce produce waste.
3. INJoo Networks, from Northwestern University, won third place for their next generation smart building software, which utilizes a building's Building Automation System and pairs that with external web data to predict and optimize energy usage.

Rice Business Plan Competition

1. Gecko Robotics, from Carnegie Mellon University, won first place at the Rice Business Plan Competition for their wall-climbing reusable robots, which change the way power plant inspections are performed.
2. BlueWave Cleaning System, from the University of Florida, won second place for their hygienic, water-free, detergent-free, and chemical-free plasma device that cleans items that are extremely hard or impossible to clean with a washer and dryer, in as little as five minutes.
3. MDAR Technologies, from Northwestern University, developed a next-generation 3D scanner that enables machines to see accurately in full outdoor sunlight at video rates.

Rutgers LaunchR

1. Sail-Based Wind Harvester, from Rutgers University, won first place at the Rutgers LaunchR competition for their wind turbine design for commercial buildings, whose lifetime cost is 25% less than that of a solar array.
2. ParaTrees, from the New Jersey Institute of Technology, is a technology-based reforestation and sustainability company, whose mission is to innovate and merge the gap between technology, people, and nature.
3. Revolution Outboards, from Princeton University, is combatting marine ecosystem pollution by developing emission-free, fully-electric outboard boat motors.

MIT Clean Energy Prize

1. Iron Goat, from George Mason University, won first place at the MIT Clean Energy Prize for their vision-guided mobile robotics that remove labor and fossil fuels from cellulose feedstock production.
2. Heila Technologies, from MIT, is making microgrids more efficient and easier to operate by giving them the ability to sense, communicate, control, and learn through their innovative Heila IQ local controller.
3. Ampér, from Northwestern, is building a smart circuit breaker that allows consumers to monitor and reduce their energy use on a per-appliance basis.

Caltech First Look West (FLoW)

1. XStream Trucking, from Stanford University, won first place at Caltech FLoW for their patented GapGorilla technology, which increases the efficiency of trailer trucks by streamlining the gap between the cab and the trailer.

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2. Akabotics, from the University of Hawaii, is improving power plant turbine efficiency with their Microdredger system, which removes sediment buildups in waterways that increase flooding vulnerabilities and impede water commerce.
3. SkyCool Systems, from Stanford University, has engineered a breakthrough in building-scale chiller and refrigeration systems through a renewable approach to cooling without input electricity or evaporating water.

University of Central Florida (UCF) MegaWatt Ventures

1. Sensatek Propulsion Technology, Inc., from the University of Central Florida, won first place at UCF MegaWatt Ventures for their Wireless In-Situ Nexus Sensor, which optimizes fuel cell operation by reducing membrane degradation and measures pressure and temperature distributions in real-time.
2. Grow Bioplastics, from the University of Tennessee, Knoxville, is working to improve food sustainability by offering farmers and gardeners renewable, biodegradable plant containers and mulch films that eliminate oil based plastics from our agricultural system.
3. Capacitech Energy, from the University of Central Florida, combines modern nanoscience with coaxial cable and supercapacitors into an innovative, energy effective product easily adapted for use in consumer electronics, energy production and storage, transportation, and military applications.

Other start-ups from the competition have demonstrated enormous success after participating in Cleantech UP. OPUS 12, a runner-up in the 2016 Berkeley Cleantech University Prize, was announced as a winner of the Forbes Under 30 Summit Change the World competition, receiving \$425,000 in prizes. Grow Bioplastics, a runner-up at UCF's 2016 Megawatt Ventures Cleantech Competition, was announced as a finalist in the 2017 Farm Bureau Rural Entrepreneurship Challenge and awarded \$15,000. They advanced to the next phase of the challenge in January 2017.

A.4.3 EV Everywhere Logo Challenge⁴¹

Summary: The EV Everywhere Logo Challenge was set up in order to produce a logo for EV Everywhere, the umbrella activity for all of the Department of Energy's (DOE) efforts to increase the use of plug-in electric vehicles. The ideal logo would be a compelling graphic that communicated two main ideas: (1) plug-in electric vehicles (PEVs) are beneficial and practical; and (2) EV Everywhere is the place for drivers to come for data-driven, objective information about them. As PEVs can help increase America's economic, energy, and environmental security, the Department of Energy and its stakeholders will be leading the way through EV Everywhere. The competition was only the first part of an expanded outreach and education effort to increase consumer awareness of the benefits of PEVs.

Solution Type: Creative (design and multimedia)

⁴¹ www.challenge.gov/challenge/ev-everywhere-logo-challenge

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Primary Goals: Inform and educate the public; engage new people and communities; and stimulate a market

Results: The winning design, submitted by Brian Marquis, is being used as the official logo for EV Everywhere.

Problem Statement: The EV Everywhere Logo Design Challenge invited designers to create a compelling graphic that communicates two main ideas: (1) plug-in electric vehicles (PEVs) are beneficial and practical; and (2) EV Everywhere is the place for drivers to come for data-driven, objective information about them. As PEVs can help increase America's economic, energy, and environmental security, the Department of Energy and its stakeholders will be leading the way through EV Everywhere. The competition was only the first part of an expanded outreach and education effort to increase consumer awareness of the benefits of PEVs. This was specifically a creative challenge.

Proposed Goals: The goal was to develop a unique logo for the EV Everywhere program that helps consumers become more interested in both PEVs and the information the Department of Energy provides about them.

Measures of Success: Besides obtaining a new logo from 89 entries, most of the measures of success were in raising awareness of EV Everywhere. On social media, promotion of the contest resulted in 499 likes and 172 shares. In addition to the nearly 1500 views of the blog post on Energy.gov, there was also an article in *The Washington Post* that led to much more exposure. The logo has been used on EV Everywhere communication materials such as social media, publications, and magnetic decals—over 30,000 have been distributed to date.

Participants: The competition was open to all participants generally allowed to participate in competitions on Challenge.gov.⁴²

There were 50 participants with 89 entries (several participants submitted multiple entries). While some participants appeared to be associated with a specific company or organization, all of them appeared to be entering as individuals. A number of entries appeared to be from professional graphic designers, but not all of them.

Timeline: Submissions opened August 13, 2015, closed September 25, 2015, and winners were announced November 7, 2015.

Solicitation and Outreach:

- Social Media (e.g., Twitter posts and Facebook posts);

⁴² The specific requirements were for an individual to be a citizen or permanent resident of the United States before the submission period ends; for a private entity to be incorporated in and maintain a principal place of business in the United States; for the participant not to be a Federal employee acting within the scope of their employment; and to not be an entity with an outstanding, unresolved financial obligation to, or that is currently suspended or debarred by, the Federal Government.

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- Email Outreach (e.g., listservs).

To advertise the challenge, the EV Everywhere team created a blog post on the Office of Energy Efficiency and Renewable Energy's (EERE) blog about the contest⁴³, made multiple posts on social media (EERE Facebook, DOE Twitter, Challenge.gov Twitter), and sent information to a number of plug-in electric vehicle stakeholders via email (PEV Community Readiness listserv with 5,000+ subscribers, Clean Cities coordinators). Advertising through stakeholders and social media were both fairly successful.

Incentives: A \$5,000 prize was awarded to the winning designer.

Evaluation and Judging: The contest had three major judging criteria:

- Effectiveness of communicating the EV Everywhere mission and brand: This includes the idea of plug-in electric vehicles, their benefits and viability for the average driver, and the DOE as a source of unbiased, data-driven information. This may be done through a realistic or abstract design. This criteria will count for a maximum of 500 out of 1000 points.
- Creativity and originality: Is the visual quality of the design at once informative and representative of imagery connected to EV Everywhere? This criteria will count for a maximum of 300 out of 1000 points.
- Replicability: Design can be easily replicated, especially as a magnetic decal. Can this design be replicated successfully, without excessive cost, for many media formats? This criteria will count for a maximum of 200 out of 1000 points.

The judging process followed an abbreviated version of EERE's process for funding opportunity announcements. A team of seven volunteer non-Federal experts each evaluated a selection of the logos using the above criteria. A panel of three Federal employees then took these scores into account to develop a consensus on three logos that met the above criteria. The panel presented these finalists to senior leadership, which made the final decision.

Partnerships: While not formal partnerships, a number of Clean Cities coalitions and other EV Everywhere stakeholders advertised the competition to their contacts. These contacts likely encouraged a number of submissions that may not have otherwise been received.

Resources: The Department of Energy used only in-house resources and existing funding to conduct the competition. The funding for the prize money was under the overall communications efforts for EERE's Vehicle Technologies Office. The Federal employees working on the Challenge already focus on communications and EV Everywhere, so this fit into their existing duties.

Results: The winning design, submitted by Brian Marquis, is being used as the official logo for EV Everywhere, the umbrella activity for all of the Department of Energy's (DOE) efforts to increase the use of plug-in electric vehicles. It is used on EV Everywhere communication materials such as the website, social media, publications, and magnetic decals—over 30,000 have been distributed to date.

⁴³ energy.gov/eere/articles/ev-everywhere-seeks-your-designs



A.4.4 JUMP Prize Competitions⁴⁴

Summary: JUMP is designed to broaden the pool of innovators working with DOE and move innovative technology concepts to market more efficiently. The Competition spans 13 separate challenges addressing topics from increasing efficiency in commercial air conditioning systems to expanding the usefulness of the internet of things, each co-sponsored by an industry partner. Winners receive both money from their industry partner and technical support from the DOE national laboratory responsible for the challenge. Winners also had opportunities to participate in additional programs to accelerate their technologies.

Solution Type: Ideas

Primary Goals: Develop technology; solve a specific problem; and engage new people and communities

Results: For all 13 calls for innovation, a total of 160 ideas were received. Most of the ideas were submitted by individual users or small businesses. A list of winners can be found at web.ornl.gov/sci/buildings/jump/winners/.

Problem Statement: Below are brief problem statements for each of the 13 calls for innovation the JUMP program ran in 2016:

1. Low-Cost BTU Sensor for Use in Building HVAC Control Systems

The challenge is to develop a new BTU sensor that when compared to traditional BTU meters has an error of less than 10% full scale and an installed cost of less than 20%. The sensor could be an actual physical device or an advanced algorithm using other available system data to accurately approximate a measured value.

⁴⁴ jump.ideascale.com/

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2. Low-Temperature Intrinsically Safe Defrost System

The challenge is to develop a low-cost system to remove ice from the evaporator while conforming to UL 250 Flammable Refrigerants Addendum. Specifically, the defrost system:

- Must not require substantial physical changes to the existing evaporator or evaporator compartment;
- Must meet standard 20-year life requirements (assume 1 defrost per day);
- Must be able to raise an unfrosted evaporator from -10°F to 40°F in 15 minutes or less; and
- Must be spark resistant and surface temperatures should not exceed 680°F.

3. Mean Radiant Temperature Sensing for Improved Thermal Comfort Building

The challenge is to design and develop a proof of concept mean radiant temperature (MRT) sensor that can be integrated with Building Robotics' Comfy offering, with the following functionality targets:

- Ability to accurately measure the MRT in the presence of radiant cooling or heating systems (for example the effect on MRT of a surface with a temperature of 2-4 K below ambient, at 6-8 ft. away);
- Ability to measure shortwave conditions that are a result of solar radiation;
- Deployable solution: the solution is intended to be deployed in commercial buildings that are in active use. The sensor cannot just sit on a desk; and
- Response time of <5 min to changes in the environment.

Bonus features:

- Separate identification of short wave radiation (i.e. sunlight).

4. Distributed Temperature Sensing for Localized Comfort Measurement

The challenge is to develop methods for distributed temperature sensing in office buildings utilizing existing hardware (i.e. smartphones and laptops) to measure air temperatures at each occupant's location within an office or workspace. The solution should interface with the Callida Energy Occupant App solution deployed on smartphones. Accepted solutions should be based on smartphones or laptops to measure workplace space air temperatures. The submitter is requested to estimate the accuracy of the proposed solution and detail the number of data points and device locations required to achieve highly accurate space temperature measurements. A strong solution would have a high accuracy with a minimum number of data points and still have adequate accuracy for a single person office zone in which there is only one data point on which to base the HVAC zone air temperature measurement.

5. Ultra-High Efficiency DX System for Supermarkets

The challenge is to identify a new architecture, the next generation of Direct Expansion (DX) supermarket refrigeration systems or modification to current standard DX system, which reduces the annual energy consumption by at least 25% compared to a standard distributed DX system utilizing R404A in a typical U.S. city (e.g., Atlanta, GA).

6. Thermal Energy Storage in Residential Gas or Electric Water Heaters (WH)

The challenge is to use innovative methods (such as PCM) to deliver as much hot water as a 65 or 80 gallon tank from a 50 gallon one, representing an increase in first-hour rating (FHR) of between

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15-30%, without increasing water storage temperature. Proposed solutions would be subject to the following restrictions:

- must not increase the storage temperature;
- must stay within the existing dimensional footprint of 50 gallon units (diameter and height);
- must not negatively impact the EF as defined in 10 CFR Part 430, Subpart B, Appendix E;
- must not negatively impact the service life of the water heater;
- must not negatively impact the safety aspects of the water heater; and
- must increase the manufacturing cost by no more than \$150 at high volume.

For example, prior to NAECA III, standard 65 and 80 gallon electric WHs had FHRs of about 75 and 90 gallons respectively. The goal would be to achieve these same FHRs in the footprint of a current compliant 50 gallon WH (EF of 0.95), meaning an increase in FHR of 20-30%.

7. Residential Energy Efficiency Applications for Smart Phones

The challenge is to give the best ideas for ways to leverage the open, programmable, and sensor-rich platform that modern smartphones offer to enhance the way we live, manage, and interact with our homes today and in the future. For example, how can we use our smartphones to accomplish the following tasks:

- Monitor and/or manage energy use and reduce energy costs;
- Conduct low-cost energy assessments;
- Interact with lighting, appliances, and other devices in the home;
- Reduce energy waste by consumer electronics and other plug loads;
- Provide actionable health, safety and comfort feedback about our homes; and
- Integrate and manage multiple systems in the home, including renewables and electric vehicles.

8. Bring Your Own Controller for the Internet of Things

Employees, customers, and visitors to commercial and industrial buildings expect the same level of automation, control, and ease of use that they might find at home. The challenge is to define the concept, use cases, technology stacks, and business models that could support the private control and use of public or commercial infrastructure and devices. How might you navigate the issues related to interoperability and cybersecurity? What needs or features would you build in to this device?

9. FEMP Call for Innovation

The challenge is to identify near commercialization or newly commercialized innovative energy saving technologies that are currently underutilized in the Federal building space. The technology areas open to the JUMP call would be limited to lighting and lighting controls, and packaged HVAC and HVAC control systems. In case of innovations in control systems, interoperability with standards based communication protocols will be encouraged to facilitate rapid testing and evaluation. Technology areas that require more extensive analysis such as boilers, chillers, distributed generation/renewables, etc. will not be considered for this initial call. Commercialization efforts of qualifying technologies would benefit from analysis and verification by an accredited third party with building technologies expertise, such as Oak Ridge National Laboratory (ORNL).

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10. Low-Cost Air Flow Sensor for Residential Ducted HVAC Systems

The challenge is to develop a new air flow measurement tool or system to measure total system airflow across an indoor ducted furnace, heat pump, or central air conditioning (AC) system. The tool should be easy to use by a trained technician with average total set up and testing time of less than 20 minutes. The measured airflow should meet or exceed an accuracy of +/- 7% and the total first cost to the service contractors should be less than \$100. The tool or system should be capable of measuring 0 to 2000 cfm typical of residential HVAC air flow range and could be an actual physical device or an advanced algorithm using other available system data to accurately approximate a measured value.

11. Exhaust-to-Coolant Heat Exchanger Development for Engine Driven Heat Pump

The challenge is to design an exhaust-to-coolant heat exchanger within the following parameters:

- Exhaust temperature: 1100°F Inlet and 200°F Outlet;
- Exhaust flow rate: 16 cfm;
- Maximum allowable exhaust back pressure 1.2 psi;
- Coolant temperature: 165°F Inlet and 180°F Outlet;
- Coolant flow rate: 5 gallons per minute;
- Coolant maximum allowable pressure drop: 2.0 psi;
- Reduce the heat exchanger footprint by at least 30%;
- Heat exchanger life: >40,000 hours or 10 years; and
- The heat exchanger cost target: \$500 or less at a production volume of 100 units or more.

12. Ultra-High Efficiency Compressors for AC Applications

The challenge is to identify a new compression technology or improvements in current compression technology to reach significantly higher efficiencies. The compressor cooling capacity should be in the range of 2-5 tons and the compressor footprint should be equivalent to current compressors. The compressor efficiency level required is at least 80% at typical operating conditions.

13. Accurate, Stable Humidity Sensors for Buildings

The challenge is to identify an accurate and stable humidity sensor technology that promises performance improvements over the market's existing sensors. The proposed sensor must be able to measure relative humidity with an accuracy of +5% and maintain that accuracy to within +1% for a minimum period of 10 years. Low cost technologies, low power technologies, and technologies that integrate analog-to-digital conversion are of particular interest. While this challenge is particularly targeted to innovators who are looking to commercialize the proposed technology as a small business, emerging ideas that identify unique technology solutions to this challenge will also be considered.

Proposed Goals: JUMP is an online crowdsourcing community launched by Oak Ridge National Laboratory (ORNL) and co-hosted by five DOE national laboratories and some of the top private companies in the buildings sector. JUMP stands for Join in the discussion, Unveil innovation, Motivate transformation, and Promote technology-to-market. The goal is to broaden the pool of people from whom DOE seeks ideas and to move these ideas to the marketplace faster.

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Measures of Success: JUMP was deemed to be superior to alternative approaches due to the inherent flexibility, responsiveness and effectiveness in reaching the widest possible audience of nontraditional stakeholders. In FY16, JUMP engaged 1,300 community members and identified 13 winning ideas primed for advancement toward commercialization. These engagement and advancement opportunities would not have been possible without the JUMP platform.

Participants: JUMP aimed to mobilize individuals and small businesses with ideas and/or prototypes (though not with products already on the market) addressing the challenges mentioned above. JUMP is open to legal residents of the fifty (50) United States and the District of Columbia who are at least eighteen (18) years old (or the age of majority in their state, whichever is older) at the time of entry. However, non-U.S. residents are welcome to vote and comment on ideas. 1,322 individuals registered for the call for innovation. Geographical representation is diverse, with registrants residing in 44 states.

Timeline: Timelines varied for each of the 13 individual challenges.

Solicitation and Outreach: In recruiting and engaging campaign participants, the Labs leveraged industry-relevant blogs and social media channels. Additionally, Buildings Technologies Office and Energy Efficiency and Renewable Energy mailing lists were used. Other relevant industry associations, coalitions, news outlets, events, and groups were also used. Registered users received notifications of deadlines and updates to spur a high quality and quantity of submissions.

Incentives: For all calls for innovation, one or more of the awards below were included:

- A cash award of \$3,000–\$5,000 from the industry partner co-sponsoring the call for the top selected technology submission;
- In-kind technical support of \$10,000– \$20,000 from the sponsoring national laboratory to enable technical staff to provide prototype development, testing, 3rd party validation, or other defined needs;
- Participation in the Clean Energy Trust "mini-accelerator program designed to help prepare the winning teams for participation in the Clean Energy Trust (CET) Challenge;
- Participation in the Clean Tech Open Accelerator Program (open to select winners across all labs' JUMP calls).

Evaluation and Judging: Each JUMP Call for Innovation includes a judging panel with a minimum of three judges:

- One or more technical experts representing the industry partner;
- A technical expert from the national laboratory; and
- An independent third party that brings a fresh perspective during the judging process and may prevent a tie in the judging

The judges follow a general review process as indicated below:

Step 1: Review the shortlisted ideas and score each idea based on their technical feasibility, potential for energy savings, market readiness, economic potential, and novelty of the idea. Deployment calls for innovation will involve a different set of judging criterions.

- Step 2: The judging panel regroups to discuss the compiled scores.

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- Step 3: The judges identify the most promising ideas and appropriate next steps. More than one winner could be identified and potential collaboration could be initiated accordingly.

Partnerships: Each of the 13 JUMP Calls involved one industry partner and one lab partner, including: Oak Ridge National Laboratory (ORNL), Lawrence Berkeley National Laboratory (LBNL), National Renewable Energy Laboratory (NREL), or Argonne National Laboratory (ANL). Industry partners included United Technologies Research Group, General Electric, Building Robotics, Callida Energy, Honeywell, A.O. Smith, CLEAResult, SIEMENS, the Federal Energy Management Program, Emerson, IntelliChoice and the Clean Energy Trust. Industry partners establish an agreement with a national lab that outlines a commitment to sponsor defining JUMP calls for innovation, promote the JUMP community, participate in the technical evaluation of ideas, and provide potential cash or technical support prizes. Winning ideas will have the opportunity to advance towards potential collaboration with industry partners in an effort to take the ideas forward.

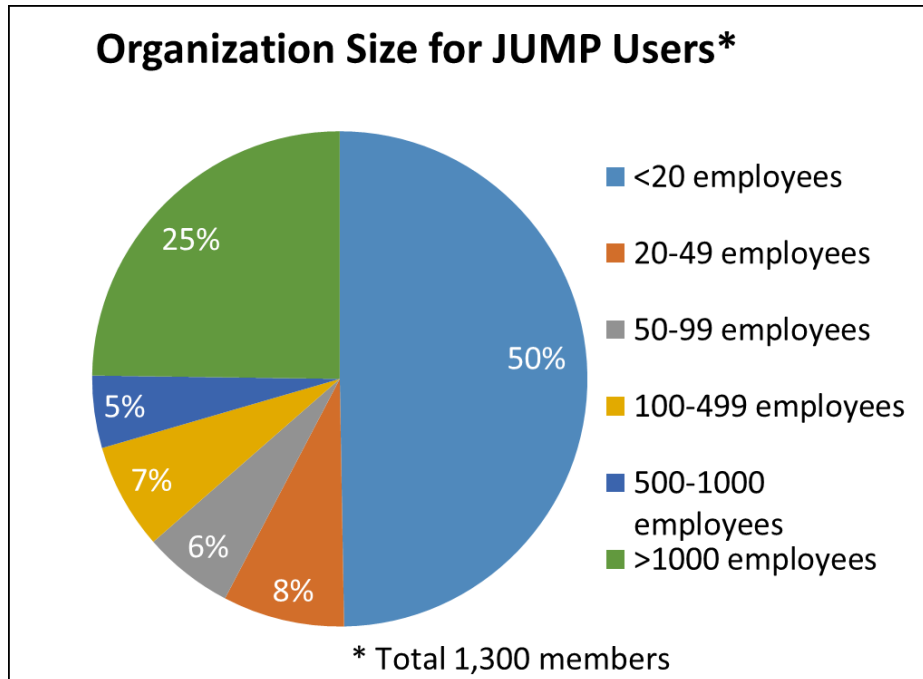
Also, the Energy Department's Building Technologies Office partnered with Cleantech Open, a not-for-profit organization that runs the world's largest cleantech accelerator. Select participants in DOE's JUMP program will be advanced into Cleantech Open's Accelerator Program, based on their technical merit and market relevance. Cleantech Open is providing 50% waived fees for up to six select winners to their Accelerator Program. LBNL will cover the rest of the 50% fees.⁴⁵

Resources: DOE EERE BTO allocated a total of \$1,060,000 in FY16 for five national laboratories to implement the 13 calls for innovation.

Results: For all 13 calls for innovation, a total of 160 ideas were received. Most of the ideas were submitted by individual users or small businesses. A list of winners can be found at web.ornl.gov/sci/buildings/jump/winners/. Below is a chart highlighting the organization size of the JUMP community membership.

⁴⁵ For more information on the Cleantech Open's Accelerator Program, see energy.gov/eere/buildings/articles/energy-department-partners-cleantech-open-help-startups-bring-technologies.

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A.4.5 SunShot Prize: Race to 7-Day Solar⁴⁶

Summary: The SunShot Prize is designed to streamline the process for the installation of residential and small commercial solar panels, in order to create a better process that can take only seven days, rather than months. By streamlining this process, the designs from the SunShot Prize allow families and small businesses to improve their energy independence.

Solution Type: Other: cross-stakeholder process streamlining and time efficiencies. The solutions may involve software and process alignment and integration.

Primary Goals: Improve government service delivery (local government, and public utility service delivery); and highlight integrated innovation solutions or platforms, not just ideas

Results: Three teams won Change Prizes after each deploying at least three megawatts (MW) of residential solar systems by March 2016 and experimenting with different approaches to streamline the permitting and interconnection processes with partner jurisdictions and utilities. These three teams, the Northern and Central California SunShot Alliance, Sunrun, and Connecticut Permit to Plug-in challenge, cover areas in California, Oregon, Connecticut, and Massachusetts.

Problem Statement: Despite unprecedented cost reductions for solar hardware over recent years, the total price to install and commission residential and small-commercial scale solar energy systems remains high. Designing and implementing practices that enable reductions in the

⁴⁶ energy.gov/eere/sunshot/sunshot-prize-race-7-day-solar

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associated non-hardware costs of solar is now the greatest challenge to achieving national targets for attaining cost-competitive solar by 2020. Customers often wait as long as six months to flip the switch on a small residential solar system that could be grid-connected simply and easily if these steps were improved. This competition will spur faster, easier, and cheaper solar deployment in the U.S. and will offer a total of \$10 million in cash awards to make permitting, installation, inspection, and interconnection (permit-to-plug-in) processes more efficient than ever before. Every one day cut due to process efficiency translates to \$2 million of electricity sales at 2013 deployment level. A positive customer experience in the U.S. will lead to a strong cascading network effect for accelerated solar deployment.

Proposed Goals: DOE aims to increase process certainty and reduce the time of permit-to-plug-in towards seven days (Small System Contest) or seven weeks (Large System Contest).

Measures of Success: Success is measured by the number of total jurisdictions, utilities, and solar installers that actively reduce the total time, from permit to interconnection, for residential systems. Success is also measured by the geographic diversity of these jurisdictions as well as reduced variabilities /uncertainty in total time. DOE uses a number of statistical metrics to measure impact of each participating team. These include:

- **Repeatability:** The repeatability criteria measure a team's ability to complete PV systems in set time durations repeatedly. Shorter time durations translate to higher points. Two metrics are used to evaluate this criteria: Time-adjusted capacity (in MW) and Normalized time-adjusted capacity (in %);
- **Time Performance:** The time performance criteria measure a team's ability to consistently reduce the Total Time for PV system and increase the certainty of going solar. Two metrics are used to evaluate this criteria: Total Time expected value (in days) and Total Time variability (in days); and
- **Replicability:** Replicability criteria measure a team's ability to apply their innovation for time reduction and increased process certainty across wide geographical areas in the United States. One metric is used to evaluate this criterion: Diversity of Authority Having Jurisdictions (in %).

Participants: There was no restricted eligibility for participating teams except as required by the COMPETES authority. DOE envisioned solar developers, local jurisdictions, communities, and utility companies forming teams to pursue the goals of this competition. No one entity can achieve the goal of improving the going solar customer experience single-handedly; close coordination among communities, cities, installers, customers, and utility companies is critical. This prize competition was designed to create the right conditions and opportunities for collaboration among all stakeholders. Five teams participated in the challenge.

Timeline: Submissions for the challenge opened in March of 2015 and closed in August, followed by the announcement of Change prize candidates in September. In May of 2016 the Change Prize winners were announced. The Grand Prize winners will be announced in July of 2017.

Solicitation and Outreach: N/A

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Incentives: The primary incentive is a \$10,000,000 total cash award given to up to 20 Change Prize winners and a number of Grand Prize winners. The grand prizes will total \$4 million for the Small System Contest and another total of \$4 million for the Large System Contest.

Evaluation and Judging: Final grand prizes have not been awarded. DOE Federal staff with support from subject matter experts in the National Labs have helped review and select candidates to participate in the competition and receive change prizes.

For final grand prizes DOE will use a statistics-based approach to evaluation and rely on an Evaluation Review Committee (ERC) composed of Federal and non-Federal subject matter experts, including third-party organizations, to review entries submitted under this competition and determine winners. In addition, DOE will use third-party auditing services to conduct record validation in order to assist the judging committee in making its selections.

There are three main criteria in judging success:

- **Repeatability**: The repeatability criteria measure a team's ability to complete PV systems in set time durations repeatedly. Shorter time durations translate to higher points. Two metrics are used to evaluate this criteria: Time-adjusted capacity (in MW) and Normalized time-adjusted capacity (in %);
- **Time Performance**: The time performance criteria measure a team's ability to consistently reduce the Total Time for PV system and increase the certainty of going solar. Two metrics are used to evaluate this criteria: Total Time expected value (in days) and Total Time variability (in days); and
- **Replicability**: Replicability criteria measure a team's ability to apply their innovation for time reduction and increased process certainty across wide geographical areas in the U.S. One metric is used to evaluate this criterion: Diversity of Authority Having Jurisdictions (in %).

In addition to the details provided in the rules document for calculating the quantitative metrics and the corresponding point system, an excel sheet was provided.

Partnerships: Challenge organizers partnered formally with the College of Nanoscale Science and Engineering at State University of New York at Albany, to promote and provide ongoing outreach activities.

Resources: DOE has partnered with the College of Nanoscale Science and Engineering (CNSE) at State University of New York at Albany as a prize administrator for the duration of the competition. Total funds allocated to the prize administrator throughout the competition is \$222,500. One dedicated DOE staff support all the participating teams as needed.

Results: Three teams won Change Prizes after each deployed at least three MW of residential solar systems by March 2016 and experimented with different approaches to streamline the permitting and interconnection processes with partner jurisdictions and utilities. These three teams continue to compete for the Grand prizes of the small-system contest. Specific highlights from each team are as follows:

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- Northern and Central California SunShot Alliance: Pacific Gas & Electric Company (Team Lead), SolarCity, Qado Energy, Accela.
During the competition, the teams have been collaborating with more than 13 jurisdictions in the PG&E service territory (e.g., Antioch, Berkeley, Clovis, Livermore, San Francisco, Stockton); demonstrated 1-day solar; and streamlined the grid interconnection to a three-day process in collaboration with Qado Energy.
- Sunrun: During the competition, the team has deployed residential solar systems in more than 100 jurisdictions in California, Oregon, Connecticut, and Massachusetts and in seven utility service territories (e.g., National Grid, Silicon Valley Power). The teams have been integrating Clean Power Research's PowerClerk permitting and interconnection.
- Connecticut Permit to Plug-in Challenge: Connecticut Green Bank (Team Lead)
The team has deployed residential systems in 49 jurisdictions in Connecticut working with more than eight installers. The team also partnered with Clean Power Research to integrate PowerClerk with a number of jurisdictions to expedite the permitting process.

A.4.6 Wave Energy Prize⁴⁷

Summary: The Wave Energy Prize was designed to support the development of innovative devices to harness wave energy and to give entrepreneurs and small businesses resources to enter this emerging market. The challenge pulled in new talent and successfully led to designs that surpassed the state-of-the-art in wave energy production. The winning team AquaHarmonics not only doubled the baseline metric for the prize, but more than quintupled it; and both the second place finisher, CalWave Power Technologies, and the third place finisher, Waveswing America, more than tripled it.

Solution Type: Technology demonstration and hardware; other: design, build and test

Primary Goals: Solve a specific problem; develop technology; and engage new people and communities

Results: The nine finalists and two alternates spanned the United States and brought in a range of new innovators who had not previously worked with wave energy converter technologies (WEC). Of the nine finalists, only two teams had received any DOE funding in the past. The finalists put forward diverse and technically innovative WEC designs, especially in the areas of geometry, materials, power conversion and controls. Of the nine finalists, seven surpassed the state-of-the-art performance, and four of the seven doubled the state-of-the-art performance to become eligible to win the prize. The winning team, AquaHarmonics not only doubled the baseline ACE for the prize but more than quintupled it; and both the second place finisher, CalWave Power Technologies, and the third place finisher, Waveswing America, more than tripled it.

Problem Statement: The wave energy industry is an emerging market that has vast potential for innovation. However, it is very difficult for entrepreneurs and small companies to secure funds to support the design, fabrication and testing of innovative, wave energy converter designs at

⁴⁷ www.waveenergyprize.org

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meaningful scale. Consequently, the U.S. Department of Energy's Water Power Technologies Office (WPTO) designed an aggressive and ground-breaking design, build and test prize competition for wave energy technology, to spur innovation and establish a pathway to sweeping cost reductions at commercial scale.

Proposed Goals: The prize measured the performance of wave energy converters (WEC) through a new metric created in the prize design process—ACE (Average Climate Capture Width per Characteristic Capital Expenditure). ACE represents the energy captured per unit structural cost of WECs. This is a proxy metric for levelized cost of energy, LCOE, which is a metric that allows for comparison of the costs of electricity produced by different means and sources. The 2014 state-of-the-art value for ACE is 1.5 m per million dollars (1.5 m/\$M). A finalist became eligible to win the \$1.5 million grand prize if they doubled the ACE metric to 3 m/\$M during the final round of testing.

Measures of Success: Quantitative

- Prize funnel
- At Technology Gate 1: 92 Registered Teams
- At Technology Gate 2: 20 Qualified Teams (down to 17 after three teams withdrew) competed to design, build and test a 1/50 scale prototype
- Company (mostly small ones): 10 Teams
- Independent/collaborations: 7 Teams
- University: 3 Teams
- At Technology Gate 3: Nine finalists and two alternates were selected to design, build and test a 1/20th scale prototype
- At Technology Gate 4: Nine finalists from Technology Gate 3 were evaluated to determine the prize winners
- Four teams exceeded the minimum threshold of doubling the energy captured per structural cost from their wave energy device compared to the baseline prior to prize launch
- The grand prize winner quintupled the energy capture per structural cost metric over the baseline.

Qualitative

- New metrics were developed to evaluate the performance of wave energy devices. Metrics and standards for evaluation in the Prize are now being leveraged by government agencies internationally for evaluation of projects funded overseas;
- Finalists' innovations spanned geometry, advanced control strategies, energy absorption and conversion capabilities, and materials;
- The Wave Energy Prize engaged a wide range of registrants ranging from entrepreneurs to students to small businesses;
- The small-scale wave testing facilities (University of Iowa, University of Maine, University of Michigan, Stevens Institute of Technology and Oregon State University) and the Naval Surface Warfare Center Carderock Division gained significant wave energy converter technical knowledge and experience during the execution of the testing program;
- Strong and ever-strengthening partnership between DOE and Navy as evidenced by (1) the Federal Laboratory Consortium's awarding DOE and Carderock the 2015 Mid-Atlantic

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region Interagency Partnership Award; and (2) commitments from the Navy for judging and facility preparation and use costs;

- The Wave Energy Prize was listed as one of the leading examples presented by the Government Accountability Office's 2016 report *Open Innovation Practice to Engage Citizens and Effectively Implement Federal Initiatives*; and
- Teams contributed between 500 and 6000 hours of labor which included both paid labor and volunteer labor time. The teams also received in-kind support which included equipment, software, licensing, computational modeling hours, and additional wave tank testing time.

Participants: The Wave Energy Prize mobilized engineers, developers, and builders from across the entire country. This included universities, small companies, more established players in wave energy, and independent entrepreneurs. Eligibility requirements were set according to the America COMPETES Reauthorization Act. Ninety-two teams registered with 66 providing full technical entries.

Timeline: Registration for the Wave Energy Prize opened April 27, 2015 and closed June 30, 2015. The design submission deadline was July 15, 2015, followed by the announcement of qualified teams on August 14, 2015. Finalists and alternates were announced March 1, 2016, and winners were announced November 16, 2016.

Solicitation and Outreach: Several approaches were used to successfully publicize the Prize and mobilize potential participants, including:

- Emailing previous applicants to funding opportunities to program office;
- Creating a Prize website (waveenergyprize.org);
- Creating a skill-sharing platform on the Prize website that promoted team-building;
- Creating and disseminating a monthly newsletter that answered frequently asked questions about the Prize and presented the technical details of the Prize in simple language, along with communicating what DOE is striving to achieve; and
- The public dissemination of all important data generated from the Prize.

The initial outreach was so successful that Prize ended up with 92 registered teams, far above the goal of attracting 30 teams.

At the end of prize, there were:

- More than 170 news stories featured the prize, including channels like *Popular Science*, *The Weather Channel* and *National Geographic*;
- Approximately one million social media impressions;
- Facebook: Followers = 378; Impressions/reach = 89,896;
- Twitter: Followers = 622; Impressions/reach = 447,300;
- LinkedIn: Followers = 366; Impressions/reach = 136,584;
- WordPress and other: Followers = ~50; Impressions/reach = ~60,000;
- Email marketing:
 - Subscribers = 694 (not including Prize Administration or DOE)
 - Average open rate = 52.82%
 - Average click through rate = 24.87%; and

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- 431 people viewed the live video stream of the Innovation Showcase Event.

Incentives: The Wave Energy Prize attracted developers to compete in the design, build and test of innovative wave energy converter devices with a goal of doubling the state-of-the-art performance:

- A total of \$2.25 million was reserved for the prize purse (\$1.5 million grand prize, \$500,000 for second place, and \$250,000 for third place)⁴⁸;
- Seed funding for up to 10 Finalists (\$125,000 each) and Alternates (\$25,000 each)⁴⁹;
- Small-scale testing to all 20 Qualified Teams valued at close to \$45,000 per team⁵⁰;
- Testing for all finalists at the MASK Basin at Carderock valued at \$180,000–\$200,000 per test⁵¹;
- The creation of a team-building platform (the Marketplace) located on the competition website, where teams solicited expert needs, or experts offered services;
- An open-source numerical software package, Wave Energy Converter Simulation (WEC-Sim) developed and supported by the DOE national labs, and supporting software provided for free by MathWorks for use by all Qualified Teams choosing to use it for the duration of the competition; and
- A team summit with opportunities to engage with technical experts, investors, media, and government.

No private or philanthropic funds were used for planning and implementation of the prize (e.g. prize seed funding, in planning and execution of testing and evaluation, or for final award purse funds).

Evaluation and Judging: A judging panel was comprised of technical experts with diverse backgrounds and experience in wave energy from the DOE national laboratories, the Navy, and private industry.

To achieve the prize goals, the participants were required to undertake more and more challenging WEC design and build tasks across each stage of the prize—the results of which were evaluated by the judging panel. First, registered teams were required to submit a detailed technical submission describing their proposed innovative WEC technology. Twenty qualified teams were selected by the judging panel based on a rigorous evaluation of their technical submissions. These teams were then required to numerically model and build a small scale (1/50th) model of their device—a model that would be tested and subsequently evaluated against other devices and against performance metrics developed by the prize team. Nine teams and two alternates were selected as finalists. Each team was provided seed funding and required to design and build a larger (1/20th) scale model of their device with control capabilities. These 1/20th scale models were tested at the Naval Surface Warfare Center’s MASK Basin in Carderock, MD. The judging panel evaluated

⁴⁸ DOE funding dispersed by Prize Administration Team.

⁴⁹ DOE funding dispersed by Prize Administration Team.

⁵⁰ DOE funding dispersed by Prize Administration Team to small-scale testing facilities.

⁵¹ \$1.7 million of DOE funding direct to Carderock through interagency agreement; \$600,000 provided by Department of the Navy.

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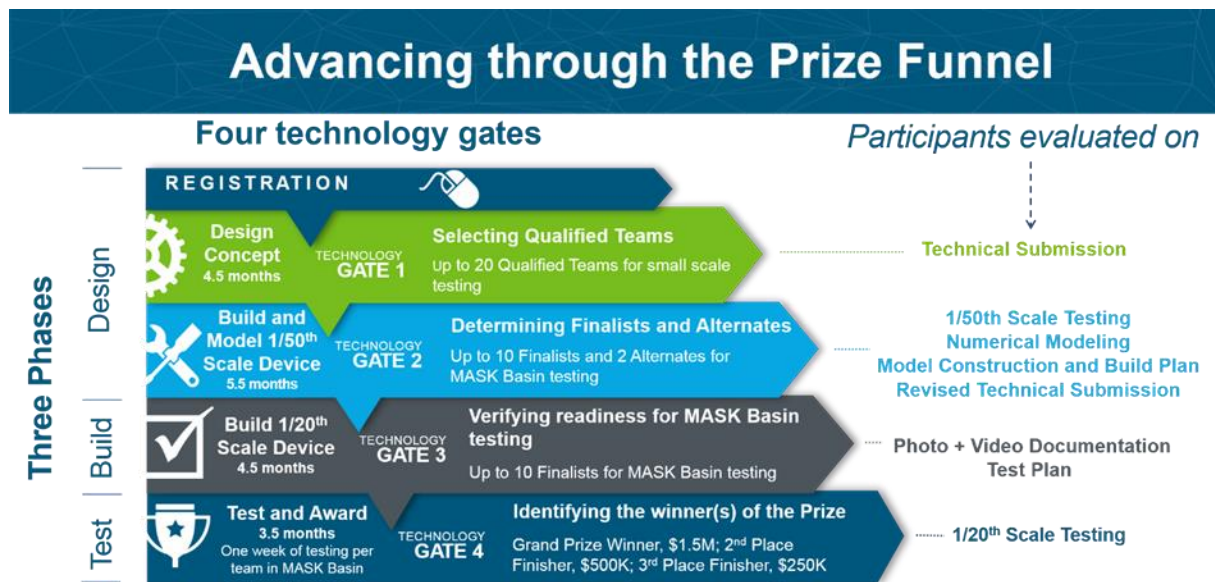
whether teams achieved the goal of doubling the ACE metric during this final round of testing and determined which teams qualified for the prize funding.

Partnerships: DOE partnered with various branches of the Department of the Navy to successfully design and execute the Prize. The Office of Naval Research provided funds to develop the technologies and capabilities required to ensure fair and rigorous testing in the MASK Basin; the Naval Surface Warfare Center provided in-kind support for the Judging Panel; and the Department of the Navy contributed funding for testing three of the nine Finalist teams in the MASK Basin.

Resources: Through a funding opportunity announcement, DOE selected a Prize Administration Team, led by Ricardo, Inc. A total of \$6.73 million was awarded to the Prize Administration Team to lead the design and execution of the prize. This amount included money for the prize purse, small scale testing, and seed funding. \$1.7 million was provided to the Naval Surface Warfare Center for their involvement in the prize, and a total of \$2.2 million was provided to the National Renewable Energy Laboratory and Sandia National Laboratories for their technical contributions to the prize. The Department of the Navy contributed \$600,000 to test three of the nine finalist teams at the MASK Basin.

There were several DOE staff, at headquarters and the Golden field office, who were constantly and intimately involved with all parties above to ensure the successful coordination and execution of the Prize.

Results: The graphic below illustrates the prize funnel:



DOE's goal was to attract thirty teams to register to compete in the prize during the registration period. In the end, 92 teams registered. Of these, 20 were chosen as qualified teams during Technology Gate (TG) 1. After TG2, nine finalists and two alternates were selected, and all nine finalists proceeded through TG3, with the alternates eliminated.

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Below are details on the finalists:

- AquaHarmonics (Portland, OR)
- CalWave Power Technologies (Berkeley, CA)
- M3 Wave (Salem, OR)
- Oscilla Power (Seattle, WA)
- RTI Wave Power (York, ME)
- Sea Potential (Bristol, RI)
- SEWEC (Redwood City, CA)
- Harvest Wave Energy (Research Triangle Park, NC)
- Waveswing America (Sacramento, CA)

As can be seen on the Team Updates webpage (waveenergyprize.org/teams/updates), all finalists and alternates successfully designed and built their 1/20th scale devices on time.

The finalists put forward diverse and technically innovative WEC designs, especially in the areas of geometry, materials, power conversion, and controls. Some of these included:

- Sea-state-to-sea-state control;
- Wave-to-wave control;
- Power absorption in multiple degrees of freedom;
- Optimized float shapes and dimensions for energy absorption for broad bandwidth of wave frequencies;
- Survival strategies such as submerging beneath the surface for extreme storms;
- Use of structures and materials that are cost-effective to manufacture; and
- Flexible membranes that react to the wave pressure over a broad area.

Of the nine finalists and two alternates, only two had previously partnered with the Water Energy Technologies Office before, thus bringing new and outside-of-the-box ideas and concept designs. The DOE would not have been able to partner with many of these entities through traditional financial assistance awards.

While the long-term impacts of the prize are still unfolding, the prize successfully achieved several of its goals:

- Spur game-changing performance enhancements to WECs: Of the nine finalists, seven surpassed the state-of-of-the-art performance, and four of the seven doubled the state-of-the-art performance to become eligible to win the prize. The winning team, AquaHarmonics not only doubled the baseline ACE for the prize, but more than quintupled it, and both the second place finisher, CalWave Power Technologies, and the third place finisher, Waveswing America, more than tripled it.
- Provide an opportunity for apples-to-apples tank testing and evaluation: The WECs proposed by the finalists span diverse WEC archetypes, and each of them had unique mooring configurations. The prize team worked with each team to create individualized test plans for the teams to ensure successful testing campaigns in the MASK Basin for each team. Eight of the nine finalists successfully completed testing at Carderock, allowing the judges of the prize to fairly and rigorously evaluate the performance of the devices.

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- Provide a pathway to sweeping cost reductions: The DOE and the public now have a robust data set of device performance for a range of device designs and configurations. The National Renewable Energy Laboratory and Sandia National Laboratories are conducting a study of the key advances made by finalists during the prize in geometry, materials, controls, configuration, and operations and maintenance. The study will also highlight the technical areas in which future work will be necessary to continue reducing the cost of wave energy.
- Mobilize new and existing talent: Of the nine finalists, only two teams had received any DOE funding in the past. The Prize competition allowed DOE to partner with new entities outside of traditional financial assistance mechanisms.
- Increase the visibility of wave energy as a viable energy resource and attract potential investors; and successfully enable the top performers to become viable and competitive industry members. The prize increased and diversified the number of players in the wave energy space. The nine finalists benefitted from strong public communications and exposure to potential investors. They also established strong partnerships with the Navy and other experts in the field.

A.5 Department of Health and Human Services

A.5.1 ASPR: “MRC Serves!” Video Challenge

Summary: This challenge was designed to allow Medical Reserve Corps volunteers to share their stories, allowing for greater volunteer engagement and an opportunity to raise awareness of the program and its activities. The Medical Reserve Corps (MRC) Program housed under the Office of the Assistant Secretary for Preparedness and Response (ASPR) within the U.S. Department of Health and Human Services (HHS) is a national network of volunteers, organized locally to improve the health and safety of their communities. Volunteers were asked to create videos highlighting why they volunteer, how MRC improves their community’s health, or how MRC has made their community more prepared and resilient.

Solution Type: Creative, design, and multimedia

Primary Goals: Find and highlight innovative ideas; inform and educate the public; engage new people and communities

Results: The challenge received 12 submissions from teams across the United States, and three winners were selected, one for each question. Winners were invited to attend the 2017 Preparedness Summit in Atlanta, GA.

Problem Statement: The Medical Reserve Corps (MRC) Program housed under the Office of the Assistant Secretary for Preparedness and Response (ASPR) within the U.S. Department of Health and Human Services (HHS) is a national network of volunteers, organized locally to improve the health and safety of their communities. MRC volunteers have medical, public health, and emergency response (among other) backgrounds and respond to natural disasters and public health emergencies, while also supporting community health activities. The MRC Program is continually looking for innovative and cost effective ways to promote these activities and demonstrate to local

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and national stakeholders how MRC units and their volunteers make their communities healthier, prepared, and more resilient.

The MRC Program created the five-week “MRC Serves!” video challenge as an opportunity to engage and encourage MRC volunteers to share their stories of service and demonstrate how the MRC is making a difference in their local community. MRC volunteers were invited to create a short video from 60-90 seconds long that answered one of the following three questions. Videos could be submitted as part of a team, or by an individual.

Video Challenge Categories

1. Why do I/we volunteer with the MRC?
2. How does the MRC make my community healthier?
3. How does the MRC make my community more prepared and resilient?

Submitted videos were judged based on the following criterion:

- Clear and consistent message/Overall impact (35 percent): Is the story clear, educational, inspiring, and persuasive? Does it motivate others to serve as MRC volunteers? Is it clear how the MRC impacts its community?
- Creativity and originality (25 percent): How creatively does the video answer the challenge question? How original is the idea?
- Production quality (25 percent): Does the video effectively use lighting, sound, and editing to tell the story? Is the dialogue clear and easy to understand? Do visual effects (if any) contribute to the message or detract from it?
- MRC Identity (15 percent): Does the video do a good job of promoting the MRC brand by showing the trademarked logo or names Medical Reserve Corps and MRC?

Proposed Goals: The goal of the challenge was to have short, promotional videos created that the MRC Program and ASPR Communications can use to highlight why people choose to volunteer with the MRC and how MRC units are improving the health, preparedness, and resiliency of their communities. These videos can be used for promotional outreach, stakeholder engagement, volunteer recruitment, and general MRC informational purposes—both on local and national levels.

Measures of Success: The MRC Program has limited resources to dedicate to outreach and branding, which is also the case for local MRC units nationwide. The “MRC Serves!” video challenge allowed us to incentivize volunteers to share their success stories and help promote the MRC in regions across the country. The challenge also served as an opportunity for units to showcase innovative projects and model best practices for the MRC network at large. The MRC Program now has multiple videos that were received within a month which can be utilized to highlight what MRC volunteers do to improve the health and safety of their communities. These videos can also be used by local MRC units to engage partners/stakeholders, recruit volunteers, and promote the MRC unit’s presence within their local community.

Participants: The video challenge was open to MRC units and their volunteers. Contestants could be individuals, public or private entities that are MRC units, or groups. An individual, whether

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participating individually or in a group, must have been a citizen or permanent resident of the United States. The challenge received six team entries and five individual entries.

Timeline: Phase 1 submissions were opened August 4, 2016, and closed September 11, 2016. Judging opened September 12, 2016, and closed September 26, 2016. Winners were notified September 29, 2016, and announced publicly November 15, 2016.

Solicitation and Outreach: The challenge was promoted using no-cost methods (i.e., email listservs, word-of-mouth, social media, website).

Incentives: A non-monetary incentive was utilized for the challenge. Winners will receive invitational travel, lodging, and applicable conference expenses to attend the 2017 Preparedness Summit in Atlanta, GA, valued at about \$6,000. Expenses will be covered by MRC Program funds. In addition, winners received public recognition with their videos being shared on the MRC listservs, website, and social media platforms, as well as the ASPR YouTube channel (https://www.youtube.com/playlist?list=PLP9YeFRSgIT4IBGOXUfL_qi4YKbo6SBuK).

Evaluation and Judging: Submissions were judged by a panel of current and former staff from within MRC and ASPR, as well as MRC partners (i.e., HOSA – Future Health Professionals). The judging criterion was as follows:

- Clear and consistent message/Overall impact (35 percent): Is the story clear, educational, inspiring, and persuasive? Does it motivate others to serve as MRC volunteers? Is it clear how the MRC impacts its community?
- Creativity and originality (25 percent): How creatively does the video answer the challenge question? How original is the idea?
- Production quality (25 percent): Does the video effectively use lighting, sound, and editing to tell the story? Is the dialogue clear and easy to understand? Do visual effects (if any) contribute to the message or detract from it?
- MRC Identity (15 percent): Does the video do a good job of promoting the MRC brand by showing the trademarked logo or names Medical Reserve Corps and MRC?

Partnerships: HOSA-Future Health Professionals served as partners on the judging panel for the challenge.

Resources: Two full-time staff members of the MRC Program planned and launched the video challenge (as part of their regular program office communication and outreach responsibilities). The challenge was run on the no-cost platform Challenge.gov and promoted using no-cost methods (i.e., email listservs, word-of-mouth, social media, website).

Results: The MRC Program received a total of 12 submissions from six teams and five individual volunteers from local MRC units across the country. (Note: One team submitted two separate videos in two different categories.) The team videos ranged from teams of two participants up to fourteen. The submissions came from various geographic regions that included the Northeast, Midwest, and Northwest areas of the United States (HHS Regions I, V, VI, VIII, IX, X).

The top video for each challenge question was recognized by the MRC Program:

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- The MRC of Eastern Washington is the winner in the category of “Why do I/we volunteer with the MRC?” The video demonstrates how the MRC brings together a diverse pool of talented volunteers who are looking to listen, make a difference, and give back to the community where they live. Their winning video is available here: https://www.youtube.com/watch?v=O23q141BhRc&list=PLP9YeFRSgIT4IBGOXUfL_qi4YKbo6SBuK&index=2
- The Mercer County MRC in Illinois is the winner in the category of “How does the MRC make my community healthier?” Their video demonstrates how MRC volunteers are improving the health of Mercer County by creating a community garden and making the healthy produce available to local children, adults, and seniors, as well as the community food pantry. Their winning video is available here: https://www.youtube.com/watch?v=fM1Bp3tKk34&index=1&list=PLP9YeFRSgIT4IBGOXUfL_qi4YKbo6SBuK
- The Rocky Mountain MRC in Colorado is the winner in the category of “How does the MRC make my community more prepared and resilient?” Two volunteers highlight how MRC volunteers are trained in personal preparedness and emergency response, providing them the necessary skills to respond in a moment’s notice and support their community during times of emergency. Their winning video is available here: https://www.youtube.com/watch?v=fM1Bp3tKk34&index=1&list=PLP9YeFRSgIT4IBGOXUfL_qi4YKbo6SBuK

A.5.2 ASPR: My Preparedness Story: Staying Healthy and Resilient Video⁵²

Summary: In order to better educate the public on disaster preparedness and steps they can take to protect themselves, their families, and their communities, this challenge invited young people across the country to produce short videos to highlight steps they were taking to make their communities more resilient, whether by volunteering in a health center or with a local Medical Reserve Corps Unit, learning first aid skills, developing an emergency plan, preparing an emergency kit, or educating their family and friends about actions they can take to be healthy.

Solution Type: Creative (design and multimedia); and ideas

Primary Goals: Find and highlight innovative ideas; inform and educate the public; and engage new people and communities

Results: From a field of 94 eligible videos submitted in the first “My Preparedness Story: Staying Healthy and Resilient” video challenge, the top six videos were recognized by the U.S. Department of Health and Human Services (HHS) Office of the Assistant Secretary for Preparedness and Response (ASPR). Winning videos ranged from artful to comedic—with one third place video using stop motion animation—and covered topics ranging from how emergency preparations differ in our nation’s least densely populated state, Alaska, to how young people volunteering in ASPR’s Medical Reserve Corps can help propel public health in their communities.

⁵² www.phe.gov/Preparedness/planning/authority/nhss/myprepstory/Pages/default.aspx

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Problem Statement: Natural disasters and other emergencies can happen anywhere and at any time. Taking action ahead of an emergency can help individuals, families, and communities fully prepare to prevent or minimize potential health impacts. Young people can help their family, friends, and community become stronger by protecting their health during disasters and every day. For example, some can do it by volunteering in a health center or with a local Medical Reserve Corps Unit, learning first aid skills, developing an emergency plan, preparing an emergency kit, or educating their family and friends about actions they can take to be healthy.

Contestants were invited to create a short closed-captioned video—up to 60 seconds long—showing how they are helping family, friends, and community protect their health during disasters and every day. Entries could be submitted as part of a team or by an individual.

Participants were asked to review the following checklist before submitting their video:

- Does your video comply with the official challenge rules?
- Does your video clearly communicate how your efforts are contributing to the health of your family, friends, and community during disasters and every day?
- Does your video provide new ideas that you can share with your peers to help their family, friends, and community prepare for a disaster?
- Have you told your story and the impact of your efforts through interesting and creative visuals?
- Do you share ideas for next steps that motivate people to take action and get prepared?

Proposed Goals: Share disaster preparedness efforts and promising practices of community resilience planning across organizations and communities, by showing how one segment of the population—young people—are making important contributions toward resilience.

Measures of Success: Many people do not understand what national health security is, much less how it affects their day-to-day lives. This challenge worked to incentivize young people to develop and share videos that showcase individuals strengthening national health security by engaging in disaster preparedness planning.

Thousands of young people across the country help their families, friends, and communities prepare for disasters and emergencies. For example, they volunteer in health centers or with local Medical Reserve Corps units, stay current on first aid skills, develop home emergency plans, prepare emergency kits, and educate their families and friends about actions they can take to be healthy even when disaster strikes. This competition provided an opportunity for them to showcase their efforts.

ASPR leads HHS in preparing the nation to respond to and recover from adverse health effects of emergencies, supporting communities' ability to withstand adversity, strengthening health and response systems, and enhancing national health security. HHS is the principal Federal agency for protecting the health of all Americans and providing essential human services, especially for those who are least able to help themselves.

Participants: “Young people are a source of support and resilience during a disaster. The contest is a way to highlight that the entire community needs to be involved. This competition gave young

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people an opportunity to display the efforts they're making to help their families and communities be better prepared for an emergency," said Dr. Nicole Lurie, HHS assistant secretary for preparedness and response. "The winners are to be congratulated not just for the quality videos they produced but also for the active role they are taking in their communities."

The video contest was open to people in the United States (U.S.) who were between the ages of 14 and 23 at the time of entry. Contestants could be individuals, public or private entities, or groups. An individual, whether participating individually or in a group, must be a citizen or permanent resident of the United States.

There were 111 total participants, producing 94 entries, 14 of which came from teams.

Timeline: Submissions for the challenge opened January 4, 2016 and closed March 28, 2016. Public Voting ran for 11 days in April 2016. Winners were announced May 9, 2016.

Solicitation and Outreach: The competition used various methods to market the competition, including social media, blog posts, and emails to national youth organizations. To market the winners, a press release was issued and the winning video was posted on the agency website phe.gov.

Incentives: The total amount of the cash prize offered as part of the challenge was \$3,500 and ASPR was responsible for providing these funds. Public recognition was used as a way to motivate participants and reward the winners through press releases⁵³ and including their work on promotional materials. The PHE Evaluation Funds were used to fund the cash prizes and awards.

Evaluation and Judging: ASPR in partnership with CDC were responsible for designating the winners. The judging criterion was as follows:

- Clear and consistent message/Overall impact (40%): Does the video show how the contestant/submitter is helping family, friends, community to protect their health during disasters and every day? Is the story clear, educational, inspiring, and persuasive? Does it motivate peers to be more prepared?
- Creativity and originality (30%): How creatively does the video answer the challenge question? How original is the idea?
- Production quality (20%): Does the video effectively use lighting, sound, and editing to tell the story? Is the dialogue clear and easy to understand? Do visual effects (if any) contribute to the message or detract from it?
- Public rating (10%): How does the public rate the video?

These evaluation methods were effective.

Partnerships: ASPR collaborated with Centers for Disease Control and Prevention (CDC), Medical Reserve Corps, 4H (Head, Heart, Hands and Health), and Health Occupations Students of America to socialize the competition in an effort to draw in more participants. Partner organizations

⁵³ www.phe.gov/Preparedness/news/Pages/prep-story-160523.aspx

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provided in-kind support, expertise, marketing, and outreach to push out messages related to the competition. ASPR engaged in partnership with HHS/CDC to support the judging process.

Resources: A total of 115 FTE hours were expended to design and execute the challenge—100 hours at the GS-14 level and 15 hours at the GS-12 level. Additionally, the challenge was run as part of a contract with Capital Consulting Corporation. This challenge was run on the no-cost platform Challenge.gov.

Results: Young producers across the country let their cameras roll this past spring to demonstrate how they protect the health of their families, friends, and communities during disasters and to inspire other young people to do the same. From a field of 94 eligible videos submitted in the first “My Preparedness Story: Staying Healthy and Resilient” video challenge, the top six videos were recognized by the U.S. Department of Health and Human Services (HHS) Office of the Assistant Secretary for Preparedness and Response (ASPR). The video that was the best overall entry was produced by Samantha Johnson, 23, of Anchorage, Alaska, who helped educate viewers about how emergency preparations differ in our nation’s least densely populated state. By submitting the best video for the challenge, she won \$2,000—coincidentally a dollar for each of the 2,000 miles between Alaska and the continental United States.

In the video that won second place, Roxanne Scott, 22, of Sierra Vista, Arizona artfully described steps each person can take to prepare for disasters of any size. She earned a check for \$1,000 for winning second.

Two videos tied for third place. In one of these videos, Zain Hashmat, 18, of Meridian, Mississippi produced a comedy sketch to show that people can never be too prepared, or too waterlogged.

The other third-place video used stop-motion animation to show how young people volunteering in ASPR’s Medical Reserve Corps can help propel public health in their communities. This video was submitted by a team from Texas: Michael Truong, 18, and Hung Le, 18, both of Arlington; Michelle Alvarez, 18, Vivian Nguyen, 18, and Kyle Vu, 18, all of Grand Prairie. Each video earned their producers \$250 for their winning submissions.

Two videos also were selected for honorable mentions: My Preparedness Story: Staying Healthy and Resilient FL Keys Jr. Medical Reserve Corps by Manuel Calabrese, 18; Claudia Cabrera, 15; Jennifer Lopez, 16; Nicole Lera, 16; Claudia Bacallao, 18; and Betsy Estevez, 16, all of Marathon, Florida; and My Preparedness Story: Keep Warm Bags for the Homeless by Abby Wist, 18, of Centennial, Colorado.

The competition submissions opened on January 4, 2016 and closed on March 28, 2016.

A.5.3 CDC: 2015 Million Hearts Hypertension Control Challenge⁵⁴

Summary: Improving hypertension control will directly reduce the number of fatal and non-fatal strokes that occur each year in the United States. Antihypertensive therapy is probably the main

⁵⁴ millionhearts.hhs.gov/partners-progress/champions/index.html

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reason why stroke fatalities have dropped dramatically in the United States over the past 50 years. The Million Hearts® Hypertension Control Challenge is a competition to identify clinicians, practices, and health systems that have demonstrated exceptional achievements in working with their patients to control hypertension. Winners must have a hypertension control rate of at least 70% during the 12-month reporting period among the practice's hypertensive patient population.

Solution Type: Ideas; technology demonstration and hardware; analytics, visualizations, algorithms; and other: innovative care solutions

Primary Goals: Find and highlight innovative ideas; inform and educate the public; and engage new people and communities

Results: The challenge received 26 entries and awarded 18 winners. To date, Million Hearts® has recognized a total of 59 Hypertension Control Champions (56 private, 3 Federal) that serve 13.8 million people, 4.7 million of whom have hypertension, achieving an average blood pressure control rate of 78.2%.

Problem Statement: The Million Hearts® Hypertension Control Challenge is a competition to identify clinicians, practices, and health systems that have demonstrated exceptional achievements in working with their patients to control hypertension. The Million Hearts® Hypertension Control Challenge is open to public and private individual clinicians, practices, and health systems providing health care services to patients in a U.S. state or territory. To be eligible to win the challenge, the nominee must submit a nomination form.

Winners must have a hypertension control rate of at least 70% among the practice's hypertensive patient population during the 12-month reporting period. They must also have a data management system (electronic or paper) that allows for verification of data submitted. The type of systems or processes in place that support hypertension control and are likely to endure, such as electronic reminder systems or team-based care, is also looked at during the selection of winners.

Proposed Goals: To identify practices, clinicians, and health systems that have worked with their patients to achieve hypertension control rates at or above 70% through innovations in health information technology, electronic health records, patient communication, and health care team approaches.

Measures of Success: Success was primarily measured by the number of qualifying entries and the number of winners. Secondly, the strategies used by the applicants to achieve a hypertension blood pressure control rate of 70% or better to either reinforce the tenets of Million Hearts® or highlight original care processes used to improve their outcome measure were also assessed. In addition, the size of the patient population and the hypertension prevalence were used to assess the overall reach of the practices, clinicians, and health systems. Finally, assessment was made on how many champions leveraged quality improvement support provided by private or publicly-funded entities (i.e., Centers for Medicare & Medicaid Services (CMS) Quality Improvement Organizations (QIOs) or Quality Innovation Network (QIN)-QIOs, CMS Accountable Care Organizations (ACOs), or participation in the Center for Medicare and Medicaid Innovation

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innovation models; Office of the National Coordinator for Health Information Technology (ONC) Regional Extension Centers (RECs) and Health Information Technology.

Participants: The Million Hearts® Hypertension Control Challenge was open to public and private individual clinicians, practices, and health systems providing health care services to patients in a U.S. state or territory. The challenge received 26 submissions from 18 entrants.

Timeline: Submissions for this challenge opened August 18, 2015 and closed October 31, 2015. Winners were announced May 5, 2016.

Solicitation and Outreach: The agency marketed the challenge primarily through Million Hearts® partners in order to effectively reach the most appropriate and high quality nominees. The challenge was prominently displayed on the Million Hearts® website. A flyer and badge were created and distributed to provide easy access to the challenge site. Key leaders of agencies and organizations such as the American Medical Association were requested to contact their constituents and encourage them to apply. Following are highlights of how some partners distributed the announcement:

- Million Hearts® sent out the announcement on August 18, 2015 to all 120 partner organizations and 50 state health agency grantees, many of which publicized the announcement;
- Health Resources and Services Administration (HRSA) announced the opportunity to enter into the challenge in their October 2015 issue of the HRSA eNews newsletter sent to approximately 1,300 Federally Qualified Health Centers (FQHCs);
- The National Association of Community Health Centers featured the notice in their newsletter and featured the pending notice at their 2015 Community Health Institute and Expo;
- The National Association of Chronic Disease Directors (NACDD) announced that the challenge was open on their August 18, 2015 general webinar for their 6,000 NACDD members; and
- The American Medical Group Association forwarded the letter to all member groups, promoted through their monthly webinar, shared through their social media channels, posted the challenge badge on their website, and included a notice about the challenge in Inside AMGA and Public Policy e-newsletters.

Future Hypertension Control Challenges intend to use this same method, and will promote the challenge through relevant conferences and journal notifications.

Incentives: Incentives included recognition by Centers for Disease Control and Prevention (CDC) Director Dr. Tom Frieden. In addition to recognition on the Million Hearts® and CDC websites, national press releases were developed to recognize and congratulate champions. Plaques were delivered to each champion. Documentation of clinical systems and the strategies champions adopted that support hypertension control are also housed on the Million Hearts website and attributed to champions.

Evaluation and Judging: Nominations were scored using the following criteria: 95% of the overall score was attributed to the reported hypertension control rate and 5% of the score was based on

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the systems and process reported that supported hypertension control. The nomination was autoscored as it was received. A panel of judges reviewed the top nominations to approve their selection as finalists and to identify questions for further investigation. Each finalist participated in a process to validate the data submitted which was conducted by an independent contractor. For this type of challenge, a more extensive review and minimal validation of the hypertension control rate reported is required.

Partnerships: Implementation of the challenge relied heavily upon existing Million Hearts® partners to promote and judge the challenge. Partners were very responsive in using their social media and web presence to promote and support the challenge. In future challenges, partners should be engaged much earlier to plan and promote the challenge and perhaps as a partner in funding and recognizing the champions.

Resources: Sensis and their platform partner Skild were hired to host the competition, at a cost of \$62,000. CDC also established a cooperative agreement at the cost of \$179,000 with the National Association of Chronic Disease Directors to sub-contract with the National Committee of Quality Assurance to provide assistance in data validation and vetting. Total resources for these two contracts totaled \$241,000.

Results: Improving hypertension control will directly reduce the number of fatal and non-fatal strokes that occur each year in the United States. Antihypertensive therapy is probably the main reason why stroke fatalities have dropped dramatically in the United States over the past 50 years, according to an American Heart Association study published 12/5/2013 in Stroke by DT Lackland, MD. The competition awarded 18 winners, including 10 FQHCs 11 small practices (<50,000 patients), and 7 large practices or health systems. These Hypertension Control Champions also include 4 winners who are affiliated with CMS Accountable Care Organizations (ACOs), 1 winner participating in the CMS Million Hearts® Cardiovascular Disease Risk Reduction Model, 12 winners who had connections to ONC, and 5 winners who participated in the American Medical Group Association Measure Up Pressure Down campaign.

To date, Million Hearts® has recognized a total of 59 Hypertension Control Champions (56 private, 3 Federal) that serve 13.8 million, 4.7 million of whom have hypertension, achieving an average blood pressure control rate of 78.2%.

A.5.4 CDC: Healthcare-Associated Venous Thromboembolism Prevention Challenge⁵⁵

Summary: This challenge was created to draw attention to venous thromboembolism (VTE), blood clots occurring as deep vein thrombosis (DVT), pulmonary embolism (PE), or both—an important and growing public health issue. Prevention of healthcare associated VTE (HA-VTE) is a national hospital safety priority. Many HA-VTEs can be prevented, but VTE prevention strategies are still not being applied regularly or effectively across the United States. By highlighting organizations with effective VTE prevention techniques, this challenge provides awareness of the problem and provides options and motivation for other health care systems to strengthen their VTE prevention efforts.

⁵⁵ www.cdc.gov/ncbddd/dvt/ha-vte-challenge.html

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Solution Type: Ideas; and nominations

Primary Goals: Find and highlight innovative ideas; inform and educate the public and engage new people and communities

Results: The challenge received 19 submissions from across the United States and from Ireland. The eight selected champions ranged from a small community hospital to some of the country's largest health systems, and they represent both rural and urban areas. Together they cared for more than 450,000 patients admitted to hospitals across the United States in 2014. They were able to improve VTE prevention within their institutions and organizations by implementing innovative, effective, and sustainable VTE prevention strategies, including, among others, engaging teams of different healthcare experts to support and promote prevention activities, and using technology (such as electronic risk assessment and clinical decision support tools and alerts) to ensure that all patients are assessed for their risk for VTE and bleeding.

Problem Statement: Venous thromboembolism (VTE), blood clots occurring as deep vein thrombosis (DVT), pulmonary embolism (PE), or both, is an important and growing public health issue. Prevention of healthcare associated VTE (HA-VTE) is a national hospital safety priority. Many HA-VTEs can be prevented, but VTE prevention strategies are still not being applied regularly or effectively across the United States.

To support and promote HA-VTE prevention, HHS/CDC conducted the 2015 HA-VTE Prevention Challenge to bring prestige to organizations that invest in VTE prevention, improve understanding of successful implementation strategies at the health system level, and motivate health systems to strengthen their VTE prevention efforts.

To participate, interested parties were asked to navigate to www.challenge.gov. On this site, nominees had access to the nomination form and the submission link. Information required of the nominees on the nomination form included:

- The name, address, and contact information of the organization nominee;
- The size, scope, and general demographic characteristics of the nominees' patient population;
- Details regarding the nominee's VTE prevention strategy and implementation including the population(s) observed, intervention, and methods of implementation. Examples of strategies include implementation of sustainable systems or processes that support VTE prevention. These may include but are not limited to implementation of VTE protocols and order sets, risk assessment, electronic alerts, clinical decision support tools, performance monitoring systems and dashboards, patient and/or provider education, and post-discharge follow-up;
- A description of the observed results of the VTE prevention strategy including the pre-implementation and post-implementation measures for the observed VTE prevention activity. Examples of outcome measures include but are not limited to the number of patients assessed for VTE risk, the number of at-risk patients receiving appropriate VTE prevention, and the number of patients and/or providers receiving education on VTE prevention; and

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- A brief summary of the barriers and successes to implementation.

Proposed Goals: The goal of the challenge was to identify hospitals, multi-hospital systems, hospital networks, and managed care organizations that have implemented an innovative and effective VTE prevention strategy using one or more interventions (e.g., VTE protocols and order sets, risk assessment, electronic alerts, clinical decision support tools, performance monitoring systems and dashboards, patient and/or provider education and awareness, post-discharge follow-up, etc.) designed to increase VTE prevention.

Primary Objectives:

- Identify public and private hospitals, multi-hospital systems, hospital networks, and managed care organizations that have implemented innovative and successful VTE prevention strategies using one or more VTE prevention interventions;
- Identify Federal and international hospitals, multi-hospital systems, hospital networks, and managed care organizations that have implemented innovative and successful VTE prevention strategies using one or more specific VTE prevention interventions; and
- Document and highlight successful innovative system-level processes or approaches used by high performers to achieve improvement in VTE prevention.

Measures of Success: The HA-VTE Prevention Challenge was very successful at achieving the goals and objectives for the challenge. Eight hospitals and healthcare systems across the United States were recognized as Healthcare-Associated Venous Thromboembolism (HA-VTE) Prevention Champions for their success in implementing innovative and effective ways to prevent venous thromboembolism in healthcare settings. CDC was able to share best practices for VTE prevention at all levels and provide examples of how any health care setting, from a small hospital to a large healthcare system, can implement approaches and tools to improve prevention of HA-VTE.

This challenge and the COMPETES authority provided CDC a lower-cost, quicker method to receive novel and effective ideas and solutions to prevent VTE in hospitals at different sizes and resources. The challenge also allowed CDC to expand its reach beyond its usual partners and collaborators. CDC was able to hear from new partners across the nation and internationally, allowing it to better assess what is working in real world settings to better inform prevention activities and future work. Specifically, CDC was able to:

- Identify organizations that have implemented innovative and effective VTE prevention strategies;
- Identify and promote exemplary strategies for improving VTE prevention;
- Document the systems, processes, and staffing configurations that contribute to success;
- Reward and congratulate organizations who have achieved successful results; and
- Promote these best practices widely to inform and improve VTE prevention in the nation's hospitals and healthcare settings.

Participants: The challenge was open to hospitals, multi-hospital systems, hospital networks, and managed care organizations that have implemented a VTE prevention strategy designed to increase

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VTE prevention and reduce HA-VTE rates in their respective setting(s). There were 19 submissions.

Eligibility Rules for Participating in the Competition:

To be eligible to win a monetary prize under this challenge, an individual or entity:

- Shall have completed and submitted the nomination form in its entirety to participate in the competition under the rules promulgated by HHS/CDC;
- Must be a hospital, multi-hospital system, hospital network, or managed care organization, incorporated in and maintaining a primary place of business in the United States, that provides inpatient medical care for patients;
- May not be a Federal entity or Federal employee acting within the scope of their employment (Federal entities or employees are eligible to participate in the challenge; however, they are not eligible to receive a monetary prize. Federal entities are eligible for non-monetary recognition only.);
- Shall not be an HHS employee working on their applications or submissions during assigned duty hours;
- Shall not be an employee or contractor at CDC;
- Federal grantees may not use Federal funds to develop COMPETES Act challenge applications unless consistent with the purpose of their grant award;
- Federal contractors may not use Federal funds from a contract to develop COMPETES Act challenge applications or to fund efforts in support of a COMPETES Act challenge submission;
- Must agree to participate in a data validation process to be conducted by a CDC-selected contractor. To the extent applicable law allows, data will be kept confidential by the contractor and will be shared with the CDC in aggregate form only (i.e., the VTE prevention coverage rate for the practice not individual data);
- Must have a data management system (electronic or paper) that allows HHS/CDC or their contractor to check data submitted;
- Individual nominees and individuals in a group practice must be free from convictions or pending investigations of criminal and health care fraud offenses such as felony health care fraud, patient abuse or neglect; felony convictions for other healthcare-related fraud, theft, or other financial misconduct; and felony convictions relating to unlawful manufacture, distribution, prescription, or dispensing of controlled substances as verified through the Office of the Inspector General List of Excluded Individuals and Entities.⁵⁶ Individual nominees must be free from serious sanctions, such as those for misuse or misprescribing of prescription medications. Such serious sanctions will be determined at the discretion of the agency consistent with CDC's public health mission. CDC's contractor may perform background checks on individual clinicians or medical practices;
- Health systems must have a written policy in place that conducts periodic background checks as described above on all providers and takes appropriate action accordingly. In addition, a health system background check may be conducted, as deemed necessary, by CDC or a CDC contractor that includes a search for The Joint Commission sanctions and current investigations for serious institutional misconduct (e.g., attorney general

⁵⁶ oig.hhs.gov/exclusions/background.asp

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investigation). CDC's contractor may also request the policy and any supporting information deemed necessary; and

- Must agree to accept the monetary prize and be recognized if selected, and agree to participate in an interview to develop a success story that describes the systems and processes that support VTE prevention. Champions will be recognized on CDC websites. Strategies used by champions that support VTE prevention may be written into a success story, placed on CDC websites, and attributed to champions.

An individual or entity shall not be deemed ineligible because the individual or entity used Federal facilities or consulted with Federal employees during a competition if the facilities and employees are made available to all individuals and entities participating in the competition on an equal basis.

By participating in this challenge, an individual or organization agrees to assume any and all risks related to participating in the challenge. Individuals or organizations also agree to waive claims against the Federal Government and its related entities, except in the case of willful misconduct, when participating in the challenge, including claims for injury, death, damage, or loss of property, money, or profits, and including those risks caused by negligence or other causes.

By participating in this challenge, individuals or organizations agree to protect the Federal Government against third-party claims for damages arising from or related to challenge activities.

Entrants who are a U.S. Federal hospital, multi-hospital system, hospital network, or managed care organization that provides inpatient medical care for patients may apply for non-monetary recognition. No monetary prize will be awarded.

Entrants who are an international hospital, multi-hospital system, hospital network, or managed care organization that provides inpatient medical care for patients may apply for non-monetary recognition. No monetary prize will be awarded.

Timeline: Submissions were opened November 2, 2015 and closed January 10, 2016. Winners were announced March 26, 2016.

Solicitation and Outreach:

- Partnered with other CDC divisions to reach their partners and stakeholders to advertise challenge and announce winners;
- Worked with external partners and other federal agencies to solicit submissions and announce winners—AHRQ, NIH/NHLBI, The Joint Commission, National Blood Clot Association, American Society of Hematology, Thrombosis and Hemostasis Network of America, World Thrombosis Day, International Society of Thrombosis and Haemostasis, and others; and
- Video announcement of challenge winners by Agency Director.

Incentives: Eight entrants were recognized as HA-VTE Prevention champions and received a cash award of \$10,000. Additionally four honorable mention awards were identified but did not receive a cash award. Other non-monetary incentives received included a formal congratulatory letter from Dr. Frieden; national recognition as an HA-VTE Prevention champion or honorable mention by

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CDC through press releases, social media, and awardee profiles on CDC’s website dedicated to the challenge winners⁵⁷; formal recognition at a plenary session at the Thrombosis and Hemostasis Summit of America (THSNA) bi-annual meeting; and an in press supplement in the *Journal of Hospital Medicine*.

Evaluation and Judging: Challenge submissions were evaluated by a panel of five judges (three from CDC, one from AHRQ, and one from NIH). The judges used a rubric based on the following evaluation criteria: methods (30% of score), results (50% of score), and feasibility/utility (20% of score) of the strategy and interventions associated with the intended outcome of interest. Entrants were divided and reviewed within categories so that organizations with similar size (number of beds, patient admissions, hospitals, etc.) were evaluated together. In addition to the size, we also left open the consideration for the final selection to include geographic distribution and scope (urban, rural) to ensure a balance of champions.

Category	Criteria	Weight (points)
Methods	Was the problem statement clearly stated? Was the strategy clearly described and appropriate for the organization? Were the interventions scientifically sound? Were data collection and evaluation methods, including case definitions, patient population, time frame, baseline and outcome measures, clearly defined and appropriate?	30
Results	Were pre- and post-intervention measures provided and interpreted correctly? Was the intervention (or interventions) successful in increasing VTE prevention? Did the organization offer insightful reflection on reasons for success, challenges or limitations, lessons learned and future steps?	50
Feasibility & Utility	Can the intervention(s) be easily and routinely monitored and updated? Can the intervention(s) be applied to diverse populations or similar settings? Will the strategy and intervention(s) employed result in a reduction of VTE events over time?	20

Partnerships: Partners included the Agency for Healthcare Research and Quality (AHRQ) to promote the challenge and its winners. Because of the short timeline there was difficulty creating more formal partnerships for this challenge. In the future this challenge would formalize partnerships and any MOUs earlier in the development process.

Resources: Using HHS’s blanket purchasing agreement for challenges, SENSIS Agency was contracted to help conduct this challenge. Funds were used to develop the submission website, judging web-based platform, and pre- and post-challenge materials and promotions, which

⁵⁷ www.cdc.gov/ncbddd/dvt/ha-vte.html

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included pre-challenge fact sheets and flyers, graphics for the challenge, profile factsheets of the winners, payment of prizes, posters for the THSNA meeting, and coordination of the journal supplement.

Results: The challenge received 19 submissions from across the United States and from Ireland. The eight selected Champions range from a small community hospital to some of the country's largest health systems, and they represent both rural and urban areas. Together they cared for more than 450,000 patients admitted to hospitals across the United States in 2014. They were able to improve VTE prevention within their institutions and organizations by implementing innovative, effective and sustainable VTE prevention strategies, including these:

- Engaging teams of different healthcare experts to support and promote prevention activities;
- Informing patients and providers about the need for and benefits of VTE prevention;
- Using technology (such as electronic risk assessment and clinical decision support tools and alerts) to ensure that all patients are assessed for their risk for VTE and bleeding. These tools also help ensure patients, when appropriate, are provided with and use appropriate prevention measures for their level of risk; and
- Providing real-time feedback, scorecards, and dashboards for providers and organizations to monitor performance and identify areas for improvement.

CDC also recognized four organizations with honorable mentions for their innovative and unique approaches to prevention in special populations and settings. These included post-discharge monitoring, a unique ambulation program for psychiatric inpatients, an innovative prophylaxis-dosing protocol for level 1 trauma units, and an international submission on risk assessment for obstetric patients.

The HA-VTE Prevention Challenge Champions are:

Large Healthcare Network or Multi-Hospital System

- Mayo Clinic, Rochester, Minnesota
- University of California Health, Center for Health Quality and Innovation, Oakland, California

Medium Healthcare Network or Multi-Hospital System

- University of Wisconsin Health, Madison, Wisconsin
- Intermountain Healthcare, Murray, Utah

Large Single Hospital

- Northwestern Memorial Hospital, Chicago, Illinois
- The Johns Hopkins Hospital, Baltimore, Maryland

Small to Medium Single Hospital

- Harborview Medical Center, Seattle, Washington
- Hutchinson Regional Medical Center, Hutchinson, Kansas

Honorable Mention for Unique Populations and Interventions

- Michigan Hospital Medicine Safety Consortium, Ann Arbor, Michigan
- Sheppard Pratt Hospital, Baltimore, Maryland
- Rotunda Hospital, Dublin, Ireland
- University of Cincinnati Medical Center, Cincinnati, Ohio

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A.5.5 CMS: “A Bill You Can Understand” Design and Innovation Challenge⁵⁸

Summary: This challenge aimed to produce designs for more understandable medical bills to improve patient experience. Two winners were chosen. RadNet aimed to make bills as concise as possible and aligned with patients’ current experiences. Color coding and plain language explanations made bills easier to read. Sequence’s “Clarify” provided an online and mobile service that allowed patients more opportunity to search and compare options when handling their bills, providing a personalized service.

Solution Type: Software and apps; creative (design and multimedia); technology demonstration and hardware; ideas; and analytics, visualizations, algorithms

Primary Goals: Find and highlight innovative ideas; solve a specific problem; and engage new people and communities

Results: Two winners were chosen. RadNet aimed to make bills as concise as possible and aligned with patients’ current experiences. Color coding and plain language explanations made bills easier to read. Sequence’s “Clarify” provided an online and mobile service that allowed patients more opportunity to search and compare options when handling their bills, providing a personalized service.

Problem Statement: Patients in the U.S. struggle to understand their medical bills and the medical billing process. Providers, payers, and consumers all benefit if we improve the current system. This design and innovation challenge sought to tackle a current consumer pain point to help deliver solutions that result in clearer, less complex, and more understandable medical bills that ultimately improve the patient financial experience.

Many health care organizations have been doing important work to address the complex problems that individuals face when navigating the medical billing process. A national challenge presented a unique opportunity to both support these ongoing efforts and catalyze innovation by bringing new players to the table—designers, developers, digital tech start-ups, entrepreneurs, and other innovators—who may traditionally be outside the healthcare space.

Participants were asked to submit the following components in order for their submissions to be considered complete and eligible to win the challenge:

- A written design brief (not to exceed 2,250 words) describing the concept, the design principles it follows, and how it meets the evaluation criteria;
- A brief video (less than three minutes) describing the concept, the design principles it follows, and how it meets the evaluation criteria;
- Visual compositions (including information, layout, and aesthetic) of the tools and materials the patient may see and interact with, including the medical bill itself; and

⁵⁸ www.abillyoucanunderstand.com

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- A journey map that illustrates changes to the medical billing process from the patient's perspective in terms of his/her specific experience and what solutions are provided by the health care organizations involved.

Proposed Goals: The dual purpose of this challenge was to catalyze private sector innovation to redesign the medical bill itself so that it is easier for patients to understand, as well as to innovate the experience of medical billing to make the financial aspect of health easier to manage. With this challenge, HHS started a national conversation about what steps can be taken to improve the medical bill and patients' experience of the medical billing process—something many Americans have voiced that they want addressed. The challenge invited new players that may traditionally be outside the health care space, such as designers, developers, digital tech start-ups, entrepreneurs, and other innovators, to be part of the solution.

Measures of Success: Success was also measured by lining up a set of pioneering health systems and payers, or "pilot partners," who were willing to work with HHS to develop the challenge, and commit to evaluating and testing the concepts that emerged from the challenge for real-world implementation. The pilot partners' commitment allowed HHS to create a path forward for the challenge winners and participants receiving honorable mention to further develop and drive their solutions toward implementation. The challenge provided pilot partners, and other interested stakeholders in health care, the opportunity to uncover new ideas and opportunities to improve medical billing for patients and families navigating the U.S. health care system.

Participants: The challenge was open to any contestant, defined as (1) a business or non-profit entity or (2) an individual or team of no more than five U.S. citizens or permanent residents of the United States who are 18 years of age or older at the time of entry. All individual members of a team had to meet the eligibility requirements.

To be eligible to win a prize under this challenge, an individual or entity:

- Shall have registered to participate in the competition under the rules issued by Centers for Medicare & Medicaid Services (CMS);
- Shall have complied with all the requirements under this Notice, the rules for participants referenced herein below, and the requirements set forth in 15 U.S.C. 3719;
- In the case of a private entity, shall be incorporated in and maintain a primary place of business in the United States, and in the case of an individual, whether participating singly or in a group, shall be a citizen or permanent resident of the United States; and
- May not be a Federal entity or Federal employee acting within the scope of their employment. Federal employees seeking to participate in this contest outside the scope of their employment should consult their ethics official prior to developing their submission.
- May not be employees of CMS, judges of the challenge, or any other party involved with the design, production, execution, or distribution of the challenge or their immediate family (spouse, parents or step-parents, siblings and step-siblings, and children and step-children);
- May not be the trustees, directors, shareholders, employees, clients (with respect to Mad*Pow only), contractors, agents, representatives, and affiliates of AARP, Mad*Pow and any entity associated with the funding, administration, judging, or processing of the challenge and the members of the immediate family which includes a person's

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spouse/domestic partner and the parents, siblings, children and grandchildren of the person and his or her spouse/domestic partner;

- Federal grantees may not use Federal funds to develop COMPETES Act challenge applications unless consistent with the purpose of their grant award;
- Federal contractors may not use Federal funds from a contract to develop COMPETES Act challenge applications or to fund efforts in support of a COMPETES Act challenge submission;
- An individual or entity shall not be deemed ineligible because the individual or entity used Federal facilities or consulted with Federal employees during a competition, if the facilities and employees are made available to all individuals and entities participating in the competition on an equitable basis.

By entering, each contestant agreed to:

- Comply with, and be bound by, these official rules and the decisions of the challenge and judges which are binding and final in all matters relating to this challenge;
- Assume any and all risks and waive claims against the Federal Government and its related entities, except in the case of willful misconduct, for any injury, death, damage, or loss of property, revenue, or profits, whether direct, indirect, or consequential, arising from the contestant's participation in the challenge, whether the injury, death, damage, or loss arises through negligence or otherwise. The contestant/submitter shall be liable for, and shall indemnify and hold harmless the government against, all actions or claims for any claim, demand, judgment, or other allegation arising from alleged violation of an individual's trademark, copyright, or other legally protected interest in challenge entries submitted to Mad*Pow. Provided, however, that contestants are not required to waive claims arising out of the unauthorized use or disclosure by AARP and/or Mad*Pow of the intellectual property, trade secrets, or confidential business information of the contestant;
- Be responsible for obtaining their own liability insurance to cover claims by any third party for death, bodily injury, or property damage, or loss resulting from an activity carried out in connection with participation in the challenge, and claims by the Federal Government for damage or loss to government property resulting from such an activity; and
- Indemnify the Federal Government against third-party claims for damages arising from or related to challenge activities.

Based on the subject matter of the challenge, the type of work that it will possibly require, as well as an analysis of the likelihood of any claims for death, bodily injury, property damage, or loss potentially resulting from challenge participation, no individual (whether competing singly or in a group) or entity participating in the challenge is required to obtain liability insurance or demonstrate financial responsibility in order to participate in this challenge.

Contestants who are determined at any time to have violated the eligibility criteria will be disqualified from the challenge.

Timeline: Submissions were opened May 9, 2016 and closed August 10, 2016. Winners were announced September 28, 2016.

Solicitation and Outreach:

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- Social Media;
- Email Outreach;
- Press Release;
- High-profile challenge announcements (e.g., HHS Secretary Sylvia Burwell announced the challenge at Health Datapalooza, generating national, regional, and trade press coverage; HHS Assistant Secretary for Health, Dr. Karen DeSalvo announced the challenge winners at the Health 2.0 Annual Fall Conference, generating regional and trade press coverage); and
- Partnership with Outside Organizations.

Incentives: AARP, the financial sponsor for this challenge, provided \$10,000 for the prize purse. In addition to cash prizes, winners were given national, public recognition. Winners and entrants receiving honorable mention for their submissions were able to access health care systems and payers committed to improving the patient financial experience, as well as benefit from expert and patient input on their designs (provided through the selection process).

Evaluation and Judging: A Federal panel of judges was responsible for the final designation of winners.

Judges:

- Dr. Patrick Conway, Deputy Administrator for Innovation & Quality, Chief Medical Officer, Centers for Medicare & Medicaid Services, U.S. Department of Health and Human Services
- Dr. Karen DeSalvo, Acting Assistant Secretary for Health, U.S. Department of Health and Human Services
- Dr. Mary Wakefield, Acting Deputy Secretary, U.S. Department of Health and Human Services

Submissions that received the highest aggregate score from a ten-point scale for each core and applicable additional criterion were selected as winners. The Federal panel had the benefit of scores and feedback, including a recommendation on top ten submission (five for each prize) from a stakeholder Advisory Panel. These top ten recommendations were also shared with a patient focus group, such that the Federal panel could also take input from a diverse set of real patients when scoring these submissions.

Winners were selected based on how well they addressed core criteria and additional criteria specific to each prize. Core criteria included:

- Most appropriate use of information and data;
- Addresses top concerns associated with the current medical billing experience;
- Usefulness and understandability of patient facing materials and tools (including the medical bill and any other patient facing materials and tools);
- Use of human-centered design process in creation of concept;
- Use of plain language; and
- Uniqueness and creativity of solution.

Additional Criteria for Prize 1: Easiest Bill to Understand

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- Addresses issues and opportunities associated with bill design; and
- Incremental innovation—works within existing models (workflow, data, technology, patient facing materials, and tools).

Additional Criteria for Prize 2: Transformational Approach

- Addresses issues and opportunities associated with medical cost estimation and billing journey;
- Alignment with modern consumer expectations; and
- Future forward innovation—evolves existing models (workflow, data, technology, patient facing materials, and tools).

Partnerships: AARP was the financial sponsor, providing funds for challenge administration and the \$10,000 prize purse. Mad*Pow entered into a memorandum of understanding with HHS to administer the challenge, subcontracting Health 2.0. The “pilot partner” health systems and payers (Cambia Health Solutions, Geisinger Health System, Integris Health, The MetroHealth System, Providence Health & Services, and University of Utah Health Care) provided guidance during challenge development and comprised the Advisory Panel alongside other stakeholders. These other stakeholders included health experience designers from Mad*Pow, innovators and subject matter experts from AARP, health literacy experts, academics, consumer and patient advocates. The patient advocacy coalition, Partners for Better Care, facilitated the patient focus group leveraged during the evaluation process.

Additional collaborators providing expertise, challenge design, or promotional support include:

- American Hospital Association (AHA);
- American Medical Association (AMA);
- Center on Health Insurance Reforms, Health Policy Institute, Georgetown University;
- Community Catalyst: Center for Consumer Engagement in Health Innovation;
- Department of Health Care Policy, Harvard Medical School;
- Families USA;
- Healthcare Financial Management Association (HFMA);
- Humana;
- Kaiser Permanente;
- Partners for Better Care;
- Roundtable on Health Literacy of the National Academies of Sciences, Engineering, and Medicine; and
- Simplee.

Resources: HHS personnel from the Office of the Secretary were deployed toward the execution of this challenge. These personnel secured a memorandum of understanding with Mad*Pow to administer the challenge. In turn, Mad*Pow secured AARP as a financial sponsor to fund challenge administration and the prize purse.

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Results: Participants hailed from health care companies, organizations, design agencies, and/or were independent citizens from across the country. Many were new to working with the Federal Government and/or outside the traditional health care space.

The challenge was open to any contestant, defined as (1) a business or non-profit entity or (2) an individual or team of no more than five U.S. citizens or permanent residents of the United States who are 18 years of age or older at the time of entry.

Prize 1 was awarded to RadNet⁵⁹ of Los Angeles, CA. RadNet's design aims to make the bill as concise as possible. RadNet provides adaptable bills that line up with the patient's current experience, including options for uninsured patients and for patients who are past due on payments. Their use of color segments make it easy for patients to locate and read specific information, and the bill includes a clear presentation of payment due, payment options, and insurance details. Additionally, plain language explanations put charges in context.

Prize 2 was awarded to Sequence⁶⁰ of San Francisco, CA. Sequence developed "Clarify," a new online- and mobile-based service that extends a retail model of consumer behavior to medical billing. "Clarify" presents health care services in new ways that allow people to search, browse, weigh their options, compare prices, and decide how they will pay. By modernizing, automating, and personalizing the transactional aspect of health care services, "Clarify" could enable better relationships among consumers, providers, and payers.

A.5.6 CMS: Merit Based Incentive Payment System (MIPS) Mobile Challenge⁶¹

Summary: The Medicare Access and CHIP Reauthorization Act of 2015 requires the Secretary to establish a new Merit-based Incentive Payment System (MIPS) program, which will assist the Centers for Medicare & Medicaid Services (CMS) in accelerating the transition from the traditional fee-for-service payment model to a system that rewards health care providers for value rather than volume of services provided. One of the most important aspects and challenges of the program is educating and providing outreach to the potential 1.2 million MIPS clinicians. Feedback received from customers/end users is that they want more real-time information and access to assistance so they can successfully report to CMS programs. CMS launched a MIPS mobile challenge to find innovative ways of improving communication to educate physicians, support staff, health organization leadership, data vendors, and other impacted parties. This challenge has the potential to make a significant impact as not only are there 1.2 million MIPS clinicians but also millions of people who support the success of these MIPS clinicians. Having key information and access to the right support at the right time reduces burden and provides increased satisfaction for the MIPS clinicians and their supporting entities.

Solution Type: Websites and apps; and ideation/creative (design and multimedia)

⁵⁹ www.abillyoucanunderstand.com/winners-list/prize-1-winner

⁶⁰ www.abillyoucanunderstand.com/winners-list/prize-2-winner

⁶¹ www.challenge.gov/challenge/medicare-program-merit-based-incentive-payment-system-mips-mobile-challenge-phase-ii

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Primary Goals: Inform and educate the public about a new quality reporting program; build the solution around the user community; and engage new people and communities

Results: Five winners were awarded from Phase 1, and one was awarded from Phase 2.

Problem Statement: The Medicare Access and CHIP Reauthorization Act of 2015 (Pub. L. 114 10, enacted April 16, 2015) (MACRA) requires the Secretary to establish a new Merit-based Incentive Payment System (MIPS) program, which will assist the Centers for Medicare & Medicaid Services (CMS) in accelerating the transition from the traditional fee-for-service payment model to a system that rewards health care providers for value rather than volume of services provided. The MIPS program combines parts of the Physician Quality Reporting System, the Value Modifier (VM or Value-based Payment Modifier), and the Medicare Electronic Health Record (EHR) Incentive Program into one single program that assesses the performance of MIPS eligible clinicians based on four performance categories: (1) quality; (2) resource use; (3) clinical practice improvement activities; and (4) meaningful use of certified EHR technology. This program has the potential of impacting 1.2 million MIPS clinicians.

One of the most important aspects and challenges of the program is educating and providing outreach to the potential 1.2 million MIPS clinicians. Feedback received from customers/end users is that they want more real-time information and access to assistance so they can successfully report to CMS programs.

Proposed Goals: CMS launched a MIPS mobile challenge to find innovative ways of improving communication to educate physicians, support staff, health organization leadership, data vendors, and other impacted parties. Due to the multiple user types and facets of the MIPS program CMS is interested in mobile platforms, which could be a mobile site or application to determine how to best keep customers/end users informed and meet their specific needs. CMS also wants to provide assistance to help MIPS clinicians learn and get help with specific concerns. This challenge has the potential to make a significant impact as not only are there 1.2 million MIPS clinicians but also millions of people who support the success of these MIPS clinicians. Having key information and access to the right support at the right time reduces burden and provides increased satisfaction for the MIPS clinicians and their supporting entities.

Measures of Success: Having key information and access to the right support at the right time reduces burden and provides increased satisfaction for the MIPS clinicians and their supporting entities. Running the challenge will help CMS evaluate if an app or mobile technology would benefit MIPS clinicians. Doing this through the challenge would help CMS better focus contract funding to build the right solution the first time.

Participants: Anyone interested in developing a solution to meet the intended audience's needs.

Eligibility requirements:

- Entrants shall register to participate in the competition under the rules promulgated below by the Department of Health and Human Services (HHS);

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- In the case of a private entity, shall be incorporated in and maintain a primary place of business in the United States, and in the case of an individual, whether participating individually or in a group, shall be a citizen or permanent resident of the United States;
- HHS Employees may participate in the MIPS Mobile Challenge, but may not submit in the scope of their employment and may not pursue an application while in the Federal workplace or while on duty;
- Shall not be an employee of the CMS;
- Federal grantees may not use Federal funds to develop the America COMPETES Reauthorization Act of 2010 (Pub. L. 111-358, enacted January 4, 2011) (COMPETES Act) challenge applications unless consistent with the purpose of their grant award;
- Federal contractors may not use Federal funds from a contract to develop COMPETES Act challenge applications or to fund efforts in support of a COMPETES Act challenge submission; and
- Applicants must agree to provide the Federal Government an irrevocable, royalty-free, non-exclusive worldwide license in the winning work(s) or component parts thereof, in the event that they are prize winner(s). HHS shall be granted the rights to reproduce, distribute copies to the public, publicly display, create derivative works, and publicly post, link to, and share the winning work(s) or parts thereof.

Timeline: Phase 1 ran from May 3, 2016 to August 30, 2016, when winners were awarded. Phase 2 began August 15, 2016, and concluded with the announcement of winners November 15, 2016.

Solicitation and Outreach: N/A

Incentives: \$75,000 was offered as the total prize, originating from E & O MACRA Funds. The public announcement of winners also served as a non-monetary incentive.

Evaluation and Judging: The judges were all CMS employees. A standard survey was used, based on the criteria, with every judge reviewing the submissions to help eliminate bias.

Partnerships: No partnerships were utilized.

Resources: The amounts listed above for the contracting with Capital Consulting and then three Federal employees to support the challenge.

Results: Five winners were awarded from Phase 1, and one was awarded from Phase 2.

A.5.7 ONC Consumer Health Data Aggregator Challenge⁶²

Summary: The lack of interoperability between electronic health record (EHR) systems remains a significant barrier to the modernization of health IT, making it difficult to effectively transfer from a paper-based to an electronic health record system. Fast Healthcare Interoperability Resources (FHIR), developed by HL7, is a standard designed to improve interoperability. The Consumer

⁶² www.challenge.gov/challenge/consumer-health-data-aggregator-challenge

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Health Data Aggregator Challenge, combined with its partner challenge, the Provider User Experience Challenge, is part of ONC's Connecting and Accelerating a FHIR App Ecosystem initiative. This initiative calls on innovators to develop market-ready software apps for consumers and healthcare providers in an effort to improve the health and care of the country.

Solution Type: Software and apps

Primary Goals: Solve a specific problem; engage new people and communities; and stimulate a market

Results: Phase 1 required the creation of an app development proposal, which included detailed technical plans, mockups/wireframes of the proposed app, a business model/sustainability plan, and demonstration of agreements to conduct pilot testing with actual users. Twenty-five submissions were received for Phase 1. Virtually all submissions were by small technology companies that already had a product available or in development, which they planned to modify. Phase 2 required the actual development of the proposed app (or modification of an existing one). Evaluation criteria were similar to those of Phase 1, just modified to reflect review of an app rather than a proposal.

Problem Statement: The lack of interoperability between electronic health record (EHR) systems remains a significant barrier to the modernization of health IT. Fast Healthcare Interoperability Resources (FHIR), developed by HL7, is a standard designed to increase the liquidity of granular patient data.⁶³ The FHIR API allows data to move between vendor systems at different providers and to third-party applications for direct use by consumers. The latter use case is key to enabling patients to play a more active role in managing their health. Patients' ability to seamlessly take their data with them as they move from provider to provider is one of the main goals of moving from a paper-based to an electronic health record system. The Consumer Health Data Aggregator Challenge, combined with its partner challenge, the Provider User Experience Challenge, is part of ONC's Connecting and Accelerating a FHIR App Ecosystem initiative. This initiative calls on innovators to develop market-ready software apps for consumers and healthcare providers in an effort to improve the health and care of the country.

Proposed Goals: The Consumer Health Data Aggregator Challenge has several objectives, the primary one being to increase the number of apps available to consumers that can aggregate their data from multiple sources. Specifically, this had to be done using the FHIR API, which is the most widely-known and developed open API for exchanging patient health data. Even as the open API with the highest level of awareness, the challenge was also intended to raise this level higher, and to incentivize more developers to work with and familiarize themselves with FHIR.

Measures of Success: The clearest measure of success will be the number of apps available for public download and use for consumers by the conclusion of Phase 2 of the challenge. A second degree of success will be measured by follow-on actions involving Phase 2 participants and their apps—how many times have they been downloaded and are they rated well by users? Do challenge

⁶³ More on FHIR can be found at www.hl7.org/fhir/overview.html

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participants execute new business arrangements with other health companies? Do they receive useful, non-Federal publicity from winning or participating in the challenge?

Participants: While the challenge is open to any developer, the need to understand the intersection of EHRs, patient care, and patient data sharing made it most relevant to companies that already had working knowledge of those areas and are active in health IT. The challenge was run under the authority of Section 105 of the America COMPETES Reauthorization Act and therefore had the eligibility criteria pursuant to it. The challenge received 25 submissions in Phase 1.

Timeline: Phase 1 opened March 1, 2016 and closed June 1, 2016, with winners announced July 18, 2016. Phase 2 opened June 2, 2016, and closed November 7, 2016, with winners announced January 11, 2017.

Solicitation and Outreach: The Consumer Health Data Aggregator and Provider User Experience Challenges were announced by the National Coordinator for Health IT at a prominent industry conference, HIMSS, on March 1, 2016. Many of ONC's communications channels were leveraged, including blog posts, social media, press releases, webinars, and listservs.

Incentives: The challenge has a prize purse of up to \$175,000. In Phase 1, up to five prizes of \$5,000 to \$15,000 were available; four \$10,000 prizes were awarded. In Phase 2, prizes available for award include one \$50,000 first prize, one \$25,000 second prize, and an additional \$25,000 prize for the app demonstrating the highest level of patient data exchange. The primary non-monetary incentives are the publicity and recognition for winning an ONC challenge. Award funds were disbursed by a contractor acquired through the HHS Competes Blanket Purchasing Agreement.

Evaluation and Judging: A combined review panel of Federal and non-Federal subject matter experts reviewed and scored all Phase 1 submissions; the Federal challenge managers selected the winners, factoring in those reviews. In Phase 1, equal co-winners were chosen rather than ranked winners because the submissions—written proposals—are steps toward the eventual outcome of the challenge, not the outcome itself. The final outcomes of Phase 2—consumer apps—will be ranked and awarded. Four evaluation criteria were used to review submissions: the technical feasibility of the plan; the adherence to data privacy and security best practices and applicable law; the strength of the business/sustainability plan; and the provider and/or health IT developer partnerships. These criteria captured the most important aspects that needed to be identified in the submissions.

Partnerships: No partnerships were utilized.

Resources: A small ONC team, with one primary challenge manager, developed and executed the Consumer Health Data Aggregator and Provider User Experience Challenges. Additional funds for the challenge prizes were required on top of the annual ONC challenge funding allocation; these were designated to the project from the national coordinator's discretionary pool. A third-party contractor, acquired through the HHS Competes Blanket Purchasing Agreement, provided administrative, management, and communications assistance. Given the challenge manager's

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extensive experience in running prize challenges, challenge development services were not needed.

Results: The challenge has two phases. Phase 1 required the creation of an app development proposal, which included detailed technical plans, mockups/wireframes of the proposed app, a business model/sustainability plan, and demonstration of agreements to conduct pilot testing with actual users. Twenty-five submissions were received for Phase 1, one of which was assessed as not eligible. Virtually all submissions were by small technology companies that already had a product available or in development, which they planned to modify. Four winners (out of a maximum of five) were selected to each receive a \$15,000 prize. Phase 2 required the development or modification of the app, which was to be submitted along with a video demo and slide deck. Five submissions were received, from which two winners were selected, each receiving an award of \$50,000

A.5.8 FDA: The 2016 Naloxone App Competition⁶⁴

Summary: This challenge is designed to help address the growing health problem of opioid overdose by creating a smartphone app that can help alert persons with Naloxone, a medication that reverses the effects of opioid overdose, to individuals suffering from an overdose.

Solution Type: Software and apps

Primary Goals: Find and highlight innovative ideas; solve a specific problem; and engage new people and communities

Results: Registration for the competition closed on October 7, 2016. One hundred fifty-three teams registered with a total of 452 individuals. The winning submission was OD Help, submitted by Team Pwrdbby, a small startup based in Venice, California.

Problem Statement: In 2014, nearly two million Americans aged 12 or older either abused or were dependent on opioid- analgesics, and 61% of drug overdose deaths involved either an opioid analgesic or heroin. Naloxone reverses the effects of an opioid overdose, whether from prescription opioids or heroin. It is a prescription drug with few side effects that works rapidly and can be life-saving. Although most frequently used in emergency rooms and on ambulances, many states have recently taken steps to make it easier for people in the general public, including family and friends of drug users, to carry and administer naloxone.

Despite the increasing availability of naloxone, people carrying naloxone are often unaware when an overdose occurs nearby. Currently, there are no mechanisms to alert carriers of naloxone to a person in need of the medication.

FDA hosted the 2016 FDA Naloxone App Competition to encourage computer scientists, public health advocates, clinical researchers, and entrepreneurs to develop creative solutions to this problem. Specifically the goal of the competition was to generate innovative ideas for a

⁶⁴ www.challenge.gov/challenge/the-2016-fda-naloxone-app-competition

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smartphone app that connects people experiencing an opioid overdose to nearby carriers of naloxone. FDA sought submissions that were readily scalable, free or low-cost to the end-user, and took advantage of existing systems for naloxone distribution and use.

Proposed Goals: The primary objectives of the prize competition were to: spur innovation around the development of an app that increases the likelihood of timely naloxone administration by connecting opioid users experiencing an overdose with nearby naloxone carriers; propose innovative solutions to the opioid overdose epidemic, and foster the development of a multi-disciplinary community engaged in addressing this public health issue.

Measures of Success:

Measures of success include registration for the Naloxone App Competition, participation in the optional two-day Code-A-Thon event held midway through the Competition, and the number of eligible app prototype submissions received.

Participants: A total of 153 teams registered, encompassing 452 participants. 45 submissions were evaluated by judges from FDA, the National Institute of Drug Abuse, and the Substance Abuse and Mental Health Services Administration. The winning team, announced on December 16, 2016, was Team Pwerdby.⁶⁵ A video demonstrating their app can be found at: www.youtube.com/watch?v=wiiNvSLbUgo&feature=youtu.be

Timeline: Submissions opened September 23, 2016 and closed November 7, 2016. Winners have yet to be announced.

Solicitation and Outreach: Media calls with interested stakeholder communities were held to respond to inquiries about the challenge. Social media outlets such as twitter (#naloxoneapp), and the FDA website were used to engage interested participants and to communicate up-to-date information on the challenge.

Incentives: The highest scoring entrant, based on the aforementioned description, received \$40,000.

Evaluation and Judging: Judging of submissions was based on the minimum requirements outlined below along with four equally weighted criteria: innovation, usability, functionality and adaptability. The minimum requirements for the proposed app were: use of crowd-sourcing technology to identify one or more individuals in close proximity to the overdose who could administer naloxone; minimize the time required to identify one or more individuals in close proximity to the overdose who could deliver naloxone to an individual experiencing an opioid overdose; and compatibility with multiple platforms, including Android and iOS. Submissions were required to include a video of the functional app prototype and a supporting summary document.

Partnerships: In-kind support from NIDA and SAMHSA in the form of subject matter experts, judges and presenters at the Code-A-Thon.

⁶⁵ www.fda.gov/NewsEvents/PublicHealthFocus/ucm533711.htm

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Resources: N/A

Results: A total of 153 teams (452 participants) registered for the Naloxone App Competition. Over 30 teams participated, either in-person or virtually, in the two-day Code-A-Thon event on the FDA campus, at which participants heard background presentations on topics ranging from an overview of the opioid epidemic and the Emergency Medical System, to a discussion of mobile health IT. At the close of the Code-A-Thon, twenty teams briefly pitched their ideas to receive feedback from other participants. By the submission deadline, FDA received 45 eligible mobile app prototypes. Throughout the process, the Competition garnered significant interest from the tech community, in the lay press, and from those interested in addressing this public health issue.

A.5.9 HRSA: Bridging the Word Gap Challenge⁶⁶

Summary: This challenge is designed to address the “word gap,” a term coined to describe research that indicates that children from low income families hear approximately 30 million fewer words than children from higher income families, leading to children falling behind in vocabulary and school readiness before they even start kindergarten, and shaping educational and health outcomes for decades to come. This challenge hopes to produce scalable, technology based systems that will encourage family members and caregivers to focus on their child’s early language environment, and help close the word gap, giving children an opportunity to start their education on a more even footing. The challenge has so far brought in tremendous innovation in producing creative, effective, scalable systems.

Solution Type: Software and apps; ideas; and technology demonstration and hardware

Primary Goals: Solve a specific problem; develop technology; and inform and educate the public

Results: The prize is currently in Phase 3; five winners from Phase 2 advanced to participate in this final phase. These teams’ interventions represent an incredible diversity of approaches and expertise, including hardware devices, apps that provide feedback to families, apps that are location-based and send prompts to parents in real-time, and apps that are available in English and Spanish. The challenge ended on March 26, 2017. The final winner will be announced in May 2017.

Problem Statement: Research shows that during the first three years of life, a poor child hears roughly 30 million fewer words than his or her more affluent peers. This is known as the “word gap,” and it can lead to disparities not just in vocabulary size, but also in school readiness, long term educational and health outcomes, earnings, and family stability even decades later. In fact, children who experience this drought in heard words have vocabularies that are half the size of their peers by age three, putting them at a disadvantage before they even step foot in a classroom.

The good news is that technologies now exist to support low-cost, broadly scalable approaches to helping parents/caregivers focus on the early language environment, and the technical expertise

⁶⁶ www.wordgapchallenge.hrsa.gov

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exists to address the issue in creative ways. This challenge was designed to cultivate an environment to attract a broad array of innovators from multiple disciplines to propose inventive, creative, and effective interventions to address the word gap through technology.

For Phase 1, participants were asked to submit their ideas for a technology-based device that encourages more back-and-forth interaction between caregivers and young children. The 10 teams with the best ideas were each awarded \$10,000, which they used to develop (or adapt) and test their intervention in Phase 2. On September 22, 2016, these teams competed in a live Demo Day where they demonstrated their devices to a panel of judges, and five finalists were selected to advance to Phase 3, each receiving \$25,000. Currently in Phase 3, these five teams are implementing their device/intervention at larger scale, in a program or community, to test the scalability of their intervention at low cost. The final winner will be awarded at the conclusion of this phase in March 2017 and will receive a prize of \$100,000.

For each stage, the evaluation criteria were adjusted, however the core subjects of accessibility, measurability, sustainability, and impact were guides for the judging of submissions.

The challenge works in collaboration with the HRSA-funded Bridging the Word Gap Research Network, a collaborative network of more than 100 nationally recognized researchers, practitioners, policymakers, and funders working together on a coordinated national research agenda that addresses the word gap.

Proposed Goals: The main goal of the challenge, as put forth in the challenge statement, is to spur the development of a low-cost, scalable, technology-based intervention that drives parents and caregivers to talk and engage in more back-and-forth interactions with their young children (ages 0-4). But in addition to spurring innovation in technology-based solutions, the larger goals were also to raise awareness of the word gap issue, to spur innovation in the market, and to partner with non-traditional partners to address this issue through innovative means. Through the challenge, HRSA hopes to have one intervention that will win the final prize at the conclusion of Phase 3, and also to have spurred multiple promising interventions through the phased approach, from teams who have been exposed to multiple non-monetary incentives and support throughout the challenge. In addition, through promoting the winners at each phase, HRSA has drawn attention to the challenge (especially via a strong social media presence at the Demo Day) and to the word gap issue, and has developed partnerships with other agencies and with external groups. HRSA will continue this collaborative work to address the word gap and maintain these partnerships after the conclusion of the challenge.

Measures of Success: The competition is still underway, but HRSA already has some examples of success. After advertising the challenge widely, the first phase received 80 excellent submissions, and 10 Phase 1 winners were chosen from this pool. The goal was to reach a diverse audience of solvers. The submissions were from developers, start-ups, academia, and even high school students. The quantity and quality of these submissions was considered a success. In Phase 2, the nine winners (one winner declined to compete after Phase 1) were charged with building or adapting their proposed intervention, and conducting small scale testing to prove that the intervention would indeed result in the intended outcomes. All of the teams achieved positive results from their small-scale testing, confirming that these interventions have great potential to

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make a meaningful impact on the word gap. Additionally, the nine interventions represented an incredible diversity of approaches and expertise, including hardware devices, apps that provide feedback to families, apps that are location-based and send prompts to parents in real-time, and an app that is available in English and Spanish.

HRSA held a Demo Day for Phase 2 to showcase the nine winners and what they have developed. On Demo Day, held September 22, 2016, each of the nine winners gave a live pitch demonstrating their device, and presenting the results from their small scale testing. HRSA organized a Federal innovation panel to provide information to the winners about opportunities for further development and scaling, and a commercialization panel where representatives from start-ups and incubators discussed different avenues for continuing to develop interventions.

While the challenge is still underway, the partnerships that HRSA has established with its challenge advisors, other agencies, and stakeholders in the field are also considered a success, and the plan is to continue these collaborations after the challenge is completed. The collaborations were successful, because they contributed to increased public awareness of the challenge and the underlying issue it is trying to resolve. Additionally, the advisors and federal colleagues provided expertise for the challenge design.

Participants: HRSA used the standard eligibility requirements as suggested in the HHS IDEA Lab guidance. The intent was to mobilize non-traditional partners for the agency and to attract a diverse array of innovators and solvers, including coders, public health experts, individuals affiliated with academic institutions, research and development communities in the private sector, students, and others. Phase 1 received 80 submissions, which was narrowed down to 10 winners, nine of which participated in Phase 2. Phase 2 had five winners who have proceeded to Phase 3.

Timeline: Submissions were opened November 9, 2015 and closed January 29, 2016, with winners announced March 8, 2016. Phase 2 then continued from March 11, 2016 through August 11, 2016, with winners announced September 22, 2016. Phase 3 was open from September 26, 2016 to March 26, 2017, and winners will be announced May 2017.

Solicitation and Outreach: HRSA's Maternal Child Health Bureau (MCHB), as well as the contractor Sensis, used social media, email outreach, partnerships with outside organizations, and live video streaming of Demo Day to market the competition as well as to promote the winners of each Phase. Working with the contractor, HRSA was able to reach diverse populations outside of the normal reach of government to garner Phase 1 submissions, as they targeted the technology sector, start-ups, and communities of solvers. HRSA also widely promoted the challenge through existing grantee networks, which led to greater awareness of the challenge and submissions from academia. The nine challenge advisors widely promoted the challenge through their professional networks, which include non-profit early childhood organizations, the technology field, and pediatric networks.

Incentives: The total cash prize is \$325,000 divided among phases as described below:

- Phase 1: 10 winners, \$10,000 each;
- Phase 2: 5 winners; \$25,000 each; and
- Phase 3: 1 winner; \$100,000

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HRSA offered multiple non-monetary incentives to participants. This challenge was announced by the White House Office of Science and Technology Policy, and their involvement offered a level of national awareness to the challenge. From the beginning of the challenge, nine Federal experts were invited to voluntarily serve as advisors. They have not only provided guidance to the Federal staff on areas such as structuring the challenge and on the evaluation criteria, but they each agreed to serve as a one-on-one advisor to a team they were assigned to in Phase 2. They reviewed materials and provided invaluable individualized feedback to their teams throughout this phase.

Additionally, opportunities were provided to the Phase 1 winners for networking with members of a local start-up (1776) when the winners were in Washington, DC for Demo Day, as well as access to panelists who presented during the day. The panelists represented those in Federal Government (including the White House) who promote innovation, as well as members of local incubators. HRSA MCHB funds the Bridging the Word Gap Research Network, a collaborative of 100 nationally recognized researchers, practitioners, policymakers, and funders working together on a coordinated national research agenda that addresses the word gap. All 10 Phase 1 teams' information is advertised on this website as a mechanism for interested researchers affiliated with the network to reach out to them and pursue opportunities for future collaboration.

Evaluation and Judging: A Federal judging panel, with input from the challenge advisors, made the judging decisions in both Phase 1 and Phase 2. For Phase 1, both qualitative and quantitative goals were set, that allowed for a cohort of the highest-scoring submissions to be discussed and evaluated. For Phase 2, the judging was also based on a set of previously established criteria, and the judges and advisors used both quantitative and qualitative means to determine the five winners.

The specific criteria for Phase 1 and Phase 2 evaluation are listed below:

In Phase 1, interventions were judged on the following criteria

- **Accessibility:** Is the proposed intervention able to be easily utilized by parents of diverse economic, social, and cultural backgrounds? Is it functional across disciplines/users?
- **Measurability:** How easily will the proposed intervention be evaluated in order to determine its efficacy (in both lab testing and in the real world)? Is the proposed intervention measurable among various audiences?
- **Sustainability:** Is the proposed intervention “sticky?” Does it fit into daily life? Is it fun to use?
- **Impact:** Does the applicant present a theory or explanation of how the proposed intervention would inspire behavior change?

In Phase 2, interventions were judged on the following criteria

- **Impact:** How did the intervention impact target outcomes for parents/caregivers and children? What did the data show?
- **Evidence base:** Is the intervention grounded in existing science related to the word gap, behavior change, etc.?
- **Sustainability:** Was the intervention “sticky” among users? Did users want to continuously engage with the program?

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- Implementation: How feasible is the intervention? How much support for implementation will the intervention require (estimated financial and time commitment)?

Partnerships: HRSA partnered with nine expert advisors, who provide insight and guidance on all aspects of the challenge, including design and evaluation criteria. They served as individual advisors to the nine Phase 2 winners.

HRSA partnered with other agencies to develop the Federal judging panel; Federal judges include staff from the Department of Education and HHS's Administration of Children and Families and the Office of the Assistant Secretary for Planning and Evaluation. They also helped to promote the challenge.

The primary lesson learned from these partnerships is the incredible value of a diverse set of expert advisors. They provided unique insights into multiple aspects of the challenge, and their feedback to the teams improved the quality of their interventions as they proceed through the stages of the challenge.

Resources: HRSA's MCHB worked with a contractor to implement the challenge. Sensis was awarded approximately \$300,000 for three years in September 2014 to administer the challenge. These funds are separate from the \$325,000 prize purse. HRSA's MCHB also supported travel of the nine Phase 1 winners to attend and compete in the in-person Demo Day held at HHS, where the five winning teams were announced for Phase 2.

Additionally, multiple Federal staff has been involved in managing the project.

Results: For Phase 1, the challenge received 80 submissions, of which 10 were selected to move forward to Phase 2. One of these teams declined to compete in further stages, and the nine remaining Phase 1 winners competed in a live Phase 2 Demo Day on September 22, 2016. At the conclusion of Demo Day, five winners were selected to advance to Phase 3, the final phase of the competition. These teams' interventions represent an incredible diversity of approaches and expertise, including hardware devices, apps that provide feedback to families, apps that are location-based and send prompts to parents in real-time, and an app that is available in English and Spanish. The challenge completed Phase 3 on March 26, 2017. The final winner will be announced in May 2017.

A.5.10 Move Health Data Forward Challenge⁶⁷

Summary: As health IT adoption continues to grow and mobile health technology becomes more accessible, consumers are playing an even greater role in how and when their health information is exchanged or shared. Unleashing this data is one of the Office of the National Coordinator for Health Information Technology's (ONC) top priorities, as outlined in the Nationwide Interoperability Roadmap, which aims to improve individuals' ability to send, receive, find, and use their health information in the near term. This challenge is designed to produce apps that will

⁶⁷ www.challenge.gov/challenge/move-health-data-forward-challenge

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allow patients to access their health data safely and securely, based on the implementation specifications of the HEART working group.

Solution Type: Software and apps; technology demonstration and hardware; and business plans

Primary Goals: Find and highlight innovative ideas; solve a specific problem; and develop technology

Results: The challenge has completed two of three phases. The challenge received 28 submissions for Phase 1. The submissions included organizations that have not previously submitted to ONC challenges, reflecting a broad applicant pool. Submissions mostly came from small technology companies that were familiar with the HEART working group implementation specifications and planned to use them as part of their solution.

Problem Statement: The Move Health Data Forward Challenge encourages participants to create an application programming interface (API) solution that uses the implementation specifications created by the HEART Workgroup (HEART WG) to allow people to securely authorize the movement of their health data to destinations they choose.

The HEART WG was developed to advance the process of gathering representatives from many different health-related technical communities worldwide (private-sector, government and non-governmental organizations) working in areas such as patient authentication, authorization, and consent to collaborate on developing open-source specifications.

The HEART WG has created a set of privacy and security specifications (HEART implementation specifications) using the following open standards: OAuth 2.0, OpenID Connect and User Managed Access (UMA). These specifications empower people to control the authorization of access to health-related data sharing APIs.

Participants are expected to engage people to test the implementation of the solution and make possible processes that need consumers to authorize the release of their health data to a destination they choose. Participants must recruit individuals and obtain their authorizations to test the implementation of the solution using their health data. The data for the API and solution was provided by Phase 2 finalists.

The challenge has three phases and two finalists each winning \$75,000. Phase 1 awarded \$5,000 for 10 finalists each based on the proposals they submitted to the challenge. Phase 1 winners moved to Phase 2, which awarded \$20,000 to five finalists each based on the prototype of their solution. Phase 2 winners moved to Phase 3, which will award \$50,000 for up to two winners each based on the participants' ability to implement their solution.

This multi-phased approach allows participants to assemble, implement and test their solutions. The final phase of the challenge will require finalists to show a consumer-facing solution that incorporates the HEART implementation specifications and uses an API that empowers consumers to control the movement of their health data.

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Phase 1 submission requirements included a business case and a presentation describing the solution and use case for the project. Phase 1 submissions were selected on the strength of their business case and a presentation describing their team capabilities, their proposed solution and use case for the project.

Phase 2 submission requirements included an implementation plan and a live demo presentation of prototypes. Phase 2 submissions were selected on the strength of their implementation plan and a presentation demonstrating the effectiveness of their Solutions and their potential impact on health records accessibility and data exchange.

Proposed Goals: As health IT adoption continues to grow and mobile health technology becomes more accessible, consumers are playing an even greater role in how and when their health information is exchanged or shared. Unleashing this data is one of ONC's top priorities, as outlined in the Nationwide Interoperability Roadmap, which aims to improve individuals' ability to send, receive, find, and use their health information in the near term.

To stimulate this work, sometimes referred to as "consumer-mediated exchange" between and among their clinicians, hospitals, or even family members, the Move Health Data Forward Challenge was launched. The objective of the challenge is to create application programming interface (API) solutions combined with new implementation specifications that have the potential for individuals to securely and electronically authorize the movement of their health data to destinations they choose. This work builds on ONC's work with a number of security, privacy, and health information technology stakeholders to develop a set of privacy and security specifications that enable an individual to control the authorization of access to health data.

Measures of Success: The competition is underway and Phase 1 and 2 winners have been publicly announced. Early success measures for the challenge include the number of submissions (28) for Phase 1 which is a high number given the complexity of the requirements and the duration of the challenge. Additionally, ONC received submissions from a diverse array of organizations, including organizations that have not previously submitted proposals for other ONC challenges. An important measure of success for this challenge will be whether the winning solutions are able to demonstrate a consumer-facing solution that incorporates the HEART implementation specifications and uses an API that empowers consumers to control the movement of their health data.

Participants: The challenge is open to the public and targeted technology developers and health care organizations. Phase 1 required participants to describe the technical, operational, financial and business aspects of their proposed solution. The main goal of Phase 1 was for participants to show feasible and executable plans for innovative solutions and prove its impact potential. Phase 1 received 28 submissions. The challenge was run under the authority of Section 105 of the America COMPETES Reauthorization Act and therefore had the eligibility criteria pursuant to it.

Timeline: Submissions opened for Phase 1 May 10, 2016, and closed September 8, 2016. Winners were announced on November 2, 2016. Phase 2 submissions were due January 16, 2017 and winners were announced February 21, 2017. Phase 3 submissions will be due May 1, 2017, and winners will be announced May 31, 2017.

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Solicitation and Outreach:

- Social Media;
- Email Outreach;
- High-profile challenge announcement (e.g. National Coordinator for Health Information, Dr. Karen DeSalvo announced the challenge at Health Datapalooza)
- Blog posts

Incentives: The challenge has a prize purse of up to \$250,000. In Phase 1, up to 10 prizes of \$5,000 are available. In Phase 2, up to five prizes of \$20,000 are available. In Phase 3, up to two prizes of \$50,000 are available. The primary non-monetary incentives are the publicity and recognition for winning an ONC challenge. Awards will be disbursed by a contractor acquired through the HHS Competes Blanket Purchasing Agreement.

Evaluation and Judging: A combined review panel of Federal and non-Federal subject matter experts reviewed and scored all Phase 1 and 2 submissions and the Federal challenge managers selected the winners, factoring in those reviews. The review was based on adherence to submission requirements and the judging criteria outlined in the *Federal Register* notice. In Phases 1 and 2 the Federal challenge managers selected the top 10 and 5 winners respectively, based on quantitative results provided by the review panel and their own review of submissions.

Partnerships: No partnerships were utilized.

Resources: A small team of ONC Federal employees, with one primary challenge manager, developed and executed the Move Health Data Forward Challenge. Sensis was acquired through the HHS Competes Blanket Purchasing Agreement. The competition used FY15 ONC funding. ONC worked with Sensis, a third-party contractor, who provided administrative, challenge development, management and communications assistance.

Results: The challenge has three phases and to date two phases have been completed. The challenge received 28 submissions for Phase 1, however not all of the submissions met the eligibility criteria to make it to the judging process. The submissions included organizations that have not previously submitted to ONC challenges, reflecting a broad applicant pool. Submissions were from individuals, single organizations, and teams with representation from multiple companies. Submissions mostly came from small technology companies that were familiar with the HEART working group implementation specifications and planned to use them as part of their solution. Completion of the challenge is expected by June 2017.

A.5.11 NIH: Up For A Challenge (U4C)-Stimulating Innovation in Breast Cancer Genetic Epidemiology

Summary: In order to better understand genetic factors that play a key role in the risk of breast cancer, this challenge incentivizes scientists to shift their focus from identifying individual gene variants to better understanding the pathways that contribute to breast cancer. The winning teams

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developed innovative methods and discovered novel connections with pathways leading to breast cancer risk.

Solution Type: Scientific; and analytics, visualizations, algorithms

Primary Goals: Find and highlight innovative ideas; advance scientific research; and engage new people and communities

Results: There were three winning teams, two tying for the grand prize and one placing second. Team UCSF not only identified novel associations, but suggested possible biological mechanisms. UMN-CSBIO used a novel computational method to identify a major hub of interactions associated with breast cancer, one which would have been missed using traditional approaches. The second place team, Team Transcription, identified novel associations and developed a framework that can be used to identify candidate causal variants for disease risk.

Problem Statement: Despite knowing that genetic factors play a key role in determining who is at increased risk of developing breast cancer, results to date explain only a small proportion of the estimated genetic contribution to the risk of breast cancer. Participants were challenged to shift their focus of analysis from individual single nucleotide polymorphisms (SNPs) to pathways, ideally leading to the identification of novel gene sets involved in breast cancer risk. Participants will submit a project narrative, which addresses the challenge evaluation criteria, including identification of novel findings, replication of findings, innovation of approach, evidence of novel biological hypotheses, and collaboration. Currently this is a single challenge but NIH is considering additional challenges.

Entries were scored by the U4C Evaluation Panel, 10 extramural expert scientists from diverse fields including biostatistics/statistics, breast cancer biology, breast cancer genetic epidemiology, computer science, functional research, genetic epidemiology, informatics, and population genetics. Scoring was based on the following scoring criteria: Identification of Novel Findings (25 points), Replication of Findings (25 points), Innovation of Approach (25 points), Evidence of Novel Biological Hypothesis(es) (10 points), and Collaboration (15 points). After the U4C evaluation panel provided scores, the highest scoring applications were evaluated for reproducibility, or ability to reproduce the novel findings. NIH judges reviewed summaries from the U4C evaluation panel, scores, and results from the reproduction to make recommendations to the NCI Director. The National Cancer Institute (NCI) Director made the final selection of entries for award.

Proposed Goals: The goals of U4C included (1) making breast cancer genetic epidemiologic data more widely available (when consistent with participant informed consent); (2) increasing the number and diversity of minds tackling a tough scientific problem; (3) shifting the focus of analysis from individual genetic variants (i.e., single nucleotide polymorphisms or SNPs) to pathways (i.e., combinations of genes, genetic variants, or sets of genomic features); (4) encouraging the use of innovative approaches to identify novel pathways, which might lead to the discovery of additional gene sets involved in breast cancer risk; and (5) exploring the heritable contribution to breast cancer disparities.

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Measures of Success: Winners were recently selected, so the complete evaluation of the impact of the competition is still underway. The first measure was enhanced data sharing. Seven breast cancer genetic datasets were designated for the challenge, four of which were newly available for the U4C for a total of approximately 13,000 cases and 13,000 controls. Thirty-three teams were approved for access to one or more U4C datasets (through dbGaP application process). Second, NIH aimed to broaden the expertise examining the problem. Eighty-seven individuals participated in the competition and only 44% of these individuals had previously had an NIH grant. Participants in the U4C were from a variety of fields of expertise including bioinformatics, biology, biostatistics, computational biology, computer science, genetics, genetic epidemiology, epidemiology, population genetics, statistics and statistical genetics. Furthermore, several entries were from investigators who had not worked with this type of data previously. Third, the competition seemed to encourage formation of new collaborations as the teams participating in the challenge had a median of seven new pairwise collaborations. Fourth, the challenge was cost effective. The U4C received 15 entries, which represented a substantial amount of work by each team. When compared to a grant mechanism that might support this type of work (R21, maximum budget of \$275K or \$4.1 M for 15 projects), the challenge was cost effective. Finally, teams were able to identify novel findings using new approaches in these datasets. This demonstrated an opportunity to advance research using existing data.

Participants: NIH hoped to engage genetic epidemiologists as well as participants from other disciplines such as bioinformatics and computer scientists. Participation was limited based on COMPETES and NIH requirements. Eighty-seven individuals in 14 teams produced 15 submissions.

Timeline: Submissions opened June 15, 2015 and closed February 25, 2016. Winners were announced October 20, 2016.

Solicitation and Outreach: NIH used the following methods of outreach. NIH aimed to mirror the innovation of the challenge mechanism in its approaches and believes the outreach was very successful. NIH worked with its NCI Offices of Communication to develop detailed communication plans.

- Social Media—posted to Twitter, performed a thunderclap campaign, posted to Facebook, and LinkedIn. NIH asked many researchers and colleagues to post on social media;
- Email Outreach (such as listservs)—included posting to several listservs and asking many key investigators to reach out to their communities. Also utilized contractor lists of challenge participants. NIH also emailed innovation hubs, relevant advocacy groups, and educational institutions directly;
- Press Release—NIH's contractor issued a press release;
- Other (please specify)—blog posts, newsletter posts, flyers at several largely attended meetings, and meeting presentations.

Incentives: The NCI will award up to \$50,000 in prizes based on identification of novel findings, replication of findings, innovation of approach, evidence of novel biological hypothesis(es), and collaboration. The two grand prize entries will be awarded \$20,000. The second place entry will be awarded a runner-up prize of \$10,000. The top five entries (grand prize, second place, and the next two runner-ups) are highlighted on the challenge and DCCPS EGRP websites. The top five

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entries were invited to prepare a manuscript for publication in a special issue of PLoS Genetics describing their approach and results.

Evaluation and Judging: Entries were scored by the U4C Evaluation Panel, 10 extramural expert scientists from diverse fields including biostatistics/statistics, breast cancer biology, breast cancer genetic epidemiology, computer science, functional research, genetic epidemiology, informatics, and population genetics. Scoring was based on the following scoring criteria: Identification of Novel Findings (25 points), Replication of Findings (25 points), Innovation of Approach (25 points), Evidence of Novel Biological Hypothesis(es) (10 points), and Collaboration (15 points).⁶⁸ After the U4C evaluation panel provided scores, the highest scoring applications were evaluated for reproducibility, or ability to reproduce the novel findings by NCI contracted data scientists. NIH judges reviewed summaries from the U4C evaluation panel, scores, and results from the reproduction to make recommendations to the NCI Director. The NCI Director made the final selection of entries for award.

Overall, these evaluation methods were largely effective. The main lesson learned was in regards to reproducibility. The process of reproducing submitted findings was more difficult and lengthy than initially anticipated. While it was possible to reproduce the main findings, it was necessary to consult the entry investigators numerous times to collaboratively solve reproducibility issues which arose. In addition, there was tremendous variation in the quality of meta-data and instructions for reproduction provided with each application. In some cases, details essential for reproduction (e.g. files used, documentation on order of running the provided scripts, and versions of software requirement) were not initially provided. This may reflect field-specific conventions. In future challenges, NIH suggests considering the following options to facilitate reproduction: improving instructions regarding required annotations, designing the competition using dockerized tools, and considering a phased approach with a results submission following a submission of clearly annotated code.

Partnerships: NIH formed many informal partnerships to ensure a successful prize competition. Most partnerships were focused on sharing challenge best practices marketing and outreach.

Resources: Several resources were used to support the prize competition. Internal resources, or specifically staff time, led the management and coordination of the challenge. Moreover, staff supported the outreach and communications and data access for the challenge. In addition to internal resources, funding was used to support a contractor, Sage Bionetworks (\$188,000 plus \$50,000 for the prize) for assistance with coordination. Specifically, Sage advised NCI on the development of the challenge, provided and supported the web-based infrastructure for the challenge (included registration, entry submission, and evaluation), assisted with addressing questions from registrants and participants, managed two webinars, performed the reproduction of top scoring entries, and will provide the monetary award to winners. Another contractor, an expert research scientist (\$44,000), was used to provide scientific insight and leadership to the challenge.

Results: At the end of the competition, there were 201 registrants, 33 teams were approved access to the datasets, and 15 entries were submitted from 14 teams (one team made two separate

⁶⁸ www.synapse.org/#!/Synapse:syn3157598/wiki/232618

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submissions). Eighty-seven individuals participated as part of the 14 teams; 44% (N=38) of these individuals had previously been a recipient of an NIH grant, and 44% (N=38) of the individuals were graduate students. The median number of participants on a team was five (range: 2–13 members) with a median number of new pairwise collaborations of seven (range: 1–60). Teams originated from nine different states (California, Connecticut, Illinois, Minnesota, New Hampshire, New York, North Carolina, Virginia, and Texas). Participants in the U4C were from a variety of fields of expertise including bioinformatics, biology, biostatistics, computational biology, computer science, genetics, genetic epidemiology, epidemiology, population genetics, statistics and statistical genetics.

Three entries were selected to win the U4C prize competition. Team UCSF and UMN-CSBIO were tied for the grand prize, and Team Transcription was awarded second place.

Team UCSF used all the designated GWAS datasets provided and performed a traditional GWAS to replicate previous findings, a genome-wide association of gene expression and admixture mapping. Using the genome-wide association of gene expression approach, they identified novel associations with the ACAP1 and RTKN2 genes and breast cancer, which was replicated using data from the UK biobank. ACAP1 and RTKN2 are in the same gene family. Moreover, ACAP1 interacts with the third cytoplasmic loop of SLC2A4/GLUT4, while RTKN2 is implicated in the activation of NF- κ B pathway, suggesting possible biological mechanisms for these findings.

The second grand-prize winner, UMN-CSBIO applied a novel computational method, developed initially to analyze yeast data, called BridGE (Bridging Gene sets with Epistasis) for explicitly searching for pathway level interactions guided by annotated gene sets from the Molecular Signatures Database (MSigDB). By examining pathway interactions using two of the U4C designated GWAS datasets, the team identified steroid hormone biosynthesis as a major hub of interactions and was implicated as interacting with many pathways, including a gene set previously associated with acute myeloid leukemia (AML). Most existing studies have reported that chemotherapy treatment for breast cancer was a risk factor for AML. Importantly, these interactions would have been missed using traditional approaches.

Team Transcription employed a novel integrative genomics approach to explore the hypothesis that many of the non-coding single nucleotide polymorphisms (SNPs) identified by GWAS alter transcription factor (TF) binding sites and mediate effect on disease by modulating TF binding and gene regulation. This team identified a SNP, rs4802200, in perfect linkage disequilibrium (LD) with a GWAS-identified SNP, which is predicted to disrupt ZNF143 binding within a breast cancer-relevant regulatory element. This SNP is a strong expression quantitative trait loci (eQTL) of ZNF404 in breast tissue. This work flow and analysis pipeline can be used as a general framework to identify candidate causal variants with regulatory regions and TF binding sites that confer phenotypic variation and disease risk.

A.5.12 NIH: A Wearable Alcohol Biosensor Challenge⁶⁹

⁶⁹ www.challenge.gov/challenge/a-wearable-alcohol-biosensor

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Summary: NIAAA sought the design and production of a wearable device to monitor blood alcohol levels in real time and inconspicuous, low profile, and appealing to the wearer. Current technology for continuous alcohol monitoring takes a reading every 30 minutes. NIAAA sought a solution that improved on this interval and most closely approximated real-time monitoring and data collection.

Solution Type: Technology demonstration and hardware

Primary Goals: Advance scientific research; stimulate market; development of technology

Results: NIAAA received eight submissions. The working prototypes were tested for accuracy and reliability in a laboratory setting. The winning prototype and recipient of the \$200,000 first prize was submitted by BACTrack, and second-prize (\$100,000) was awarded to Milo, a Santa Barbara technology startup of graduate students. Both devices were noninvasive, worn on the wrist, and connected with smartphones.

Problem Statement: NIAAA sought the design and production of a wearable device to monitor blood alcohol levels in real time and inconspicuous, low profile, and appealing to the wearer. The design could take the form of jewelry, clothing, or any other format located in contact with the human body. A non-invasive technology was preferred. Current technologies for real-time monitoring of alcohol consumption, used in criminal justice applications, have performed adequately, but have disadvantages for broader use. Current technology for continuous alcohol monitoring takes a reading every 30 minutes. NIAAA sought a solution that improved on this interval and most closely approximated real-time monitoring and data collection. The device was to be able to quantitate blood alcohol level, interpret and store the data, or transmit it to a smartphone or other device by wireless transmission. Data storage and transmission had to be completely secure in order to protect the privacy of the individual. The device was expected to have the ability to verify standardization at regular intervals and to indicate loss of functionality. The power source was to be dependable and rechargeable. A form of subject identification was an added benefit. The device could be removable. This was a reduction to practice challenge that required written documentation and a working prototype of the submitted solution. NIAAA was open to a range of design forms which could accomplish the above tasks. This remains part of a larger portfolio which aims to spur the creation of a wearable biosensor through both this challenge and the SBIR program.

The award was contingent upon experimental validation of the submitted solution by the seeker. Submissions were judged by a qualified panel selected by NIAAA. The panel evaluated submissions based on the following judging criteria:

- Accuracy, reliability, and frequency of blood alcohol measurement;
- Functionality, accuracy, and integration of data collection, data transmission, and data storage;
- Safeguards for privacy protection and data integrity;
- Plans for process of manufacture;
- Marketability and likelihood of bringing the product to market;
- Appeal and acceptability to wearers; and
- Feasibility.

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During the judging period, the expert panel was allowed to request additional information or clarification in order to evaluate the entry.

Proposed Goals: NIAAA sought the creation of a prototype of a wearable device to monitor blood alcohol levels in real time.

Measures of Success: This competition furthered the NIAAA mission in several ways. First and foremost, the outreach and press served to increase NIAAA's presence in not only traditional circles but also in areas of industry and academia that have historically been less aware of the institute and its mission. Secondly, the competition has led to interest from others outside of the competition and the possibility of more novel and innovative solutions to monitoring and tracking alcohol use and its effects. Thirdly, NIAAA was able to successfully select two working prototypes as winners. These will have profound effects on every area of NIAAA's programs, science, and ability to achieve its mission. The speed with which NIAAA was able to do this is profound. Traditional mechanisms (i.e., grants, or contracts) would not have produced such innovation at such a speed.

Participants: NIAAA required that the individuals be U.S. citizens, or that the companies be registered as U.S. companies, and not a U.S. Federal employee. The intent was to incentivize innovators, be they academics, individuals, or commercial entities. Eight submissions were entered.

Timeline: Submissions were open from March to December 2015, and the winners were announced May 2016.

Solicitation and Outreach: NIAAA actively attended trade shows, lectures, and conferences that were attended by innovators, academics, and technology companies. This helped to amplify the outreach NIAAA did through the use of email, a press release, and social media. NIAAA did not hire a third party and feels that its individual presence at such conferences worked to mobilize submissions by attaching significance to its need.

Incentives: 1st Prize \$200,000, 2nd Prize \$100,000. This money was allocated from NIAAA's unconditional gift fund and electronically transferred to the winning companies. They were obligated through the use of the public voucher SF-1034.

Evaluation and Judging: Judges included the NIAAA Director, a senior staff member from the NIAAA, senior staff members from the National Institute of Biomedical Imaging and Bioengineering (NIBIB), a member from the National Advisory Council of the NIAAA, and program staff from the NIAAA. The challenge judges were advised by a technical panel consisting of individuals with expertise in the following areas:

- Alcohol Pharmacokinetics;
- Chemistry;
- Engineering;
- Information technology and information system security;
- Behavioral and social sciences;

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- Development of vehicular alcohol detection systems; and
- Wearables.

The submissions were evaluated based on the following judging criteria:

- Accuracy, reliability, and frequency of blood alcohol measurement as validated by NIAAA;
- Functionality, accuracy, and integration of data collection, data transmission, and data storage;
- Safeguards for privacy protection and data integrity;
- Plans for process of manufacture;
- Marketability and likelihood of bringing the product to market;
- Appeal and acceptability to wearers; and
- Feasibility.

Each entry was lab tested using human subjects, and approved by the NIAAA IRB, by a leading researcher within NIAAA. Data was collected and compared to existing well-established methods and models for detecting blood alcohol levels. The results were compared to each other and used a key indicator of the prototype's viability. Each entry was consulted and their individual data was shared only with that entry in order to protect intellectual property.

Judges scored each entry based upon the results and evaluation of the criteria.

Partnerships: No partnerships were formed.

Resources: Prize money was allocated from NIAAA's unconditional gift fund. Personnel costs were covered under allocated resources already budgeted for activities related to the NIAAA's mission and the job descriptions of the managers of the competition. An estimated total of 820 FTE hours were expended to design and execute the challenge: 128 hours at the GS-12 level, 226 hours at the GS-13 level, 286 at the GS-14 level, and 180 hours at the GS-15 level. Approximately \$10,000 was spent on travel to pertinent conferences, trade shows, and conventions to perform outreach and research for the challenge.

Results: The winning prototype and recipient of the \$200,000 first prize was submitted by BACTrack, a company known nationally for designing and selling portable breath alcohol testers for consumer and professional use. Their entry, the BACTrack Skyn, is worn on the wrist and offers continuous, passive, and non-invasive monitoring of a user's BAC. Alcohol is detected using a fuel cell technology similar to that in devices used by law enforcement for roadside alcohol testing. The device connects via Bluetooth to a smartphone to store data.

Second Prize: Second-prize (\$100,000) was awarded to Milo, a Santa Barbara technology startup of graduate students, for their design for a wearable blood alcohol sensor. Milo's wrist-worn wearable pairs with a smartphone and uses disposable cartridges to continuously track BAC.

Because the solutions were also novel, NIAAA made two Honorable Mentions: BioInk (a color-changing tattoo design by a company of the same name), and TAMS (transdermal alcohol monitoring system from a team affiliated with Florida International University).

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NIAAA received eight submissions. The working prototypes were tested for accuracy and reliability in a laboratory setting. Most of the designs took the form of fitness tracker-type watches that estimate blood alcohol content (BAC) based on the amount of alcohol escaping through perspiration (known as “transdermal monitoring”). One notable exception was a color-changing temporary tattoo applied directly to the skin.

Entries were judged based on accuracy, reliability, and frequency of blood alcohol measurements; ability to accurately collect and store data or transmit data to a wireless device; data security and privacy safeguards; and plans for manufacturing. The designs were also evaluated for marketability, appeal to wearers, and overall feasibility.

With wearable technology becoming ever more popular, NIAAA believes that the Wearable Alcohol Biosensor Challenge will continue to stimulate public and private investment in alcohol-monitoring devices. Well-calibrated alcohol biosensors will provide an objective measure of alcohol consumption for research studies, with participants being able to avoid the inconvenience and discomfort of having blood drawn at regular intervals. The data collected would also be more accurate than self-report. Alcohol biosensors have commercial appeal as well; members of the public concerned with their personal drinking, or in the counsel of a therapist, would be able to use the discreet device without stigma.

A.5.13 NIH: Addiction Research: There’s an App for that⁷⁰

Summary: This challenge’s goal was to develop apps that could be used in addiction research to better understand the roots of drug abuse and addiction. Apps allow for collection of data from a wider range and larger number of participants, improving research methods to help address this public health crisis.

Solution Type: Software/apps

Primary Goals: Develop technology/app; find and highlight innovative ideas; and advance scientific research

Results: From 20 submissions, three developed apps were awarded prizes: ICF International Inc., Rockville, MD, “Track the Crave”; University of Michigan, Ann Arbor, MI, “Substance Abuse Research Assistant (SARA)”; Washington University School of Medicine, St. Louis, MO, “Genomics of Addiction (GENA) App.” The National Institute on Drug Abuse (NIDA) concluded that functional mobile prototypes could be successfully developed using challenge as a funding mechanism, and this mechanism allowed for combining the cost-effective, below R-type, funding, interdisciplinary team building, and adoption of the most relevant technological innovations.

Problem Statement: Because the problems stemming from drug abuse and addiction affect almost every community and family to some degree, NIDA issued this challenge with the hope that contestants will actively mobilize around the need to know more about the roots of drug abuse and

⁷⁰ nida.ideascale.com/a/pages/addiction-research-theres-an-app-for-that

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addiction. The causes and consequences of addiction are multi-faceted, involving biological, behavioral, social, cultural, economic, and environmental factors. These factors likely interact, with no single factor exerting substantial independent influence on drug use and addiction risk. Unfortunately, most NIDA-funded research addresses these factors separately because it is difficult to collect data on the large numbers of participants needed to understand the multi-factor relationships. Mobile technology offers the capacity to recruit large numbers of participants, in diverse and distant places, and to collect prospective data on a broad range of variables as these study participants go about their daily lives.

The recently unveiled ResearchKit™ developed by Apple Inc. was chosen as the available and sustainable platform designed specifically for biomedical research.⁷¹ ResearchKit™ is an open-source software, which makes it easy for researchers and developers to create apps for specific biomedical research questions by circumventing development of custom code. NIDA's choice of ResearchKit™ as the platform was a response to Apple's release of a set of tools specifically intended for use in health research.

NIDA aimed at coders, data scientists and physicians to develop a novel mobile application (app) for future addiction research.

NIDA expected that research questions to be answered could include, but were not limited to: Would tracking lifestyle choices, behaviors, nutrition, stress, social participation, work, school, home, neighborhood, genetics, exposure to technology, etc. help to understand why some people manage to stay away from drug abuse and addiction? What contributes to the choice to abuse prescription drugs? How can we systematically collect the experience of patients recovering from addiction? Are there innovative approaches to recording patients' experiences of impact and burden of drug addiction over time? Can the benefits of reduced drug use be meaningfully detected? Can we reveal and collect the participant-identified disease impacts and the preferences for treatment impacts to identify meaningful, significant, perhaps novel, and potential measures of benefit?

Proposed Goals: The challenge had three goals:

- NIDA aimed to develop novel apps for future addiction research explicitly created on Apple Inc.'s ResearchKit™ framework.
NIDA was seeking to engage communities to envision and to create an app which will help advance scientific research in areas of nicotine, opioids, cannabinoids (including marijuana), methamphetamines, and prescription drug use. NIDA was also interested in further understanding abstinence and wellness as it relates to drug addiction. The app must be explicitly created for future scientific research purposes, and not for self-help, education, or self-wellness monitoring like other apps already available on iTunes.
- NIDA aimed to test if research apps can be developed using the challenge funding mechanism.

⁷¹ www.apple.com/researchkit

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- NIDA aimed to confirm that the challenge and prize competition funding authority is a good funding mechanism for NIDA. This challenge aimed to test “best practices” in partnership and outreach.

Measures of Success: The general purpose of NIDA is to conduct and support biomedical and behavioral research, health-services research, research training, and health-information dissemination with respect to the prevention of drug abuse and the treatment of drug abusers. Apps developed as a result of this challenge could help NIDA to gain strides in behavioral addiction research. NIDA plans to develop a subsequent funding program for a future research study with real human subjects that will help researchers to better understand drug abuse and addiction.

Participants: The challenge received 20 entries. The eligibility requirements included U.S. citizenship or permanent residency. The submission package included:

- A white paper describing the app built upon the proposed design of future scientific research studies;
- A video of the app prototype; and
- App working software using Apple’s ResearchKit™ framework.

Although Apple’s ResearchKit™ lowers the barriers for medical researchers in terms of custom coding, NIDA hoped that the creation of new apps will be done best by contestants with a combination of IT skills and clinical research expertise.

NIDA encouraged addiction researchers to use the newly available technical capabilities of ResearchKit™ and seek collaboration(s) with app developers and engineers to create the winning research app.

Timeline: Submissions opened November 3, 2015 and closed April 29, 2016. Winners were announced August 19, 2016.

Solicitation and Outreach:

- Social Media (Twitter, LinkedIn, and Facebook posts);
- Email Outreach (NIH/NIDA grantees listserv; Facing Addiction listserv);
- Press Release (29 publications including Apple ResearchKit™ website and *Fortune*);
- Conference presentations (mHealth summit 2016, Washington, DC; BHI-2016 International Conference on Biomedical and Health Informatics, LA); and
- Partnership with Outside Organizations.

NIDA has learned that the level of the public interest to the challenge strongly correlates with the level of outreach activities.

Incentives: The total amount of the cash prize was \$100,000 (NIDA FY16 Appropriation Extramural funds): \$50,000 for first place, \$30,000 for second place, and \$20,000 for third place.

Non-monetary incentives included:

- Public recognition on Ideascale, NIDA, and Apple ResearchKit™ Blog websites; and

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- Invitation of the first place winners to the Open Data Innovation Summit on September 28, 2016.

Evaluation and Judging: The challenge review panel included Federal employees from National Institute on Drug Abuse (NIDA), Substance Abuse and Mental Health Services Administration (SAMHSA), and Department of Health and Human Services (HHS).

The judging panel made recommendations to the award approving official based upon eight success criteria. Each criterion was scored with the maximum of five points.

- Quality of the research agenda;
- Proposed ResearchKit™ modules;
- Add-apters;
- Compliance with applicable legal policies;
- Study participants' engagement;
- Durability of study participation;
- Clarity of the app context; and
- Data quality for researchers.

The partners from Scripps Translational Science Institute and Sage Bionetworks Inc. served as executive consultants for technical questions.

NIDA found that involvement of judges in the process of challenge development was valuable in order to increase the quality of submissions and review expectations.

Partnerships: NIDA was partnering with the Department of Health and Human Services (HHS) Innovation, Design, Entrepreneurship and Action Lab program; U.S. General Services Administration; Substance Abuse and Mental Health Services Administration (SAMHSA); Centers for Disease Control and Prevention (CDC); Sage Bionetworks; Scripps Translational Science Institute; and IdeaScale.

The partnering organizations provided voluntary in-kind support to design review criteria, marketing the challenge through the public media, email outreach, and blogs.

Resources: The challenge was executed by:

- NIDA challenge manager, GS-15 (10 % efforts), 168 FTE hours;
- NIDA challenge administrator, GS-14 (35% efforts), 588 FTE hours; and
- NIDA contractor (15% efforts), 252 hours.

Additionally, IdeaScale was used as the platform at a cost of \$17,104.

Results: The “Addiction Research: There’s an App for that” challenge became the 700th challenge launched on Challenge.gov.

NIDA received 20 submissions;

- 18 submissions were compliant with eligibility criteria and reviewed;
- 14 developed apps were found well responsive to the challenge goals; and

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- 3 developed apps were selected for the cash prizes

The challenge participating teams were from U.S. academic institutions, small business companies, and public. Only 25% of submitted ideas came from NIH/NIDA researchers.

Winners:

- First place: ICF International Inc., Rockville, MD. The team of three ICF employees was awarded for the submission entitled “Track the Crave.”
- Second place: University of Michigan, Ann Arbor, MI. The team of five undergraduate and master’s students was awarded for the submission entitled “Substance Abuse Research Assistant (SARA).” Five UM faculty served as the consultants to the team.
- Third place: Washington University School of Medicine, St. Louis, MO. The team of two WU faculty and a small business partner (Slickers Inc.) was awarded for the submission entitled “Genomics of Addiction (GENA) App.”

NIDA concluded:

- Functional mobile prototypes could be successfully developed using challenge as a funding mechanism;
- The challenge mechanism allows for combining the cost-effective, below R-type, funding, interdisciplinary team building and adoption of the most relevant technological innovations; and
- Challenge mechanism is more suitable for the solving of discrete, persistent scientific problems in the research portfolio.

A.5.14 NIH/ASPR: Antimicrobial Resistance Rapid, Point-of-Need Diagnostic Test⁷²

Summary: Given the escalating crisis of antimicrobial resistance, this challenge is designed to develop in vitro diagnostic tests to better inform clinical treatment decisions in antibiotic use and addressing antibiotic resistant pathogens found in patients. More rapid diagnostic tests could significantly improve patient outcomes and combat the spread of antibiotic resistant bacteria.

Solution Type: Scientific

Primary Goals: Find and highlight innovative ideas; advance scientific research; and develop technology

Results: As of October 24, 2016, the challenge has eight registrants. Step 1 remained open through January 9, 2017, and the entire challenge will run through July 2020.

Problem Statement: Through the “Antimicrobial Resistance Rapid, Point-of-Need Diagnostic Test” challenge, the National Institutes of Health (NIH) and the Biomedical Advanced Research and Development Authority (BARDA) of the Office of the Assistant Secretary for Preparedness and Response (ASPR) are searching for novel and innovative in vitro diagnostic tests that would

⁷² www.challenge.gov/challenge/antimicrobial-resistance-rapid-point-of-care-diagnostic-letter-of-intent

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rapidly inform clinical treatment decisions and be of potential significant clinical and public health utility to combat the development and spread of antibiotic resistant bacteria. Tests of interest will provide novel, innovative solutions for use in inpatient and/or outpatient settings. The goal of the challenge is to identify a diagnostic test that when utilized would lead to more rapid clinical decision-making such that antibiotic use and/or outcomes of patients infected with resistant pathogens are fundamentally improved compared to current standard of care, and/or reduce transmission of resistant pathogens such that population infection rates significantly decrease. The challenge competition seeks to incentivize a broad range of scientists, engineers, and innovators to develop diagnostic tests that would enable health care providers to make more informed decisions on appropriate antibiotic use and infection prevention.

This challenge, structured in three steps, will complement existing BARDA and NIH research portfolios by reaching out to a diverse population of innovators and solvers, including not only those from academic institutions, but also those from research and development communities in the private sector, and others who are outside biomedical disciplines. This challenge will stimulate investment from both public and private sectors in rapid, point-of-need in vitro diagnostic assay research and product development, which, in turn, could lead to the development of more sensitive, accurate, robust, and cost-effective assay approaches and devices for clinical diagnosis.

The prize-winning in vitro diagnostic(s) must meet a set of predefined technical criteria and performance characteristics based on the intended use(s). Solutions submitted to this challenge should have the potential to significantly improve clinical decision-making compared to the current standard of care. Solutions also should be novel, innovative, rapid, and appropriate for use at the point-of-need. Ultimately the solution should be an in vitro diagnostic assay(s) that can improve antibiotic decision-making by health care providers and be effective in reducing inappropriate use of antibiotics; demonstrate a clinically significant advance in diagnostic test performance; and address gaps or deficiencies in current capabilities that may include, but are not limited to ease of use, time to result, significant advances in sensitivity and specificity, and ability to process a broad range of specimen types.

Proposed Goals: The goal of the challenge is to identify a diagnostic test that when utilized would lead to more rapid clinical decision-making such that antibiotic use and/or outcomes of patients infected with resistant pathogens are fundamentally improved compared to current standard of care, and/or reduce transmission of resistant pathogens such that population infection rates significantly decrease. The challenge competition seeks to incentivize a broad range of scientists, engineers, and innovators to develop diagnostic tests that would enable health care providers to make more informed decisions on appropriate antibiotic use and infection prevention.

Measures of Success: As this competition is still ongoing, it is not possible to measure its success in incentivizing the development of innovative, rapid, point-of-care in vitro diagnostics for the detection of drug resistant bacteria. We have received a number of inquiries from potential submitters from academic institutions, medical schools, and the medical diagnostic industry. These inquiries have provided NIH the opportunity to provide information on other relevant funding opportunities in the area of AMR research and to share information on our existing research programs. Another benefit resulting from this competition is the ongoing discussions between the NIH and BARDA in regards to the complementary portfolios each is supporting in

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the area of AMR diagnostics, as well as the advantage to participate in technical discussions with FDA and CDC about AMR diagnostics. Additionally, this competition has provided NIH the opportunity to become familiar with the U.K. Longitude Prize and the European Union Horizon Prize—both of which are prize competitions for the development of novel in vitro diagnostics for AMR bacteria.

Participants: The AMR Diagnostic challenge seeks to incentivize a broad range of scientists, engineers, and innovators, including not only those from academic institutions, but also those from research and development communities in the private sector and others who are outside biomedical disciplines, to develop diagnostic tests which will enable health care providers to make more informed decisions on appropriate antibiotic use and infection prevention. As the contest is ongoing the total participant pool has not yet been established.

Timeline: Step 1 of the challenge opened September 8, 2016 and closed January 9, 2017. Winners of Step 1 will be announced March 27, 2017 and Step 2 opens March 28, 2017. Step 2 will be due September 4, 2018. Winners will be announced on December 3, 2018. Step 3 will open December 4, 2018. Step 3 will be due January 3, 2020. Winner(s) will be announced July 31, 2020.

Solicitation and Outreach: N/A

Incentives: A total of \$20 million in cash prizes will be offered. In Step 1, up to 20 awards of up to \$50k each are offered; in Step 2, up to 10 awards of up to \$100k are offered; in Step 3, up to three awards totaling \$18 million are offered. Additionally, access to expert feedback, a national platform, and future market opportunities are expected to drive additional participation.

Evaluation and Judging: Judging will occur in three steps. In the first two steps, a panel of judges (yet to be identified) will select winners. In the final step, an additional laboratory testing element will be added, likely conducted by a third-party laboratory testing facility.

Partnerships: NIH and HHS/ASPR's Biomedical Advanced Research and Development Authority (BARDA) have partnered with other HHS Agencies, the Food and Drug Administration (FDA), and Centers for Disease Control and Prevention (CDC) in designing and operationalizing the challenge. Additionally, informal discussions are ongoing with UK's NESTA, which is running a similar prize competition globally called the Longitude Prize.

Resources: In addition to the \$20 million in cash prize obligations, NIH has obligated \$1m in contractor costs to help operationalize the challenge. Additionally, several FTEs have been dedicated to managing the internal collaborations and the design.

Results: The AMR Diagnostic challenge opened September 8, 2016, and is ongoing. As of October 24, 2016, the challenge has eight registrants and each has submitted the mandatory letter of intent. The deadline for Step 1 submissions was January 9, 2017. The deadline for Step 2 submissions is September 4, 2018, and the deadline for Step 3 submissions is January 3, 2020. The winner(s) of the AMR Diagnostic Challenge will be announced on July 31, 2020.

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A.5.15 NIH: Climate Change and Environmental Exposures Challenge⁷³

Summary: This challenge is designed to help visualize and share data on the effects of increasing exposures to extreme heat, air pollution, flooding, and other effects of climate change on communities. These kinds of tools can help cities reduce risk and prioritize efforts to protect communities from these effects. Participants were asked to produce submissions that could help identify potential areas or zones of increased exposure and/or the degree of changes in exposure or health risk resulting from climate change.

Solution Type: Software and apps; and analytics, visualizations, algorithm

Primary Goals: Inform and educate the public; engage new people and communities; and build capacity

Results: A total of 11 entries were submitted. Participants ranged from academic teams to public health departments, students, and unaffiliated individuals. Participants came from all across the United States. In general, the winning entries were novel and interesting in the quality of presentation and the creative juxtaposition of datasets for produce visualizations, and called for in the challenge description. One national and one local first place winner were selected, and there was a tie for the local second place winners.

Problem Statement: Research into the effects of climate change on environmental exposures is growing, but data from such studies needs real world application. This challenge asked innovators to develop visualizations, analytics, and/or apps that show how particular exposures (e.g., pesticides, toxic waste, etc.) would affect a particular location. Awards were offered for solutions at both the national and the local/municipal levels. This challenge was part of the larger Climate and Health Innovation Challenge Series, a collaboration among Esri, the HHS Office of Business Management and Transformation, and NIEHS.

Participants were asked to use existing tools or platforms or create their own application to produce these visualizations. The geographic scale of the visualization could be as small as the neighborhood or community level or as large as the regional or national level. Participants were asked to produce submissions that could help identify potential areas or zones of increased exposure and/or the degree of changes in exposure or health risk resulting from climate change. Participants could consider a short-term time scale (e.g., 0 to 20 years) for impacts associated with extreme events, or a longer time scale (e.g., 2050 or beyond) for impacts associated with sea level rise or other phenomena whose greatest impact will clearly be decades from now.

Proposed Goals: The primary objectives of the prize competition were to engage new technical communities in considering the health implications of climate change; to better inform and educate the public; and to build capacity to inform local and national decisions regarding environmental exposures.

⁷³ www.niehs.nih.gov/funding/challenges/climate_change

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Communities can face health risks from a variety of environmental exposures, including hazardous wastes and deposits of industrial chemicals, air pollution, harmful algal blooms, toxic contaminants in food, and exposures to pesticides. The effects of climate change may exacerbate these health risks. Fortunately, newly released data and tools, in combination with other publicly available datasets, allow for innovative approaches to demonstrate and assess such risks.

Better information about climate change's potential impacts on environmental exposures would improve a wide range of important protective decisions. At the local level, such decisions might include where to build structures for potentially vulnerable populations, like day care centers or new housing. This information could also assist local decision makers on critical infrastructure questions, such as where to place new water intakes for drinking water systems, design or siting of urban waste water drainage or green infrastructure, or placement of monitoring equipment or other sensors.

At the national level, greater understanding of climate change's influence on the magnitude and spatial distribution of environmental exposures could inform decisions about prioritizing efforts to remove or control pollution and contaminants.

Measures of Success: Because the goals of the challenge were qualitative in nature, a qualitative narrative is provided to illustrate the challenge's success with respect to its goals.

Inform and educate the public

The challenge, its results, and the tools that were recognized as winners were all conveyed to a broad general audience. The challenge winners were announced at a public meeting of the NAEHS Council, which was also webcast. The announcement of winning tools was disseminated on NIEHS websites⁷⁴ as well as through multiple listservs and networks inside and outside the Federal Government.

Stories about the challenge appeared in widely disseminated government newsletters and websites, including:

- White House Climate and Health Fact Sheet⁷⁵;
- The NIEHS Environmental Factor, June 2016⁷⁶;
- PEPH newsletter⁷⁷, webinar⁷⁸;
- Challenge.gov⁷⁹; and
- The HHS COMPETES newsletter (April 28, #3)

The challenge and individual winners were also written up in:

⁷⁴ www.niehs.nih.gov/research/programs/geh/climatechange/index.cfm;
www.niehs.nih.gov/funding/challenges/climate_change/index.cfm

⁷⁵ Obamawhitehouse.archives.gov/the-press-office/2016/04/04/fact-sheet-what-climate-change-means-your-health-and-family

⁷⁶ www.niehs.nih.gov/news/newsletter//2016/4/feature/feature1-climate/index.htm

⁷⁷ April 2016 at www.niehs.nih.gov/PEPH

⁷⁸ www.niehs.nih.gov/research/supported/translational/peph/webinars/climate_change

⁷⁹ www.challenge.gov/challenge/the-niehs-climate-change-and-environmental-exposures-challenge

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- Non-governmental blogs and articles, including the American Lung Association blog⁸⁰;
- A TV and web story⁸¹; and
- Web story.⁸²

In addition, NIEHS staff are demonstrating and discussing the winning tools in numerous professional society and academic settings, including the American Public Health Association, American Meteorological Society, American Geophysical Union, lectures at UNC and other academic institutions, NIEHS webinars.

Engage new people and communities

The challenge was broadly disseminated to data science/engineering/visualization/mapping communities, including undergraduate and graduate programs that had not previously engaged with NIEHS directly on the issue of climate change. Entrants included people from fields of technology and engineering, data and climate science, modeling and mapping, data visualization, and others that are not traditionally engaged on environmental health research questions. Judges included professionals from data science/mapping (Esri) who were relatively new to the nexus of environmental exposures and climate change.

Build capacity

With the winning tools only recently being published and demonstrated, it is still early to evaluate the challenge's success with respect to the goal of building capacity. The tools have been well placed on the internet, however, for communities to be able to access and use them. These sites include the NIEHS website Resources for Scientists and Climate Change and Health webpages; and the Climate Resilience Toolkit www.toolkit.climate.gov, a Federal repository of publicly available data and information tools to build individual and community resilience on climate change. In addition, the winning tools are posted on entrant organization websites.^{83,84,85,86}

Participants: The agency hoped to mobilize students of public health, environmental sciences, geography, and computer science, as well as professionals working in those fields, to address issues at the nexus of climate change and environmental exposure assessment. Eleven submissions were received from 10 teams.

The rules for participating in the challenge and eligibility were as follows:

- To be eligible to win a prize under this challenge, an individual or entity:
 - Shall have registered to participate in the challenge under the rules promulgated by the NIEHS as published in this notice;
 - Shall have complied with all the requirements set forth in this notice;

⁸⁰ www.lung.org/about-us/blog/2016/04/protecting-our-climate-earth-day.html

⁸¹ www.wdbj7.com/news/local/new-technology-provides-data-for-first-responders-ahead-of-disasters/38863794

⁸² news.medicine.iu.edu/releases/2016/03/environmental-climate-change-challenge-wang.shtml

⁸³ upwiththewaters.wustl.edu

⁸⁴ www.sfclimatehealth.org

⁸⁵ sites.google.com/site/iumdcat

⁸⁶ ndssl.vbi.vt.edu/gis/pieviz

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- In the case of a private entity, shall be incorporated in and maintain a primary place of business in the United States, and in the case of an individual, whether participating singly or in a group, shall be a citizen or permanent resident of the United States 18 years of age or older;
- May not be a Federal entity;
- May not be a Federal employee acting within the scope of the employee's employment and further, in the case of HHS employees, may not work on their submission(s) during assigned duty hours;
- May not be an employee of the NIH, a judge of the challenge, or any other party involved with the design, production, execution, or distribution of the challenge or the immediate family of such a party (i.e., spouse, parent, step-parent, child, or step-child).
- Federal grantees may not use Federal grant funds to develop their challenge submissions unless use of such funds is consistent with the purpose of their grant award and specifically requested to do so due to the challenge design, and as announced in the *Federal Register*.
- Federal contractors may not use Federal funds from a contract to develop their challenge submissions or to fund efforts in support of their challenge submission.
- Submissions must not infringe upon any copyright or any other rights of any third party.
- By participating in this challenge, each individual (whether competing singly or in a group) and entity agrees to assume any and all risks and waive claims against the Federal Government and its related entities (as defined in the America COMPETES Act), except in the case of willful misconduct, for any injury, death, damage, or loss of property, revenue, or profits, whether direct, indirect, or consequential, arising from participation in this challenge, whether the injury, death, damage, or loss arises through negligence or otherwise.
- Based on the subject matter of the challenge, the type of work that it will possibly require, as well as an analysis of the likelihood of any claims for death, bodily injury, property damage, or loss potentially resulting from challenge participation, no individual (whether competing singly or in a group) or entity participating in the challenge is required to obtain liability insurance or demonstrate financial responsibility in order to participate in this challenge.
- By participating in this challenge, each individual (whether competing singly or in a group) and entity agrees to indemnify the Federal Government against third-party claims for damages arising from or related to challenge activities.
- An individual or entity shall not be deemed ineligible because the individual or entity used Federal facilities or consulted with Federal employees during the challenge, if the facilities and employees are made available to all individuals and entities participating in the challenge on an equitable basis.
- By participating in this challenge, each individual (whether participating singly or in a group) and entity grants to the NIH an irrevocable, paid-up, royalty-free nonexclusive worldwide license to post, link to, share, and display publicly on the Web the submission. Each participant will retain all other intellectual property rights in their submissions, as applicable.
- NIH reserves the right, in its sole discretion, to (a) cancel, suspend, or modify the challenge; and/or (b) not award any prizes if no submissions are deemed worthy.
- Each individual (whether participating singly or in a group) or entity agrees to follow all applicable Federal, State, and local laws, regulations, and policies.

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- Each individual (whether participating singly or in a group) and entity participating in this challenge must comply with all terms and conditions of these rules, and participation in this challenge constitutes each such participant's full and unconditional agreement to abide by these rules. Winning is contingent upon fulfilling all requirements herein.

Timeline: Submissions opened October 1, 2015 and ran through February 2, 2016. Winners were announced February 23, 2016.

Solicitation and Outreach: N/A

Incentives: The total amount of prize money available was \$35,000, which was obligated in FY 2015. A total of \$30,000 was awarded by the judges in FY 2016 after evaluating the entries. The source of the funds was NIEHS Office of the Director Research and Development allocation. All participants received reviews and written feedback from a panel of expert advisors as well as from the Federal judges. Winners of the challenge also received publicity, including a formal announcement at the publicly webcast NIEHS Advisory Council meeting in February 2016, as well as mention in the NIEHS eFactor newsletter, the NIEHS Global Environmental Health newsletter, the NIEHS Partnerships for Environmental Public Health (PEPH) newsletter and a podcast, and other outlets. Finally, winning entries were posted to the White House Climate Resilience Toolkit, affording extra visibility and credibility.

Evaluation and Judging: A panel of three Federal employees served as judges for the challenge. The judges were aided by evaluations of the entries by a panel of five technical advisors who represented a diversity of technical expertise and included community perspectives. Because of the diversity of topics and approaches, the judging was based on a rubric that weighed scientific validity (34%), innovative use of data (33%), and clarity/accessibility (33%). The use of non-Federal advisors and Federal judges worked well for this challenge. The use of a standard rubric and evaluation form also helped with making the evaluation and judging process objective and transparent, as well as providing a useful means for giving feedback to all the participants.

Partnerships: The primary partner for NIEHS was Esri, which provided technical guidance, including two of the technical advisors on the panel, as well as support for publicity (through Esri websites and Twitter accounts) and the offering of the Esri ArcGIS developer platform for participants to use.

The HHS Office of Business Management and Transformation provided assistance with setting up and managing the Challenge.gov website and providing additional publicity for the challenge.

Resources: Permanent staff were utilized to design, implement, judge, communicate with participants, and publicize the results for this challenge. A small amount of contractor support was also utilized to create forms and reports and to facilitate conference calls and meetings. The challenge was run on the no-cost Challenge.gov platform.

Results: A total of eleven entries were submitted. Participants ranged from academic teams to public health departments, students, and unaffiliated individuals. Participants came from all across

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the United States. It is unknown whether all participants had worked with the Federal Government previously. Several participants had separate grants from HHS for work on climate change and health. In general, the winning entries were novel and interesting in the quality of presentation and the creative juxtaposition of datasets for produce visualizations, and called for in the challenge description.

Here is a description of the winners:

National First Place Winner: PIE VIZ: Populations, Infrastructures, and Exposures Visualization Tool (Virginia Tech University)⁸⁷

Developed by a team at Virginia Tech, PIE VIZ combines datasets on power outages, air pollution levels, and extreme heat across the contiguous United States and includes tools to incorporate social isolation metrics. It allow users to visualize county-level extreme heat and dangerous air pollution days and to view county specific attributes including numbers of isolated persons.

Local First Place Winner: Effects of Climate Change on the Future of Local Communities in Indianapolis: A Prototype (Indiana University-Purdue University Indianapolis)⁸⁸

Created by a team at IUPUI, this tool leverages climate and health data in an interactive web portal that displays and communicates potential health and environmental effects of climate change including flooding, extreme heat, and air pollution, on a low income, disadvantaged Indianapolis neighborhood, the Near West Neighborhood.

Local Second Place Winner (Tie): The San Francisco Climate and Health Profile (San Francisco Department of Public Health)⁸⁹

Developed by the San Francisco Department of Public Health, the San Francisco Climate and Health profile is an innovative web-based tool that links climate change projections with their associated health outcomes and identifies populations and locations most vulnerable to these health outcomes. By centralizing and formalizing the collection of neighborhood-level data, the Climate and Health Profile provides neighborhood organizations, city departments, and direct service providers a simple, streamlined way to access information on climate and health.

Local Second Place Winner (Tie): Up with the Waters: Climate Change, Flooding and Contamination in the River City (Washington University)⁹⁰

Developed by a team based at Washington University in St. Louis, Up With the Waters is a series of maps that help residents identify areas of greatest potential risks of exposure in future flooding events. The tool includes various maps highlighting the number of St. Louisans that live and work near contamination sites within the floodplain. Visualizations also identify public parks that have high likelihood of becoming contaminated. This tool is intended to help government and land managers prioritize clean-up of the most heavily contaminated and populated areas within the flood plain in order to minimize exposure risks to the people of St. Louis.

⁸⁷ ndssl.vbi.vt.edu/gis/pieviz

⁸⁸ sites.google.com/site/iumdcat

⁸⁹ www.sfclimatehealth.org

⁹⁰ upwiththewaters.wustl.edu

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A.5.16 NIH: Design by Biomedical Undergraduate Teams (DEBUT)⁹¹

Summary: This challenge encourages undergraduate students to pursue solving biomedical problems. Not only does this challenge produce useful biomedical developments, many of which are translated into patents and startups, the challenge encourages students to push their boundaries and strengthens the future STEM workforce.

Solution Type: Technology demonstration and hardware (main); business plans; and analytics, visualizations, algorithms

Primary Goals: Build capacity; develop technology; and find and highlight innovative ideas

Results: In 2016, DEBUT engaged 354 students in 72 teams from 30 universities in 17 states and Washington, D.C. Not only the winners, but a majority of the submissions were noted by the judges to be of very high quality suggesting that DEBUT had succeeded in encouraging students to push their boundaries. Five prizes were awarded, along with four honorable mentions. Winning teams included smart pills for sample collection from TB patients, improved cervical cancer detection, and devices to help better sterilize and guide standard hospital work. Several of the winning teams of this year's competition are in the process of applying for patents or forming startups to commercialize their products.

Problem Statement: DEBUT challenge is open to teams of undergraduate students working on projects that develop innovative solutions to unmet health and clinical problems. The main requirement was a working technology solution to a real-world problem in healthcare. Specific judging criteria were significance, impact, innovative design, and working prototype. The entrants had the option of including an additional section that addressed patentability, market potential and economic feasibility of the project in order to be eligible for Venture and Design Excellence prizes awarded by partner VentureWell.

Proposed Goals:

- To provide undergraduate students valuable experiences such as working in teams, identifying unmet clinical needs, and designing, building, and debugging solutions for such open-ended problems;
- To generate novel, innovative tools to improve healthcare, consistent with NIBIB's purpose to support research, training, the dissemination of health information, and other programs with respect to biomedical imaging and engineering and associated technologies and modalities with biomedical applications;
- To highlight and acknowledge the contributions and accomplishments of undergraduate students; and

⁹¹ www.nibib.nih.gov/training-careers/undergraduate-graduate/design-biomedical-undergraduate-teams-debut-challenge

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- To encourage students to think about the patentability, market potential, and economic feasibility of the solutions they developed.

Measures of Success: In 2016, DEBUT engaged 354 students in 72 teams from 30 universities in 17 states and Washington, D.C. Not only the winners, but a majority of the submissions were noted by the judges to be of very high quality suggesting that DEBUT had succeeded in encouraging students to push their boundaries. Biomedical Engineering (BME) Capstone Design instructors around the country use DEBUT as a galvanizing tool and require/encourage their students to prepare/submit entries to DEBUT. Several of the winning teams of this year's competition are in the process of applying for patents or forming startups to commercialize their products. Having successfully completed the fifth year of the DEBUT challenge, NIBIB is in the process of reaching out to past winners to determine how many of the teams have taken further steps to translate their innovation.

Participants: Seventy-two teams composed of a total of 354 students competed in DEBUT. DEBUT is geared toward undergraduate students in BME. Teams made up of at least three undergraduate students can compete in the competition. At least one student must be in a BME department. Foreign students can compete and receive public recognition if their team wins. However, they are not eligible to receive prize money.

Timeline: Submissions for DEBUT opened March 1, 2016 and closed May 30, 2016. The winners were announced August 22, 2016.

Solicitation and Outreach: N/A

Incentives: \$75,000 was distributed in total prizes. Six prize winners and four honorable mentions were recognized at an award ceremony held at the 2016 Biomedical Engineering Society Conference in Minneapolis, Minnesota in October. Public recognition also included press releases, website, and social media postings.

All cash prizes were obligated to NIBIB's Direct Appropriation Account, TAFS 75-16-0898.

Evaluation and Judging: The NIBIB director was responsible for the final designation of winners of the NIBIB prizes. He based this decision on the evaluation of a judging panel made up of NIH staff with related expertise. This panel took into consideration the evaluation of a panel of experts our partner VentureWell convened in order to make its selections for Venture and Design Excellence prizes. All judging was based on the review criteria announced for the prizes. The most important lesson learned was that in evaluating biomedical design projects, judges with technical and clinical backgrounds can place emphasis on different aspects of a product. Hence it is important to have sufficient representation from both groups.

Partnerships: In this fifth year of the DEBUT challenge, NIBIB formed a public-private partnership with VentureWell, a higher education non-profit that describes its mission as "to launch new ventures from an emerging generation of young inventors driven to improve life for people and the planet." The joint competition was able to enhance the set of prizes available to students as well as offer a single portal for submitting entries. In addition to maintaining this

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informational and entry submission portal, VentureWell contributed to publicizing the competition as well as the receipt and evaluation of the entries.

Resources: Three members of NIBIB staff were mostly responsible for the management of the competition and the awarding of prizes. Eight others were involved in the judging of the entries. Agency funding was used for the prizes. As mentioned above, NIBIB's partner VentureWell contributed to publicizing the competition, maintaining an informational and submission website, and the receipt and evaluation of the entries.

Results: In 2016, DEBUT engaged 354 students in 72 teams from 30 universities in 17 states and Washington, D.C. The teams were made up of 3 to 20 students, with most teams comprising 4 to 6 students. Most entrants were seniors in BME departments. However, many teams included students from other departments as well as students from different years (freshman, sophomore, and junior). This was in line with our goal of engaging students in complex, interdisciplinary teams. Additionally, engaging of students in sophisticated design projects in the initial years of their education introduces them to design concepts early and allows them to build on this foundation in subsequent years.

This year's first prize winner was a smart pill that collects a gastric acid sample from pediatric patients who cannot cough forcefully enough to produce a sputum to be used in the diagnosis of Tuberculosis (TB). TB, which inflicted 9.6 million people around the world in 2014, can be treated with high success rate if diagnosed early. Hence the smart pill has the potential for significant impact on global health. Other winning projects included a point-of-care device for the improved diagnosis and staging of sepsis, which is critical for proper treatment; a system that improves sensitivity and specificity of cervical cancer detection in LMICs by integrating a speculum-fitted custom camera system with a lesion detection algorithm on a smart phone, with a projected cost of \$22/device; a practical and safe device that eradicates 99.9% of bacteria in a central venous catheter (CVC) hub using germicidal ultraviolet-C rays; a device for the single-handed insertion of CVCs that allows the physician to use the other hand to hold an ultrasound probe for image guidance, helping to prevent the needle tip from puncturing nearby structures; and a custom naso-pancreatic stent for localized cooling of the pancreas for the treatment of acute pancreatitis.

A.5.17 NIH: Novel, Innovative Tools to Increase Public Awareness and Knowledge of Sickle Cell Disease Undergraduate Challenge⁹²

Summary: Lack of awareness of sickle cell disease (SCD) contributes to stigma and sub-optimal patient care. For that reason, this challenge targets undergraduate students, encouraging them to develop tools, apps, and designs that spread awareness of SCD. Three winning solutions were identified from the challenge. The winning designs are continuing on to be spread to larger audiences and communities, creating greater awareness of SCD.

Solution Type: Software and apps; and creative (design and multimedia)

⁹² www.nhlbi.nih.gov

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Primary Goals: Find and highlight innovative ideas; inform and educate the public; and engage new people and communities

Results: Three winners were selected from a total of six entries. These solutions ranged from new cellphone apps to songs. The teams proposed to continue to improve functionality and extend access of their tools to larger audiences. The Institute plans to utilize challenges on a consistent basis to engage the next generation in solving difficult public health problems in heart, lung, and blood diseases and sleep disorders.

Problem Statement: The National Heart, Lung, and Blood Institute (NHLBI), a component of the National Institutes of Health (NIH) announced the “Novel, Innovative Tools to Increase Public Awareness and Knowledge of Sickle Cell Disease Undergraduate Challenge” to help address the lack of awareness about sickle cell disease and its associated complications. Sickle cell disease (also known as sickle cell anemia) (SCD) is the most common genetic disorder in the United States. About 100,000 Americans are thought to be living with SCD, and each year another 1,000 babies are born with the disease. Sickle cell disease is an inherited disease that results in abnormal hemoglobin, the protein in human red blood cells that carries oxygen to all tissues in the body. Hemoglobin is essential for life. A specific single mutation in the gene (DNA) for hemoglobin, when inherited from both parents, causes SCD. The sickle hemoglobin distorts the shape of the red blood cell into a “sickle” or crescent moon shape that flows poorly through small blood vessels. This can cause problems in virtually any organ by reducing the delivery of oxygen and inflaming the surrounding tissue. These abnormal sickle cells usually die after only about 10 to 20 days (as compared to normal red blood cells that live about 120 days). Over time, organ damage occurs, possibly resulting in a stroke in the brain, kidney damage, or complications in other organ systems. SCD also causes significant pain in the affected tissues. This pain, which can begin in childhood, often escalates into adulthood, severely affecting the quality of life of individuals with SCD. Sickle cell disease not only affects the individual but also his or her family and communities.

Proposed Goals: There is a lack of awareness about SCD and its associated complications among the general public and affected communities. This unawareness can contribute to the stigma associated with SCD, the lack of understanding of how the disease affects individuals and families’ daily lives, and to less than optimal care experienced by many patients. Through this challenge, the NHLBI challenged undergraduate students to create novel, innovative information dissemination tools that may be used to increase the general public’s awareness of SCD, and to provide information on SCD and its complications (particularly pain) to individuals, caregivers, families, and communities affected by SCD in an easily comprehensible manner.

More specifically, the goals of the challenge were to: (1) generate novel, innovative tools that may be used to increase public awareness and knowledge of SCD and associated complications that could potentially improve patient care; (2) advance the field of implementation science research through training, mentoring, and highlighting the contributions of a new generation of undergraduate researchers using a systems science approach to address multi-faceted problems; and (3) encourage “team science” by providing undergraduate students valuable experiences to pursue science collectively as they engage in complex problem solving to improve outcomes.

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Measures of Success: The “Novel, Innovative Tools to Increase Public Awareness and Knowledge of Sickle Cell Disease Undergraduate Challenge,” was a prize competition designed to inspire undergraduate students to value and use transdisciplinary skill sets to solve important public health challenges. The incentive was to promote the development of innovative information dissemination tools that may be used to (1) increase the general public’s awareness of SCD; (2) provide information on SCD and its complications to individuals, caregivers, families, and communities affected by SCD in an easily comprehensible manner; and (3) improve patient care and outcomes. Since this is a new area of research for undergraduate students, the challenge also aimed to advance the field of implementation science research through training, mentoring, and highlighting the contributions of a new generation of undergraduate researchers using a systems science approach to address multi-faceted problems.

Participants: Six submissions were received for this challenge, which was open to any Student Team—defined as a group of at least three and no more than five individuals, each of whom is at least 18 years of age and currently enrolled as a full-time student pursuing an undergraduate or associates degree.

The Student Team had to be transdisciplinary, that is, composed of undergraduate students from diverse disciplines such as fine arts, performing arts, humanities, psychology, science, engineering, graphic design, IT (hardware, software), mathematics, statistics, environmental science, computational modeling, and others.

The Student Team had to be mentored by an individual from the teaching staff at the academic institution. The mentor could be a Professor, Associate Professor, Assistant Professor, Instructor, or a Teaching Assistant within the same academic institution as the Student Team. The teaching staff member could mentor only one team; however, a team could have more than one mentor (co-mentors could be located at a different institution).

Timeline: Submissions opened November 30, 2015 and closed April 6, 2016. The winners were announced August 16, 2016.

Solicitation and Outreach: A massive outreach campaign was employed to reach undergraduate students, which included: development of an NHLBI web page with a description of the challenge; posting on Challenge.gov; development of an NHLBI Ideascale page for applicants to get detailed information on the challenge and to register and post their submissions; an NHLBI social media campaign; more than 300 emails to undergraduate institutions; notification of the challenge to individuals who work with undergraduate students; and an NHLBI webinar on the challenge so that potential submitters could learn about sickle cell disease and ask questions about the disease and the challenge.

Incentives: The NHLBI awarded up to three prizes: first prize of \$7,000, second prize of \$5,000, and third prize of \$3,000. An additional \$2,000 was awarded to each team for travel to the NHLBI/National Sickle Cell Disease meeting (August 2016) to present and demonstrate their winning entry. Prizes were shared equally by team members.

Evaluation and Judging: N/A

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Partnerships: N/A

Resources: N/A

Results: The Institute announced three winning teams and one honorable mention for the challenge.⁹³

First Place: University of Pittsburgh

The University of Pittsburgh won the first place prize of \$7,000 for their mobile phone application named “Sickle Share.” This team designed Sickle Share as a platform for sharing information about SCD. The application includes resources, facts, and videos featuring researchers and patients. The University of Pittsburgh team created a video to present their idea.⁹⁴

Second Place: University of Notre Dame

The University of Notre Dame won second place, earning them \$5,000. Their project, “Snap Out of Sickle Cell,” leverages a social media application called Snapchat to disseminate information about sickle cell disease. This team also created a video to present their idea.⁹⁵

Third Place: Connecticut College

In third place, Connecticut College won \$3,000 for their hip hop song, “Blood Red Crescent Moon.” The song addresses various misconceptions surrounding SCD and how it affects the everyday life of individuals living with SCD.⁹⁶

Honorable Mention: City College of New York

This team proposed a model for a grassroots sickle cell awareness campaign that could be scaled nationally. The campaign involved word-of-mouth, social media, and on-campus events.

The first, second, and third place teams were invited to present and demonstrate the winning tools at the NHLBI Annual Sickle Cell Disease Clinical Research Meeting in August 2016.⁹⁷ The presentations were given to a packed audience with an opportunity to network with the SCD experts at the NHLBI and the SCD research community. The teams proposed to improve functionality and extend access of their tools to larger audiences.

The Institute plans to utilize this mechanism on a consistent basis to engage the next generation in solving difficult public health problems in heart, lung, and blood diseases and sleep disorders.

⁹³ The announcement can be found at www.nhlbi.nih.gov/news/spotlight/fact-sheet/nhlbis-novel-innovative-tools-increase-public-awareness-and-knowledge-sickle-cell-disease

⁹⁴ www.youtube.com/watch?v=5s3a55c0U3g&feature=youtu.be

⁹⁵ www.youtube.com/watch?v=iIM7GQIXyQk&feature=youtu.be

⁹⁶ soundcloud.com/conncollege/blood-red-crescent-moon

⁹⁷ More information on the meeting can be found at www.nhlbi.nih.gov/news/events/annual-sickle-cell-disease-clinical-research-meetings

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A.5.18 NIH: \$100,000 for Start a SUD Startup⁹⁸

Summary: This challenge is designed to fund “would be” biotech startups working to further an understanding of substance abuse disorders (SUDs), in order to mitigate this ongoing public health crisis. This challenge is unique because NIDA intends to fund the startup founders much earlier than most investors, incubators, or traditional modes of research funding (e.g. small business grants).

Solution Type: Ideas

Primary Goals: Find and highlight innovative ideas

Results: The 10 winning teams encompassed biosensors and optogenetics, natural language processing, biofeedback and brain stimulation, data mining of proteomics, and many others. These teams will continue to work towards providing minimum viable proof six months after the prize’s conclusion.

Problem Statement: This challenge is unique because NIDA intends to fund the “would be” startup founders much earlier than most investors, incubators, or traditional modes of research funding (e.g. small business grants).

NIDA expects that the team or an individual must have a research idea that could further the understanding of substance use disorders (SUDs) and is intended to be the basis of the development of a new and potentially successful startup. The research “idea” is the product that a future startup will offer. The research idea must be broad enough to address multiple conditions, diseases, or indications consistent with SUD or be specific for prevention and treatments of SUD. Product is any source of value for the people who become customers. Services, subscriptions, software as a service (SaaS), physical/tangible products, aggregations, etc. could all provide value and thus be considered startup products. The startup product could be the result of novel scientific discoveries, repurposing an existing technology for a new use, extending a research observation into a different area, devising a new business model or distribution/delivery channel that unlocks value currently concealed, or simply bringing a product or service to a previously underserved set of customers. The founder (the teams or an individual) must demonstrate through the submission the passion, drive, discipline, ability to work collaboratively, and willingness to push forward under conditions of extreme business uncertainty.

The winners of this challenge are encouraged to use the prize funds to develop a minimum viable proof (MVP) as quickly as possible and to obtain customer feedback to discover if MVP meets the customer needs. If the product prototype is successfully validated, winners are encouraged to create or further advance their biotech startup no later than six months after the prize is awarded.

Proposed Goals: The challenge goal is to support research ideas that would further an understanding of neurobiology as it relates to substance use disorders and that are intended to be the basis for the development of a new and potentially successful start-up. NIDA hopes that

⁹⁸ www.challenge.gov/challenge/100000-for-start-a-sud-startup

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participation in the contest will enable scientists to test the hypothesis that their research idea can be fostered into a biotech startup, and that eventually any newly created startups will contribute to the pool of innovative small business companies that can successfully compete for NIDA's Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) funding.

Measures of Success: The general purpose of NIDA is to conduct and support biomedical and behavioral research, health-services research, research training, and health-information dissemination with respect to the prevention of drug abuse and the treatment of drug abusers. This challenge is consistent with and advances the mission of NIDA as described in 42 U.S.C. 285o in that it supports new and potential biotech start-ups in the development of research ideas that would further an understanding of neurobiology as it relates to substance use disorders.

Participants: The eligibility requirements included U.S. citizenship or permanent residency. A challenge participant ("founder") may be an entity or an individual or group of individuals (i.e., a team assembled with the purpose of participating in this challenge). A founder must be a potential start-up (i.e., not yet formed) or a new start-up (i.e., in the early stage of formation and development). Seventeen teams encompassing 41 people entered the challenge.

Winners are encouraged to submit the minimum viable proof (MVP) report six months after the prize payment.

Each submission for this challenge requires a completed submission package that includes a four-page written proposal describing an idea and a five-minute video introducing the team.

Timeline: Submissions ran from June 13, 2016 to September 16, 2016, with the winners announced November 8, 2016.

Solicitation and Outreach:

- Contacting Outside Organizations to promote outreach (JLAB incubator; BHI incubator, QB3 incubator, NSF hubs); and
- NIDA Social Media (Twitter, LinkedIn, and Facebook posts) and email outreach (NIH/NIDA grantees listserv).

Incentives: Ten monetary prizes were awarded, \$10,000 each. The total prize award pool was up to \$100,000. The names of the winners and the titles of their submissions are posted on the NIDA web site.

Post Challenge, NIDA staff will provide dedicated assistance and guidance about development of a minimum viable proof.

Evaluation and Judging: The challenge review panel included Federal employees from National Institute on Drug Abuse (NIDA).

The challenge has five success criteria for selection of winners. Each criterion is scored with the maximum of 10 points.

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- **Significance and Unmet Needs:** Are there significant needs for your product or service? Does the project address an important problem or a critical barrier to progress in the field of drug abuse research? If the aims of the project are achieved, how will scientific knowledge, technical capability, service, or clinical practice be improved?
- **Innovation:** Does the submission seek to shift current paradigms by utilizing novel theoretical concepts, approaches, methodologies, instrumentation, service, or interventions for drug abuse research? Is your product novel in a broad sense? Is a refinement, improvement, or new application of theoretical concepts, approaches, or methodologies instrumentation or interventions proposed?
- **Approach:** Are the overall strategy, methodology, and analyses well-reasoned and appropriate to test the proposed idea? Has feedback from end users been incorporated into the validity of the idea proposed?
- **Team expertise:** Does the individual or team demonstrate high level of ability, perseverance and grit?
- **Commercialization:** Is there a clear path for the product/service to reach the market? Are the product users and purchasers clearly identified?

Partnerships: No partnerships were formed for this challenge.

Resources: The current estimated efforts are:

- NIDA challenge manager, GS-15 (5% efforts); 44 FTE hours;
- NIDA challenge administrator, GS-14 (20% efforts), 176 FTE hours; and
- NIDA contractor (10% efforts), 88 hours.

NIDA is hosting this challenge on Challenge.gov platform at no cost.

Results: NIDA received 17 submissions; 15 submissions were compliant with eligibility criteria and reviewed. The idea submitting teams were from U.S. academic institutions, newly-formed small business companies, and the public. Only two submissions came from NIH researchers.

Based upon the challenge criteria, the judging panel has selected 10 submissions for the challenge awards:

- Team 1: PainQx Inc. (Frank Minella, Leslie Pritchep, Alejandro Zamorano)
Submission Title: PQX Objective Pain Measurement
- Team 2: Albert Einstein College of Medicine (Vlad Verkhusha and Daria Shcherbakova)
Submission Title: Near-infrared biosensors and optogenetics to advance preclinical studies in neurobiology
- Team 3: Florida International University (Francisco R. Ortega, Armando Barreto, Jules Calella, Alain Galvan, Santiago Bolivar)
Submission Title: Bio-Interactive Device for SUD
- Team 4: Beacon Health. Co (Shrenik Jain)
Submission Title: Applying Natural Language Processing to Increase Provider Efficiency in SUD group therapy setting
- Team 5: Joseph Insler, Scott Weiner, John Moustoukas, Ajoy Basu, Michael Gilbert (Boston, MA)

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Submission Title: Opioid Recovery Bracelet

- Team 6: JADE Biotech (John Lowman, Randall Brenn, Elora Hilmas, Dan Charytonowicz)
Submission Title: Developing a Solution to Prevent the Diversion, Abuse, and Addiction to Hospital Narcotic Waste
- Team 7: University of Kentucky College of Medicine (Michael Wesley, Josh Lile, Arit Harvanko, David Hempy)
Submission Title: Biofeedback and brain stimulation Device
- Team 8: Care Analytics, University of Texas Health Science Center (Benson M Irungu, Mon-Ju Wu, Phillip Beckett)
Submission Title: A software tool to predict relapse-related readmissions and provide post-discharge care coordination.
- Team 9: Clare Zhu and Anin Sayana
Submission Title: Blockchain-Based Healthcare Data Management
- Team 10: Viralchemistry Bioscience (Trevor Gale, Tim Horton, Ben Bradley)
Submission Title: Proteomics, Informatics, & Data Mining to Reduce Costs of Drug Development for Substance Use Disorders

A.5.19 NIH: Open Science Prize⁹⁹

Summary: The amount of digital publications, datasets, codes, and other research outputs publicly available is greater than ever before. In order to best allow for the public to take advantage of this data, this challenge is intended to support the development of new systems that will make this data more accessible and usable. The challenge is necessary to accelerate the field of “open” biomedical research beyond what current funding mechanisms can achieve.

Solution Type: Software and apps; technology demonstration and hardware; analytics, visualizations, algorithms; and scientific

Primary Goals: Find and highlight innovative ideas; advance scientific research; and engage new people and communities

Results: Six finalists were selected from 96 teams for entry into Phase 2. These six teams were submitted from eight countries. Submissions to date have been innovative and have fostered many international collaborations, and the challenge is considered to have succeeded in its goals.

Problem Statement: The volume of digital objects for research available to researchers and the wider public is greater now than ever before, and so, consequently, are the opportunities to mine and extract value from existing open content and to generate new discoveries and other societal benefits. A key obstacle in realizing these benefits is the discoverability of open content, and the ability to access and utilize it.

The Open Science Prize provides funding to encourage and support the prototyping and development of services, tools, or platforms that enable open content—including publications,

⁹⁹ www.openscienceprize.org

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datasets, codes, and other research outputs—to be discovered, accessed, and reused in ways that will advance research, spark innovation, and generate new societal benefits. The challenge is necessary to accelerate the field of “open” biomedical research beyond what current funding mechanisms can achieve.

Proposed Goals: The goal of this challenge is to stimulate the development of novel and ground-breaking tools and platforms to enable the reuse and repurposing of open digital research objects (e.g., data, publications, and other research outputs) relevant to biomedical or health applications. The prize also aims to forge new international collaborations that bring together open science innovators from the United States and abroad to co-develop services and tools of benefit to the global research community.

Measures of Success: At the midway point of the competition, the prize is succeeding in the goals described above. Submissions to date have been innovative and have fostered many international collaborations. The full array of initial solutions and six Phase 1 finalists can be found on the Open Science Prize website.¹⁰⁰ As the competition nears the demonstration of Phase 2 prototypes, the NIH will gain a better understanding of the potential impact on human health, a key measure of the success of the prize, and the enablement of Open Science.

Participants: The agency hoped to mobilize teams of solvers from around the world and to build new international collaborations in the field of Open Science. Competitors had to be teams with at least one member from the United States and one member from outside the United States. This requirement was put in place to achieve the goal of encouraging international collaboration in the field of Open Science. Ninety-six teams composing 450 individuals submitted entries.

Timeline: Phase 1 opened October 20, 2015 and closed February 29, 2016. Winners were announced April 30, 2016. Phase 2 entries were due December 1, 2016, and winners were to be announced February 28, 2017.

Solicitation and Outreach: The NIH utilized social media, email outreach, webinars, and press releases in its initial marketing of the prize. An important aspect of the outreach strategy has been showcasing results at public events that garner media attention. For example, the NIH and Wellcome Trust announced the Phase 1 winner at the Health Datapalooza (a three-day conference supported by the U.S. Department of Health and Human Services) on May 9, 2016, and as a result received press coverage from more than three dozen news organizations in over a dozen languages. In Phase 2 of the prize competition, NIH plans to showcase the finalists’ solutions at the Big Data to Knowledge Open Data Science Symposium, a full-day event celebrating uses of open data and open science at NIH. For this event, NIH will utilize live streaming and social media as way of engaging diverse audiences. NIH and Wellcome Trust will also utilize this meeting to launch five weeks of public voting as a way to engage diverse audiences and expose the public to the prototypes developed by the six finalist teams. Throughout this prize competition, NIH has worked closely with partner organizations (such as the Federal Community of Prizes and Challenges) and Open Data and Open Science Organizations to help educate the public about the prize and the resulting solutions.

¹⁰⁰ www.openscienceprize.org

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Incentives: The total amount of prize money was \$710,000, of which \$355,000 came from the National Institutes of Health and \$355,000 came from its partner, the Wellcome Trust (with a portion of the funds (\$80,000) contributed to the Wellcome Trust by the Howard Hughes Medical Institute). The NIH funded the U.S. solvers only. The prize money from the NIH is being awarded to the prize winners through a contract vehicle NIH established with the Capitol Consulting Corporation, who is overseeing prize administration. In addition to a monetary reward, it is anticipated that the participants were also motivated by the potential publicity and recognition offered by National Institutes of Health, Wellcome Trust, and Howard Hughes Medical Institute.

Evaluation and Judging: Participants were given wide latitude to choose their project and build their prototype accordingly. Judging has been based on the following criteria:

- **Impact**: What level of impact and benefit could the proposal—if successful—deliver to the research enterprise and health/healthcare research? Does the proposal/prototype address implementation in multiple settings in a cross-national manner?
- **Innovation**: What level of creativity and technological innovation does the entrant demonstrate?
- **Originality**: Is the technology or service genuinely novel and targeting an unmet need? Has the applicant evaluated other existing or alternative approaches, or delineated their approach in comparison to existing approaches (if applicable)?
- **Technological viability**: Is the approach proposed viable? Can the proposed technology deliver?
- **Resource feasibility**: Does the team have the required skills and resources?
- **Advancement of Open Science**: To what extent does the proposal/prototype advance the goals of open science in biomedical/health research, and fulfill the goals of openness in terms of the product and way of working? To what extent would it move the field forward?

Judges from NIH and the partnering organizations scored all of the Phase 1 solutions using a five-point scale, based on these factors. The most promising solutions were submitted to a panel of external advisors for additional review. After considering the panel's viewpoints, NIH, Wellcome Trust, and HHMI judges selected the top six solution for Phase 1.

In Phase 2 of this competition, public voting will help to determine the top three prototypes. Judges from NIH and Wellcome Trust will review these top three prototypes and also seek input from the expert advisors. A single finalist will be selected with the aforementioned criteria.

Partnerships: This competition is a collaboration with the Wellcome Trust and Howard Hughes Medical Institute. These partners provided substantial monetary contributions, in-kind support, expert advice, marketing, and outreach assistance. Wellcome Trust estimates their costs at \$275,000 in prize money plus an extra \$50,000 in logistical support. Howard Hughes Medical Institute contributed \$80,000 in prize money. This partnership has been very successful, and as a result, the funding organizations are exploring future types of collaborations.

Resources: The NIH utilized one and a half staff persons to oversee conceptual development of the prize, develop judging materials and judging processes, and coordinate all promotional and outreach activities. The Wellcome Trust utilized roughly the same number of employees for these

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tasks, focusing particularly on development of the website and on-line tools such as the public voting site. In addition, NIH utilized a contractor to assist with the logistical aspects of the prize, including meeting coordination, webinars, travel of participants to events, etc.

Results: Registration and Phase 1 of the competition is complete. Ninety-six teams, representing 450 entrants from 45 countries, submitted entries to the Phase 1. A summary of all 96 entrants' submissions can be found here: <https://www.openscienceprize.org/p/>.

Phase 2 has six teams competing, representing eight countries around the world. Teams varied in size from 2 to 12 people. A summary of the six finalist teams and their innovations can be found here: <https://www.openscienceprize.org/res/p/finalists/>.

It is estimated that at least a third of the solvers had not been previously funded by the National Institutes of Health prior to this challenge competition.

A.5.20 NIH: Pill Image Recognition Challenge¹⁰¹

Summary: Unidentified and misidentified prescription pills present challenges for patients and professionals. The nine out of 10 U.S. citizens over age 65 who take more than one prescription pill can be prone to misidentifying those pills. Taking such pills can result in adverse drug events that affect health or cause death. In order to reduce misidentification of prescription pills, this challenge sought to build a system that could use patient photographs of pills to match their pills against a database and identify them for the patient.

Solution Type: Software and algorithm

Primary Goals: Solve a specific problem; advance scientific research; and develop technology

Results: Eleven teams encompassing 37 individuals participated in the challenge, none of whom had worked with the Federal Government previously, indicating that this challenge successfully expanded the reach of NIH innovation and brought in new communities. This challenge did not result in a solution reliable enough to be used by the general public, but it did raise the consciousness level within the appropriate communities and increased awareness of new technologies. Like the original DARPA Driverless Vehicle Challenge many years ago, a second challenge, after an appropriate lessons learned interval, has a much better chance for complete success.

Problem Statement: Unidentified and misidentified prescription pills present challenges for patients and professionals. The nine out of 10 U.S. citizens over age 65 who take more than one prescription pill can be prone to misidentifying those pills. Taking such pills can result in adverse drug events that affect health or cause death. To reduce such errors, any person should easily be able to confirm that a prescription pill or a refill is correct. For example, a person should be able to easily verify (or not) that a refill that has a different color, shape, or text imprinted on the pill is

¹⁰¹ pir.nlm.nih.gov/challenge

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a different generic version of equivalent drugs he or she was already taking. To help address these problems, the NLM Computational Photography Project for Pill Identification (C3PI) is developing infrastructure and tools for identifying prescription pills. The infrastructure includes photographs of such pills taken under laboratory lighting conditions, from a camera directly above the front and the back faces of the pill, and at high resolution. Specialized digital macro-photography techniques were then used to capture JPEG pill images. The NLM RxIMAGE database contains these high-quality images and associated pill data such as appearance (color, shape, size, text imprinted on the pill, etc.), ingredients, and identifiers such as its National Drug Code (NDC).¹⁰² RxIMAGE images and data are freely available. The freely accessible RxIMAGE API provides text-based search and retrieval of images and data from the RxIMAGE database. By contributing their algorithm and software, challenge participants took part in a broader National Library of Medicine (NLM) effort to develop a freely usable software system and a freely accessible API for image-based search and retrieval from a mobile device. Challenge participants were required to submit a virtual machine (VM) which included the executable software for ranking how well consumer images of pills taken by digital cameras matched the reference images, and a source code for the executive files, as well as documentation describing the results of their work. To evaluate the results, NLM ran each submission software on a database of consumer-quality and reference images different from the ones provided to participants. The score was computed as the Mean Average Precision (MAP) of the ranking matrix. The challenge entries were ranked by their MAP scores, and the entries with the highest scores were selected as winners. The challenge was part of the overall work of the C3PI and its efforts to research image recognition.

Proposed Goals: The objective of the challenge is the development and discovery of high-quality algorithms and software that rank how well consumer images of prescription pills match reference images of pills in the authoritative NLM RxIMAGE database. NLM may use all or part of any challenge entry (i.e., algorithm and software) to create a future software system and a future API (Application Programming Interface) for pill image recognition; the system will be freely usable and the API will be freely accessible. The NLM Computational Photography Project for Pill Identification (C3PI) is a research and development project in the Office of High Performance Computing and Communications (OHPCC) within the NLM Lister Hill National Center for Biomedical Communications (LHNCBC). C3PI computer scientists conduct computer vision R&D in text- and image-based search and retrieval. C3PI's overall goal is to help improve the prescription drug information made available to health professionals and consumers.

Measures of Success: The objective of this challenge was to research and develop high-quality algorithms and software that match consumer quality images of prescription pills to reference images of pills in the authoritative NLM RxIMAGE database. There are several technically different ways to potentially solve this problem. NLM does not have in-house expertise in any of these. The solution requires advanced research as well as development. The technical literature has not recorded a solution reliable enough to be used by the general public for healthcare. It is therefore impossible to know what a reliable enough contract-based solution might cost or if it would have been found under a single fixed contract. This challenge did not result in a solution reliable enough to be used by the general public but it did raise the consciousness level within the appropriate communities and made NIH aware of a very promising brand new technology of which

¹⁰² www.fda.gov/Drugs/InformationOnDrugs/ucm142438.htm

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it was not aware. Like the original DARPA Driverless Vehicle Challenge many years ago, a second challenge, after an appropriate lessons learned interval, has a much better chance for complete success.

Participants: The challenge was designed to attract the image recognition community, especially those interested in facial recognition and text recognition, and the Artificial Intelligence (AI) community including those interested in Deep Learning. The only eligibility requirement was that a member of each team must be a U.S. Citizen or an employee of the U.S. corporation sponsoring the team. Eleven teams encompassing 37 people sent in entries.

Timeline: Submissions for this challenge were opened April 4, 2016 and closed May 31, 2016. Winners were announced August 1, 2016.

Solicitation and Outreach: N/A

Incentives: The total amount of the cash prizes awarded was \$45,000 taken from the NLM research budget. No non-monetary incentives were used to motivate participants and reward winners.

Evaluation and Judging: The final designation of award winners was determined by the highest quantitative test score on a Mean Average Precision (MAP) test described in the FRN announcement. This method worked well and will be reused for future challenges.

Partnerships: There were no formal partnerships or informal collaborations.

Resources: The entire challenge was conducted by in-house personnel. About \$100,000 in personnel time and \$45,000 for prizes were spent.

Results: There were 37 entrants making up 11 teams. On average each team was made up of three or four individuals. The 11 teams came from locations all across the United States. All of the entrants had not worked with the Federal Government previously or the National Library of Medicine. The entrants were largely students and amateur programmers. All of the winning teams used Deep Learning technology, which is still in its infancy. There was a great variation in the reliability of the results.

A.5.21 Provider User Experience Challenge¹⁰³

Summary: The lack of interoperability between electronic health record (EHR) systems remains a significant barrier to the modernization of health IT, making it difficult to effectively transfer from a paper based to an electronic health record system. Fast Healthcare Interoperability Resources (FHIR), developed by HL7, is a standard designed to improve interoperability. The Provider User Experience Challenge, combined with its partner challenge, the Consumer Health Data Aggregator Challenge, is part of ONC's Connecting and Accelerating a FHIR App Ecosystem initiative. This initiative calls on innovators to develop market-ready software apps for consumers and healthcare providers in an effort to improve the health and care of the country.

¹⁰³ www.challenge.gov/challenge/provider-user-experience-challenge

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Solution Type: Software and app

Primary Goals: Solve a specific problem; engage new people and communities; and stimulate a market

Results: Phase 1 required the creation of an app development proposal, which included detailed technical plans, mockups/wireframes of the proposed app, a business model/sustainability plan, and demonstration of agreements to conduct pilot testing with actual users. Thirty-four submissions were received for Phase 1. Virtually all submissions were by small technology companies that already had a product available or in development, which they planned to modify. Phase 2 entailed the development of the proposed app or modification of an app that already exists. Seven submissions were received in Phase 2.

Problem Statement: The lack of interoperability between electronic health record (EHR) systems remains a significant barrier to the modernization of health IT. Fast Healthcare Interoperability Resources (FHIR), developed by HL7, is a standard designed to increase the liquidity of granular patient data. The FHIR API allows data to move between vendor systems both within and across different providers, not to mention through third-party applications for direct use by both clinicians and consumers. Among several opportunities now enabled by this interoperability standard are the new channels being opened up for improving a provider's user experience when interacting with EHRs and the "consumability" of interrelated health data. The Provider User Experience Challenge, combined with its partner challenge, the Consumer Health Data Aggregator Challenge, is part of ONC's Connecting and Accelerating a FHIR App Ecosystem initiative. This initiative calls on innovators to develop market-ready software apps for consumers and healthcare providers in an effort to improve the health and care of the country.

Proposed Goals: The Provider User Experience Challenge has several objectives, the primary one being to increase the number of apps available to providers that can aggregate patient data from multiple sources into one place, and utilize modern web and information design to simplify and enhance the user experience. Specifically, this had to be done using the FHIR API, which is the most widely-known and developed open API for exchanging patient health data. Even though FHIR is the open API with the highest level of awareness, the challenge was also intended to raise this level higher, and to incentivize more developers to work with and familiarize themselves with FHIR.

Measures of Success: The clearest measure of success will be the number of apps available for public download and use for providers by the conclusion of Phase 2 of the challenge. A second degree of success will be measured by follow-on actions involving Phase 2 participants and their apps—how many times have they been downloaded and are they rated well by users? Do challenge participants execute new business arrangements with other health companies? Do they receive useful, non-Federal publicity from winning or participating in the challenge?

Participants: While the challenge is open to any developers, the need to understand the intersection of EHRs, patient care, and patient data sharing made it most relevant to companies that already had working knowledge of those areas and are active in health IT. The challenge was run under

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the authority of Section 105 of the America COMPETES Reauthorization Act and therefore had the eligibility criteria pursuant to it. Phase 1 received 34 entries.

Timeline: Phase 1 of this challenge opened March 1, 2016 and closed June 1, 2016. Winners were announced July 18, 2016. Phase 2 opened June 2, 2016, and closed November 7, 2016. Winners were announced January 11, 2017.

Solicitation and Outreach: The Consumer Health Data Aggregator and Provider User Experience Challenges were announced by the National Coordinator for Health IT at a prominent industry conference, HIMSS, on March 1, 2016. Many of ONC's communications channels were leveraged, including blog posts, social media, press releases, webinars, and listservs.

Incentives: The challenge has a prize purse of up to \$175,000. In Phase 1, up to five prizes of \$5,000 to \$15,000 were available; four \$10,000 prizes were awarded. In Phase 2, prizes include one \$50,000 first prize, one \$25,000 second prize, and an additional \$25,000 prize for the app demonstrating the highest level of patient data exchange. The primary non-monetary incentives are the publicity and recognition for winning an ONC challenge. Award funds were disbursed by a contractor acquired through the HHS Competes Blanket Purchasing Agreement.

Evaluation and Judging: A combined review panel of Federal and non-Federal subject matter experts reviewed and scored all Phase 1 submissions; the Federal challenge managers selected the winners, factoring in those reviews. In Phase 1, equal co-winners were chosen rather than ranked winners because the submissions—written proposals—are steps toward the eventual outcome of the challenge, not the outcome itself. The final outcomes of Phase 2—health provider apps—will be ranked and awarded. Five evaluation criteria were used to review submissions: the technical feasibility of the plan; the adherence to data privacy and security best practices and applicable law; the strength of the business/sustainability plan; the impact potential in a clinical setting; and the provider and/or health IT developer partnerships. These criteria captured the most important aspects that needed to be identified in the submissions.

Partnerships: No partnerships were utilized.

Resources: A small ONC team, with one primary challenge manager, developed and executed the Consumer Health Data Aggregator and Provider User Experience Challenges. Additional funds for the challenge prizes were required on top of the annual ONC challenge funding allocation; these were designated to the project from the national coordinator's discretionary pool. A third-party contractor, acquired through the HHS Competes Blanket Purchasing Agreement, provided administrative, management, and communications assistance. Given the challenge manager's extensive experience in running prize challenges, challenge development services were not needed.

Results: The challenge has two phases. Phase 1 required the creation of an app development proposal, which included detailed technical plans, mockups/wireframes of the proposed app, a business model/sustainability plan, and demonstration of agreements to conduct pilot testing with actual users. Thirty-four submissions were received for Phase 1, five of which were assessed as not eligible. Virtually all submissions were by small technology companies that already had a

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product available or in development, which they planned to modify. Four winners (out of a potential maximum of five) were selected, each receiving a \$15,000 award. Phase 2, the app development phase, received seven submissions, of which two were selected; each received an award of \$50,000.

A.5.22 SAMHSA: Opioid Recovery App Challenge¹⁰⁴

Summary: This challenge seeks to help give patients tools in recovering from opioid addiction, a chronic brain disease. Those who suffer from a substance use disorder need help to change their behavior and learn new strategies to maintain health. They can get this help with treatment—with the care of doctors and substance use disorders treatment providers. This challenge intends to help support this treatment by designing apps that can help patients learn more about managing recovery outside of treatment sessions, and remind them of their motivation for sticking with their recovery programs. This challenge received a range of submissions, the majority of which will continue to be developed and made available to those who will benefit from them.

Solution Type: Software and apps

Primary Goals: Solve a specific problem; develop technology; and engage new people and communities

Results: From 15 submissions, three winning products were selected. Teams participating in the challenge included individuals currently in recovery, those with personal connections to addiction, and behavioral health care providers. Team members who were not currently in recovery had the opportunity to learn more about treatment and recovery, and in one case reached out to other individuals in recovery for input into their application. A majority of the teams wrote that they would continue to improve, enhance, research, and make their apps available for download to the people who need them.

Problem Statement: Addiction is a chronic brain disease. Those who suffer from a substance use disorder need help to change their behavior and learn new strategies to maintain health. They can get this help with treatment—with the care of doctors and substance use disorders treatment providers. Treatment can help people stop using substances. It helps them get through withdrawal and cope with cravings. Treatment also helps address other harmful behaviors that are not conducive to recovery.

Just as important, treatment helps people address life issues they might have that can trigger relapse, such as feelings of low self-worth, a bad situation at work or home, a co-occurring mental disorder, or spending time with people who use drugs. In short, treatment helps people move into healthy lifestyles—into a new way of living which is referred to as recovery.

Treatment may include medication. Medication-assisted treatment (MAT) is treatment that includes the use of medication along with counseling and other types of support. Treatment that includes medication-assisted treatment is an important option for opioid use disorder. Medication-

¹⁰⁴ samhsaopioidrecoveryapp.devpost.com/?ref_content=default&ref_feature=challenge&ref_medium=discover

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assisted treatment can reduce problems of withdrawal and craving. Research also shows maintenance treatment typically leads to reduction or cessation of illicit opioid use and its adverse consequences, including cellulitis, hepatitis, and HIV infection from use of non-sterile injection equipment, as well as criminal behavior associated with obtaining drugs. These changes can give the person the chance to focus on the lifestyle changes that lead back to healthy living. People in outpatient MAT could benefit from a mobile app for smartphones that provides features and information that supports their maintenance in recovery.

Below are some ideas and information on the insights regarding what patients receiving MAT might need, and what an app like this might do to respond to those insights. There are some required features and resources that must be included in the final product. They have been provided in an assets file. The rest is up to the participants. Participants were asked to be creative and innovative, and to develop a good user experience. Participants were encouraged to collaborate with an existing recovery tool already on the market, or think of a recovery-related use to an existing tool.

What does someone in recovery from opioid use disorder need and what type of mobile app could you create?

- Insight one: Since medication-assisted treatment is likely an important part of an individual's recovery, patients may need drug interaction and side effect information for methadone, buprenorphine, and naltrexone that they can access on their own, 24/7. For instance, an individual may have started methadone treatment a couple of days ago but is suddenly feeling some side effects and can't reach a doctor to ask them about these side effects. With the app, they can look up side effects, how long they might last, and what else they can anticipate—all via the privacy of their smartphone.
- Insight two: Patients receiving MAT need education and psychoeducational materials for opioid recovery support, such as how to manage their time, information on parenting skills, and the effects of drug use on their family. Perhaps they haven't told their friends yet that they're receiving MAT, and aren't sure how to go about it. Access to information that explains to friends and family what MAT is and how it helps with recovery could be made available, or shared with a friend, via their smartphone. While a person receiving MAT has a doctor, case manager, and addiction counselor, the provider may not have enough time in an appointment to provide all of the resources that a patient may need. A patient could use a one-stop shop for psycho-educational resources that provide tips, facts, and worksheets on how to deal with common issues and concerns that occur in opioid recovery, such as problems sleeping; dealing with drug triggers; avoiding relapse; dealing with guilt; managing time, life, money, and emotions; repairing relationships; and dealing with other health issues. Having these resources on a smartphone, a tool many people carry with them everywhere, means that they are available for use and referral in down time, waiting time, or crisis time.
- Insight three is related to relapse prevention, an important component of recovery. One of the main ways to prevent relapse is getting involved in healthy activities by replacing unhealthy habits with new habits that have emotional, physical, and/or social wellness benefits, such as participating in peer support groups, and exercise. An app feature that helps patients find local recovery support meetings easily and anonymously, or online peer support groups they could access via their phone, would put recovery support at their

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fingertips. The second important component of relapse prevention is being aware and avoiding triggers for drug use. Triggers could be certain people, places, or situations. Perhaps a feature that reminds patients, via a call or text when a trigger is present, would be useful to help keep their recovery at the forefront of their awareness.

- Insight four describes how individuals in MAT need support in relapse prevention such as warning signs, trigger alerts, and motivations for recovery. Could recovery motivation reminders in a calendar tool, with links to personal motivations such as photos of family, friends, pets, or goals help patients stay focused on their reasons for recovery? Could a trigger response feature be created with contacts when a person needs support? Perhaps they could link other motivational materials to reminders like links to inspiring YouTube videos, songs, talks/podcasts, fitness links, memes, or photos from their photo gallery. Another important component of relapse prevention is being aware and avoiding triggers for drug use. Triggers could be certain people, places, or situations. Perhaps a feature that reminds patients, via a call or text when a trigger is present, would be useful to help keep their recovery at the forefront of their awareness.
- Insight five shows that individuals in MAT maintenance are often juggling their work, personal, and treatment schedules. Maintaining recovery means finding new ways to live a healthy lifestyle just as other individuals with chronic health conditions must do. How could an app help with this? Could a time management tool, with daily reminders for doctor, counselor, and treatment appointments help?

Proposed Goals: The primary objective of this challenge was to spur innovation and expose the tech development field to the possibilities of creating mobile apps for people in treatment and recovery from substance use disorder, specifically those receiving medication-assisted treatment services. The Substance Abuse and Mental Health Services Administration (SAMHSA) also intended to bring further awareness of the opioid crisis to technologists and those disciplines outside of the traditional behavioral health field to stimulate development, growth, and conversation about behavioral health IT. SAMHSA wanted to award an app that would have the potential to enhance treatment services and improve the lives and the quality of engagement of people in recovery using medication-assisted treatment.

Measures of Success: Success was measured in the amount of developed apps produced to address this issue, and the quality of those apps based on a stringent set of criteria (see judging section). SAMHSA received 15 completed apps, all which met the requirement and judging criteria of the requirement sections. Many of the apps are easy to use, creative, engaging, and address the five “insights” related to MAT and recovery care management for people in recovery. This prize competition advances the mission of SAMHSA and the Health Information Technology Strategic Initiative goals of creating space for technological development of tools that will advance and enhance the lives of Americans in recovery from substance use disorders. SAMHSA was successful in engaging a myriad of disciplines and stakeholders in the creation of these apps, and received positive feedback from the applicant pool on developing tools that address substance use disorders and recovery (see results section). The 15 apps submitted in this competition reflected the uniqueness and diversity across the app development world and how different disciplines and personal experiences can affect creativity in problem-solving through technology. This competition was also successful in its ability to bring awareness and education to the app development community on addiction and recovery. One hundred and twenty-two teams registered

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for this challenge and it is hoped that it may have inspired future development, open-mindedness, and exposure to problem-solving for an important public health crisis.

Participants: The agency aimed to mobilize app and software developers with an interest in solving behavioral health problems. SAMHSA used Devpost.com and the Challenge Post platforms to accomplish this goal. This contest required a long list of criteria to apply, including eligibility requirements, submission and registration requirements, requirements around text descriptions and imagery/video, content requirements, and application requirements which can be found here: <https://samhsaopioidrecoveryapp.devpost.com/rules>. One hundred and twenty-two teams registered for the hackathon with 15 submissions to this specific challenge.

Timeline: SAMHSA accepted submissions for this challenge ran through from March 4—March 27, 2016 and winners were announced in July 2016.

Solicitation and Outreach:

- Social Media (Twitter posts and Facebook posts);
- Email Outreach (sent to a Health IT listserv);
- Press Release by SAMHSA;
- Personal outreach to SAMHSA stakeholders with relationships to the opioid recovery community and stakeholders in the behavioral health IT industry; and
- Outreach to Federal partners to encourage participation in judging and cross-promotion of the competition.

The team also developed a communications plan for promoting the winning app (this was not included in the publicized incentives to challenge applicants):

- Posting winners on SAMHSA’s Twitter and Facebook accounts;
- Presenting on the challenge and winners at the AATOD and APHA conferences (and all other relevant presentations for the Health IT Team);
- Distributing a one-page document on the winning apps to the Recovery Month Planning Partners; and
- Sending an email about the winning apps to 1,400 treatment providers and physicians.

Lessons Learned

The Health IT team would like to provide some lessons learned in addition to the required reporting material. Due to running three challenges in the past two years, the SAMHSA Health IT has tracked lessons learned and best practices for quality control and process improvement purposes. Based on this “study,” the team has added some new elements to the process and surmised further recommendations based on how the Opioid App challenge ran. These recommendations can be applied to multiple areas in the challenge process.

On the development of the challenge concept:

- Provide more information to allow developers to better solve problems: For the Opioid Recovery App Challenge, this recommendation from the 2015 challenges led to the development of the five Insights. The team utilized a report on research conducted about the recovery support needs of individuals receiving treatment for MAT. The team then determined which of those needs could be met in an app, and developed five “insights”

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into what individuals receiving MAT might need to help support their recovery. These insights were provided to the developers; some of the insights were required to be answered in the app and some were optional.

- Employ a technology specialist for the challenge: The Rules and Regulations are the legal, binding, public language that specifies all of the requirements of the challenge. They are critical to protecting the sponsor, the administrator, the participants, and the winners from any legal issues that could arise during the challenge or how and when the solution is utilized by the public. For the Opioid Recovery App Challenge, a technology expert was involved in the development of the challenge concept and the rules and regulations. The Technology Expert participated in the challenge concept meetings to help the team understand what was technically feasible in the concepts that were being considered. This provided valuable insight as the concept was being developed and contributed to a more efficient concept development process. The technology expert then provided detailed direction for the technology requirements of the entries, including submission requirements, privacy requirements, and application requirements.
- Explain requirements with more detail: For this challenge the Health IT team tried to clarify requirements with more detail and learned where to apply even more detail as a result of the answers received. State what is required in each field in the entry form. For example: *Insights* should have stated, “Please specify how your app answers the insights.” Many responded with “Yes” rather than providing the information. The team then had to go back to them and ask for specific information via email. The form has to be updated by Devpost staff, so be clear with Devpost about what is being asked. Develop a standard form the developers must complete that explains how to install their app. For the required videos that accompany submissions, be clear what content the video must include. For example:
 - How the app/entry responds to or meets the requirements/insights
 - What is unique about the app?
 - The name of the app
 - Security/confidentiality features
 - Each feature

On Judging Process

- Consider technology needs in judging: Utilize the same devices for the technical review as for the final/judging review process. It cuts down on the time needed to download and test the apps. Use a projector to project and demo the apps on devices for the in-person judging meeting, rather than sharing devices around the table. This will save costs and allows the judging team to review the apps together.

On Relationship with Developers

- In this challenge, the team also included a requirement that winning app developers provide occasional updates on app downloads and progress to SAMHSA throughout the year indicating that they were made available for free to the public. This information will help SAMHSA better understand how the apps are meeting the goals of the challenge with the end-users; and to continue to refine the process and requirements for issuing future technology challenges.

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Incentives: Cash prizes totaled \$32,500. Prizes were awarded through a contract task dedicated to behavioral health IT challenge competitions in the FY 2016 Behavioral Health Information Technology and Standards contract (FY 2016 BHITS Optional Task 3.4), overseen by the SAMHSA Health Information Technology Team. The first place winner was also invited to co-present on a SAMHSA Health IT panel at the 2016 AATOD conference in Baltimore, MD. Winners also received digital “banner awards,” icons to use in their own marketing material that verified they were winners of this SAMHSA challenge. Cash prizes were distributed from a third-party contractor, FEI, who is the primary contractor on the SAMHSA BHITS contract.

Evaluation and Judging: SAMHSA and the contractor/sub-contractor team were responsible for the proper analysis of scores from two rounds of judging. Judges were recruited across SAMHSA and other Federal agencies with expertise in substance use disorders, MAT, mental health, and other health care disciplines, public health, and Health IT. The first round of judging, held June 6–13, 2016, judges were asked to review up to five app submission demo videos (up to five minutes long each) on their own and with a total time commitment to review all of the videos of no more than two hours. Scoring sheets, information on assessing the five Insights, links to videos, conflict of interest forms, and instructions were provided. Judges were invited to attend a one-hour orientation webinar. All apps that met the submission requirements of the video challenges (addressed insights and technical requirements) went on to round two, where judges were asked to attend an all-day in-person meeting at SAMHSA on June 24, 2016. Judges reviewed apps in person on devices and a large screen, scored them, and open-forum discussion was held with subject matter experts in the room to determine final scores.

Scoring Criteria: Quantitative values were assigned to multiple criteria for assessment (see below). Qualitative assessment was done through identifying strengths and weaknesses on the judging forms for free text explanation of scoring, and any other points judges felt necessary to factor into scores that was not captured through the criteria. The numeric point system/scores and the open-forum discussion on the apps were used to affect score, were used to identify strong applicants and decide on the winners and honorable mention awardees.

Quantitative Score Forms:

PATIENT VALUE (up to 70 points)

In determining the patient value, consider the following questions:

Criteria	Score
Does the app provide solutions to patient needs? (Score a. –e. below)	
How well does the solution address insight 1 (10 points)?	
How well does the solution address insight 2 (10 points)?	
How well does the solution address insight 3 (10 points)?	
How well does the solution address insight 4 (5 points)?	

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How well does the solution address insight 5 (5 points)?	
Could a patient use this app for ongoing recovery support? (10 points)	
Could a patient use this app in discussion with their support team? (10 points)	
Do you feel the app has the potential to have a meaningful impact on the patient's recovery? (10 points)	
TOTAL SCORE PATIENT VALUE 1-4	

CREATIVITY (up to 15 points)

Creativity applies to how imaginative the overall app is in providing recovery support. In determining creativity, consider the following factors:

Criteria	Score
Does the proposed app offer an original approach to address recovery needs? This could include approaching an old idea in a new way. (5 points)	
Is the overall feeling of the proposed app fresh and interesting? (5 points)	
Does the app consider the specific health and confidentiality needs of the end user? (5 points)	
TOTAL SCORE CREATIVITY 1-3	

INNOVATION (up to 15 points)

Innovation applies to the implementation of the creative idea. While you are judging based on the summary and video, please consider how the applicant is implementing the idea. For example, if a submission proposes to provide all drug interaction, but suggests implementation with links to external sites, the creativity may be high, but the innovation is low. In determining innovation, consider the following factors:

Criteria	Score
Does the app present the required information in interesting, engaging, and/or innovative ways? (5 points)	
Does the application use design and visual assets to increase the creativity and user experience? (5 points)	
Does the application exhibit interactive and engaging features or qualities? (5 points)	
TOTAL SCORE INNOVATION 1-3	

Quality of Idea Final Score Summary

Evaluation Criteria	Possible Points	Final Scores
Patient Value	70	
Creativity	15	

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Innovation	15	
TOTAL RATING	100	

HONORABLE MENTION: ADDRESSING INSIGHTS (\$1,000 prizes to the highest scoring team in each Insight).

Insight	Score
How well does the solution address Insight 1: Drug Interaction Info and Drug Side Effects Info for Methadone, Buprenorphine, Naltrexone (10 points)?	
How well does the solution address Insight 2: MAT education and Psychoeducational Materials (10 points)?	
How well does the solution address Insight 3: Peer support/mutual aid groups meeting finder open API and other resources (10 points)?	
How well does the solution address Insight 4: Relapse prevention, trigger alerts, motivations for recovery are included (10 points)?	
How well does the solution address Insight 5: Support for juggling work, personal life, and treatment schedules are included (10 points)?	

Partnerships: SAMHSA had informal partnerships with other agencies who participated on our judging panels. This team was proud of the vast array of disciplines, expertise, and agency participation that reviewed and scored these submissions in the two-part judging process. Federal partner-judges came from across SAMHSA centers/offices, the White House Office of National Drug Control Policy, HRSA, ONC, FDA, NIDA, NIAA, ACF, and DOJ.

SAMHSA did not have formal partnerships with other agencies in administering or funding this challenge. It has been this team's observation that cross-funding cash prizes may be a challenging arrangement with other agencies due to the lack of guidance on administering challenges, and due to time constraints in one-year contracts to launch, administer, judge, and award challenges. The team opines that planning to collaborate with other agencies may take up to a year in advance due to negotiations, securing funding, and working out contract mechanisms and the transfer of dollars, and will continue to investigate ideas on how to do cross-agency collaborative challenges with cash prizes in the future.

Resources: The SAMHSA Center for Substance Abuse Treatment (CSAT), Performance Measurement Branch (PMB), and Health Information Technology (HIT) Team used an optional task (Task 3.4) out of the Behavioral Health Information Technology and Standards (BHITS) contract to fund this challenge. This task was funded by the CSAT Division of Pharmacological Therapies (DPT). A third-party contractor, FEI, who is the primary contractor on the SAMHSA BHITS contract, was used acquire the correct sub-contractor/consultant services to create materials and project manage, distribute funds to winners, and run security, compliance, and debugging reviews of the apps. Challenge administration, contractor oversight, and Health IT and recovery subject expertise was managed by one SAMHSA FTE on the Health IT team. Subject matter expertise was contributed by one SAMHSA FTE in the CSAT Division of Pharmacological Therapies. Management and administrative support was provided by two Abt Associate sub-contractors with experience in running challenges on DevPost, creation of marketing materials, and management of the judging process. Cash prizes were released as cheques after the apps were analyzed for bugs/security issues by the prime contractor's IT personnel and assessed for accuracy.

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to challenge criteria. In addition, affidavits were distributed to be signed before money was released to winners.

Results: On the closing day of the challenge admission period, SAMHSA received 15 products to review. The 15 teams who submitted a video and technology all consisted of one- or two-person teams according their DevPost profiles, however some “stories” indicated there were more team members who were not named on the applications. Many submission stories revealed information that a majority of the developers/team members are in recovery from substance use disorders, or have personal connections to addiction and substance abuse, or were behavioral health care providers. One provider stated that he learned the process of building an app for the purpose of competing in this challenge. Multiple stories relayed that team members were inspired by the process of learning about people with substance use disorders, medication-assisted treatment, and the recovery process through their studies to better understand the challenge and the solutions. One team said that they reached out to people in recovery for input. A majority of the teams wrote that they would continue to improve, enhance, research, and make their apps available for download to the people who need them.

Applicants submitted a myriad of ideas and concepts. SAMHSA received everything from traditional health app devices (which of course incorporated the five Insights) to innovative approaches using film and art to engage people in recovery and MAT.

Winners were selected based on two rounds of judging. A preliminary score to determine the top submissions was based on the video demonstration and a second round of judging by subject matter expertise on the applications.

First Place: FlexDek for MAT by Sober Recovery Network

Second Place: RePear by Sara Du (Student at University of California Los Angeles)

Third Place: Recopia by Jae Jang

Honorable Mention, Insight 1: Recopia

Honorable Mention, Insight 2: Recopia

Honorable Mention, Insight 3: FlexDek for MAT

Honorable Mention, Insight 4: FlexDek for MAT

Honorable Mention, Insight 5: FlexDek for MAT

A.5.23 The Simple Extensible Sampling Tool Challenge¹⁰⁵

Summary: Statistical sampling of the hundreds of millions of Medicare and Medicaid claims HHS handles is necessary for effective oversight of those claims. The current statistical package used, RAT-STATS, does not meet Federal accessibility standards. This challenge is designed to produce a statistical package that can meet RAT-STATS performance while being 508 compliant and user friendly.

Solution Type: Software and apps

¹⁰⁵ www.challenge.gov/challenge/statistical-software-for-healthcare-oversight

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Primary Goals: Solve a specific problem; and inform and educate the public

Results: This challenge was only recently opened, it is too soon to report results.

Problem Statement: Each year HHS handles hundreds of millions of Medicare and Medicaid claims valued at more than a trillion dollars. Due to the high volume of claims, statistical sampling provides a critical tool to ensure effective oversight of these expenditures. Sampling is used by the providers in their own efforts to monitor their performance and by the various organizations within HHS. There are a wide range of different software tools for performing statistical analysis. The RAT-STATS software package, which was originally developed by HHS/OIG, has a unique niche in that it provides a straightforward tool for individuals who need a simple but robust method for selecting and analyzing statistical samples. Unlike a full statistical package that attempts to answer all types of questions for a wide range of users, RAT-STATS serves as a streamlined solution to help users develop valid statistical samples and estimates within the health care oversight setting. For example, an OIG investigator may pull a simple random sample in order to estimate damages for a provider suspected of fraud. RAT-STATS generates valid pseudo-random numbers and outputs all of the information needed to replicate the sample. Once the investigator finishes reviewing the sample, he or she can then enter the results into RAT-STATS to get the final statistical estimate. While the investigator may need some basic training in statistics, he or she would not need the same level of expertise as would be required to navigate the many options available in a full-service statistical or data analysis package.

In order to complete the challenge, participants must submit a 508 compliant software package (source code and executable) that replicates the operation of four of the functions of the original RAT-STATS software: (1) Single Stage Random Numbers; (2) Unrestricted Attribute Appraisal; (3) Unrestricted Variable Appraisal; and (4) Stratified Variable Appraisal. The participants also must submit an explanation of how their program can be extended to include additional functions beyond the four that have been listed here.

Proposed Goals: The objective of the current challenge is to develop the foundation for an upgraded version of RAT-STATS software that is 508 compliant with a user-friendly design. The current version of RAT-STATS is well validated; however, its user interface can be difficult to navigate and does not meet Federal accessibility standards. OIG needs a new, modern version of the software that is easier to use and is 508 compliant. In addition, by using a competition, OIG hopes to increase public awareness about the RAT-STATS software.

Measures of Success: The core objective measure of success will be the creation of a software package that is 508 compliant and can replicate the four target functions from the original RAT-STATS software. Other key objective measures include the decrease in time needed to train new employees on the use of the RAT-STATS software and the decrease in effort required by users to execute common program functions. The most important subjective measure of success will be the user satisfaction that is reported for the winning software package compared to the original RAT-STATS.

Participants: The contest is open to the public and anyone who could provide a solution. HHS targeted individuals who are knowledgeable about programming and software design. Rules for

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participation in the challenge can be found at: <https://www.challenge.gov/challenge/statistical-software-for-healthcare-oversight/>. The challenge is still ongoing and so the total number of participants has not yet been established.

Timeline: Submissions opened for this challenge September 29, 2016 and will close May 15, 2017.

Solicitation and Outreach: N/A

Incentives: This challenge involves the identification of up to five finalists who will each receive \$3,000. A grand prize winner, who will be selected from these finalists, will receive an additional \$25,000. The total potential prize purse is \$40,000. The grand prize winner will be recognized within the software that results from the competition. The grand prize winner will also be listed on the agency website and within the instruction manual for the software. No private sector or philanthropic funds were contributed for the prizes. All funds were obligated from HHS OIG appropriations.

Evaluation and Judging: The first five eligible submissions that are complete, follow the competition rules, and are able to fully replicate RAT-STATS on the 60 target cases will each be declared a finalist. The grand prize will be selected by a committee of 12 HHS OIG employees who represent the type of individuals who would be end-users for the new software. Each of the 12 individuals will vote on which of the software packages they would prefer to use moving forward. The finalist with the most votes will be declared the grand prize winner.

Partnerships: No partnerships were utilized.

Resources: The challenge has been run using only internal agency resources. To date, these include IT resources and 60 FTE hours, including 10 hours at GS-13 level and 50 hours at GS-15 level.

Results: No entries have been received yet, and there are no preliminary results to report. We do not expect winners to be announced until summer 2017.

A.5.24 Use of Blockchain in Health IT and Health-related Research¹⁰⁶

Summary: Blockchains are distributed databases that are secure by design and resist retroactive editing. This security makes them desirable for use in protecting patient health data, however the work on this concept has not been proportionate to the hype. Participants in this challenge were asked to submit white papers examining how blockchain can be used to improve health data sharing and interoperability.

Solution Type: Ideas

Primary Goals: Find and highlight innovative ideas; inform and educate the public; and engage new people and communities

¹⁰⁶ www.cccinnovationcenter.com/challenges/blockchain-challenge

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Results: A total of 77 white papers were received. Submission types included 42 business and 35 individual papers. Approximately 40% of the individual submissions were unaffiliated with any organization. Submissions included 16 universities, five hospitals or health systems, 12 health IT vendors, 12 large consultancies or general technology providers, three blockchain technology vendors, one pharmaceutical company, and five nonprofit organizations. The 15 winning submissions were publicly announced and posted to healthit.gov on August 29th, 2016.

Problem Statement: A tremendous amount of hype existed around the use of blockchain for healthcare yet, at the time, there was no real substantive effort or work to reference or point to. The Ideation Challenge solicited white papers that investigated the relationships between blockchain technology and its use in Health IT and/or health-related research. Participants were asked submit a white paper that discussed the cryptography and underlying fundamentals of blockchain technology, examined how the use of blockchain can advance industry interoperability needs expressed in the ONC's Shared Nationwide Interoperability Roadmap, as well as for Patient Centered Outcomes Research (PCOR), the Precision Medicine Initiative (PMI), delivery system reform, and other health care delivery needs, as well as provide recommendations for blockchain's implementations.

Proposed Goals: The goals were to inform and educate the public and Health IT policy makers, highlight innovative uses of blockchain and engage the innovation community with Health IT policy, technologist, and implementers. Papers from the Ideation Challenge were used to shape the agenda and provide presenters for the public Blockchain and Healthcare workshop co-sponsored by NIST, held at the NIST campus in Gaithersburg.

Measures of Success: Before the challenge, only three public references could be found regarding the use of blockchain for healthcare.¹⁰⁷ Only one of them was in the United States. Challenge organizers expected 20 submissions at best and received 77. A number of workshops, initiatives, and collaborative efforts have launched since the launch of the challenge and hosting of the workshop. The combination of ONC and NIST taking notice has spurred those in the market to step up, or at least to be vocal about their work.

Participants: The challenge targeted designers, developers, investigators, patient privacy experts, and others to submit white papers on the topic of "Use of Blockchain in Health IT and Health-Related Research." Participation was open to all members of the community who agreed to the terms and conditions of the challenge and who were eligible for participation under the challenge guidelines. Seventy-seven teams, made up of 105 total individuals, submitted entries to the challenge.

To be eligible to win a prize under this challenge, an individual or entity had to meet the following eligibility rules:

- Shall have registered to participate in the challenge under the rules promulgated by the Office of the National Coordinator for Health Information Technology.
- Shall have complied with all the stated requirements of the "Blockchain and Its Emerging Role in Healthcare and Health-Related Research Challenge."

¹⁰⁷ MIT, Phillips and Estonia

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- In the case of a private entity, shall be incorporated in and maintain a primary place of business in the United States, and in the case of an individual, whether participating singly or in a group, shall be a citizen or permanent resident of the United States.
- May not be a Federal entity or Federal employee acting within the scope of their employment.
- Shall not be an HHS employee working on their applications or submissions during assigned duty hours.
- Shall not be an employee of the Office of the National Coordinator for Health Information Technology.
- Federal grantees may not use Federal funds to develop COMPETES Act challenge applications unless consistent with the purpose of their grant award.
- Federal contractors may not use Federal funds from a contract to develop COMPETES Act challenge applications or to fund efforts in support of a COMPETES Act challenge Submission.
- An individual or entity shall not be deemed ineligible because the individual or entity used Federal facilities or consulted with Federal employees during a challenge, if the facilities and employees are made available to all individuals and entities participating in the challenge on an equitable basis.
- Submissions must not display HHS's or ONC's logos or official seals and must not claim endorsement.
- Accuracy: A white paper submission may be disqualified if it provides inaccurate or incomplete information.

Timeline: Submissions for this challenge opened July 5, 2016 and closed August 8, 2016. Winners were announced August 29, 2016.

Solicitation and Outreach:

- Social Media;
- Email Outreach;
- Two-Day Long Event at the conclusion of the Competition; and
- Partnership with Outside Organizations.

Incentives: The total available prize money was \$45,000; 15 winners received cash prizes of \$3,000 each. Additionally, eight of the challenge winners were invited to present their white papers at the "Use of Blockchain in Health IT and Health-Related Research Workshop." Awards and travel for presenters were managed thorough a contractor under the HHS Idea Lab BPA which was awarded a contract to manage up to five challenges on behalf of ONC. The funding for the challenges was provided by a projected funded through Patient Center Outcomes Resource Trust fund.

Evaluation and Judging: The judging panel rated each submission based upon:

- Potential of the overall concept to help foster transformative change in the culture of health IT;
- Viability of the proposed recommendations;
- Innovativeness of the approach; and

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- Potential for achieving the objectives of ONC.

Although equal weight was given to each criterion in the initial rounds of judging, a greater emphasis, during the final selection process, was given to the viability of the proposed solution and potential to help foster transformative change.

Partnerships: NIST co-sponsored the associated blockchain workshop with ONC, provided staff to assist with the reviews of the papers, presented at the workshop, and provided funding to increase the number of registrations for the workshop (257 registered).

Presentations, briefings, and panels were delivered by the White House Office of Science and Technology and Policy (WH OSTP), the NIST Cryptographic Technology Group of the Computer Security Division, and the Department of Homeland Security, Homeland Security Advanced Research Projects Agency (HSARPA) Identity Innovation Project.

A total of 27 reviewers from DHS, GSA, USPS, USPTO and leaders in the blockchain community provided initial reviews of the white papers. Additionally, representatives from Ping Identity, Constellation Research, and Respect Network provided private sector perspectives regarding the strengths and weaknesses of blockchain and alternative distributed ledger technologies.

The challenge sponsors found that by combining various communities in both the ideation challenge and associated workshop, an enormous amount of sharing of information and perspectives occurred.

Resources: This challenge was managed from initiation to completion by ONC staff, with the assistance of contractors as well as two support staff from NIST. The operational cost paid by HHS was estimated at \$16,000, and an estimated \$3,000 was provided by NIST for supporting the workshop.

Results: A total of 77 white papers were received. Submission types included 42 business and 35 individual papers. Approximately 40% of the individual submissions were unaffiliated with any organization. Submissions included 16 universities, five hospitals or health systems, 12 health IT vendors, 12 large consultancies or general technology providers, three blockchain technology vendors, one pharmaceutical company, and five nonprofit organizations.

The 15 winning submissions were publicly announced and posted to healthit.gov on August 29, 2016. The following table displays the winning submissions, their author(s), and organizational affiliations:

Note: Submissions listed in alphabetical not rank order.

Title	Link	Authors	Organization
A Blockchain Profile for Medicaid Applicants and Recipients	onprojectracking.healthit.gov/wiki/download/attachments/14582699/14-38-blockchain_medicaid_solution_8.8.15.pdf?version=1&modificationDate=1472657517000&api=v2	Kathi Vian, Alessandro Voto, and Katherine Haynes-Sanstead	Blockchain Futures Lab - Institute for the Future

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Title	Link	Authors	Organization
A Blockchain-Based Approach to Health Information Exchange Networks	www.healthit.gov/sites/default/files/12-55-blockchain-based-approach-final.pdf	Kevin Peterson, Rammohan Deeduvanu, Pradip Kanjamala, and Kelly Boles	Mayo Clinic
A Case Study for Blockchain in Healthcare: “MedRec” Prototype for Electronic Health Records and Medical Research Data	www.healthit.gov/sites/default/files/5-56-onc_blockchainchallenge_mit_whitepaper.pdf	Ariel Ekblaw, Asaph Azaria, John D. Halamka, MD, and Andrew Lippman	MIT Media Lab, Beth Israel Deaconess Medical Center
Adoption of Blockchain to enable the Scalability and Adoption of Accountable Care	oncprojecttracking.healthit.gov/wiki/download/attachments/14582699/13-71-blockchain_for_healthcare_paper_final.pdf?version=1&modificationDate=1472657492000&api=v2	Ramkrishna Prakash	Unaffiliated
Blockchain & Alternate Payment Models	www.healthit.gov/sites/default/files/15-54-kyip_blockchainapms_080816.pdf	King Yip	Unaffiliated
Blockchain and Health IT: Algorithms, Privacy, and Data	www.healthit.gov/sites/default/files/1-78-blockchainandhealthitalgorithmprivacydata_whitepaper.pdf	Allison Ackerman Shrier, Anne Chang, Nadia Diakun-Thibault, Luca Forni, Fernando Landa, Jerry Mayo, Raul van Riezen, and Thomas Hardjono	Project PharmOrchard of MIT’s Experimental Learning “MIT FinTech: Future Commerce.”
Blockchain for Health Data and Its Potential Use in Health IT and Health Care Related Research	oncprojecttracking.healthit.gov/wiki/download/attachments/14582699/11-74-ablockchainforhealthcare.pdf?version=1&modificationDate=1472657425000&api=v2	Linn L., and Koo M.	Unaffiliated
Blockchain Technologies: A Whitepaper Discussing how Claims Process can be Improved	oncprojecttracking.healthit.gov/wiki/download/attachments/14582699/3-47-whitepaperblockchainforclaims_v10.pdf?version=1&modificationDate=1472657193000&api=v2	Kyle Culver	Unaffiliated
Blockchain: Opportunities for Health Care	oncprojecttracking.healthit.gov/wiki/download/attachments/14582699/Deloitte%20Blockchain%20in%20Healthcare%20-%20HHS%20White%20Paper%20-%20August%202016%20-%20vF.pdf?version=1&modifi	RJ Krawiec, Dan Barr, Jason Killmeyer, Mariya Filipova, Allen Nesbitt, Adam Israel, Florian Quarre, Kate Fedosva, and Lindsay Tsai	Deloitte Consulting LLP

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Title	Link	Authors	Organization
Blockchain: Securing a New Health Interoperability Experience	onprojecttracking.healthit.gov/wiki/download/attachments/14582699/2-49-accenture_onc_blockchain_challenge_response_august8_final.pdf?version=1&modificationDate=1472657006000&api=v2	Brodersen C, Brian Kalis, Emily Mitchell, Eril Pupo, and Andy Truscott	Accenture LLP
Blockchain: The Chain of Trust and its Potential to Transform Healthcare – Our Point of View	onprojecttracking.healthit.gov/wiki/download/attachments/14582699/8-31-blockchain-ibm_ideation_challenge_aug8.pdf?version=1&modificationDate=1472657336000&api=v2	Srinivas Attili, Susheel K Ladwa, Udit Sharma, and Anthony F. Trenkle	IBM Global Business Service Public Sector
ModelChain: Decentralized Privacy-Preserving Health Care Predictive Modeling Framework on Private Blockchain Networks		Tsung-Ting Kuo, PhD, Chun-Nan Hsu, PhD, Lucila Ohno-Machado, MD, PhD	Health System Department of Biomedical, University of California San Diego and Division of Health Services Research & Development
Moving Toward a Blockchain-based Method for the Secure Storage of Patient Records	onprojecttracking.healthit.gov/wiki/download/attachments/14582699/9-16-drew_ivan_20160804_blockchain_for_healthcare_final.pdf?version=1&modificationDate=1472657370000&api=v2	Drew Ivan	Unaffiliated
Powering the Physician Patient Relationship with ‘HIE of One’ Blockchain Health IT	www.healthit.gov/sites/default/files/7-29-poweringthephysician-patientrelationshipwithblockchainhealthit.pdf	Adrian Gropper	Unaffiliated
The Use of a Blockchain to Foster the Development of Patient-Reported Outcome Measures	www.healthit.gov/sites/default/files/6-42-use_of_blockchain_to_develop_proms.pdf	Jason Goldwater	National Quality Forum

A.6 Department of Homeland Security

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A.6.1 Think and Do Challenge: Enhancing Collaboration, Innovation, Talent and Training¹⁰⁸

Summary: The Department of Homeland Security (DHS) Science and Technology Directorate's (S&T) Office of National Laboratories (ONL) sought solutions that propose instruments to help seed collaboration, and innovation. ONL also enhanced the new National Bio and Agro-Defense Facility's (NBAF) ability to establish strong bonds with related communities of interest, and spur innovation and success. The NBAF will open in 2022 in Manhattan, Kansas, and will be a state-of-the-art biocontainment facility for large animal agricultural research, training, and diagnostics. The facility will strengthen the Nation's ability to conduct research, develop vaccines, diagnose emerging diseases, and train veterinarians. To capitalize on the benefits of the NBAF, ONL pursued novel, smart strategies to advance the innovation, collaboration, training, and talent required to support this future facility. The prize competition sought business plans that improved the NBAF's mission to shape and advance bio/agro security. The competition generated a total of 33 proposals. The first place winning solution was submitted by Dawn Krause on behalf of the Manhattan Area Technical College (MATC). The second place winning solution was submitted by Gina Becker on behalf of DynaSim Technical Services, INC. The total prize amount to the two winners was \$92,306 and both winners applied for additional grant funding from Kansas State University.

Solution Type: Ideas; and business plans

Primary Goals: The prize competition's primary objective was to encourage innovation and promote and find novel approaches to building one or more pieces of the innovation ecosystem that enhances the NBAF's mission and role in shaping bio/agro security.

The desired outcomes included:

- Advance scientific research
- Improve government service delivery
- Find and highlight innovative ideas
- Engage new people and communities
- Build capacity

Results: Over 4,300 individuals viewed the prize competition website, 221 individuals from 37 countries registered for the competition, and 33 proposals were submitted. The first place winning solution was submitted by Dawn Krause on behalf of the Manhattan Area Technical College (MATC). This solution will kick-start new training programs at MATC and will provide a pool of individuals to recruit to the lab. The second place winning solution was submitted by Gina Becker on behalf of DynaSim Technical Services, INC. This solution will provide a collaborative data platform which will enhance the research collaboration potential of projects at the lab. Both winners have entered into agreements with DHS S&T and have applied for further grant funding with the State of Kansas.

¹⁰⁸ www.dhs.gov/nbafchallenge; www.innocentive.com/ar/challenge/9933727

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Problem Statement: The National Bio and Agro-Defense Facility (NBAF) will open in 2022 in Manhattan, Kansas, and will be a state-of-the-art biocontainment facility for large animal agricultural research, training, and diagnostics. The facility will strengthen the Nation's ability to conduct research, develop vaccines, diagnose emerging diseases, and train veterinarians. To capitalize on the benefits of the NBAF, ONL pursued novel, smart strategies to advance the innovation, collaboration, training, and talent required to support this future facility. A new approach will build one or more pieces of the innovation ecosystem—an ecosystem consisting of people, institutions, policies, and resources that promote research.

The prize competition sought business plans that improved the NBAF's mission to shape and advance bio/agro security. A successful solution had to contribute and enable a highly integrated bio/agro security innovation ecosystem, and was expected to meet a five-step success criteria to:

1. Engage: Reach out to stakeholders throughout private industry, livestock producers, animal health companies, research universities, local/State/Federal Government;
2. Align: Pinpoint nature alignments that exist within the stakeholder network and determine which alignments may provide a foundation for more significant and committed partnerships;
3. Enable: Connect needs with system capabilities offered by others within the network to begin creating a symbiotic framework for protection of animal health, public health, and the food supply, while also promoting economic growth;
4. Advance: Secure key partnerships by identifying specific shared goals within each aligned relationship, ascertaining progressive benchmarks for success and operationalizing each partnership; and
5. Enrich: Mature ecosystem elements that support regional economic growth and further develop the partnerships nationally and internationally as appropriate.

This was a single-phase ideation prize competition that required a written business plan. Winning solutions were expected to enter into an agreement with DHS S&T to implement their business plan and provide periodic progress reports.

Proposed Goals: The prize competition's primary objective was to encourage innovation, promote and find novel approaches to building one or more pieces of the innovation ecosystem that enhance the NBAF's mission and role in shaping bio/agro security.

Measures of Success: Success was measured in three ways:

1. Interest in the prize
 - a. 4,346 views on the prize competition page
 - b. 221 opened project rooms (participating solvers)
 - c. 33 submitted solution proposals
 - d. 2 winning solution proposals
2. Quality of ideas (enhanced collaboration, training, research, or talent)
 - a. DynaSim enhanced collaboration
 - b. MATC provided training program
3. Establish long-term partnerships
 - a. Both solvers completed agreements with DHS S&T
 - b. Both solvers applied for the State of Kansas grants

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Participants: With this prize competition, DHS S&T was trying to reach a new and diverse group of individuals and organizations interested in agricultural research and potential long-term facility partners. The competition provided an opportunity to reach new innovators and partners that do not normally participate in the government contract and grant process and also known individuals and entities that previously expressed interest in the facility. Most of the outreach was targeted to the Animal Health Corridor because of their national presence and ability to assist DHS S&T with marketing the competition to a broader audience. A majority of submissions and those of the winning solutions were submitted from that area of the United States. A total of 221 individuals from 37 countries registered for the competition, and 33 proposals from 5 countries were received.

Timeline: The prize competition opened the submission period on September 30, 2015, and stopped accepting submissions on November 30, 2015. Winners were announced February 8, 2016.

Solicitation and Outreach: On September 29, 2015 DHS S&T announced the National Bio and Agro-Defense Facility Think and Do Challenge: Enhancing Collaboration, Innovation, Talent and Training prize competition with the goal of reaching a non-traditional audience of innovators and advancing bio/agro security. The competition was announced in the *Federal Register*, posted on Challenge.gov and went live on the InnoCentive Prize Competition page. The S&T team developed a communications and outreach package which defined which outreach methods should be used, and contained a rollout schedule for content.

Twitter was used for both the initial competition announcement in September 2015 and the winner announcement in February 2016. S&T staff posted tweets for the S&T Twitter account (@dhsscitech) using the hashtags: #NBAFChallenge, #Innovation, #training, #NBAF, and #talent. The S&T Facebook page (www.facebook.com/dhsscitech/) also posted twice, linking to the competition page on the DHS website.

InnoCentive also posted content to their Twitter account, Facebook page, and LinkedIn page. S&T sent locally targeted email blasts, and InnoCentive promoted the prize competition through their weekly challenge Bulletin. This Bulletin was sent to over 140,000 solvers every Thursday during the competition for a total of nine bulletins.

S&T utilized press releases during the Open Submission Period. After the *Federal Register* notice, Challenge.gov post, and InnoCentive prize competition page went live, S&T announced the beginning of the NBAF 'Think and Do' prize competition submission period via press release. The S&T prize competition press release was issued on Wednesday, September 30, 2015. The announcement was picked up by the following sites:

- KSU: Homeland Security offers \$100K to support Think and Do competition for NBAF;
- Global Biodefense: DHS Launches New Biosecurity Lab Prize Competition;
- Duke University, Research Funding: National Bio and Agro-Defense Facility (NBAF) Think and Do Challenge: Enhancing Collaboration, Innovation, Talent and Training; and
- Homeland Security News Wire: DHS S&T launches \$100,000 prize competition to support NBAF facility.

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The S&T prize winners' announcement press release was issued on Monday, February 8, 2016. InnoCentive cross-posted the S&T press release and the Manhattan Area Technical College announced their win for the competition.

Web Content—customized web content was developed by both the S&T and InnoCentive teams.

- The following pages went live shortly before the press release was issued:
 - DHS NBAF Challenge page
 - NBAF Prize Competition Video
- In addition to the content at the start of the submission period, S&T also published a blog on November 17, reminding potential solvers of the upcoming November 30 deadline.
- A blog from the Under Secretary for Science and Technology was also posted announcing the winners.
- InnoCentive tracked the traffic of visitors to the InnoCentive prize competition page. A total of 4,346 people visited the competition page. The landing pages visitors came from and the number of page views per landing page, are listed below:

Visitor Landing Page	Number of Page Views
InnoCentive.com	3430
DHS.gov	526
Challenge.gov	256
InnoCentive Marketing	134
Grand Total	4346

Conference and Events

- The Executive Director of the NBAF Program Executive Office attended two national conferences to promote the prize competition.
- The NBAF Partnerships Director launched the competition at the Animal Health Corridor Reunion Banquet.

Lessons Learned: There are several lessons learned that S&T can implement in future prize competitions. There was an intentional strategic decision to use the regional contacts to market this prize competition to entities with a national presence. This found success in meeting the intent of the competition. Now that the ecosystem concept is branded and accepted, next time S&T should consider a broader national campaign. There was also confusion as to which site to link potential participants to: the S&T competition page or the InnoCentive website. S&T linked to their page in their social media outreach but determined there should be more clarity on which site link to use for future competitions. DHS S&T will begin using the Challenge.gov website as the primary prize competition, information, social media, and registration website. Enhancements to the Challenge.gov website will provide future prize competition managers with a dynamic, flexible tool for promoting their prize competition, interacting with solvers, and cross-populating social media information. The site will also provide the ability to directly link a solver to a third party vendor for registration and submission. This enhancement will help to reduce confusion between the various websites used for prize competitions.

Incentives: A total cash prize pool of up to \$100,000 with a guaranteed award of at least \$15,000, and no award to be less than \$15,000. Along with the cash prize, winning solvers would enter into an agreement with DHS S&T to implement their proposed solution and provide periodic progress reports. Winners could opt for their solution to be considered for grants from the State of Kansas,

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administered by Kansas State University. The grant would match the S&T prize award for solvers to continue their project.

Evaluation and Judging: A total of 33 submissions were received and filtered by InnoCentive based on non-U.S. citizenship, non-U.S. permanent resident status, non-U.S.-based entities, low-quality submissions, and submissions that did not provide a cover page. This left 18 proposals for DHS S&T to evaluate. Then, seven competent judges from S&T and the U.S. Department of Agriculture rated each of the 18 submissions using a point system (0-100 points) against three weighted criteria: impact, method/feasibility, and cost realism. The judges populated a spreadsheet with the ratings and comments from their evaluation which S&T consolidated. A three-hour conference call was held between the seven judges to discuss each submission and reach a consensus on the top five submissions. Only two submissions were chosen as winners due to the limited prize pool of \$100,000. The subjective and objective method to evaluate the submissions was deemed effective.

Criteria: Solutions for this competition were evaluated by a judging panel using the criteria and rating scales described below. A total of 100 points was possible for each proposed solution. Judges individually scored accepted proposed solutions that met the eligibility and submission criteria of this challenge.

Solution Rating System (1-10 points for each criterion)

- Excellent: Fully addressed all elements of this criterion (10 points).
- Very Good: High quality, addressed most significant elements of this criterion (8-9 points).
- Good: Quality, adequately addressed some important elements of this criterion (6-7 points).
- Fair: Solver failed to address one or more critical aspects of this criterion (4-5 points).
- Poor: this criterion has serious deficiencies (1-3 points).

Scoring: Criterion Score X Weighted Importance = Total

Judging Criteria:

Impact (Weighted Importance: 5) (50 possible points)

Proposed solutions were evaluated on their plan's ability to effectively develop and implement/commercialize solutions that enhance innovation, education, training, and the improvement of skills within the (NBAF) ecosystem.

- A clear understanding of a real or persistent problem or an unaddressed opportunity, its urgency, and the ability of the proposed solution to solve the problem or capitalize on the opportunity;
- Creative or even potentially transformative solutions based on an understanding of their role, benefit, and best practices within the innovation ecosystem;
- A clear understanding of the current and future challenges facing the Nation's agricultural system;
- Alignment with current and future needs for the success of the NBAF;

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- Quantifiable benefits that go beyond the solver and benefit the innovation ecosystem and the NBAF; and
- The extent to which innovation, collaboration, training, or talent aligned to the NBAF visions will be enhanced.

Method/Feasibility (Weighted Importance: 3) (30 possible points)

The extent to which the proposed solution demonstrates:

- An understanding, use and incorporation of the five-step success criteria in developing and implementing the solution:
 - Step 1 (Engage): Reach out to stakeholders throughout private industry, livestock producers, animal health companies, research universities, local/State/Federal Government;
 - Step 2 (Align): Pinpoint natural alignments that exist within the stakeholder network and determine which alignments may provide a foundation for more significant and committed partnerships;
 - Step 3 (Connect): Link needs with system capabilities offered by others within the network to begin creating a symbiotic framework for protection of animal health, public health, and the food supply, while also promoting economic growth;
 - Step 4 (Advance): Secure key partnerships by identifying specific shared goals within each aligned relationship, ascertaining progressive benchmarks for success and operationalizing each partnership; and
 - Step 5 (Enrich): Mature ecosystem elements that support regional economic growth and further develop the partnerships nationally and internationally as appropriate.
- Successful execution of the idea with a reasonable degree of success in the next year and demonstrated sustainability;
- Qualified personnel: Demonstrated project management expertise; the education, experience, and accomplishments of key personnel; adequacy of the individual/entity to carry out the proposed work and achieve success; previous performance; quality of any partnerships and extent of partnership commitments; and
- Appropriateness, quality, and availability of any facilities, materials and resources to be used in implementing the proposed solution.

Cost Realism (Weighted Importance: 2) (20 possible points)

- Adequate financial resources to ensure robust institutional capacity;
- Strong potential to become self-sustaining, even without significant future Federal funding;
- Extent to which prize funding will support implementation of the idea;
- Access to venture capital, angel financing, or other funding needed to implement/transition the solution;
- Business plan presents accurate, well-founded, and reasonable estimate of costs to kick-start the idea; and
- A long-term, broad, and deep commitment to implement/commercialize the solution with buy-in from stakeholders.

Partnerships: DHS S&T informally partnered with the State of Kansas and Kansas State University for this prize competition to support potential grants for the winning solvers. USDA provided two judges to evaluate submissions. A representative from the ONL and DHS S&T's prize competition

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program office met with the DHS National Protection and Program Directorate's (NPPD) Agricultural Sector, which included interagency, private sector, and academic members, to promote the competition.

Resources: InnoCentive, Inc. was utilized as a third party vendor to help plan and conduct the prize competition.

The following DHS resources were utilized in the planning and conduct of the prize competition.

- DHS S&T, Prize Competition Manager;
- DHS S&T, Program Manager provided overall planning and support of the prize competition;
- DHS S&T and a third party contractor provided communications and marketing plan;
- DHS Office of Corporate Communications developed support material and approval for all public affairs announcements, supported a public facing website for the prize competition, addressed inquiries from the public, and created a marketing pamphlet;
- DHS S&T General Counsel provided legal review and support to the planning and execution process; and
- DHS S&T and USDA provided judging support.

Prize Competition Resources	
Category	Work (hours)
DHS S&T	355
DHS HQ Review	10
Third Party Contractor	338
Office of Corporate Communication	29
Judging Support	138
KSU Video Support	2
TOTAL	952

The chart represents approximately \$133,280 of administrative support required to conduct this prize competition.

Results: The prize competition advanced the NBAF mission by generating public interest and gathering novel ideas for the innovation ecosystem. DHS S&T measured the success of this prize competition by using three criteria: interest in the prize, quality of the ideas submitted, and the establishment of long-term partnerships. The competition generated much interest as over 4,300 individuals viewed the prize competition website; 221 individuals from 37 countries registered for the competition, and 33 proposals from 5 countries were submitted.

The quality of ideas was high. One prize winner will kick-start new training programs at a local community college near the facility and will provide a pool of individuals to recruit to the lab. The other prize winner will provide a collaborative data platform which will enhance the research collaboration potential of projects at the lab. Both winners have entered into agreements with DHS S&T and have applied for further grant funding with the State of Kansas. In addition to the two winners, S&T will further discuss and collaborate with other participating solvers.

The first place winning solution was submitted by Dawn Krause on behalf of the Manhattan Area Technical College (MATC). The college specializes in workforce skills training that leads to a viable career and supports industry needs and skill requirements. MATC's business plan presented

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a concept to develop a biohazardous risk reduction training program with a goal of obtaining industry-endorsed Biosafety Level 4 certification. MATC currently offers science degree applicants an Advanced Biotechnology certificate and non-science degree applicants an A.A.S. for Biotechnology Laboratory Technicians. MATC further identified gaps in workforce training that need to be addressed and groups that require an understanding of biological safety. Training and understanding will reduce community risk and fear and will better prepare future NBAF staff. MATC will provide training for facility staff prior to employment and will promote understanding within the surrounding community. The key elements and competencies to be taught during the two-part curriculum include: (1) pathogenic environment online training; (2) biohazardous risk reduction face-to-face training. This challenge submission requested prize seed funding of \$53,106; the awarded prize matched the full amount requested.

The second place winning solution was submitted by Gina Becker on behalf of DynaSim Technical Services, INC. DynaSim is a research and technical development company that provides petrochemical and other businesses' R&D efforts with custom software and mathematical models. The prize competition submission tackled the problem of managing complex data and facilitating intense dynamic collaboration throughout the innovation ecosystem. The winner will use a new data management technology, RefIt™. This data management system uses a database structuring method to make disparate data tolls generically useful for any type of data. This technology, when fully developed, will allow the facility's scientists and others to adapt quickly, create a secure database and data management strategy, and gain secure access internally and externally to the NBAF. DynaSim identified multiple problems associated with current database technologies such as the rigidity of a custom database making it difficult to change or modernize, and the dependence on a supplier to maintain and support the database. The proposal included an implementation plan that outlined how they would use the prize money to develop, implement, and test a prototype along with resources required and risk factors with implementing the solution. The challenge submission requested prize seed funding of \$39,200; the awarded prize matched the full amount requested.

The total prize amount to the two winners was \$92,306 and both winners applied for grant funding.

Post-Challenge Progress (as of September 2016): The development of the MATC's specialized NBAF training curriculum is currently underway and embedded in the NBAF Operational Stand-up Branch. MATC has managed to secure additional grant funding and will expand their effort beyond the initial proposal.

DynaSim Technical Services' collaborative research support tool project is pending prioritization of pilot research and available funding. The NBAF program embedded the project within its Program Support branch while a permanent solution toward establishing the collaborative research project continues to materialize. In the interim, NBAF has held several meetings to establish requirements for a complimentary stakeholder tracking tool that uses the same technology platform pitched in DynaSim's winning proposal.

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A.6.2 Environmentally-Friendly Replacement for Buoy Mooring Systems Challenge¹⁰⁹

Summary: The Department of Homeland Security (DHS) Science and Technology Directorate's (S&T) Borders and Maritime Security Division, in conjunction with the United States Coast Guard Research and Development Center (USCG RDC), was looking for a new, innovative approach to develop an adequate buoy mooring system that would have minimal impacts on the ocean floor, especially in environmentally-sensitive areas. Three phases were originally planned with a total prize purse set at \$290,000. A total of 98 submissions were received during Phase I of the competition. A viable, cost-effective, winning solution was identified during Phase I of the competition and the additional phases were canceled. The winner received a cash prize of \$10,000 and the winning solution will undergo testing in late FY 2017.

Solution Type: Ideas; and technology demonstration and hardware

Primary Goals: The prize competition's primary objective was to encourage innovation, promote and find novel approaches to develop a buoy mooring system that would update the current system, while having minimal environmental impact. The challenge also provided the USCG with innovative technologies and ideas that could be engaged outside of a traditional contract. A viable solution will significantly enhance environmental stewardship for this crucial subset of the Nation's navigational system.

The USCG RDC and DHS S&T wanted to use this competition to engage a new and diverse group of problem solvers. The desired outcomes were:

- Develop a new approach and technology solution;
- Solve a specific problem;
- Advance scientific research;
- Find and highlight innovative ideas;
- Engage new people and communities; and
- Inform and educate the public.

Results: Phase I generated 98 total submissions. A winning solution was identified during Phase I of the competition. The winner received a cash prize of \$10,000 and the winning solution will undergo testing in late FY 2017. The winning solution proposal was submitted by Cole Santos from Maui, Hawaii. His solution addressed all of the ten criteria for the competition.

Problem Statement: The United States Coast Guard Research and Development Center (USCG RDC), in conjunction with the DHS Science and Technology Directorate's Borders and Maritime Security Division, was looking for individuals and entities to submit a new, innovative technology approach for fixing a navigational buoy in a body of water. The goal was to develop an adequate buoy mooring system that would have minimal impacts on the ocean floor, especially in environmentally-sensitive areas. The technology for mooring buoys—the use of a concrete anchor and a heavy chain—has not changed substantially in decades.

¹⁰⁹ www.innocentive.com/ar/challenge/9933728

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The prize competition sought a new, innovative, buoy mooring system. Buoys are an important part of the U.S. Aids to Navigation system. They convey information to boats by their visual or audible characteristics. The current system secures the floating buoy with the use of a chain and concrete sinker that causes damage to the marine life and habitat. Therefore, a new system approach requires a solution that is environmentally sensitive in order to protect the coral reefs and seagrass areas.

Solutions submitted to the prize competition could suggest alternative methods for using the current technology but would need to address and overcome the drawbacks associated with each method.

Aspects of a successful environmentally-friendly mooring system must consider the following:

- 1) The method to fix or anchor a buoy marker to a precise location on the seafloor or bottom that minimizes environmental damage.
- 2) The method that physically connects the surface marker to a precisely located anchor that allows for motion in a seaway due to winds, waves, tides, or other forces, while minimizing or eliminating any contact with the seafloor or adjacent vegetation.
- 3) A technique to install, inspect, remove or replace any parts of the system. Ideally, the installation should be as simple as possible, and only use a ship with a boom. For example, methods requiring the use of drills, barges, or divers might be scored lower than other proposed solutions.
- 4) These mooring systems may be fixed or moveable, passive or active, etc., with the goal of deployment in the following operating conditions:
 - a. Hull Type: 6 x 16 or 8 x 22 LFR (foam buoy);
 - b. Water Depth: 30 ft.–50 ft.;
 - c. Bottom Type: Sand or Mud;
 - d. Current: 2 kts. – 4 kts.;
 - e. Wind/Seas: 0 kts./0 ft.–70 kts./14 ft.; and
 - f. Tide: < 5 ft.
- 5) Additionally, proposed mooring systems should have the following properties:
 - a. Ability to withstand occasional allisions by vessels and not sustain damage; and
 - b. Ability to be deployed and retrieved using existing USCG resources, specifically: 175 foot Coastal Buoy Tender (WLM; Beam: 36 ft.; Buoy Deck Area: 1335 sq. ft.; Crane: 10 ton hydraulic with a 42 ft. reach; Dynamic Positioning System); or a 225 foot Seagoing Buoy Tender (WLB; Beam: 46 ft.; Buoy Deck Area: 2875 sq. ft.; Crane: 20 ton hydraulic with a 60 ft. reach; Dynamic Positioning System).
- 6) Prototype installation and assessment areas of particular interest to the USCG include the St. Johns River outside of Jacksonville, Florida, and the area around Guayanilla, Puerto Rico.

Proposed Goals: The prize competition’s primary objective was to encourage innovation, promote and find novel approaches to develop a buoy mooring system that would update the current system, while having minimal environmental impact. The challenge also provided the USCG with innovative technologies and ideas that could be engaged outside of a traditional contract. A viable solution will significantly enhance environmental stewardship for this crucial subset of the Nation’s navigational system.

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Measures of Success: USCG measured the success of this prize competition in the following ways:

- 1) Interest in the competition
 - a. 4,886 views on the prize competition page
 - b. 498 opened project rooms (participating solvers)
 - c. 98 submitted solution proposals
 - d. 53 submitted solution proposals eligible for award
 - e. 1 winning solution proposal
 - f. Received submissions from solvers of all backgrounds who wanted to participate
- 2) End result
 - a. Received a feasible, environmentally-friendly concept solution to the problem.
 - b. Proposed concept will enter into RDT&E by the USCG R&D Center in FY17.
 - c. The prize competition ended after Phase I and a cost savings of \$240,000.

Participants: With this prize competition, the USCG RDC was trying to reach a diverse set of non-traditional and traditional innovators that could contribute novel approaches for an environmentally-friendly mooring system. This prize competition also sought a core audience of innovators involved in marine operations and marine engineering. This competition attracted a diverse set of innovators and ideas from persons with little to no background in marine operations or marine engineering. A total of 498 individuals participated in this challenge.

Eligibility Rules: Eligibility requirements are those as detailed by the *Federal Register* notice in the eligibility section from the America COMPETES Reauthorization Act of 2010.

Timeline: The prize competition opened the submission period on January 6, 2016, and stopped accepting submissions on February 12, 2016. Winners were announced May 23, 2016.

Solicitation and Outreach: On January 6, 2016, DHS S&T announced the Environmentally-Friendly Replacement for Buoy Mooring Systems prize competition with the goal of discovering a new, innovative method for the buoy mooring system. The competition was announced in the *Federal Register*, posted on the DHS S&T Prize Competition page, posted on Challenge.gov, and went live on the InnoCentive prize competition page. The S&T Office of Corporate Communications managed the outreach and marketing of the challenge. The team developed a communications and outreach package which identified which outreach methods should be used, and contained a rollout schedule for content.

Social Media: For both the initial competition announcement in January 2016 and the winner announcement in May 2016, S&T staff posted tweets for the S&T Twitter account (@dhsscitech) using the hashtags: #prize, #ideas, #tech, and #ecosystem. Additionally, the S&T Facebook page (www.facebook.com/dhsscitech/) posted information about the competition using the hashtags: #prize, #ocean, and #technologies. InnoCentive also posted content to their Twitter account, Facebook page, and LinkedIn page.

Email Outreach: InnoCentive promoted the prize competition through email blasts and their weekly challenge bulletin. This bulletin was sent to over 140,000 solvers every Thursday during the competition for a total of five bulletins.

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Press Releases: Open Submission Period—The S&T prize competition press release was issued on Thursday, January 7, 2016. The press release was cross-posted on InnoCentive and a local Maui news site. DHS S&T and the USCG R&D Center are planning additional press announcements related to this competition when the R&D Center begins testing of proposed solution and upon successful completion of the pilot. The USCG R&D Center anticipates beginning testing in late FY 2017.

Prize Winners Announcement—The S&T prize winners announcement press release was issued on May 23, 2016. InnoCentive cross-posted the S&T press release.

Other:

Web Content—Customized web content was developed by both the S&T and InnoCentive teams.

- A blog from the Under Secretary for Science and Technology was also posted announcing the challenge.
- InnoCentive tracked the traffic of visitors to the InnoCentive prize competition page. A total of 4,886 people visited the competition page. The landing pages visitors came from and the number of page views per landing page, are listed below:

Visitor Landing Page	Number of Page Views
InnoCentive.com	4447
Challenge.gov	345
InnoCentive Marketing	50
DHS.gov	44
Grand Total	4886

Lessons Learned: Although the outreach for this prize competition was less extensive than the previous two prize competitions conducted by DHS, it generated more public interest and participation. This competition had over 150 more registrants and over 40 more submissions. The marketing and outreach was successful and effective as a winner was selected and the idea was received that can be moved into government research, development, test, and evaluation.

Incentives: The prize competition was originally planned for three phases with a total prize purse for \$250,000. Phase II and III were optional phases that the USCG could leverage if Phase I submission resulted in a promising solution and the submitter was able to enter into the development of the prototype.

Evaluation and Judging: InnoCentive, Inc., the DHS S&T contracted prize competition administrator, filtered 98 submissions to the contest based on non-U.S. citizenship, non-U.S. legal permanent resident status, non-U.S.-based entities, low quality submissions, and submissions that did not provide a cover page, leaving 53 proposals for judging.

Seven Federal employee judges from the USCG and one S&T technical advisor divided themselves and the submissions into three groups having at least one subject matter expert in each group to ensure across-the-board knowledge. The judges rated the submissions using a point system (0-100 points) against three criteria:

- Clear discussion of the solution;

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- Implementation plan and feasibility; and
- Cost analysis.

The judges also reviewed the proposals based on those with the capability to participate in future competition. The S&T technical advisor collected each group's top three rated submissions and one additional submission for consensus judging.

Of the ten submissions discussed during the consensus judging phase, only one clear submission provided a feasible solution. The judges to this prize competition collectively provided 275 hours to determining the winner.

Partnerships: DHS S&T, Borders and Maritime Security Division partnered with the United States Coast Guard Research and Development Center for this prize competition. This was the first time both the USCG R&D point of contact, Danielle Elam, and the DHS S&T point of contact, Charlotte Sullivan, partnered together. Danielle Elam commented that the partnership was greatly beneficial.

Resources: InnoCentive, Inc. was utilized as a third party vendor to help plan and conduct the prize competition.

The following DHS resources were utilized in the planning and conduct of the prize competition:

- DHS S&T InnoPrize Program Office
- DHS S&T General Counsel, Intellectual Property Attorney and legal review
- DHS S&T, Prize Competition Manager
- USCG Research and Development Center provided overall planning and support of the prize competition.
- DHS Office of Corporate Communications developed support material and approval for all public affairs announcements, supported a public facing website for the prize competition, and addressed inquiries from the public.
- DHS S&T and USCG provided judging support.

Prize Competition Resources	
Category	Work (hours)
DHS S&T Prize Program Office	90
USCG R&D Center Personnel	240
DHS S&T BMD Prize Competition Manager	130
Office of Corporate Communication	40
Judging Support	275
TOTAL	775

The chart represents approximately \$57,498 of administrative support required to conduct this prize competition.

Results: The prize competition advanced the USCG's research and development of an approach for mooring buoys in environmentally-sensitive areas. The winning idea for Phase I of the competition provided a potential solution using commercially available items configured in a new system not previously envisioned. The proposed system uses an ultra-high strength poly-fiber rope

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with inner elastic cords and screw anchor that potentially causes less damage to the coral reefs and seagrass areas. The idea also proposes the use of a more secure anchor that may decrease the chance of the buoy moving off its station. Since the proposed idea uses commercially available materials, the judges recommended that the winning solution receive a \$10,000 cash prize and that the USCG move forward with procuring the recommended material and independently conduct test and evaluation.

The competition generated a lot of interest from all over the world with 4,886 individuals viewing the prize competition website, 498 individuals registering for the competition from 62 countries, and 58 proposals competing for an award. There were an additional 40 proposals that were submitted that could not be considered as a solution to the competition due to eligibility rules.

The overall quality of ideas was considered by the judges as high. The USCG is not continuing a partnership with any of the participating solvers but considers the competition a success since a probable solution may have been discovered through the prize competition process. Testing of the concept will be conducted by the USCG R&D Center in FY17.

Eco Mooring by Cole Santos:

The winning solution proposal was submitted by Cole Santos from Maui, Hawaii. He submitted as an individual and is self-employed. In the solution, he proposes using elastic components protected by ultra-high strength poly-fiber rope with inner elastic cords instead of the traditional chain. For an anchor, he suggests using a screw anchor or Manta anchors with GPs which allows for more precise installation and a stronger hold than the current concrete weights. The elastic rope would float above the marine habitat instead of dragging on the ground as the current slack chain does. The screw anchor has a smaller footprint and would cause less damage to the marine habitat. The solution also proposes the use of reef balls that create a fish habitat in areas that are already damaged or could be damaged from anchors. The solution addressed all of the ten criteria for the competition and was selected for an award of \$10,000.

About the winner:

Cole Keaoulu Santos is a native Hawaiian from Maui. He is a scuba dive instructor and self-employed real estate professional, and has experience building and maintaining moorings locally on Maui, where mooring conservation is an important topic. He developed his winning proposal after observing several different types of mooring and anchoring techniques, including using divers to install manta moorings locally, screw-type anchors used in Australia, and elastic mooring cables employed in New England. Santos is a founding member of a makerspace organization, Maui Makers LLC. One of his life goals is to build artificial islands for seasteading and space habitats.

A.7 Department of the Interior

A.7.1 NPS: Memorials for the Future

Summary: This challenge called for new ways to create memorials in Washington, DC, honoring our diverse histories, heritage, and culture. This challenge looked beyond the boundaries of existing memorial landscape, seeking options that were thematically different and less land-intensive.

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Solution Type: Ideas

Primary Goals: Solve as specific problem

Results: From over 300 submissions from 90 teams, a winner and three runners up were selected. The winning concept, Climate Chronograph, would allow visitors to interact with the space as it creates a personal experience of climate change. Designs were showcased at the John F. Kennedy Center for the Performing Arts.

Problem Statement: Memorials for the Future called for designers, artists, and social scientists to develop new ways to commemorate people and events that are more inclusive and flexible, and that enrich Washington's landscape while responding to the limitations of traditional commemoration. As the National Park Service (NPS) celebrated its centennial in 2016, Memorials for the Future created new ideas for honoring our diverse histories, heritage, and culture.

Memorials enshrine what a society wants to remember. But the places, people, and stories that it memorializes, and the audiences that engage with them, are in fact constantly changing. A memorial tells its story through subject matter and design. This story is often complex and multi-dimensional as a memorial's interpretive elements embody ideas of identity, culture, and heritage, and each have intensely personal interpretations for every individual.

As the national capital, Washington is a focal point for commemorations of the nation's collective memory. Monuments sited throughout the city take on heightened significance as they reflect relationships among nations, of national remembrance, and of many important events and figures in our history. Often the traditional and fixed nature of memorial design does not allow for adaptation and redefinition over time, or encourage more than one interpretation of a given narrative.

Memorials for the Future was a conscious effort to look beyond the traditional approach to developing memorials in Washington, an approach which has resulted in a commemorative landscape that is thematically similar and increasingly land-intensive, poses challenges for Washington's urban park system, and has long-term implications for the potential uses of a memorial's surrounding park setting.

Proposed Goals: The goals of the competition were to create new approaches to and forms of memorializing that would:

- Advance a framework for the planning and design of commemorative works in the 21st century;
- Demonstrate how temporary, mobile, interactive, or adaptive displays can provide powerful and memorable experiences that are cost-efficient;
- Develop ways to commemorate that are inclusive of multiple narratives and have the potential to be flexible as perspectives change;
- Honor the scale, context and national significance of Washington, DC.

Measures of Success: Proposals presented:

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- Exciting possibilities for future memorials;
- New ways to engage diverse new subject matter;
- Ways for reinterpretation over time;
- Ways to enable and respect multiple narratives;
- Considerations of technology;
- Ways to honor national contexts and local experiences; and
- Designs that can adapt and evolve, are sometimes ephemeral or temporary, and often engage the public directly as part of the memorial.

All of these will be used as lessons learned and provided to memorial sponsors as examples of ways to commemorate in ways that do not require granite and stone.

Participants: The challenge received over 300 submissions from 90 teams. The challenge sought participation from designers, artists, and social scientists.

Timeline: Submissions were opened April 11, 2016, with the first deadline on May 4, 2016. The top four finalists were announced June 8, 2016, and then began their proposals with a design framework working session on the same day. Final presentations were August 3, 2016 and final deliverables were due August 8, 2016. The competition winner was announced September 8, 2016, and the exhibition was launched the same day.

Solicitation and Outreach: Van Alen Institute assisted with outreach.

Incentives: Total Cash Prize: \$60,000

The submissions were offered recognition, rather than a cash prize or monetary incentive. The four finalists each received a \$15,000 stipend to participate in a research and design process. Teams were required to convene in Washington, DC four times so each team was offered a reimbursement stipend of up to \$5,200 for flights, hotel, and ground transportation.

Evaluation and Judging: Jurors, drawn from experts in the art, history, and architecture communities and among the project partners, helped select finalist teams and winning teams. They also provided feedback during the design framework working session and the final presentation.

Evaluation criteria included:

- Responsiveness to the goals of the competition;
- Overall strength and quality in approach to developing initial concept, design, and narrative;
- Multidisciplinary nature of team members and partners;
- Experience working on research and design projects that incorporate understanding of local context and narratives;
- Experience engaging diverse public audiences;
- Clear communication of a process to relate conceptual narratives to a general audience;
- Commemoration subject is a recognizable part of the American story, reflective of our heritage, history, and culture;
- Clear communication of a process to engage the surrounding community with the proposed concept design; and

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- Location selected (locations NOT on the National Mall were given preference).

Partnerships: NPS partnered with National Capital Planning Commission and the Van Alen Institute.

Resources: Appropriations to NPS and National Capital Planning Commission funded the prize competition. Agency staff was involved in the design and conduct of the competition. Prize competition contracting services from Van Alen provided prize competition design, outreach, and administration services. National Capital Planning Commission provided all the staff and resources required for the production of the competition website, videos, and photography, as well as for the panel discussion. Total operational costs from the agency are valued at \$124,233.05 and partner contributions are estimated at \$65,000.

Results: As part of the event announcing the four finalists, NPS hosted a panel discussion at the National Archives on June 8, 2016. The panel, moderated by Jason Schupbach, Director of Design Programs, National Endowment for the Arts, examined new approaches for commemoration. The full panel discussion is available at: www.youtube.com/watch?v=FemGqG6mcw8; or view the highlights at: www.youtube.com/watch?v=uVtYz3lbj-4.

The winning concept, Climate Chronograph, is a forward-looking memorial that takes a complex global process—climate change—and turns it into a personal experience. While memorials conventionally commemorate a moment in the past, this initially traditional-looking memorial offers a reimagined landscape and a living observatory that allows people to interact with the space as it evolves unpredictably over time.



Figure 3 Climate Chronograph, Photo by Azimuth Land Craft

A free public exhibition showcasing the winner and finalists' design concepts opened September 8, 2016, in the Hall of Nations at the John F. Kennedy Center for the Performing Arts and ran through October 20, 2016.

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Figure 4 Exhibit at the Kennedy Center, Photo by NPS

A video documents the competition and its key findings. It is available at www.youtube.com/watch?v=y28fBhj0mKU/

A.7.2 USBR: Detecting the Movement of Soils (Internal Erosion) Within Earthen Dams, Canals, Levees, and their Foundations

Summary: The structural integrity of dams and other earthen embankments are important to protect the public and their property. Internal erosion is a threat to the structural integrity of dams, and often remains invisible until it is a serious threat. Better detection of early internal erosion can allow for reduction of these risks by enabling effective early intervention. This challenge is designed to seek out new solutions for improved detection of early internal erosion.

Solution Type: Ideas

Primary Goals: Build capacity; engage new people and communities; solve a specific problem

Results: From 29 submissions, five prizes were awarded, and all submissions are eligible for further pursuit. Two winning submissions—a phased array seismic tomographic anomaly solution and a superconducting quantum interference device—are highlighted as novel applications of existing technology. Two other non-winning solutions are highlighted as useful for further pursuit.

Problem Statement: Are there better methods for detecting directly the movement (erosion) of soils in earthen structures and foundations, or detecting indirect indicators of soil movement as internal erosion initiates or is in the early stages of propagation? The goal is to detect soil movement earlier than occurs by current visual inspection and instrumentation methods.

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The Bureau of Reclamation (USBR), U.S. Army Corp of Engineers (USACE), and State agencies inspect, and assess the condition and performance of dams and other earthen embankments. While inspection and condition assessment programs are effective ways to protect the public and property, these current methods are resource intensive and cannot reliably detect internal erosion early in the process. Internal erosion can take place over a long period of time, but often remains invisible (inside or below the structure) until serious damage occurs, placing lives, property, critical water supply or flood retention capabilities at risk. The ability to reliably detect internal erosion early in the process would help Reclamation, USACE, and all dam, levee, and canal owners to reduce risks by encouraging early intervention.

Proposed Goals: Find better, affordable, and more effective ideas/methods that will help the Bureau of Reclamation—as well as other Federal, State, and local organizations—improve the safety and reliability of earthen embankments designed to store and convey water.

Measures of Success: The ability to solicit solution concepts from the broader public demonstrated the merit of prize competitions to introduce new or improved ideas into the thinking of our subject matter experts, and stimulated our thinking about other ways to make some of these ideas work.

Some of the awarded solutions proposed variations or improvements to existing methods, while other awarded approaches had not been previously considered or known by the panel of expert judges. While each solution had novel elements, each will also require additional development and testing before merit can be fully accessed. But the need for additional development and testing is expected for prize competitions seeking new ideas.

Participants: The challenge received 29 submissions. Participation requirements were as follows:

ELIGIBILITY RULES: To be able to win a prize under this competition, an individual or entity must:

1. Agree to the rules of the competition (15 U.S. Code § 3719(g)(1));
2. Be an entity that is incorporated in and maintains a primary place of business in the United States, or, in the case of an individual, a citizen or permanent resident of the United States (15 U.S. Code § 3719(g)(3));
3. Not be a Federal entity or Federal employee acting within the scope of their employment; (15 U.S. Code § 3719(g)(4));
4. Assume risks and waive claims against the Federal Government and its related entities (15 U.S. Code § 3719(i)(1)(B)); and,
5. Not use Federal facilities, or consult with Federal employees during the competition unless the facilities and employees are made available to all individuals and entities participating in the competition on an equitable basis.

The following individuals or entities are not eligible regardless of whether they meet the criteria set forth above:

1. Any individual who employs an evaluator on the Judging Panel or otherwise has a material business relationship or affiliation with any Judge;
2. Any individual who is a member of any Judge's immediate family or household;

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3. The Seeker, participating organizations, and any advertising agency, contractor, or other individual or organization involved with the design, production, promotion, execution, or distribution of the prize competition; all employees, representatives and agents thereof; and all members of the immediate family or household of any such individual, employee, representative, or agent;
4. Any individual or entity that uses Federal funds to develop the proposed solution now or any time in the past, unless such use is consistent with the grant award, or other applicable Federal funds awarding document. NOTE: Submissions that propose to improve or adapt existing federally funded technologies for the solution sought in this prize competition are eligible.

Timeline: Submissions were opened March 31, 2016, and submissions were due May 10, 2016. Winners were announced July 29, 2016.

Solicitation and Outreach: N/A

Incentives: Total Cash Prize: \$20,000

Source: Funds appropriated to the Bureau of Reclamation Science and Technology Program specific for prize competitions.

Evaluation and Judging: Winning submission recommendations are made to Reclamation's Science Advisor by a judging panel. Reclamation's Science Advisor is Reclamation's delegated official with the authority to implement prize competitions under 15 USC 3719.

Submissions required solvers to submit a concept paper explaining why their proposed solution could meet stated technical performance specifications. Submissions were evaluated by a judging panel composed of scientists, engineers, and other related technical experts. Solutions that meet the requirements will also be judged on the following items in order of priority:

- Adaptability
- Scalability
- Readiness
- Originality

Partnerships: U.S. Army Corps of Engineers, and the State of Colorado provided prize competition design and judging assistance.

Resources: Reclamation used the contracting services of InnoCentive to help design and administer this competition, and to distribute the challenge to the InnoCentive curated solver community.

Reclamation funded InnoCentive and Reclamation staff. All other agencies/organizations funded their own contributed collaboration.

Results: Reclamation received 29 submissions and awarded monetary prizes to 5 submissions. The rules of the competition provided the Federal Government with a license to use all 29 ideas and allow others to do so. A synopsis of the winning solutions is provided below:

\$6,250 Award: Phased array seismic tomographic anomaly imaging

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\$6,250 Award: Superconducting quantum interference device

\$2,500 Award: Robot enabled underwater flowmeter

\$2,500 Award: Brine seepage tracer

\$2,500 Award: Shear-wave reflection seismic imaging

The phased array seismic tomographic anomaly solution is the most solid and well-presented solution relative to the prize competition criteria. The approach uses existing technologies. However, Reclamation is unaware of any prior applications of this technology by the dam safety and engineering community. The submission reinforces and strengthens the concepts considered to be technically viable by the judging team. Implementation introduces cost, maintenance, and vandalism concerns, which require further consideration, but it is the most implementation-ready solution.

The superconducting quantum interference device has a high probability for implementation as an indirect method to detect internal erosion. It is believed that the proposed solution could feasibly detect new concentrated seepage pathways prior to initiation of internal erosion. It proposes using existing technology in a novel way/application that is untested for effectiveness in detecting concentrated seepage and/or the movement of soils in embankment structures. It is theoretically sound and does not require permanent installation on an embankment. Additional research and testing is needed to evaluate its capabilities and reliability. Equipment cost could be a limiting factor, but costs are expected to be lower in the near-future.

Two additional solutions included noteworthy components that may be worth carrying forward even though the solution itself did not qualify for an award. These are an infra-red thermography and statistical analysis of sinkholes (as a basis for remote sensing detection). Both may be interesting topics to explore further. Judges discussed the citizen science component offered by another solution which would allow visitors to an embankment to formalize their observations by submitting text and photographs to a website or a database. Often, indications of internal erosion are noticed by visual inspection.

A.7.3 USBR: Downstream Fish Passage at Tall Dams

Summary: Passage across tall dams is important for increasing habitat availability for threatened and endangered fish populations. While options exist for some fish populations, moving juvenile fish downstream around tall dams remains a challenge. This Challenge seeks out successful and cost-effective solutions for the downstream movement of juvenile fish around tall dams.

Solution Type: Ideas

Primary Goals: Build capacity; engage new people and communities; solve a specific problem

Results: From 44 solutions submitted, four prizes were awarded. The solutions proposed were novel and merit further investigation, but all face technical challenges. While work with these solutions will continue, the broad conclusion is that the current, collective efforts of Reclamation and other Federal and State collaborators largely represent best known practices.

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Problem Statement: Is there a better way to pass downstream-moving juvenile fish over or around tall (i.e. high-head) dams?

While downstream passage over high-head dams for some fish species and life history stages has been achieved to a limited degree, significant improvement in downstream juvenile fish passage is still needed. Effective downstream passage, paired with effective upstream passage, would increase habitat availability that many threatened and endangered fish populations need to rebuild resilient populations. New ideas for gaining successful and cost-effective downstream passage of juvenile fish at tall dams are being sought by this Challenge.

Proposed Goals: Find better, affordable, and more effective ideas/methods that will help the Bureau of Reclamation, as well as other Federal, State, and local organizations, protect and recover threatened and endangered fish species.

Measures of Success: The prize competition approach enabled us to engage individuals with impressive credentials that work in other technical domains. The ability to solicit solution concepts from the broader public demonstrated the merit of prize competitions to introduce new or improved ideas into the thinking of our subject matter experts, and stimulated our thinking about other ways to make some of these proposals effective.

Some of the awarded solutions proposed variations or improvements to existing methods, while other awarded approaches had not been previously considered or known by Federal fish recovery subject matter experts. While each solution had novel elements, each will also require additional development and testing before merit can be fully accessed. However, the need for additional development and testing is expected for prize competitions seeking new ideas.

The prize competition generated very favorable press coverage in Northern California where salmon passage past dams is a major problem. As such, the prize competition successfully demonstrated to the public and our stakeholders that the Bureau of Reclamation and our Federal and State collaborators are trying everything to find new or better solutions to this difficult problem.

Participants: 44 teams participated in this challenge. Eligibility requirements were as follows:

ELIGIBILITY RULES: To be able to win a prize under this competition, an individual or entity must:

1. Agree to the rules of the competition (15 U.S. Code § 3719(g)(1));
2. Be an entity that is incorporated in and maintains a primary place of business in the United States, or, in the case of an individual, a citizen or permanent resident of the United States (15 U.S. Code § 3719(g)(3));
3. Not be a Federal entity or Federal employee acting within the scope of their employment; (15 U.S. Code § 3719(g)(4));
4. Assume risks and waive claims against the Federal Government and its related entities (15 U.S. Code § 3719(i)(1)(B)); and,

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5. Not use Federal facilities, or consult with Federal employees during the competition unless the facilities and employees are made available to all individuals and entities participating in the competition on an equitable basis.

The following individuals or entities are not eligible regardless of whether they meet the criteria set forth above:

1. Any individual who employs an evaluator on the Judging Panel or otherwise has a material business relationship or affiliation with any Judge;
2. Any individual who is a member of any Judge's immediate family or household;
3. The Seeker, participating organizations, and any advertising agency, contractor or other individual or organization involved with the design, production, promotion, execution, or distribution of the prize competition; all employees, representatives and agents thereof; and all members of the immediate family or household of any such individual, employee, representative, or agent;
4. Any individual or entity that uses Federal funds to develop the proposed solution now or any time in the past, unless such use is consistent with the grant award, or other applicable Federal funds awarding document. NOTE: Submissions that propose to improve or adapt existing federally funded technologies for the solution sought in this prize competition are eligible.

Timeline: Submissions for this challenge opened March 31, 2016, and were due May 10, 2016. Winners were announced July 29, 2016,

Solicitation and Outreach: N/A

Incentives: Total Cash Prize: \$20,000

Source: Funds appropriated to the Bureau of Reclamation Science and Technology Program specific for prize competitions.

Evaluation and Judging: Winning submission recommendations are made to Reclamation's Science Advisor by a judging panel. Reclamation's Science Advisor is Reclamation's delegated official with the authority to implement prize competitions under 15 USC 3719.

Submissions required solvers to submit a theoretical paper explaining why their proposed solution could meet stated technical performance specifications. Submissions were evaluated by a judging panel composed of scientists, engineers, and other related technical experts. Solutions that met the requirements were also judged on the following items in order of priority:

- Feasibility
- Flexibility to changing conditions (water level, temperature, debris)
- Overall costs
- Scalability

Partnerships: U.S. Geological Survey, NOAA-National Marine Fisheries Service, U.S. Army Corps of Engineers, and the State of California provided prize competition design and judging assistance.

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Resources: The Bureau of Reclamation used the contracting services of InnoCentive to help design and administer this competition, and to distribute the challenge to the InnoCentive curated solver community.

Reclamation funded InnoCentive and Reclamation staff and a portion of the USGS assistance. All other agencies/organizations funded their own contributed collaboration.

Agency costs included about \$16,000 in contract costs and about \$42,000 in labor costs. Partner contributions totaled about \$30,000.

Results: Reclamation received 44 submissions and awarded monetary prizes to four submissions. The rules of the competition provided the Federal Government with a license to use all 44 ideas and to allow others to do so.

\$10,000 Award: The top submission is a system that utilizes a drag conveyor system, similar to the systems used to transport delicate solids, to pass fish downstream. A person that worked as food manufacturing process engineer proposed this solution. The system could manage pressure within the chambers, minimizing barotrauma. This concept should be investigated further to see if the pipe diameter could be scaled up, and to see the applications for which it is being used currently. The other concepts presented for attraction and discharge are similar to existing methods used. The team agreed that this was the top submission.

\$4,000 Award: The use of an Archimedean internal helical “de-elevator” device to move small fish downstream past high head dams is novel and worth further investigation. There may be difficulty in scaling this concept to the size needed to move the anticipated volume of water, and the ability to attract fish to the entrance of the bypass remains unresolved based on this submission.

\$3,500 Award: The solution uses nets to guide fish to multiple extractions points, and flexible pipe attached to buoy to convey fish through the dam abutment to the river downstream in atmospheric pressure conditions. This is a simple solution with not many moving parts, which provides a volitional method to convey fish downstream in atmospheric pressure conditions.

\$2,500 Award: This proposal described innovative ways of attracting fish to a collection location, particularly the use of cover, and protecting them from predators at that location. The use of cover to congregate fish at a collection location has not, to Reclamation’s knowledge, been used in a fish passage situation. It may have merit in the future.

Although we found a few new ideas that have some merit for parts of the problem, the prize competition results also demonstrates that the current, collective efforts of Reclamation and other Federal and State collaborators largely represents best known practices.

A.7.4 USBR: Preventing Rodent Burrows in Earthen Embankments

Summary: The structural integrity of dams and other earthen embankments are important to protect the public and their property. Rodent burrows can lead to internal erosion in such embankments, leading to failures causing property damage, loss of life, and interruptions to crucial deliveries of

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water in the West and across the nation. While short term solutions exist, this challenge seeks to gather novel, long-term, cost effective solutions to this problem.

Solution Type: Ideas

Primary Goals: Build capacity; engage new people and communities; solve a specific problem

Results: Of 75 entries, five were awarded prizes. Solutions ranged from new surface materials, natural methods including plant and predator management, to robotic smart traps, among others. While solutions still require further development, all are innovative and several have advantages in cost effectiveness and requiring limited maintenance.

Problem Statement: Is there a way to stop and prevent rodents from burrowing into earthen embankments of dams, canals, and levees?

Rodent burrows can fill with water when the water levels change, creating seepage paths which can lead to internal erosion in embankments resulting in the potential for catastrophic failure. Embankment failures can cause property damage, cause loss of life, and interrupt crucial deliveries of water in the West and across the nation.

Trapping or baiting rodents on earthen embankments are short term remedies, and experience has shown that within a short time, the rodents inevitably return. Annual programs of rodent removal over thousands of miles of earthen embankment are cost prohibitive and only marginally successful. Solvers are asked for creative, cost effective, long-term solutions to this very real and serious problem.

Proposed Goals:

- a. Reduce by 95% the ability of rodents to burrow in the embankments;
- b. Be able to be applied at discrete, remote locations where power is not available;
- c. Work reliably for a minimum of five years without interruption or major repairs;
- d. Requires maintenance labor activities no more than every six months;
- e. Be cost effective to treat or cover earthen embankments that are one mile long, but be scalable to treat embankments that are 50 miles long.

Measures of Success: The ability to solicit solution concepts from the broader public demonstrated the merit of prize competitions to introduce new or improved ideas into the thinking of our subject matter experts, and stimulated our thinking about other ways to make some of these ideas work

Some of the awarded solutions proposed variations or improvements to existing methods, while other awarded approaches had not been previously considered or known by the panel of expert judges. While each solution had novel elements, each will also require additional development and testing before merit can be fully accessed. But the need for additional development and testing is expected for prize competitions seeking new ideas.

Participants: 75 entries were received for this challenge. Participation requirements were as follows:

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ELIGIBILITY RULES: To be able to win a prize under this competition, an individual or entity must:

1. Agree to the rules of the competition (15 U.S.C. 3719(g)(1));
2. Be an entity that is incorporated in and maintains a primary place of business in the United States, or, in the case of an individual, a citizen or permanent resident of the United States (15 U.S.C. 3719(g)(3));
3. Not be a Federal entity or Federal employee acting within the scope of their employment; (15 U.S.C. 3719(g)(4));
4. Assume risks and waive claims against the Federal Government and its related entities (15 U.S.C. 3719(i)(1)(B)); and,
5. Not use Federal facilities, or consult with Federal employees during the competition, unless the facilities and employees are made available to all individuals and entities participating in the competition on an equitable basis.

The following individuals or entities are not eligible regardless of whether they meet the criteria set forth above:

1. Any individual who employs an evaluator on the Judging Panel or otherwise has a material business relationship or affiliation with any Judge;
2. Any individual who is a member of any Judge's immediate family or household;
3. The Seeker, participating organizations, and any advertising agency, contractor, or other individual or organization involved with the design, production, promotion, execution, or distribution of the prize competition; all employees, representatives and agents thereof; and all members of the immediate family or household of any such individual, employee, representative, or agent;
4. Any individual or entity that uses Federal funds to develop the proposed solution now or any time in the past, unless such use is consistent with the grant award, or other applicable Federal funds awarding document. NOTE: Submissions that propose to improve or adapt existing federally funded technologies for the solution sought in this prize competition are eligible.

Timeline: Submissions were opened August 29, 2016, and closed October 11, 2016. Winners were announced December 27, 2016.

Solicitation and Outreach: N/A

Incentives: Total Cash Prize: \$20,000

Source: Funds appropriated to the Bureau of Reclamation Science and Technology Program specific for prize competitions.

Evaluation and Judging: Winning submission recommendations are made to Reclamation's Science Advisor by a judging panel. Reclamation's Science Advisor is Reclamation's delegated official with the authority to implement prize competitions under 15 USC 3719.

Submissions required solvers to submit a concept paper explaining why their proposed solution could meet stated technical performance specifications. Submissions were evaluated by a judging

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panel composed of scientists, engineers, and other related technical experts. Solutions that meet the requirements will also be judged on the logistical feasibility, applicability to varying environments, readiness, overall costs, and scalability.

Partnerships: The U.S. Army Corps of Engineers, the State of Colorado Department of Natural Resources and with Federal canal operating entities—including the Boise Project Board of Control and the South Columbia Basin Irrigation District—provided prize competition design and judging assistance.

Resources: Reclamation used the contracting services of InnoCentive to help design and administer this competition, and to distribute the challenge to the InnoCentive curated solver community.

Reclamation funded InnoCentive and Reclamation staff. All other agencies/organizations funded their own contributed collaboration.

Results: Reclamation received 75 submissions and awarded monetary prizes to five submissions. The rules of the competition provided the Federal Government with a license to use all 75 ideas and allow others to do so. A synopsis of the winning solutions is provided below:

\$5,500 Award: Subsurface cut-off wall barrier using hydro-excavation

\$5,500 Award: Surface geotextile with embedded steel wool

\$4,000 Award: Combination of predators and hydro-seeded plant deterrents

\$2,500 Award: Simple machine for subsurface acoustic deterrent

\$2,500 Award: Robotic smart trap

The subsurface cut-off wall barrier using hydro-excavation is a solid and well-presented solution relative to the prize competition criteria. The approach uses existing cut-off wall applications. However, Reclamation is not aware of any prior uses of hydro-excavation applications to create narrower trenches in embankments. The submission reinforces and strengthens the concepts considered to be technically viable by the judging team. Implementation description addresses the technical requirements, and is one of the most implementation-ready solutions.

The surface geotextile with embedded steel wool is a solid solution that is likely to have a high initial cost but likely to be a very effective and cost-effective long-term solution. The solution is a surface treatment that still allows vegetation to become established on the embankment for erosion control and would still allow visual observation of the embankment for inspection purposes. Further investigation would be needed to determine actual costs and long-term effectiveness.

The combination of predators and hydro-seeded plant deterrents solution is considered to be a viable combination solution that is inexpensive, easy to install, and requires little overall maintenance. This proposal incorporates certain agricultural techniques in combination with native wildlife predator management, such as owls, to ensure effective rodent control in water embankment areas with minimal intrusion to the ecosystem. Because it requires growth of particular vegetation, it may not be suitable for all climates; however, with the combination of predator management and vegetation establishment, it could be adapted to many, if not most climates. Further investigation is needed to evaluate the appropriate combinations of vegetation

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and predator establishment for different climates and regions. If suitable habitat can be established for threatened and endangered birds of prey, such a solution might also assist with the recovery of threatened and endangered species in certain areas.

The simple machine for subsurface acoustic deterrent is activated by wind and has potential to be inexpensive, easy to install, and low-maintenance. There were many proposed solutions using acoustics and this one stood out to the judges because of the simple method to develop random acoustics without a power source. Random acoustic emissions are not as susceptible to rodent habituation, which is a weakness of acoustic methods. Further investigation is needed to determine the effectiveness of this random acoustic method and the transmission distance.

The robotic smart trap is the most innovative solution. This solution provided an outside-the-box idea that addressed all of the technical requirements, but requires further investigation and development of the ability to avoid non-target species. Although addressed by the solver, additional innovation of the robot will be necessary to ensure the movement of the robot on steep embankment slopes, refining the design to limit O&M costs of the robot, and ability of the trap to attract rodents.

A.7.5 USBR: Quantifying Drift Invertebrates in River and Estuary Systems

Summary: Zooplankton and drift invertebrates are key sources of food for fish. Having an accurate count of these organisms is vital in evaluating and restoring fish habitat. While technology for these counts exists for ocean habitats, rivers, streams, and estuaries present challenges not addressed by existing technology. This challenge was designed to gather novel technologies and methods for collecting counts in rivers, streams, and estuaries. Five prizes were awarded, each providing novel approaches which continue to be pursued by the Bureau.

Solution Type: Ideas

Primary Goals: Build capacity; engage new people and communities; solve a specific problem

Results: Five solutions were awarded. Only the first place solution met the technical requirements of the challenge and continues to be pursued; however, the remaining ideas all had sufficient merit for further development and testing and are also continuing on. All awarded solutions were proposals not previously considered by Federal subject matter experts.

Problem Statement: The Bureau of Reclamation wanted to identify devices and methods that can detect, count, and identify zooplankton and drift invertebrates in an economical way in rivers and estuary systems.

Accurate food counts, such as counts of zooplankton and drift invertebrates, are instrumental in evaluating and restoring fish habitat in our rivers and streams. Although technologies have been developed for automated detection and identification of zooplankton and drift invertebrates in oceanographic settings, they have not been developed for the unique environmental conditions in rivers and estuaries. High flow rates and turbidity cause problems with the automated visual systems used today. The main obstacle in estuaries is turbidity; while the main obstacle in river

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systems is flow velocity. In addition, the horizontal nature of rivers invokes problems not encountered in deep ocean waters (e.g., sunlight effects at the surface of water and the mixing of food sources throughout the water column in rivers due to turbulence, as opposed to more stratified food webs in ocean waters).

Proposed Goals: Find better, affordable, and more effective ideas/methods that will help the Bureau of Reclamation, as well as other Federal, State, and local organizations protect and recover threatened and endangered fish species.

Measures of Success: The prize competition approach enabled us to engage individuals with impressive credentials that work in other technical domains. The ability to solicit solution concepts from the broader public demonstrated the merit of prize competitions to introduce new or improved ideas into the thinking of our subject matter experts, and stimulated our thinking about alternative methods to make some of the proposed ideas effective.

All of the awarded solutions proposed approaches that had not been previously considered by Federal fish recovery subject matter experts. While each solution has novel elements, each will also require additional development and testing before its merit can be fully accessed. However, the need for additional development and testing is expected for prize competitions seeking new ideas.

Participants: Twenty-three teams participated. Eligibility requirements were as follows:

ELIGIBILITY RULES: To be able to win a prize under this competition, an individual or entity must:

1. Agree to the rules of the competition (15 U.S. Code § 3719(g)(1));
2. Be an entity that is incorporated in and maintains a primary place of business in the United States, or, in the case of an individual, a citizen or permanent resident of the United States (15 U.S. Code § 3719(g)(3));
3. Not be a Federal entity or Federal employee acting within the scope of their employment; (15 U.S. Code § 3719(g)(4));
4. Assume risks and waive claims against the Federal Government and its related entities (15 U.S. Code § 3719(i)(1)(B)); and,
5. Not use Federal facilities, or consult with Federal employees during the competition unless the facilities and employees are made available to all individuals and entities participating in the competition on an equitable basis.

The following individuals or entities are not eligible regardless of whether they meet the criteria set forth above:

1. Any individual who employs an evaluator on the Judging Panel or otherwise has a material business relationship or affiliation with any Judge;
2. Any individual who is a member of any Judge's immediate family or household;
3. The Seeker, participating organizations, and any advertising agency, contractor, or other individual or organization involved with the design, production, promotion, execution, or distribution of the prize competition; all employees, representatives and agents thereof; and

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all members of the immediate family or household of any such individual, employee, representative, or agent;

4. Any individual or entity that uses Federal funds to develop the proposed solution now or any time in the past, unless such use is consistent with the grant award, or other applicable Federal funds awarding document. NOTE: Submissions that propose to improve or adapt existing federally funded technologies for the solution sought in this prize competition are eligible.

Timeline: Submissions were opened October 7, 2015, and closed November 16, 2015. Winners were announced January 29, 2016.

Solicitation and Outreach: N/A

Incentives: Total Cash Prize: \$30,000

Source: Funds appropriated to the Bureau of Reclamation Science and Technology Program specific for prize competitions.

Evaluation and Judging: Winning submission recommendations are made to Reclamation's Science Advisor by a judging panel. Reclamation's Science Advisor is Reclamation's delegated official with the authority to implement prize competitions under 15 USC 3719.

Submissions required solvers to submit a theoretical paper explaining why their proposed solution could meet stated technical performance specifications. Submissions were evaluated by a judging panel composed of scientists, engineers, and other related technical experts.

Solutions that meet the technical requirements were also judged on the following items in order of priority:

- Practical feasibility
- Detection precision
- Manufacturing cost
- Required power source
- Extra weight/space
- Time to market

Partnerships: The NOAA-National Marine Fisheries Service, U.S. Geological Survey, U.S. Fish and Wildlife Service, and U.S. Army Corps of Engineers provided prize competition design and judging assistance.

Resources: The Bureau of Reclamation used the contracting services of InnoCentive to help design and administer this competition, and to distribute the challenge to the InnoCentive curated solver community.

The Bureau of Reclamation funded InnoCentive and Reclamation staff and a portion of the USGS assistance. All other agencies funded their own contributed collaboration.

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Operational costs for the agency included about \$36,000 in contract costs and \$25,000 in reclamation labor cost. Partner contributions totaled about \$39,000.

Results: The Bureau of Reclamation received 24 submissions and awarded monetary prizes to five submissions. The rules of the competition grant the Federal Government a right to use only the awarded submissions.

The two top-ranked solutions were submitted by Edem Tsikata, Ph.D. Tsikata has a Ph.D. in physics from Harvard University and is currently working as a researcher at Harvard Medical School and Massachusetts Eye and Ear Infirmary. His top ranked solution proposed using commercially available digital holographic imaging equipment with modifications that would enable successful identification and quantification of invertebrates in rivers and estuary environments. This was the only submission meeting all the solution technical requirements stated in the prize competition. A team of Federal researchers are now considering approaches to further develop, scale-up, and test this concept.

Tsikata's second place solution proposed using high resolution sonar. Although not readily apparent that this solution could meet all the stated technical requirements, it demonstrated sufficient merit for the Bureau of Reclamation to further explore how it can make this concept work. He received \$17,500 for submitting the two ideas.

Other solutions identified to have sufficient merit to be awarded prizes include:

- Matt Vaillancourt submitted a design for an examination chamber where water could be collected and processed with the capability to electronically identify and quantify the various drift invertebrates in the water. A \$5,000 prize has been awarded to secure a license that will allow the Federal government to further develop, test and use this concept. Vaillancourt has a degree in mechanical engineering from California Polytechnic State University with an emphasis in mechatronics and is now working on projects that integrate complimentary technologies such as microcomputers, motion control, and 3D modeling.
- Ted Ground submitted a design for a continuous sampling device that uses air bubbles to lift and concentrate invertebrates at the water surface where imaging and cataloging could occur with an array of cameras. Mr. Ground has also received a \$5,000 prize to secure a license that will allow the Federal Government to further develop, test, and use this concept. Ground has a Master of Science degree in Aquatic Biology from Texas State University and is currently an independent technical consultant working on a wide variety of aquaculture, water quality, and natural resources related projects.
- Michael May, Ph.D., proposed using an array of lensless cameras to search a volume of water backlit by a commercial flat-panel display. Lensless camera technology is low cost and has an infinite depth of focus. The Federal Government also secured a license to further develop, test, and use this concept by awarding May a \$2,500 prize. May earned his Ph.D. in physics from Johns Hopkins University and is currently the president of the technology and strategy consulting firm Dana Point Analytics.

A.8 Department of the Treasury

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A.8.1 2016 Community Development Financial Institutions Fund Prize Challenge

Summary: The Community Development Financial Institutions (CDFI) Fund solicited applications in the form of a prize challenge to discover innovative opportunities to disburse the \$1 million appropriation for FY 2016. Applicants were asked to submit a description of the problem(s) creating barriers to accessing capital in specified rural areas and a strategy to address the problem. Applicants were judged upon their innovative idea or strategy, the depth or need of the targeted areas, any partnerships that would leverage private, public, and philanthropic capital, and the scalability and/or replicability of the idea or strategy.

Solution Type: Ideas

Primary Goals: Solve a specific problem; find and highlight innovative ideas; build capacity

Results: Contestants submitted 64 entries. The CDFI Fund awarded the \$300,000 each to Virginia Community Capital and the National Federation of Community Development; \$200,000 to First Nations Oweesta; \$100,000 to Community Ventures; and \$25,000 each to Craft3, the Community Development Corporation of Brownville, Hope Credit Union, and the Appalachian Community Federal Credit Union.

Problem Statement: The FY 2016 Community Development Financial Institutions (CDFI) Fund Prize Challenge was a single challenge that sought to stimulate innovative proposals to increase access to CDFI capital in rural areas, as laid out in the Congressional appropriation of the CDFI, with a particular focus on areas characterized by persistent poverty. Applicants were asked to submit a description of the problem(s) creating barriers to accessing capital in specified rural areas and a strategy to address the problem. Applicants were judged upon their innovative idea or strategy, the depth or need of the targeted areas, any partnerships that would leverage private, public, and philanthropic capital, and the scalability and/or replicability of the idea or strategy. Bonus points were awarded to proposals that were targeted predominantly to areas characterized by persistent poverty.

Proposed Goals: The CDFI Fund's primary objective was to stimulate innovative strategies aimed at building capacity to expand CDFI investments and increasing access to capital in underserved rural areas, particularly those that are characterized by persistent poverty. In addition, the prize competition would allow the CDFI Fund to showcase and support prize winners so as to disseminate best practices, as well as encourage other CDFIs that serve rural areas to develop new skills or practices that may have beneficial effects on the rural areas they serve.

Measures of Success: The FY 2016 Prize Competition received 64 applications compared to 39 applications for a similar FY 2015 Innovation Challenge—a 64% increase. In addition, the CDFI Fund noticed an increase in the volume of on-line posting and re-postings throughout the CDFI industry about the launch of the Prize Challenge.

The CDFI Fund also was very encouraged not only by the large number of applications but also by the diverse range of proposals, which spanned technological innovations, impact investing, data collection, job training, environmental remediation, housing, and many others. This diversity

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demonstrated that the industry is actively thinking and working on a number of creative and innovative solutions to the problems facing rural communities, and that the CDFI Fund can play a critical role in enabling these solutions.

The CDFI Fund will continue to measure the success of the winners and honorable mentions through detailed progress reports. The four winners will submit two progress reports detailing progress in implementing the application proposal and/or any outcomes, due one year and two years after distribution of their prize award. Honorable mention winners are required to submit a progress report only one year after distribution of their prize award. Each progress report will be about ten pages in length and will include an overview of the solution described in the proposal, the efforts of the winner to implement the proposal, and any outcomes derived from the implementation of the proposal. The progress reports will specifically address any challenges, successes (supported by data, where possible), and/or failures encountered during implementation, any revisions made to the original proposal, as well as lessons learned. The CDFI Fund also expects to promote the winning solutions to the public through a series of blog-posts, webinars, and other events which can help build the overall capacity of the CDFI Fund, individual CDFIs, and the industry at large.

Finally, using a prize challenge over traditional contracting vehicles allowed the CDFI Fund to reduce the administrative burden, both pre and post-award. CDFI Fund staff reduced time in pre-award development by not having to go through the sometimes arduous process of contract development.

Participants: The challenge mobilized 64 participants from across the United States. The CDFI Fund hoped to mobilize certified CDFIs, regulated and non-regulated financial institutions, academia, and any other organization or person that has a vested interest in building capacity to expand CDFI investments and increase access to capital in underserved rural areas, particularly those that are characterized by persistent poverty.

To be eligible to win a prize under the Challenge, an individual or entity must have complied with the following rules:

- In the case of a private entity, the applicant must be incorporated in and maintain a primary place of business in the United States, and in the case of an individual, whether participating singly or in a group, the applicant must be a citizen or permanent resident of the United States.
- The applicant may not be a Federal entity or Federal employee acting within the scope of their employment.
- Federal grantees may not use Federal funds to develop Challenge applications unless consistent with the purpose of their grant award.
- Federal contractors may not use Federal funds from a contract to develop Challenge applications or to fund efforts in support of a Challenge submission.
- All applications must propose or present ideas or solutions that have been implemented or are proposed to be implemented in rural areas; bonus points shall be given to ideas or solutions that have been implemented or are proposed to be implemented in rural persistent poverty areas.

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- All applications must propose or present an idea or solution that directly addresses the issue of increasing CDFI investments and access to capital in underserved rural areas and/or rural persistent poverty areas.
- Applicants must be certified CDFIs, a collaboration of CDFIs, or a non-CDFI partnering with certified CDFIs. Joint applicants as part of any collaboration or partnership should select a primary applicant to submit the application.

An individual or entity shall not be deemed ineligible because the individual or entity used Federal facilities or consulted with Federal employees during a competition, if the facilities and employees are made available to all individuals and entities participating in the Challenge on an equitable basis.

Entrants must agree to assume any and all risks and waive claims against the Federal Government, its related entities, except in the case of willful misconduct, for any injury, death, damage, or loss of property, revenue, or profits, whether direct, indirect, or consequential, arising from participation in the Challenge, whether the injury, death, damage, or loss arises through negligence or otherwise.

Entrants must also agree to indemnify the Federal Government against third-party claims for damages arising from or related to Challenge activities.

Timeline: Submissions were opened June 16, 2016 and were due July 29, 2016. Winners were announced September 23, 2016.

Solicitation and Outreach: N/A

Incentives: The total prize purse was \$1,000,000. Two top winners received \$300,000, with second and third place winners receiving \$200,000 and \$100,000 respectively, and four runners up were awarded \$25,000. The CDFI Fund noted that all winners and honorable mentions would be promoted on the CDFI Fund's website and could be asked to participate in public webinars, blog-posts, or other external activities.

All winners were notified of their selection and the funds were obligated in September 2016. Winners were asked to sign an award letter and set up an account in SAM.gov. Once the award letter was received and their organization was approved in SAM.gov, a one-time ACH payment was executed.

Evaluation and Judging: The review process was divided into two phases. In the first phase, reviewers drawn from CDFI Fund and Treasury staff were divided into teams of three and assigned a set of applications to score. Teams scored each application based on a set of criteria that included such factors as Depth of Need, Design, Scalability or Replicability, Outcomes, Innovativeness, and Community Involvement, the sum of which added up to a total numerical score of 100. The three team member scores were then averaged to provide a team score for each application. Applicants that targeted rural areas that were predominantly in counties designated as experiencing persistent poverty were given an additional ten bonus points as part of their final score resulting in a maximum possible score of 110.

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The top ten scoring applications were then forwarded to a panel of five judges who met in person to discuss and rank the applications. The judges consisted of representatives from the CDFI Fund; the Office of Small Business, Community Development, and Housing Policy at the Department of the Treasury; the Department of Interior; the Department of Agriculture; and Cobank, a national cooperative bank serving rural America. For this phase of the review, judges were asked to evaluate applications as a whole rather than the sum of the parts, while keeping in mind each proposal's potential to meet the requirements to build capacity to expand CDFI investments and increase access to capital in underserved rural areas; innovativeness; potential impact on targeted areas; replicability; as well as other considerations based on the judge's experience and expertise that might strengthen or weaken the application. Applications were not given an individual score but rather ranked in order of preference and presented to the Director of the CDFI Fund along with recommendations for those to be recognized as winners or honorable mentions. The Director then made final decisions on monetary awards.

As this was the first time conducting a Prize Challenge, CDFI staff were not sure of the number of responses to expect. Creating a two-step review process allowed the prize leadership to bring in an appropriate number of staff to do an initial review and create a ranking in a short amount of time, and then forward the top applications to the second level reviewers for a more nuanced and holistic review. The more qualitative focus of the second phase review also allowed for selection of the most innovative proposals in a way that would have been missed by a strictly quantitative review. Overall, CDFI staff viewed this process to be very effective.

Partnerships: The CDFI Fund did not partake in any formal or non-formal partnerships to co-host the competition itself.

Resources: The CDFI Fund used two internal staff to manage the development and then implementation of the Prize Challenge. A third person, from the U.S. Treasury Department, was assigned to provide additional help throughout the Prize Challenge. Those three staff relied heavily on other staff from the CDFI Fund, Treasury Department, and Challenge.gov team to get the Prize Challenge up and running. For example, the CDFI Fund used its legal team to help develop the rules and participation criteria, other CDFI Fund and U.S. Treasury staff to review all applications during its Phase I review process, and the Challenge.gov team to set up the website. The operational cost paid by the agency was \$50,000.

The CDFI Fund did not use any third party contractor, vendor, or partner to conduct the prize competition.

Results: The FY 2016 CDFI Fund Prize Challenge received 64 applications, of which 55 were deemed eligible, and awarded four winners and four honorable mentions. Overall, the eligible applicants came from 27 states and Washington, DC. Fifty-one of the 55 eligible applications were certified CDFIs or had previous contact with the CDFI Fund. Below is a listing of all eligible applications and their location:

State	Number of Applications	State	Number of Applications
California	5	New Mexico	1

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Colorado	4	New York	1
Washington, DC	2	Ohio	1
Georgia	1	Oklahoma	1
Iowa	1	Pennsylvania	1
Kentucky	4	South Carolina	1
Massachusetts	1	South Dakota	2
Maine	2	Tennessee	1
Minnesota	3	Texas	5
Mississippi	2	Virginia	1
North Carolina	3	Vermont	1
North Dakota	1	Washington	2
Nebraska	2	Wisconsin	1
New Hampshire	3	West Virginia	1

Below is a summary of each winning proposal:

1. Virginia Community Capital (VCC)

To address a lack of banking or financial knowledge and expertise among foundations that are interested in impact investing, VCC has created a social enterprise called Direct Investing for Good (DIG), a service providing fund aggregation, underwriting, investment servicing, and monitoring/tracking services to foundations so they can invest directly in CDFIs or co-invest with local CDFIs for community development projects. According to the proposal, through DIG, “VCC will provide outsourced financial expertise that adds capacity for foundations and helps them to:

1. Aggregate impact funds;
2. Source and structure community and economic development projects;
3. Evaluate the financing;
4. Conduct due diligence;
5. Service the investment including tracking performance, both financial and social impact.

“As a result, foundations will have the financial expertise to: (1) Invest in CDFIs directly; (2) Invest alongside a CDFI in a specific project; (3) Fully or partially guarantee a CDFI loan; or (4) Provide early stage investments in preparation for later capital from CDFIs.”

VCC intends to pilot the proposal to serve nine foundations that are members of the Appalachian Funders Network (AFN) and eventually scale the program to include all 80 members of the AFN to increase access to new capital for CDFIs and rural communities throughout Appalachia.

2. National Federation of Community Development Credit Unions

To enable CDFI credit unions to extend their reach and provide access to secure, affordable financial services and products in underserved rural communities, the Federation is building CU Impact, what they describe as “the first and only core system created specifically for CDFIs.” According to the application, “CU Impact will enable the credit unions [to] interact with customers through smartphones and support the credit unions to roll out features including remote deposit check capture and affordable and immediate wire transfer services for remittances.”

Initial priorities for the initiative include developing and implementing automated lending platforms, mobile banking apps, and automating incentivized savings plans. Credit unions enrolled on CU Impact will be able to share common marketing materials and content, as well as standardized products and services designed for low-income communities.

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The initiative will be piloted with Red River Mill FCU and Shreveport FCU, two CDFIs serving persistent poverty counties in Louisiana and Mississippi, and they anticipate expanding to 30 CDFI credit unions within five years.

3. Community Ventures

Community Ventures proposes to create “an innovative new capitalization approach to [attack] the loss of coal-related jobs [in Central Appalachia] through its soon-to-be-launched Build Appalachia loan fund.” The strategy is to capitalize a community facilities loan pool and product with an initial focus on health care, “given that much of the region is medically underserved and there is strong demand for qualified professionals.” According to the application, “Build Appalachia’s borrower focus will be on change agents such as colleges and universities that will create or expand academic programs to prepare Appalachian residents who have lost jobs in the coal industry for new careers in high-paying, economically stable sectors.”

The proposed loan fund also would address what the application describes as “a dearth of lending capital in the \$2 to \$5 million range to support non-business essential community facilities” in the region. Community Ventures is submitting an application for \$10 million to USDA through the newly expanded Intermediary Community Facilities Loan Fund and has set a goal of growing the loan fund to \$40 million in capital availability. They also claim the new fund “will promote increased New Markets Tax Credit investment, multi-CDFI partnerships, and increased private sector lending throughout Central Appalachia.”

4. First Nations Oweesta

Oweesta’s application argues that “One major cause of Native CDFI capital access issues is low organizational capacity to measure outcome and impact.” To address the lack of experience and staff resources among many Native CDFIs to collect and analyze data, Oweesta has begun developing Opportunities Through Impact System (OTIS), an impact tracking platform, designed specifically for Native CDFIs.

According to the application, “The goal of the OTIS platform is to provide the technological resources—combined with the technical assistance of Oweesta—to help Native CDFIs show their longitudinal impact on their communities.... This platform will also contribute to their financial strength and enhance organizational capacity to secure capital and debt capital investments by (1) lowering the cost of developing impact tracking systems for Native CDFIs through streamlining the process, and creating a scalable platform to allow for better program design and monitoring; (2) providing better access to impact data for individual funding proposals; (3) demonstrating industry viability to a broader range of investors through better access to industry-wide data; and (4) standardizing impact and evaluation metrics across the industry, allowing for increased collaboration in fundraising efforts.”

The initiative will be piloted with five identified Native CDFIs “serving American Indian, Alaska Native, and Native Hawaiian communities.” Oweesta notes that it has a growing waiting list to join the platform and have a goal of adding 10 Native CDFIs a year until they “are serving the entire industry.”

5. Craft3

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With widespread need to finance the replacement of failing septic systems in rural areas, Craft3 is undertaking a regional approach to offering their existing Clean Water Loan product. Although Craft3 has been working with local officials to offer the product on a county by county basis since 2003, the new strategy, more recently implemented in 2015, calls for a regional approach to maximize their reach to rural homeowners in poverty in Washington State.

Craft3 describes several benefits to this new strategy. By standardizing the loan program and offering it at a regional level, they are able to enable scale; streamline county-level reporting and create a single-administering entity to oversee the CDFI's use of government appropriated grant funding, reducing administrative burden; and allow on-site sewage systems professionals that work in multiple counties to discuss the same financing option with potential borrowers regardless of physical location. According to the application, "The new program [serves] five new counties (for a total of twelve) and consolidate[d] multiple, disparate county-level partnerships into a regional, standardized program that better served rural and poor homeowners. Further, it [allowed the state Department of] Ecology to work with one group of counties, rather than develop programs, grant agreements, and contracts for 14 separate counties."

6. Community Development Corporation of Brownsville (CDCB)

Working with Rio Grande Valley Multibank, CDCB has created the MiCASiTA loan pool and product to address the lack of access to both safe and affordable housing and financing in rural and colonia areas of South Texas. The strategy is "to implement a phased or staged construction solution that meets the immediate housing needs of residents and can 'grow' or expand as the family's financial situation improves and/or as their housing size needs increase." Financing for the home will be similarly structured, "with an initial loan and/or grants for the core structure and then subsequent loans/grants (two to three) to complete the home over time."

7. Hope Credit Union

To address the lack of access to capital in rural areas, Hope Credit Union has developed a strategy of taking over donated bank branches in persistent poverty counties and offering products and services appropriate to the community. With the high cost of operations in rural areas, some profit-seeking financial institutions are making decisions to leave a community, adding to the existing problem of bank deserts. Taking advantage of the abandoned infrastructure, in 2015 Hope was able to receive a donation of branch facilities in four small Mississippi Delta towns. According to the application, "HOPE has combined [its] expanded physical infrastructure, robust products and services, user friendly mobile technology, and a clear commitment to community development to attract previously unbanked and underbanked rural residents into the financial mainstream."

8. Appalachian Community Federal Credit Union (ACFCU)

To protect underserved communities in eastern Kentucky from predatory lenders and provide access to affordable financial products and services, ACFCU has developed a strategy to "provide services designed to meet the unique needs of underserved rural communities, and use technology to remotely deploy those services." The approach includes offering what they describe as "stair step" services and products that can build credit, consolidate debt, and provide affordable alternatives to predatory loan products. ACFCU has branded this approach as "myMoneyTrackSolutions," which also incorporates financial wellness services and workshops as well as financial coaching.

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In combination with the suite of products and services, to create greater access to accounts and banking services, ACFCU will be installing three Virtual Teller Machines (VTMs) in strategic locations in rural eastern Kentucky. “VTMs are ATM-like machines with a video screen and microphone that allow the customer to video chat with a credit union employee in a remote location. They have electronic signature capability, which facilitates loan applications and closings. They also function as a depository ATM, accepting deposits of checks and cash, and dispensing cash down to the dollar.” ACFCU claims to be “the only financial institution in the country,” to their knowledge, using VTMs to “sustainably reach underserved rural communities.”

Applicant	Winner/Honorable Mention	Award Amount
Virginia Community Capital	Winner	\$ 300,000.00
National Federation of Community Development Credit Unions	Winner	\$ 300,000.00
First Nations Oweesta	Winner	\$ 200,000.00
Community Ventures	Winner	\$ 100,000.00
Craft3	Honorable Mention	\$ 25,000.00
Community Development Corporation of Brownsville	Honorable Mention	\$ 25,000.00
Hope Credit Union	Honorable Mention	\$ 25,000.00
Appalachian Community Federal Credit Union	Honorable Mention	\$ 25,000.00
	TOTAL	\$1,000,000.00

A.9 General Services Administration

A.9.1 Digital Innovation Hackathon Fall 2015¹¹⁰

Summary: Coders, developers, designers, engineers, data scientists, and subject matter experts from industry, academia, and the Federal Government were invited to participate in a Digital Innovation Hackathon on October 16, 2015. GSA provided three challenges for participants. A total of 72 individuals took part in the hackathon.

Solution Type: Software and apps

Primary Goals: Solve a specific problem; engage new people and communities; and find and highlight innovative ideas

Results: A total of 138 individuals were registered and 72 actually took part in the hackathon.

Problem Statement: This competition asked the public and academia to develop smart technology solutions in the form of an application, application programming interface (API), and/or data mashup that has the capability to provide GSA with key insights and recommendations for future enhancements.

¹¹⁰ open.gsa.gov/events/digital-innovation-hackathon

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Participants were presented with the following projects for this competition:

- **Green House Gas (GHG) Reduction Visualization:** The Office of Government-wide Policy (OGP) has been working to create an analytical framework and tool to support agencies in meeting the goals outlined in a recent Executive Order 13693 “Planning for Federal Sustainability in the Next Decade”, regarding greenhouse gas emission reductions. The model currently uses several variables to help agencies examine how increasing their use of E-85 capable vehicles and replacing gas-powered vehicles with E-85 capable vehicles would affect their total greenhouse gas emissions. Skills desired include database coding ability (e.g., SQL language), analytical research, and experience using data visualization software.
- **Data Center Consolidation Mashup and Tool:** Multiple stakeholders including the White House, Congress, and government agencies share a common interest in better utilizing government data centers. This has led to multiple report generation from multiple sources to better understand power consumption and data center utilization and efficiency. The purpose of this challenge is to mashup different datasets into visualization and application for all stakeholders to utilize. Skills desired include web and application developers, user experience (UX) designers, data scientists, and data center SMEs.
- **Travel Challenge 2.0 App Development:** As a continuation of a Travel Challenge held in 2014, GSA is looking for developers to take the Travel Application to the next level. Developed in Python code, this tool is close to production quality and needs some finishing code and design ideas. Skills desired include Python developers and UX designers.

Participants were provided with specific guidelines in order for their solutions to be eligible for submission and judging as follows:

Any solutions submitted should accomplish the following two tasks:

1. Visually display or transmit data in a way that will enhance the way GSA works;
2. Through analysis of the data, identify relationships, if they exist, and provide valuable insights that could be gained through improved data collection efforts.

All final solutions are to be Open Source Code and placed on GSA’s GitHub site specified to all participants. The Hackathon was a single challenge and the solution being sought was Software and Apps.

Proposed Goals: The primary goals and desired outcomes from the Hackathon were to have participants:

1. Design and build an application, API, or data mashup using GSA data mashup that has the capability to provide GSA with key insights and recommendations for future enhancements;
2. Develop a technology-driven solution using publicly available GSA data that allows an agency to identify opportunities for improvements and transparency;
3. Create a solution using GSA data that could be replicated across government to every agency, using their own data.

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Measures of Success: The competition had many objectives including engagement with the public; gain the public's insight regarding our data; identify areas where we can improve how we use our data; and establish public engagement.

Participants: Working with the GSA General Counsel and reviewing other challenges posted on Challenge.gov, the organizers created the following eligibility requirements for participants.

Participants must:

1. Have registered to participate in the competition and complied with the rules of the competition;
2. Been incorporated in and maintain a primary place of business in the United States, and in the case of an individual, whether participating singly or in a group, the participant must be a citizen or permanent resident of the United States.

Participants may not be a Federal entity or Federal employee acting within the scope of employment. However, an individual or entity shall not be deemed ineligible to win prize money because the individual or entity used Federal facilities or consulted with Federal employees during a competition if the facilities and employees are made available to all individuals and entities participating in the competition on an equitable basis.

Pre-determined teams of up to five members are welcome to include a stand-alone or mix of private industry, non-profit, and academia. Modification to team make-up may occur based on team skill make-up at the direction of the competition host.

Participants agree to assume any and all risks and waive claims against the Federal Government and its related entities, except in the case of willful misconduct, for any injury, death, damage, or loss of property, revenue, or profits, whether direct, indirect, or consequential, arising from participation in this competition, whether the injury, death, damage, or loss arose through negligence or otherwise. Participants also agree to obtain liability insurance or demonstrate financial responsibility, to cover a third party for death, bodily injury, property damage, or loss resulting from an activity carried out in connection with participation in this competition, with the Federal Government named as an additional insured under the registered participant's insurance policy and registered participants agreeing to indemnify the Federal Government against third party claims for damages arising from or related to the competition activities, and the Federal Government for damage or loss to Government property resulting from such an activity.

As GSA is under a strict duty not to give preferential treatment to any private organization or individual, participants must agree to take diligent care to avoid the appearance of Government endorsement of competition participation and submission. Participants must agree not to refer to GSA's use of your submission (be it product or service) in any commercial advertising or similar promotions in a manner that could reasonably imply (in the judgment of a reasonable person) that the GSA or the Federal Government endorses, prefers, sponsors, or has an affiliation with participants' products or services. Participants agree that GSA's trademarks, logos, service marks, trade names, or the fact that GSA awarded a prize to a participant, shall not be used by the participant to imply direct GSA endorsement of participant or participant's submission. Both

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participants and GSA may list the other party's name in a publicly available customer or other list, so long as the name is not displayed in a more prominent fashion than any other third-party name.

Participants who attended:

The competition had a total of 138 registered participants, from organizations that included: Alpha Tech Global, Booz Allen Hamilton, CGI Federal, Department of Agriculture, Department of Labor, Forum One, GSA, George Washington University, ITG Firm, National Institutes of Health, New York University, Noblis, Octo Consulting, Office of Management and Budget, United States Patent and Trademark Office, and the Ventra Corporation. Teams were pre-determined and self-organized into 16 teams.

Participants brought unique and varied skill sets to the competition (this list was voluntarily supplied by registrants): subject matter expertise, database coding (SQL language), analytical research, experience with data visualization software, application development, user experience (UX) design, data science, data architecture, and Python programming.

Timeline: The Hackathon was held on October 16, 2015. Participants had from 8:30 AM–4:30 PM to work on their projects and winners were selected at the end of the day.

Solicitation and Outreach: The competition used the following methods to share information for the Hackathon event:

- Social Media (such as Twitter posts and Facebook posts);
- Email Outreach (such as listservs);
- *Federal Register* notice.

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Incentives: The Hackathon offered a total of \$15,000, stating no more than \$1,000 to each team member of a winning team would be awarded. A total of 14 winners from 3 teams were selected for a total prize amount of \$14,000. Funding for this competition came from GSA. A single appropriation account (2016-G-00-262X-CSD1-S00W0800-CSO40-I) was used to pay the winners of this competition. Winners were required to complete an Electronic Funds Transfer (EFT) form, and payment was to be made within 60 days of announcing the winners.

Non-monetary incentives were not used for this competition to motivate participants or reward winners.

Evaluation and Judging: Judges were GSA Senior Career Officials with Government-Wide Policy, Travel, and Information Technology and/or Acquisition. Judges awarded a score to each submission against a total of 4 criteria: (1) Technical Competence and Capabilities 50%; (2) Use of Data to Provide Effective Outcomes 20%; (3) Creativity/Innovation 10%; (4) Valuable Information and Insights regarding Data 20%. Each of the criteria above contained a point value ranging from 1 to 5, with 1 being the lowest and 5 the highest. Judges selected a point value for each criterion and the scores were added up after all solutions were presented. The winner(s) of the competition were decided based upon the highest average overall score, and if their solution met the requirements stated for each project presented.

The project requirements along with the criterion were used to assign a point value to each solution presented.

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Partnerships: No partnerships were utilized.

Resources: The total personnel and other costs for the Hackathon were \$14,632 (including two Federal employees and the *Federal Register* notice publication).

Results: A total of 14 winners from three teams were selected for a total prize amount of \$14,000.

Government-wide Earth Day Hackathon¹¹¹

Summary: Coders, developers, designers, engineers, data scientists, and subject matter experts from industry, academia, and the Federal Government were invited to participate in a Government-wide Earth Day Hackathon on April 22, 2016. GSA, along with CEQ, EPA, NIST, NOAA, and USDA, provided specific challenges for participants. A total of 63 individuals took part in the hackathon.

Solution Type: Software and apps

Primary Goals: Solve a specific problem; engage new people and communities; and find and highlight innovative ideas

Results: A total of 105 individuals were registered and 63 actually took part in the hackathon.

Problem Statement: GSA's Office of Citizen Service and Innovative Technologies (OCSIT) and 18F Organization—partnered with the White House Council on Environmental Quality (CEQ), the United States Environmental Protection Agency (EPA), the General Services Administration (GSA), the National Institute of Standards and Technology (NIST), the National Oceanic and Atmospheric Administration (NOAA), and the United States Department of Agriculture (USDA—presented a Government-wide Earth Day Hackathon, on Friday, April 22, 2016.

GSA, along with the agencies listed above, presented the following green and sustainable projects for participants to work on:

- CEQ Challenges:
 - Create a visual dashboard on sustainable purchasing, by agency, using data captured in the government-wide procurement system.
 - Create a website and/or app that allows Federal agencies and/or the public user, if appropriate, to assess whether or not their property is located in an area of wildfire risk.
- EPA's Challenges:
 - Develop a method to identify fraudulent reporting to the EPA using Benford's law of statistical probability.
 - Develop a mobile app that improves environmental awareness through the use of geofences.

¹¹¹ open.gsa.gov/EarthDayHackathon

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- Develop code that can be deployed on Android and iOS mobile apps that displays UV Index Forecast information specific to a defined beach.
- Develop improved data visualizations or a consolidated dashboard associated with the climate change indicator data.
- GSA's Challenges:
 - Create a browser extension or add-on (for IE or Chrome) that allows users to determine whether the product they are viewing meets Federal and agency sustainability requirements.
 - Develop a streamlined management tool to help teams collaborate and incorporate sustainability into any building project.
 - Build an app that allows a user to take a photo of products, building materials, and systems and receive green tips and sustainable purchasing information.
 - Create a phone application (Android or iOS) that allows a user to scan a barcode, or look up a product, and then notifies the user if the product meets the latest sustainability requirements.
- NIST Challenge:
 - Create an environmentally-friendly product selection Web Interface API.
- NOAA Challenges:
 - Create an API, browser extension or add-on (for IE or Chrome) that allows users to compute their custom normals from NOAA's records of surface temperature and precipitation.
 - Create an API or tool that allows users to easily find Next-Generation Radar (NEXRAD) data on Amazon AWS 33.
 - Create an app, browser extension or add-on (for IE or Chrome) that allows users to visualize and/or compute on NOAA's current Multi-Radar Multi-Sensor (MRMS).
- USDA Challenge:
 - Develop methods to present and compare performance on energy and water use in USFS facilities.
 - Develop a prototype of a tool available on the web or as a phone app, that allows users to quickly and easily access shade scores for any neighborhood in the United States for the USFS.

Participants were provided with specific guidelines in order for their solutions to be eligible for submission and judging as follows:

Any solutions submitted should accomplish the following two tasks:

1. Visually display or transmit data in a way that will enhance the way GSA works;
2. Provide solutions for improved data collection efforts.

All final solutions are to be Open Source Code and placed on GSA's GitHub site specified to all participants. The Hackathon was a single challenge and the solution being sought was Software and Apps.

Proposed Goals: The primary goals and desired outcomes from the Hackathon were to have participants:

1. Utilize GSA data to create an application, API, and/or data mashup.

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2. Provide GSA a better understand of use and needs of current and future data assets.
3. Post all open source solutions on the GSA GitHub site for future use by the Federal Government developer community and GSA.

Measures of Success: The competition had many objectives including engagement with the public; gaining the public's insight regarding our data; identify areas where we can improve how we use our data; and establish public engagement.

Participants: Working with the GSA General Counsel and reviewing other challenges posted on Challenge.gov, the organizers created the following eligibility requirements for participants.

Participants must:

1. Have registered to participate in the competition and complied with the rules of the competition.
2. Been incorporated in and maintain a primary place of business in the United States, and in the case of an individual, whether participating singly or in a group, the participant must be a citizen or permanent resident of the United States.

Participants may not be a Federal entity or Federal employee acting within the scope of employment. However, an individual or entity shall not be deemed ineligible because the individual or entity used Federal facilities or consulted with Federal employees during a competition if the facilities and employees are made available to all individuals and entities participating in the competition on an equitable basis.

Participants agree to assume any and all risks and waive claims against the Federal Government and its related entities, except in the case of willful misconduct, for any injury, death, damage, or loss of property, revenue, or profits, whether direct, indirect, or consequential, arising from participation in this competition, whether the injury, death, damage, or loss arose through negligence or otherwise. Entrants are not required to obtain liability insurance or demonstrate financial responsibility in order to participate in this Hackathon.

As the Federal Government is under a strict duty not to give preferential treatment to any private organization or individual, participants must agree to take diligent care to avoid the appearance of Government endorsement of competition participation and submission.

Participants must agree not to refer to GSA's use of their submission (be it product or service) in any commercial advertising or similar promotions in a manner that could reasonably imply (in the judgment of a reasonable person) that the GSA or the Federal Government endorses, prefers, sponsors, or has an affiliation with participants' products or services. Participants agree that GSA's trademarks, logos, service marks, trade names, or the fact that GSA awarded a prize to a participant, shall not be used by the participant to imply direct GSA endorsement of participant or participant's submission.

Both participants and GSA may list the other party's name in a publicly available customer or other list, so long as the name is not displayed in a more prominent fashion than any other third-party name.

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Participants who attended:

The competition had a total of 63 registered participants, from organizations that included: Booz Allen Hamilton, CGI Group Inc., District of Columbia Government, EPA, Forum One, GSA, George Washington University, ICF International, Incentive Technology Group, Mainstay Consulting, National Institutes of Health, REI Systems, and the United States Army. Teams were pre-determined and self-organized into ten teams.

Participants brought unique and varied skill sets to the competition (this list was voluntarily supplied by registrants): database coding (SQL language), analytical research, experience with data visualization software, application development, user experience (UX) design, data science, data architecture, and Python programming.

Timeline: The Hackathon was held on April 22, 2016. Participants had from 8:30 AM–4:30 PM to work on their projects and winners were selected at the end of the day.

Solicitation and Outreach: The competition used the following methods to share information for the Hackathon event:

- Social Media (such as Twitter posts and Facebook posts);
- Email Outreach (such as listservs);
- *Federal Register* notice.

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Incentives: The Hackathon offered a total of \$15,000, stating that no more than \$1,000 to each team member of a winning team would be awarded. A total of 15 winners from four teams were selected for a total prize amount of \$15,000 (\$3,750 was awarded to each of the four winning teams, to be split equally among the number of members within each team). Funding for this competition came from GSA/OCSIT/18F. A single appropriation account from OCSIT (105X.S00I0110.CA51.25.CAH40.J55/OC 25/No Year/IX020230) was used to pay the winners of this competition. Winners were required to complete an Electronic Funds Transfer (EFT) form, and payment was to be made within 60 days of announcing the winners. Non-monetary incentives were not used for this competition to motivate participants or reward winners.

Evaluation and Judging: Judges were GSA Senior Career Officials with expertise in Government-wide Policy, Travel, Information Technology, and/or Acquisition. Judges awarded a score to each submission. The winner(s) of the competition were decided based upon the highest average overall score, and if their solution met the requirements stated for each project presented.

Partnerships: OCSIT/18F partnered with the following agencies for this event to obtain “green” projects for our participants to work on: White House Council on Environmental Quality (CEQ), the United States Environmental Protection Agency (EPA), the General Services Administration (GSA), the National Institute of Standards and Technology (NIST), the National Oceanic and Atmospheric Administration (NOAA), and the United States Department of Agriculture (USDA).

Resources: GSA worked with the partner agencies to obtain “green” projects for the event. All planning and logistics, room reservations, and meetings were handled by the Digital Services Division.

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The total personnel and other costs for the Hackathon were \$14,632 (including two Federal employees and the *Federal Register* notice publication).

Results: A total of 15 winners from four teams were selected for a total prize amount of \$15,000 (\$3,750 to each team).

A.10 National Science Foundation

A.10.1 Community College Innovation Challenge¹¹²

Summary: The Community College Innovation Challenge (CCIC) is designed to encourage and provide space for community college students to participate in innovation. This year the challenge focused on creating solutions in the food-energy-water nexus. Ten teams participated in the “innovation boot camp”, and three teams were awarded prize money.

Solution Type: Software and apps; ideas; technology demonstration and hardware; and scientific

Primary Goals: Find and highlight innovative ideas; advance scientific research; and develop technology

Results: Twenty teams applied, with one winner and two second place finishers selected from ten finalists at Innovation Boot Camp. Solutions proposed ranged from improvements to solar greenhouses to creating biofuels from waste apples. Collaboration between teams is continuing in order to pursue their solutions.

Problem Statement: In Fiscal Year (FY) 2016, NSF sought science, technology, engineering and mathematics (STEM)-based solutions for issues of local to global concern within the food-energy-water nexus through CCIC. NSF, in partnership with AACC, invited teams of 3–5 community college students, alongside a faculty mentor and community/industry partner, to identify key problems and propose innovative solutions within the food-energy-water trilemma. The 2015/2016 challenge theme complements the FY 2016 NSF-wide INFEWS (innovations at the nexus of food, energy, and water systems) investment.

For the CCIC competition, teams of community college students are charged with proposing STEM-based solutions to real-world problems within one of three themes: Maker to Manufacturer; Energy and Environment; and Security Technologies. A complete entry consisted of two components: a written entry and a video entry. The short written entry described the problem entrants were to address, the solution they’ve crafted, and its impacts and benefits. The 90-second video served as a creative outlet to clearly articulate in an original way the problem, what could happen if the problem is not resolved, and the team’s proposed solution. A successful entry excelled in innovation and impact, feasibility and clarity of communication. In order to be eligible to enter CCIC, students had to be at least 18 years old, be enrolled in a two-year, degree-granting institution in the U.S., and be in academic good

¹¹² www.nsf.gov/CCchallenge

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standing.

Teams must have included a faculty mentor and a community/industry partner. This is the second annual CCIC. NSF plans to continue CCIC as an annual competition in the future, with each year varying in theme but intending to capture innovation genius at the community college level.

Proposed Goals: CCIC's primary objective is to create space for community college students, an often underrepresented population, at the innovation table and in the innovation economy. The United States leads the world in scientific discovery and innovation. NSF and AACC are calling on community college students—the nation's future scientists and engineers—to support U.S. scientific progress through CCIC. CCIC provides students with an opportunity to begin using science to make a difference in the world by transferring knowledge into action through the latest entrepreneurial and communication techniques.

Measures of Success: CCIC advances NSF's mission by specifically aligning with NSF's strategic plan for FYs 2011-2016:

- Innovate for society (goal 2): Build the capacity of the nation's citizenry for addressing societal challenges through science and engineering.
 - "A growing body of research in learning and STEM education serves as the basis for guiding NSF programs and creating the links among schools, community colleges, colleges and universities, workplaces, and informal education mechanisms that are critical to workforce preparation and STEM literacy."
- Transform the frontiers (goal 2): Prepare and engage a diverse STEM workforce motivated to participate at the frontiers.
 - "NSF's primary approach to address in this performance goal is the integration of research and education. Thus, the development of talented young people includes connection to the frontiers of knowledge and direct experience in the conduct of research in the United States and in other countries."

In addition, the competition achieves NSF's strategic goal for open innovation.

NSF routinely receives thank you notes from finalist teams continuing careers in STEM or furthering their education. One top-placing team received financial backing to further their novel idea in the innovation economy and received significant congressional attention at the CCIC winners' reception on Capitol Hill. Six congressional members attended and delivered remarks at the reception, including vice presidential candidate and Senator Tim Kaine (D-VA).

One of the finalist teams from the FY 2015 CCIC competition applied for, and was admitted to, an NSF Innovation Corps (I-Corps) cohort. This STEM-based entrepreneurial program provides an excellent opportunity to strengthen their project and successfully propel it into the marketplace. This same team has received funding from a venture capitalist to implement their project. And an FY 2016 CCIC winning team has spoken on several panels at community college conferences about the experience and their innovation. They are working on commercializing their solar nanotechnology greenhouse product and are considering

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incorporating their company.

As an unanticipated off-shoot, the second place team has actually been in close contact with the first place team and are planning on using the greenhouse on the second place team's campus as a lab for their technology—a highlight of the collaboration coming from this event.

Participants: For the CCIC competition, the agency sought to mobilize community college students who were 18 years old and older, enrolled in a two-year, degree-granting institution in the United States, and in academic good standing. Teams were comprised of 3-5 community college students, one faculty mentor, and one community/industry partner to provide real-world, entrepreneurial/societal advice. Students who advanced to finalist status and participated in a past Innovation Boot Camp were not eligible to re-enter. NSF and AACC especially hoped to garner participation from nontraditional students, veterans, and other underrepresented populations.

Timeline: The Community College Innovation Challenge opened for submissions in October 2015, with the preliminary judging at the end of February 2016. Innovation Boot Camp ran from June 20-23, with winners selected at the end.

Solicitation and Outreach:

- Social Media (such as Twitter posts and Facebook posts);
- Email Outreach (such as listservs);
- Press Release;
- Day-Long Event(s) Prior to the Competition;
- Partnership with Outside Organizations (potentially including private companies, non-profit organizations, or other Federal agencies); and
- Other (please specify): Sessions/announcements at appropriate conferences, promo toolkit on the website, mailing materials (postcards, posters) to appropriate contacts.

Incentives:

Max Prize Total: (depending on size of teams, and not including travel, room, and board for Innovation Boot Camp)—up to \$41,590

- First place team with up to 5 student members (\$1,500 each)
- Second place team with up to 5 student members (\$1,200 each)
- Finalist student team member award up to 50 students (\$500 each)
- Each team (10 in total) received \$200 each to develop their Capitol Hill reception display
- Each team (10 in total) received a plaque to take back to their home institution (\$109 each).

Funding sources: No private sector or philanthropic contributions. Funding came from the NSF Directorate for Education and Human Resources' Division of Undergraduate Education.

Additional operational incentive: Ten finalist teams attended an Innovation Boot Camp, a professional development workshop on innovation, communication, and entrepreneurship. The first and second place teams were chosen out of the ten teams at the final judging during the Innovation Boot Camp. Each student member on the finalist teams received \$500 but the first- and second-place teams received additional cash prizes (in the amounts stated above). Each team was

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reimbursed up to \$200 to create a display to showcase at the Capitol Hill reception as part of the final judging process. Travel, room, and board costs associated with attending the Innovation Boot Camp were paid on behalf of the students and faculty mentors.

Non-monetary incentive: Public recognition for 30 semifinalist and finalist teams on the competition website, via press releases and social media, and by invitations to community college conferences and forums, giving them access to experts, etc.

Evaluation and Judging: NSF recruited different populations for the three rounds of judging as follows:

- Preliminary (online): AAAS fellows across agencies
- Semifinal (online): Program officers with thematic expertise
- Final (in person): High-profile researchers and business people with expertise in the three themes: Maker to Manufacturer, Energy and Environment, and Security Technologies.

The preliminary and semifinal rounds followed a simple sliding scale to judge the innovation and impact, feasibility and clarity of communication. Online judging also includes a mandatory comments section.

Evaluation was based on the following criteria:

- Innovation and impact: An assessment of the proposed solution's use of science to address the problem, potential impact (potential to be transformative in the areas of national security, economy, quality of life, education, environment, etc.) and uniqueness (how the proposed solution differs from existing efforts in its use of novel concepts, methods and/or instrumentation);
- Feasibility: An assessment of the likelihood that the solution will work as presented, based on scientific laws and theories, and economic, political, and social constraints. Can the innovation be replicated? Evaluation of the team's recognition of potential barriers/challenges and suggestions for ways in which these might be surmounted; and
- Clarity of communication: An assessment of the team's adherence to the entry guidelines (written and video entries), as well as grammar, structure, organization of the facts and data, etc. The entry should have a clear, consistent message.

Final judging is based on the following criteria.

Does the display:

- Identify a societal need;
- Demonstrate how the innovation satisfies this need;
- Communicate the innovation's novelty, feasibility and viability; and
- Substantiate the innovation's ability to produce measurable benefits.

Does the team:

- Exhibit enthusiasm;
- Knowledgeably represent the innovation;
- Proactively seek out and engage with visitors;

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- Ask questions of visitors and actively listen to answers; and
- Align their responses and interactions to the interests of the audience.

Do the team's interactions:

- Convincingly champion their innovation's value and significance;
- Effectively explain the science behind, and the uniqueness of, their innovation;
- Make clear how society benefits;
- Express optimism and vision;
- Reflect positively on their team and their institutions; and
- Convey a roadmap for moving the project forward.

For the Formal Presentations

Does the presentation:

- Clearly identify the societal problem, need, or opportunity that the innovation addresses;
- Concisely explain how the idea solves this problem, meets the need, or pursues the opportunity;
- Succinctly convey the benefits the idea can or will produce;
- Tell a complete story that persuasively signals the idea's novelty, feasibility and viability;
- Reveal the idea's uniqueness and differentiate it from other existing or possible approaches; and
- Actively urge the listener to support further development of the idea.

Lessons learned: Based on the 2016 Innovation Boot Camp final judging, it became clear that there was disagreement about which team should claim second place. It ultimately came to a deadlock tie. One half of the panel wanted to focus on marketability and the other half on pure scientific feasibility (which had previously been evaluated in semifinal reviews by NSF experts). In developing the rubric for the 2017 Innovation Boot Camp, challenge organizers will take this into account and emphasize the focus of the final round. The CCIC team aspires to increase participation and submission numbers by bolstering promotion and outreach, and the team is currently searching for ways to support teams to carry out their innovations beyond the boot camp and through prototype and/or implementation. Unique to this year, the NSF CCIC team piloted a science coaching program for the ten final teams for six weeks prior to the boot camp. NSF program officers and science policy fellows paired up to provide one-on-one mentoring to the teams as they prepared for the final judging round at the boot camp. This program proved successful; however, the team plans to prepare NSF mentors more this year and be clearer about expectations. Each year, participants complete an evaluation that greatly informs the CCIC with what and how things can be improved for the following year.

Partnerships: NSF partners with AACC to run the CCIC competition. AACC has partnered with the foundation since the competition's inception. AACC provides expertise with the community college population in challenge development and theme identification; contributes to outreach and marketing aids in developing materials and curriculum for the Innovation Boot Camp; helps recruit expert evaluators for all judging rounds; and performs major logistical lifts in coordinating logistics and travel for the Innovation Boot Camp, including the finalist reception on Capitol Hill.

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NSF and AACC have worked with the NSF Innovation Corps (I-Corps) for the past two CCIC cycles to provide entrepreneurial coaching to teams. This has proven to be invaluable and has opened up future opportunities for CCIC finalist alumni to go on to apply for admittance into an I-Corps cohort. NSF and AACC hope to work with them again in the FY 2017 CCIC cycle.

Resources: Personnel and funding used to execute the CCIC prize competition entailed:

NSF staff time: Most aspects of the competition are handled in-house, with one or two NSF staff members managing the competition. Activities include:

- Challenge creation, year-to-year updates based on lessons learned and agency priorities;
- Updating content on the online entry platform;
- Developing the challenge website;
- Designing ads and other marketing material for the competition;
- Using social media to promote the competition;
- Recruiting expert judges;
- Responding to participant, judge and public inquiries;
- Ensuring entries are complete and meet eligibility criteria;
- Preparing correspondence and notifying participants of entry status;
- Preparing/arranging publicity for winners;
- Planning all aspects of the Innovation Boot Camp program; and
- Handling Innovation Boot Camp follow-up.

Partners: AACC provides expertise with the community college population in challenge development and theme identification; contributes to outreach and marketing; aids in developing materials and curriculum for the Innovation Boot Camp; helps recruit expert evaluators for all judging rounds; and performs major logistical lifts in coordinating logistics and travel for the Innovation Boot Camp, including the finalist reception on Capitol Hill.

Judges time: The judging process occurs in three rounds (two online, one in person). Each judge is allotted approximately two weeks to submit their scores, except for finalist judges, who submit their scores immediately in order to determine the winners at the Innovation Boot Camp. Judges volunteer their time.

Third party contractors: Skild provided the following components for \$83,730 (includes all prize costs):

- Skild platform (Pro version for eight months);
- Support–client services (50 hours);
- Creative design services;
- Strategic consulting/oversight;
- Engineering;
- QA testing;
- Prizes; and
- Prize distribution.

Products and services: \$20,930

Prize distribution fees: \$29,500

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Prize funds: \$33,300

Expert presenters at Innovation Boot Camp:

- Curricula development
- Materials development
- Presenting at entire event

Fees: \$36,200

NSF works through a contract to provide AACC with funds to support the Innovation Boot Camp. AACC provides all logistics costs (travel, lodging, food, per diem, etc.) and provides essential curricula development.

Funds provided to AACC: \$235,814

Total cost to NSF: ~ \$375,000

Results: Competitors in the FY 2016 CCIC competition were a multidisciplinary group, with participants ranging from farmers to scientists to accountants. Team members ranged in age and were comprised of nontraditional students, veterans, women, and minorities. Teams hailed from ten U.S. states and the majority of team members had never worked with NSF before, let alone with the Federal Government.

The innovations that the teams brought forward were original, practical, and potentially very impactful. Here's a snapshot of the FY 2016 CCIC winners and their projects:

First place: Forsyth Technical Community College, North Carolina

Energy Efficient Nanotech Solar Greenhouse

The Forsyth Technical Community College team proposed a way to modernize today's greenhouses to fit individual customer needs by incorporating the use of renewable energy sources. By utilizing innovative nanotechnology applications, solar-powered greenhouses can be developed to be more energy efficient, and enable sustainable plant growth while drastically reducing energy bills.

Second place (tie): Virginia Western Community College, Virginia

Efficient Mechanical Collection Method of Recovering Waste Apples

The Virginia Western Community College team proposed an efficient mechanical collection method of recovering waste apples to produce an efficient and environmentally-friendly biofuel. Doing this would allow several thousand acres of apple orchards in the United States to be used more efficiently, as both a source of food and a source of energy, as well as reduce economic losses suffered by U.S. apple producers.

Second place (tie): Normandale Community College, Minnesota

Wastewater Hydrokinetic Turbine

A team of engineering students from Normandale Community College proposed to install and implement hydrokinetic turbines in wastewater treatment plants to generate renewable energy to advance our society one step closer to a sustainable lifestyle.

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A.10.2 Generation Nano¹¹³

Summary: Given a lack of understanding of the implications of nanotechnology among the general public, and the importance of scientific engagement in students in order to build a strong STEM workforce, NSF runs Generation Nano in order to create awareness and engagement in nanotechnology among students. Generation Nano is a challenge for high school students to learn about nanotechnology and use creative design to come up with a new technology rooted in the concepts of nanotechnology that could be used by a superhero of their own design. Interest in the challenge was built by the involvement of celebrities in the science fiction and comic book communities—Wil Wheaton and Stan Lee. Three finalists received prize money based on the creativity, artistic and technical quality, and the use of technology in the entrant’s concept and proposal.

Solution Type: Creative (design and multimedia); ideas; technology demonstration and hardware

Primary Goals: Advance scientific research; inform and educate the public; and engage new people and communities

Results: Generation Nano generated 115 entries with 11 semifinalists, and three finalists won cash prizes totaling \$3000. Finalists’ presentations covered nanomedicine to nanotechnology in fabrics.

Problem Statement: There is a lack of understanding among the public, including high school students, about nanotechnology and its implications. In addition, science, technology, engineering, and mathematics (STEM) training is vital to meet the needs of the national workforce. This competition aimed to engage high school students in nanotechnology research while encouraging their creative ideas and thoughts in a science-multimedia avenue.

Participants were asked to create a novel superhero with nanotechnology-enabled gear. A complete entry consisted of two components: a written entry and a video or comic strip entry. The short written entry introduced the superhero, described the nanotechnology-driven gear and addressed any unexpected uses or consequences of the gear and how society could mitigate those risks. The 90-second video or one-page comic served as a creative outlet that was used to tell the hero’s story and emphasized how the gear is useful in overcoming the story’s conflict. The comic or video also gave insights not provided in the written entry to create a novel presentation.

This initiative was part of a single challenge that was very successful and thus is being continued for a second year for Fiscal Year 2017. Students were required to be between the ages of 13 and 19 years old, enrolled in high school or the homeschool equivalent, and be in academic good standing to enter Generation Nano. Evaluation was based on the following criteria:

- Creativity: The originality and quality of both the superhero and their story, as well as the application of nanotechnology through the accessory;
- Use of Nanotechnology: How accurately the entrant incorporated nanotechnology into their story, possible unexpected societal consequences of the technology, as well as

¹¹³ www.nsf.gov/news/special_reports/gennano

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- ways to mitigate those risks; and
- Artistic and Technical Quality: The visual appeal and refined execution of each entrant's comic or video.

Proposed Goals: Generation Nano intended to challenge individual high school students to research nanotechnology advances and then creatively apply those ideas to generate unique gear for a superhero. The competition was an opportunity to generate an early interest in, and excitement for, STEM in students, as well as provide reputable resources to guide their research.

Measures of Success: The competition advances NSF's mission by specifically aligning with the following goals in the foundation's strategic plan:

- Innovate for society (goal 2): Build the capacity of the nation's citizenry for addressing societal challenges through science and engineering.
 - "A growing body of research in learning and STEM education serves as the basis for guiding NSF programs and creating the links among schools, community colleges, colleges, and universities, workplaces, and informal education mechanisms that are critical to workforce preparation and STEM literacy."
- Transform the frontiers (goal 2): Prepare and engage a diverse STEM workforce motivated to participate at the frontiers.
 - "NSF's primary approach to address in this performance goal is the integration of research and education. Thus, the development of talented young people includes connection to the frontiers of knowledge and direct experience in the conduct of research in the United States and in other countries."

In addition, the competition achieves NSF's strategic goal for open innovation.

The Generation Nano competition inspired entrants from across the United States, and their creative uses of nanotechnology and artistic caliber was widely praised by our expert judges. The three finalists came to Washington, D.C. to participate in the USA Science & Engineering Festival, where they each staffed a table display depicting their hero. Each student engaged with festival attendees, mostly children and their parents, and described the nanotechnology behind their superheroes. This experience had a significant impact on the students, all of which are considering pursuing STEM majors in college, as well as continuing their love of art. Additionally, each student was interviewed for a nanotechnology podcast hosted by the NSF-supported Center for Sustainable Nanotechnology.

Participants: NSF hoped to engage high school students in STEM, specifically in nanotechnology. The competition had the following eligibility criteria:

- All entries must be received during the competition submission window;
- Each submission must be made by an individual;
- All students must be enrolled in a high school or be home schooled in the United States, its territories or possessions at the time of entry (e.g., the fall 2015 semester or the spring 2016 semester) and be in good standing;
- Students are limited to participating in one project for this challenge;
- Students must be U.S. citizens, nationals or permanent residents;
- Each entrant certifies, through submission to the contest, that the entry is their own

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original creative work and does not violate or infringe the creative work of others, as protected under U.S. copyright law; and

- Each entrant must submit a Parental/Guardian Permission Form and Photo Consent Form, available on the competition platform.

Timeline: Submissions for Generation Nano opened November 19, 2015, with preliminary judging beginning in February 2016. Winners were announced April 17, 2016.

Solicitation and Outreach:

- Social Media (such as Twitter posts and Facebook posts);
- Email Outreach (such as listservs);
- Press Release;
- Partnership with Outside Organizations (potentially including private companies, non-profit organizations, or other Federal agencies); and
- Other (please specify): Sessions/announcements at appropriate conferences, promo toolkit on the website, mailing materials (postcards, posters) to appropriate contacts.

Evaluation and Judging: For the Generation Nano competition, NSF recruited individuals from different populations to act as judges for the three rounds of judging:

- Preliminary (online): Fellows across agencies
- Semifinal (online): Nanotechnology researchers and members of the comic/entertainment community
- Final (in person): High-profile nanotechnology researchers, and prominent education and entertainment leaders.

The preliminary and semifinal rounds follow a simple sliding scale to judge the innovation and impact, feasibility and clarity of communication of the entry.

Evaluation during each judging round was based on the following criteria:

- Creativity: The originality and quality of both the superhero and their story as well as the application of nanotechnology through the accessory;
- Use of nanotechnology: How accurately the entrant incorporated nanotechnology into their story; and possible unexpected societal consequences of the technology, as well as ways to mitigate those risks.
- Artistic and technical quality: The visual appeal and refined execution of each entrant's comic or video; and
- For the finalist round only: The students' ability to interact and engage with the public to effectively describe their superhero's use of nanotechnology.

Lessons learned: Many students submitted entries based on nanotechnology that was not sound, but often popularized by pop culture. Future efforts will be made to direct students to reputable sources and, if possible, allow them opportunities to ask nanotechnology experts their questions.

Partnerships: The agency partnered with the National Nanotechnology Initiative (NNI) and is already benefiting from their technical knowledge base.

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In addition, the prominent comic creator Stan Lee partnered with the competition to help promote it on social media and contributed to the prizes distributed at the conclusion of the final judging round; actor Wil Wheaton hosted the awards ceremony. The support of these celebrities allowed NSF to reach populations not familiar with the foundation and encouraged their participation.

Resources: Personnel and funding used to execute the prize competition entailed:

NSF staff time—Most aspects of the competition are handled in-house, with one or two NSF staff members managing the competition. The activities include:

- Updating content on the online platform;
- Developing competition website;
- Designing ads and other marketing material for the competition;
- Using social media to promote the competition;
- Recruiting expert judges;
- Responding to participant, judge and public inquiries;
- Ensuring entries are complete and meet eligibility criteria;
- Preparing correspondence and notifying participants of entry status;
- Preparing/arranging publicity for winners; and
- Planning all aspects of the final judging presentation at the 2016 USA Science & Engineering Festival.

Partners:

- Help develop competition content; and
- Help promote competition via social media, newsletter, announcements, and at conferences; recruit judges, etc.

Judges time: The judging process occurred in three rounds (two online, one in person). Each judge was allotted about two weeks to submit their scores except for finalist judges, who submitted their scores immediately in order to determine the winners at the USA Science & Engineering Festival. Judges volunteer their time.

Third party contractors: Skild provided the following components for \$40,000 (includes all prize and logistical costs):

- Software subscription professional services (set up, testing, training, support);
- Website;
- Winner management;
- Prizes funds, travel, and logistics; and
- Miscellaneous (such as aiding in promotion).

Products and services: \$28,848

Prize distribution fees: \$1,500

Prizes funds, travel, and logistics: \$9,659

Total Cost to NSF: \$40,000

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Results: One-hundred and fifteen entrants from across the United States submitted a complete entry to the Generation Nano competition. Of the semifinalists, 11 came from seven different states. All the entrants were individuals and high school students. The exceptional caliber of the students' entries were widely praised by the expert judges from each round of judging.

Although the majority of entrants chose to enter a comic strip over a video, the video entries were well edited and executed.

Here is a snapshot of the three finalists:

First place winner: 'Nanoman' by a junior at Thomas Jefferson High School of Science and Technology in Virginia.

'Nanoman' is the "personification of nanomedicine" and fights "Cancer, the malignant crab-monster." Using tracking nanosensors inspired by current work conducted on olfactory sensors, 'Nanoman' can deliver drugs specifically to the site of carcinogenesis.

Second place and people's choice winner: 'Radio Blitz' by a sophomore from Bergen County Academies in New Jersey.

'Radio Blitz' wears a skirt lined with nanowires that can produce electricity by movement, a magnetron bow that can create a plasma around herself to fight nearby villains, and heat-resistant fabrics to protect herself from the heat of the plasma. This entrant also participated at the USA Science & Engineering Festival and came dressed as her hero.

Third place winner: 'Nine' by a junior at Martha Ellen Stilwell School of the Arts in Georgia. 'Nine' designs a nanosuit to help him fight crime. The suit includes self-healing glass, color-changing textiles and shock-absorbing polymers.

A.11 Small Business Administration

A.11.1 Growth Accelerator Fund Competition—2016¹¹⁴

Summary: In August 2016, SBA completed the third installment of the Growth Accelerator Fund competition with a total prize purse of \$4.25 million in order to continue building the support structure needed to help startups become commercially viable and create more jobs quickly. This extra infusion of capital to qualified accelerators and the burgeoning ecosystem in which they play provides resources to expand the startup and entrepreneurship communities around them in order to provide a much needed and sustainable economic impact.

In running this competition, SBA hoped to support both new and existing accelerators from all over the country that were not yet familiar with the SBA's services and that were not being fully served by the traditional venture capital or angel capital community. In addition to providing funds

¹¹⁴ www.sba.gov/offices/headquarters/ooi/resources/1428931

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to underserved groups and geographic areas with less access to capital, this year's competition had a new emphasis on accelerator models that include support for manufacturing.

Solution Type: Business plan; Creative (design & multimedia)

Primary Goals: Stimulate a market; Inform and educate the public

Results: SBA awarded \$4.25 million of Congressionally appropriated funds to 85 accelerators located in 39 states, Washington, DC and Puerto Rico.

Problem Statement: In 2016, the SBA conducted the third round of the Growth Accelerator Fund contest. SBA awarded \$50,000 prizes to the winners of the contest. These funds will be used to fund operating budgets, not for investing in startups in ecosystems. The winners of this year's contest were required to demonstrate the ability to raise (or have plans to raise) a 4 to 1 match of prizes awarded. This match can be in the form of cash, in-kind donations, or sponsorships. For this contest, "accelerators" are defined as: organizations that provide networking opportunities, mentorship, space (can be physical or virtual), and sometimes capital to startups. All models are expected to have a prescribed timeline after which startups "exit" or "graduate" their organization to function independently in the small business economy.

Judges gave particular attention to applicants that filled geographic, industry, and economic gaps in the accelerator and entrepreneurial ecosystem space. Through this competition, SBA sought to support the development of accelerators and thus startups in parts of the country where there are fewer conventional sources of access to capital (e.g., venture capital and other investors).

In addition to accelerators which fill these gaps, SBA also sought accelerators that are run by or support women or other underrepresented groups. New to this year, special consideration was given to any accelerator models that will support manufacturing and the White House POWER Initiative.

To summarize, the main premise of the competition is to ensure that a diverse set of entrepreneurs from all walks of life have the opportunity to participate in the American innovation economy. The more startup ecosystems that emerge in every corner of America and that enhance opportunities for those underrepresented in entrepreneurship, the more competitive the United States will become.

Proposed Goals: The proposed goals of the challenge were to infuse capital into qualified accelerators and the burgeoning ecosystem in which they play, which, in turn, provides resources to boost the startup and entrepreneurship communities around them.

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Measures of Success: Success was measured by the geographic spread of awarded accelerators, in this year's competition that was across 39 states and Washington, DC. Importantly, the SBA was also able to reach some of the most overlooked areas for startups given there was an explicit focus on giving prizes to accelerators that support: the underserved racial groups, women, the maker community and geographic regions which traditionally have limited access to capital.

Participants: The participants included underserved groups, geographic areas with less access to capital and organizations focused on supporting manufacturing and making. SBA accepted entries from both existing and newly launching accelerator models. The competition received 417 applications in the first round from 39 states, Washington, D.C., and Puerto Rico

Timeline: The prize was launched May 4, 2016, accepted submissions until June 3, 2016, and awarded on August 5, 2016.

Solicitation and Outreach: The organizers solicited submissions through press release, social media, blog posts, stakeholder outreach (Growth Accelerator Network), and previous applicants.

Incentives: The competition offered a \$50,000 prize for each winner, for a total \$4.25 million prize purse.

Evaluation and Judging: Judging was conducted in two rounds. The first round was public sector focused (with SBA and government-wide judges). The second round was private sector focused. "Solvers" submitted a 10-slide PowerPoint for the first round and 2-minute video for the second round.

To award the prizes, several panels composed of over 40 judges considered each applicant's stated mission, impact, implementation, and success metrics. The panel gave particular attention to accelerators that filled current geographic gaps in the entrepreneurial ecosystem, those that were run by and support women or other underrepresented groups, and accelerator models that support manufacturing. For the purposes of this competition, Growth Accelerators include accelerators, incubators, co-working startup communities, shared tinker-spaces or other models to accomplish similar goals.

Partnerships: This year SBA partnered internally with SBA's Office of Native American Affairs and Office of Veterans Business Development, as well externally with Department of Education, the National Science Foundation, and the National Institutes of Health.

Resources: SBA staff time and the \$4,250,000 prize money composed the resources expended.

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Results: SBA awarded \$4.25 million of Congressionally appropriated funds to 85 accelerators located in 39 states, Washington, DC and Puerto Rico. The winning 85 accelerators were located in 39 states and Washington, DC with 30 being in rural counties, 20 focusing on manufacturing, 70 owned by women, 20 focused on Native American communities, 72 focused on women, 60 focused on the underserved, and 20 focused on veterans. A list of the winners with links to their accelerators can be found at www.sba.gov/accelerators.

A.11.2 InnovateHER Competition—2016

Summary: The U.S. Small Business Administration (SBA) conducted the second annual InnovateHER competition for entrepreneurs to create a product or service that has a measurable impact on the lives of women and families, has the potential for commercialization, and fills a need in the marketplace.

Solution Type: Ideas; Business plan

Primary Goals: Develop technology; Inform and educate the public

Results: SBA local host organizations received 194 applications. The top three teams were awarded \$70,000 in prize money provided by Microsoft.

Problem Statement: The InnovateHER Challenge provides an opportunity for entrepreneurs to showcase products and services that:

- Have a measurable impact on the lives of women and families (30%);
- Have the potential for commercialization (40%), and,
- Fill a need in the marketplace (30%).

Proposed Goals: The American workforce looks different from 50 years ago. Women make up nearly half of the labor force and play a critical role in the nation's economic prosperity. Most children live in households where all parents work. As the population ages, families are increasingly caring for aging parents while balancing the needs of work and home. As the demands on women and families grow, the need for products and services that address these unique challenges increases. The InnovateHER Challenge provides that platform.

Measures of Success: By leveraging the resources of the private sector, through cash prizes and local competitions, and having the business and investor community serve as judges and mentors, the competition brings together the communities across the country in a way that could not be done through a grant or contract alone. Additionally, the competition itself showcased the need for these types of products and services in the marketplace and the opportunity for increased investment in them.

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Participants: Over 100 local organizations held InnovateHER competitions across the country. 74 applications were submitted to the SBA from these local competitions.

This Challenge was open only to:

1. Citizens or permanent residents of the United States who were at least eighteen (18) years of age at the time of their submission of an entry (or teams of such individuals); and
2. Private entities, such as corporations or other organizations that were incorporated in and maintained a primary place of business in the United States. Individuals submitting on behalf of corporations, nonprofits, or groups of individuals (such as an academic class or other team) had to meet the eligibility requirements for individual contestants.

An individual could belong to more than one team submitting an entry in this Challenge.

Individuals or organizations that were currently suspended or disbarred by the federal government were not eligible for this competition.

Timeline: The initial round of the InnovateHER Challenge took the form of local competitions that began August 4, 2015 and ended December 2, 2015. The host organizations running the local competitions selected and submitted one winner from each local competition to SBA, along with a Nomination package, by December 4, 2015. Winners were announced during a live pitch competition on March 17, 2016.

Solicitation and Outreach: The second round of InnovateHER consisted of local business competitions hosted by SBA Resource Partners, universities, accelerators, clusters, scale-up communities and other organizations that have been approved by SBA to host as part of InnovateHER.

With the help of SBA resource partners and Regional Administrators, the SBA made a concerted push to secure a diverse range of organizations, as reflected in hosts such as the National Latina Business Women Association-Los Angeles, Cosmo Latina, Go Africa Network Inc. in New York, and many others

The organizers heard from participants and stakeholders that with more lead time, more local organizations and entrepreneurs could be engaged and spur greater conversation, collaboration, and cooperation at all levels to support women, families, and entrepreneurs.

Incentives: Cash prizes totaling \$70,000, funded by the private sector, were awarded to the three highest-rated contestants in the final round of the competition; first place received \$40,000, second

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place \$20,000, and third place \$10,000. For winning entries submitted by teams of competitors, prize money was awarded to the self-identified project leaders for distribution to the rest of the teams at their discretion and independently from SBA. There were no non-monetary incentives involved and supported by SBA at the local level. Host locations had the autonomy to provide local prize incentives at their discretion.

Evaluation and Judging: SBA selected four judges with experience and expertise in product innovation and venture capital. The judges participated pro bono and SBA greatly appreciates their contributions to this contest and advancing consumer awareness of product safety recalls.

Contestants must have demonstrated to the satisfaction of the judges that their product or service met the criteria of the Challenge. The full judging criteria were advertised in the Challenge Rules openly posted to the event website:

1. Have a measurable impact on the lives of women and families (30%);
2. Have the potential for commercialization (40%); and
3. Fill a need in the marketplace (30%).

Partnerships: SBA partnered with Microsoft Corporation to provide prize money and support for the event. The *Washington Post* provided space and digital support for live broadcasting online.

Resources: SBA provided staff time; Microsoft funded the competition prize money; and the Washington Post provided the space and digital support.

Results: SBA local host organizations received 194 applications. The top three teams were awarded \$70,000 in prize money provided by Microsoft. The three winners of the InnovateHER 2016 Challenge, selected by a panel of expert judges were:

1. Elizabeth Caven, UpCraft Club (\$40,000)
UpCraft Club is changing the way digital goods are found and sold using a patent-pending process allowing brick and mortar retailers to receive revenue from the sale of a digital good. Because the founder's deep industry connections and experience, the technology/process is being introduced in the emerging digital sewing pattern market.
2. Dawn Dickson, Flat Out of Heels (\$20,000)
One in ten women wear high heels, and 48% have shoe related injury. Flat Out of Heels are the most convenient way for women to relieve stiletto sore feet on the go.
3. Dr. Agnes Scoville, Scoville & Company (\$10,000)
Pacidose by Aggie MD allows mothers and caregivers to accurately dose and deliver medicine to babies through its patented device. The product uses a standard hospital-grade oral syringe which measures the liquid precisely and delivers it through a soft pacifier nipple that has a narrow tube down the center to prevent wastage.

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A.11.3 Lean for Main Street Training Challenge

Summary: SBA launch the Lean for Main Street Training Challenge in January 2015 to give representatives from SBA’s resource partner network—Small Business Development Centers (SBDCs), SCORE chapters, Women’s Business Centers (WBCs), and Veteran Business Outreach Centers (VBOCs)—the opportunity to adapt an existing curriculum to help small businesses and entrepreneurs utilize the insights of lean business methodologies and become “Main Street” businesses. Contestants selected as winners participated in the development and deployment of innovative “lean startup” resources that can be delivered to small businesses in sectors or regions that have not had significant exposure or access to these resources. Winning Contestant representatives participated in an in-person and virtual train-the-trainer program and forum with I-Corps™ national instructors to develop an innovative framework for exposing lean methodology to businesses in traditional sectors. Winners implemented these newly-developed lean training resources to businesses in their respective communities on a pilot basis and provided SBA with an assessment of their effectiveness

Solution Type: Business plans

Primary Goals: Find and highlight innovative ideas; Build capacity

Results: 5 winning teams were selected from 38 submissions and 6 pilot curriculums have been submitted to the SBA for use by the wider Resource Partner network.

Problem Statement: Given the success and growing popularity of the National Science Foundation’s I-Corps™ program¹¹⁵, the SBA is interested in the potential for using adapted versions of that program as a means to assist a broader array of small businesses and aspiring entrepreneurs operating outside the I-Corps™ program’s current focus on technology-based businesses or commercialization concepts. For reference, the I-Corps™ program involves expert business trainers helping teams of scientists and entrepreneurs apply “lean principles”—a collection of practices and concepts for business model analysis—to those scientists’ and entrepreneurs’ nascent entrepreneurial efforts. Given the SBA’s esteem for the success of this program, the SBA partnered with the National Science Foundation (NSF) to offer the Lean for Main Street Training Challenge to current SBA Women’s Business Centers, Small Business Development Centers, and SCORE Chapters (“Contestants”).

Proposed Goals: The proposed goals of the challenge were train SBA Resource Partners on lean methodology and give them the tools to adapt a curriculum for their clientele.

¹¹⁵ www.nsf.gov/news/special_reports/i-corps/about.jsp

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Measures of Success: For 2016, success was measured by how many teams successfully completed the training, piloted a curriculum of lean methodology, and delivered that adapted curriculum to SBA.

Participants: For 2016, participation was restricted to members of the SBA's Resource Partner network, which is comprised of Small Business Development Centers (Lead and Service Centers), Women's Business Centers, SCORE Chapters, and Veteran's Business Outreach Centers.

Timeline: This challenge opened on January 11, 2016 and ended February 11, 2016, with progress awards announced March 10, 2016.

Solicitation and Outreach: Outreach activities included notifications of the upcoming challenge in regular newsletters to resource partners and information given on monthly calls with resource partners. Weekly "how to apply" webinars were also advertised and executed.

Incentives: In addition to cash incentives, the teams would have the professional development opportunity to attend NSF's I-Corps and train with I-Corps master instructors.

Evaluation and Judging: The challenge submissions were judged on the following criteria

- **Audience:** SBA's Resource Partners interact with a diverse group of small business owners and entrepreneurs. While lean materials aimed towards tech startups are commonly available, entrepreneurs in different industries, with different backgrounds, or from different geographies may find these materials less applicable to their immediate circumstances. In order to be successful, a Contestant should clearly identify the specific audience for which their solution would be developed. Contestants are free to define their audience according to their own parameters (e.g. Sector, Business Phase (pre-venture, startup, existing businesses) Geography, Historically Disadvantaged or Underserved Status, etc.)
- **Adaptation:** To kick off the adaptation of the I-Corps program, each winner will send two representatives to NSF's I-Corps gathering in Washington, DC, where they will work in dedicated groups with I-Corps instructors as part of a specialized Train the Trainer program. Applications should outline exactly how representatives intend to benefit from this experience, including any specific knowledge gaps that representatives are looking to fill through their participation. They should also give a clear idea of the demonstrated ability of each representative to adapt and deliver new resources to small businesses. Please note that while SBA is interested in your knowledge and experience with lean methods, preexisting expertise in lean methodology is NOT a requirement for this Competition.
- **Implementation:** An entrepreneurial development program is only as good as the people it can reach. While the ability to adapt and customize entrepreneurial development resources is clearly important, equally important will be the Contestants' solution to delivering their curriculum to small businesses and aspiring entrepreneurs in their target audience. An application should delineate, as clearly as possible, how the Resource Partner intends to leverage their existing relationships, the curriculum that they will develop, and

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the funds awarded to bring lean methods into their communities on a pilot basis. Applications should also give a clear idea of how they intend to assess the effectiveness of their program, including specific metrics that the Resource Partner will track.

Judging consisted of two rounds. For the first round of judging, the Office of Entrepreneurial Development (OED) put together a panel of 9 individuals. These individuals included members of OED's Strategic Initiatives team, as well as representatives of the four offices in charge of SBA's Resource Partner Network, viz. the Office of Small Business Development Centers (OSBDC), the Office of Women's Business Ownership (OWBO), the Office of Entrepreneurial Education (OEE), and the Office of Veterans' Business Development (OVBD). Each member of the first round judging panel was asked to review all 38 applications.

Based on these compiled, normalized scores, OED rated the top 15 submissions as "excellent" and advanced them to the Second Round of judging. For the Second Round of judging, OED convened a panel of top-level representatives, including the head of OED and representatives from OSCBD, OWBO, OED, and OVBD, as well as a representative from the White House's Office of Science and Technology Policy (OSTP). All panel members were given access to the semifinalist applications, as well as the brief synopses of each application. The Second Round Judging Panel convened on February 25, 2016, during which time the five winning applicants were selected from among the 15 semifinalists.

Partnerships: SBA executed a Memorandum of Understanding with the National Science Foundation for this challenge.

Resources: In 2016, SBA has provided staff time with support from NSF and their I-Corps team. Each team received the prize payment of \$25,000 and in return, attended the 6 week I-Corps session in the Spring of 2016, adapted the lean methodology curriculum for their target audience, piloted the curriculum, and submitted the pilot curriculum to SBA. Additionally, an \$11,000 contract NSF?

Results: Five winning teams were selected from 38 submissions and 6 pilot curriculums have been submitted to the SBA for use by the wider Resource Partner network; they include:

- Community Business Partnership (SBDC) – Springfield, Va.
- McLennan SBDC – Waco, Texas
- Renaissance Entrepreneurship Center (WBC) – San Francisco, Calif.
- University of Pittsburgh (SBDC) – Pittsburgh, Pa.
- Mississippi State University (VBOC) – Mississippi State, Miss.

Appendix B. A Selection of Agency Prizes and Challenges Conducted Under Authorities Other Than the America COMPETES Reauthorization Act of 2010

This Appendix provides a summary of select prizes and challenges conducted in FY 2016 under agency prize authorities other than COMPETES. Agency reporting on prizes conducted under non-COMPETES prize authorities was optional, therefore the selection presented here is itself based on an incomplete list.

B.1 Department of Commerce

B.1.1 NIST: Post-Quantum Crypto Project¹¹⁶

Summary: The Post-Quantum Crypto Project is an effort by NIST to solicit, evaluate, and standardize public-key cryptographic algorithms resistant to large-scale quantum computers, also known as quantum-resistant cryptography, by working closely with the cryptography community. NIST is currently accepting proposals through November 30, 2017 and intends to select at least one algorithm providing quantum-resistant public key encryption, digital signatures, and key exchange algorithms for standardization. Proposals will be subject to three to five years of public evaluation before they are standardized.

Solution Type: Analytics, visualizations, algorithms; Scientific

Primary Goals: The goal of NIST's Post-Quantum Crypto Project is to develop cryptographic systems that are secure against both quantum and classical computers, and are interoperable with existing communications protocols and networks. The challenge aims to incentivize cryptography experts to develop and assist in the vetting of these systems.

Specifically, the goals associated with this challenge are to solve a specific problem, advance scientific research, and engage new people and communities.

Results: This challenge is still in progress, so it is too early to report results.

¹¹⁶ csrc.nist.gov/groups/ST/post-quantum-crypto/cfp-announce-dec2016.html

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B.2 Department of Energy

B.2.1 Collegiate Wind Competition¹¹⁷

Summary: The Collegiate Wind Competition is an effort by the Energy Department to engage students in multidisciplinary areas of higher education in the wind industry. This competition invites college students in 2 or 4 year institutions to build and test a wind turbine, deliver a business plan, and establish a deployment strategy for their wind turbine. The Energy Department began accepting proposals from colleges and universities in fall 2014 and announced the teams it would fund for the competition in spring 2015. Teams had until May 2016 to execute their proposals and present at the competition held on May 25, 2016. The overall winning wind turbine was put on display at DOE headquarters in June 2016.

Solution Type: Creative (design and multimedia; Ideas; Technology demonstration and hardware; Business plans; Public presentation

Primary goals: Engage new people and communities; Build capacity; Stimulate a market

Results: Twelve student teams were selected to compete across the United States and Puerto Rico. Teams were composed of a diverse range of majors. There were four new teams who did not compete in the 2014 competition. Below are the winners of the 2016 Collegiate Wind Competition.

Award	Team	Merit
Overall First Place	The Pennsylvania State University	Cumulative Score
Overall Second Place	The University of Massachusetts Lowell	Cumulative Score
Overall Third Place	Boise State University	Cumulative Score
Turbine Testing	The Pennsylvania State University	Most efficient turbine in wind test tunnel
Technical Design	The University of Massachusetts Amherst	Presentation and written design report
Deployment Strategy	California State University, Chico	Presentation and written deployment strategy
Business Plan	The Pennsylvania State University	Presentation and written business plan
People's Choice	Universidad del Turabo (Puerto Rico)	Generated the most votes from the public
Bonus Challenge	Universidad del Turabo	The winning load system was the most creative, functional, informative, and elegant

¹¹⁷ wind.energy.gov/windcompetition

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Award	Team	Merit
		representation and display of the power being generated by the turbine in the wind tunnel, while also properly acting as the load on the turbine.

B.2.2 H2 Refuel H-Prize¹¹⁸

Summary: The H Prize challenges engineers and scientists to develop an on-site hydrogen generation system that uses electricity or natural gas and can be used in homes, community centers, retail sites, or similar locations to fuel hydrogen vehicles. The competition opened in October 2014 and contestants had one year to submit a preliminary design and data to DOE. DOE announced the sole finalist team in January 2016. The team constructed and demonstrated their system from January to October 2016. DOE awarded the final prize to the finalist in January 2017 to the finalist.

Solution Type: Technology demonstration and hardware

Primary goals: Develop technology; Stimulate a market; Engage new people and communities

Results: In January 2016, one team advanced to Phase 2. DOE funded the construction and demonstration of their hydrogen generation system through October 2016. The competition concluded in fall 2016 and DOE reviewed the data produced by the sole finalist team's design. In January 2017, DOE awarded \$1,000,000 to team SimpleFuel.

B.2.3 Solar Decathlon

Summary: The Solar Decathlon is designed to develop new ideas for fully solar powered houses while incentivizing and developing the STEM workforce of the future by encouraging college students to participate in this engineering and architectural challenge. Running since 2002, this competition has now been structured as a prize, increasing the incentives for top-performing teams.

Solution Type: Creative (design and multimedia); ideas; technology demonstration and hardware; analytics; visualizations; algorithms; scientific; and other: innovative houses

Primary Goals: Find and highlight innovative ideas; inform and educate the public; and other: workforce development

Results: This prize is ongoing. Current participants are college teams that have been working on this project for about two years.

¹¹⁸ hydrogenprize.org

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B.2.4 Voucher for Work at a DOE National Laboratory for Winner of National Cleantech University Prize Competition

Summary: The Cleantech University Prize Competition¹¹⁹ seeks to address multiple challenges in the clean energy sector, including underutilization of university resources, lack of funding for clean energy technologies, and a dearth of entrepreneurs working in the clean tech space. Lab Impact efforts within DOE's Office of Energy Efficiency and Renewable Energy Tech-to-Market program aim to increase the impact of DOE's national laboratory investments via a number of objectives, including facilitating access to DOE national lab resources. As an initial pilot of these efforts, Lab Impact awarded a voucher, worth \$50,000 in resources at a DOE lab, to the first place winner of the Cleantech University Prize National Competition. This voucher can provides access to the resources at a National Laboratory for the commercialization of the winning technology.

Solution Type: Technology Demonstration

Primary goals: Find and highlight innovative ideas; Develop technology; Engage new people and communities

Results: Heila Technologies, from the Massachusetts Institute of Technology, won first place for developing a universal control hub that automatically monitors and manages disparate microgrids at places like company campuses, military bases, and rural villages, for optimal performance. They are the recipient of the \$50,000 voucher.

B.3 Department of Health and Human Services

B.3.1 ACF: Domestic Violence Awareness Month YouTube Challenge¹²⁰

Summary: The Family Violence Prevention and Services Act (FVPSA) Program is seeking videos to raise awareness of the services and supports available for victims of domestic abuse. In one to three minutes, video submissions should highlight innovative approaches to improve safety, promote healing, and build resilience of victims of domestic abuse. The Challenge implores applicants to develop practices, policies, programs, safe spaces, activities, or strategies that are innovative, creative, and inclusive.

Solution Type: Creative (design and multimedia)

Primary Goals: Inform and educate the public; Engage new people and communities; Other: Learn about and share innovative ways the community is supporting this population.

¹¹⁹ See Appendix A, Section A.4.2

¹²⁰ www.challenge.gov/challenge/domestic-violence-video-challenge

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Results: Twenty-four videos were submitted online for the contest. In November 2016, the public rated the submissions and the 15 highest rated videos advanced to be evaluated by a panel of judges. FVPSA awarded the top three videos in January 2017: Marion L. Steele High School Medical Health Tech Student Wellness: Genesis House Teen Street Team (\$5,000), The Compass Center-Play Therapy in Sioux Falls, SD (\$3,000), Children’s Art Therapy Program: An innovative Strategy to Serve Children Exposed to Domestic Violence (\$2,000).

B.3.2 FDA: Counterfeit Detection Device¹²¹

Summary: FDA has developed and validated a basic portable device to detect counterfeit drugs and other adulterated pharmaceutical products. While the device has proven to be to be extremely effective, it is not convenient for field use. To develop a new prototype of this counterfeit detection device, the FDA is using a multiple award and multiple phase contract. Specifically the new prototype should increase durability, be water resistant and dustproof, and have the ability to interface with a mobile device. The challenge is currently in Phase I, which requires entrants to submit proposals that demonstrate a capability to develop both hardware and software, test, and calibrate a prototype for a counterfeit detection device.

Solution Type: Technology demonstration and hardware

Primary Goals: Solve a specific problem; Develop technology

Results: This is Phase I of this challenge. The review of submissions is still in progress, and it is too early to report results.

B.3.3 NIH: Nanotechnology Startup Challenge¹²²

Summary: NIH cancer-related technologies are typically very early stage, and there is a need to find development partners. However, potential commercial partners can be reluctant to form partnerships around early-stage discoveries because of lengthy developmental timelines and high financial risk. Based on the startup challenge model created by the Breast Cancer Startup Challenge and the Neuro Startup Challenge, the Nanotechnology Startup Challenge in Cancer provides a new channel to advance cancer nanotechnologies through the creation of startup companies that would further develop and commercialize those technologies.

¹²¹ www.fbo.gov/index?s=opportunity&mode=form&id=279c4e891dfc7f7e757200b84b5286eb&tab=core&_cview=1

¹²² www.nscsquared.org

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Challenge teams selected one of eight NIH inventions or a third-party cancer nanotechnology as the basis of their startup, and developed a business plan and video for their submission. Teams were provided with free training by leading experts from the biotechnology industry, venture capital, universities, foundations, and government. Winning teams received further mentoring coordinated by NIH's challenge partner, CAI, on launching their startup, incorporating a business, licensing, forming a management team, and raising seed investment.

Solution Type: Business plans; Scientific; Commercialization

Primary Goals: Advance scientific research; Develop technology; Stimulate a market

Results: Twenty-nine teams entered the challenge with an average of 13.5 members per team (or a total of approximately 390 total participants). The majority of entrants were from the United States, while 27.5% were from countries such as Israel, Canada, the United Kingdom, Hong Kong, Brazil, and Australia. Thirty percent of participants were women and 7 teams were led by women. In terms of team expertise: 53% had previous scientific background (graduate degree or higher), 22% had business backgrounds, 22% had an entrepreneurial background (previously founded a startup), and 3% had legal backgrounds. The participants represented 58 distinct universities, a majority of which had participants from previous NIH startup challenges.

Ten teams were announced in July 2016 as winners or finalists, and are advancing five NIH technologies as well as one third-party invention. The winners and finalists are in varying stages of launching their startups, including applying for a license to the technology and seeking inventor funding.

B.3.4 Program Focused Enabling and Supporting Early Innovation to Advance Adolescent Health and Prevent Teen Pregnancy¹²³

Summary: The Office of Adolescent Health (OAH) Teen Pregnancy Prevention (TPP) Early Innovation Grant Program (TPP Tier2A – Enabling and Supporting Early Innovation to Advance Adolescent Health and Prevent Teen Pregnancy) aims to spur innovative program-based interventions to prevent teen pregnancy, advance adolescent health, and fill the current evidence-base of TPP programs. The ultimate goal of the TPP Tier2A funding is to enable and support early innovation to prevent teen pregnancy and advance adolescent health. One of the program's objectives is to incentivize well designed, innovative interventions that are medically accurate, age appropriate, LGBTQ inclusive, trauma-informed, and ready for a rigorous evaluation.

In 2015, Texas A&M University, a Tier2A fund recipient, created iTP3, a funding program jointly administered by the College of Education and Human Development and the School of Public

¹²³ itp3.org

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Health. iTP3 launched a competition in January of 2016 which seeks innovative programs that are focused on high-risk populations. Applicants were judged on the following: innovation; project justification; significance; project approach and design; project management; challenges and risks; partnership and collaboration; environment and resources.

Solution Type: Creative (design & multimedia); Ideas; Pilot programs

Primary Goals: Find and highlight innovative ideas; Build capacity; Develop new and innovative programs

Results: iTP3 received 51 applications, consisting of on average 3 people per team (153 individuals total). In April 2016, iTP3 awarded up to \$100,000 to 15 proposed programs from a wide geographic distribution: Be Legendary (TX), Capacity Building for Foster Care Organizations (NY), Chrome to Color (PA), Healthy Pathways (NM), Momentary Affect Regulation Safer Sex Intervention (MA), Omega Gents Sexual Health Module (CA), Online Health 4 Young Adults (AK, HI, ID, WA), Peers Advocating for Safer Sex Program (IA), Peer Mentors for Pregnancy and Parenting Youth (TX), Rural ImPACT (CA), Sexual Health Equity for Individual with Intellectual/Developmental Disabilities (OR), Testing and Adolescent-Centered Model of Contraceptive Care (PA), The ♥Beat Project (MD), Transition to Success: Preventing Unplanned Pregnancy Among Older Youth in Foster Care (DC), Waikiki Health (HI).

B.3.5 Tech Focused Enabling and Supporting Early Innovation to Advance Adolescent Health and Prevent Teen Pregnancy¹²⁴

Summary: The Office of Adolescent Health (OAH) Teen Pregnancy Prevention (TPP) Early Innovation Grant Program (TPP Tier2A – Enabling and Supporting Early Innovation to Advance Adolescent Health and Prevent Teen Pregnancy) aims to spur innovative technology-based interventions to prevent teen pregnancy, advance adolescent health, and fill the current evidence-base of Teen Pregnancy Prevention (TPP) programs. The ultimate goal of the TPP Tier2A funding is to enable and support early innovation to prevent teen pregnancy and advance adolescent health. One of the program’s objectives is to incentivize well designed, innovative interventions that are medically accurate, age appropriate, LGBTQ inclusive, trauma-informed, and ready for a rigorous evaluation.

Innovation Next...The National Campaign to Prevent Teen and Unplanned Pregnancy (National Campaign), a Tier2A technology-focused fund recipient, created Innovation Next, an accelerator program, in partnership with IDEO, a product design company. Innovation Next launched a two-phase competition which seeks innovative technology-based solutions to preventing teen pregnancy. Prior to Phase 1, challenge competitors applied to participate in teams of three. In Phase

¹²⁴ innovationnext.org

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1, 10 teams received \$80,000 to participate in the first Innovation Next cohort. In September 2016, Innovation Next and the National Campaign selected the top five teams from Phase 1 to receive additional funding to further develop their technology-based solutions to prevent teen pregnancy.

Solution Type: Software and apps; Creative (design & multimedia); Ideas; Technology demonstration and hardware; Business plans

Primary Goals: Find and highlight innovative ideas; Develop technology; Build capacity

Results: Innovation Next had 127 teams apply, consisting of 3 people each on a team (381 individuals), and selected 10 teams to participate in Phase 1. Winners in Phase I produced a pitch and prototype after a 6-month period of design-thinking workshops and capacity-building assistance (CBA) and support. In September 2016, Innovation Next awarded the top five teams from Phase 1 up to \$325,000 to fully develop their technology-based solutions to teen pregnancy.

B.4 Department of the Interior

B.4.1 BSEE: High School Offshore and Technology Stars Challenge¹²⁵

Summary: The Bureau of Safety and Environmental Enforcement (BSEE) seeks to engage high school students in science and technology projects to increase their awareness of employment opportunities in the natural resources sector. Students competing in the High School Offshore and Technology Stars Challenge learned the basics of electrical engineering and harnessed energy generated by underwater soundwaves to power a remote control helicopter and fly it to a mock offshore platform.

Solution Type: Ideas

Primary Goals: Build capacity; Engage new people and communities

Results: There were 120 participating high school students in the Houston area. Top teams were awarded prizes and teaching grants for their schools, and the winning team, “The Underdogs” from Westside High School — was featured at the Offshore Technology Conference in May. It is anticipated that the Tech Challenge will be expanded in 2017 beyond Houston to include schools and competition sites in California and Louisiana.

B.4.2 FWS: Crushed Ivory Design Challenge¹²⁶

Summary: In November 2013, the U.S. Fish and Wildlife Service (FWS) destroyed approximately six tons of illegal elephant ivory – all seized as a result of law enforcement investigations and at

¹²⁵ www.bsee.gov/newsroom/feature-stories/tech-challenge

¹²⁶ www.fws.gov/international/ivory-challenge.html

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U.S. ports of entry. This action was intended to send a clear message to ivory traffickers and buyers that the United States does not tolerate the illegal ivory trade. It was also designed to educate consumers and to urge them not to buy illegal ivory products.

Subsequently, the FWS, in partnership with the Association of Zoos and Aquariums (AZA), launched a global design challenge that sought creative ideas on how to use the 2013 crushed ivory, and further efforts to raise awareness and reduce the demand for illegal wildlife products.

Solution Type: Ideas

Primary Goals: Solve a specific problem

Results: Two winners were selected from 44 submissions. AZA will assist with the production of the winning designs and help distribute final products to zoos, aquariums, airports, schools and other public facilities, as appropriate. A detailed list of measurable results will be available after the final designs have been constructed and distributed.

B.5 Environmental Protection Agency

B.5.1 2016 Toxics Release Inventory University Challenge¹²⁷

Summary: The 2016 Toxics Release Inventory (TRI) University Challenge aims to (1) increase awareness of the EPA TRI Program within academic communities; (2) expose students to TRI data, tools, and analysis; and (3) generate innovative programs, activities, recommendations, or research that improve the accessibility, awareness, and use of TRI data. Through this challenge, the EPA is soliciting help from academic institutions to build a diverse portfolio of practical and replicable projects that benefit communities, the environment, academic institutions, and the TRI Program. The two theme areas of the 2016 TRI University Challenge were “promoting broader use of TRI data by academics” and “using TRI to measure program effectiveness.”

Solution Type: Ideas; Technology demonstration and hardware; Analytics, visualizations, algorithms; Scientific

Primary Goals: Find and highlight innovative ideas; Inform and educate the public; Engage new people and communities

Results: Six universities were selected to collaborate with the TRI Program for the 2016-2017 academic year, including: Arizona State University, Drexel University, Lincoln University, Missouri University of Science and Technology, the University of Arizona, and the University of West Florida.

¹²⁷ www.epa.gov/toxics-release-inventory-tri-program/tri-university-challenge

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B.5.2 Campus RainWorks Challenge¹²⁸

Summary: EPA's Campus RainWorks Challenge engages students to demonstrate climate resilient water infrastructure and water management solutions in their local college and university communities. As part of this challenge, students learn about the impacts of climate change and how green infrastructure practices can increase resiliency while effectively managing stormwater runoff. EPA invited student teams to compete in one of two design categories—the Master Plan category, which examines how green infrastructure can be integrated into a broad area of a school's campus, or the Demonstration Project category, which focuses on how green infrastructure can be integrated into a particular site on the team's campus.

Solution Type: Creative (design & multimedia); Ideas; Technology demonstration and hardware; Scientific

Primary Goals: Find and highlight innovative ideas; Solve a specific problem; Build capacity

Results: There are currently 135 university teams from 30 states registered. Submissions were due December 16, 2016 and winners will be announced in Spring 2017. Two 1st place student teams will be awarded \$2,000 to be split evenly among the members. The faculty advisors will receive \$3,000 for their institution. Two 2nd place teams will be awarded \$1,000 to be split evenly among the members. The faculty advisors will receive \$2,000 for their institution.

B.5.3 Nutrient Recycling Challenge¹²⁹

Summary: EPA's Nutrient Recycling Challenge aims to (1) accelerate the development of nutrient recovery technologies for pork and dairy farms that produce environmental and economic benefits; (2) increase awareness of issues and opportunities related to nutrients and manure management; (3) connect innovators and agricultural stakeholders; and (4) stimulate markets for products generated by nutrient recovery technologies.

The EPA has taken interest in developing nutrient recovery technologies due to potential positive impacts on the environment, agriculture, and the economy. Nutrient recovery technologies have the potential to improve water quality, reduce greenhouse gas emissions, and provide animal agriculture producers with a product they can use or sell. Producers would be incentivized to adopt these technologies if they become economically viable by efficiently converting manure into fertilizers.

Solution Type: Ideas

¹²⁸ www.epa.gov/campusrainworks

¹²⁹ www.nutrientrecyclingchallenge.org

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Primary Goals: Solve a specific problem; Develop technology; Engage new people and communities

Results: A total of 75 submissions were received at the end of Phase I (January 15, 2016), and a total prize amount of \$30,000 was given out. Each of the six Phase I winners were awarded \$6,000 each and each of the four honorable mentions received \$1,000 each. The Phase I concepts outlined mechanical, biological, chemical, thermal, and hybrid types of technologies to extract nutrients from pork and dairy manure, some of which aim to be compatible with anaerobic digesters. Sixty-two percent of concepts were categorized as suitable for both pork and dairy operations, 29% for just dairy operations, and 9% for just pork operations.

Phase II began October 2016 and is anticipated to end in March 2017. Phase II of the Nutrient Recycling Challenge is a non-competitive incubation and technical support program which is only open to the 34 teams selected in Phase I, to develop technology designs based on the concept papers they submitted.

Innovators registered for the challenge through InnoCentive's platform from every continent except Antarctica; submissions came from teams registered from North America, Europe, Asia, Africa, and Australia; and there were also innovators from South America involved in the teams. Concepts were submitted by both individuals and teams, and ranged in development level from concept to technologies already being piloted. Many innovators are newly applying nutrient recovery concepts to manure management that were previously used in the wastewater treatment and other industrial sectors.

B.5.4 Nutrient Sensor Challenge¹³⁰

Summary: Current methods for measuring nutrient loads and tracking nutrients throughout ecosystems are costly and do not capture the full complexity of how nutrients exist in space and time within ecosystems. The Nutrient Sensor Challenge aims to address the need to reduce the high cost and complexity of collecting data to better measure nutrients and track progress by accelerating the development and deployment of affordable nutrient sensors. Next-generation sensors developed through the challenge should be easy to use in maintenance-free deployments of up to three months, cost less than \$5,000 to purchase, and be commercially available by 2017. This initiative is part of a larger staging and portfolio of competitions under the Challenging Nutrients Coalition.

Solution Type: Technology demonstration and hardware; Scientific

Primary Goals: Advance scientific research; Develop technology; Stimulate a market

¹³⁰ www.act-us.info/nutrients-challenge

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Results: This challenge took place in two phases. Five winners from the Phase I of the challenge entered into Phase 2 of the challenge. Teams were international small businesses, representing England, Canada, USA, Italy, and Ireland. In February 2017 EPA awarded first place to Systea, an Italian water quality analysis company, and granted an honorable mention to the National Oceanography Centre, a research institution in the United Kingdom.

B.5.5 Smart City Air Challenge¹³¹

Summary: The EPA's Smart City Air Challenge aims to help communities develop and implement plans for collecting and sharing data from air quality sensors. The EPA will award up to \$40,000 a piece to two communities in the United States. The EPA expects the challenge to yield several benefits, such as identifying best practices for managing big data at the community level, engaging citizens in collecting data about their community, and using data from many sensors to understand environmental condition and its relationship to human health.

Solution Type: Technology demonstration and hardware; Business plans

Primary Goals: Find and highlight innovative ideas; engage new people and communities; and build capacity

Results: A total of 22 submissions were received during Phase I of the competition. The EPA found all submissions to be of excellent quality, though several have technical, institutional and financial barriers for the implementation of their projects.

The EPA selected Baltimore, MD and Lafayette, LA as the winners of the Smart City Air Challenge. After a year, the EPA will evaluate the two cities' projects and award up to \$10,000 to each of the winners based on their accomplishments in implementation. In addition, the EPA recognized the following cities with an honorable mention based on their innovation and potential to help other communities: Mesa, CO; Minneapolis, MN and St. Paul, MN; New York, NY; and Raleigh, NC.

B.5.6 Transform Tox Testing Challenge¹³²

Summary: In this challenge, the EPA seeks to find new ways to incorporate physiological levels of chemical metabolism into high-throughput screening (HTS) assays. The primary objective of this competition is to find innovative technological solutions to retrofit existing HTS assays to allow both chemicals and their metabolite products to be evaluated, and the intent is to apply this technology to future chemical evaluation.

¹³¹ www.challenge.gov/challenge/smart-city-air-challenge

¹³² www.challenge.gov/challenge/transform-tox-testing-challenge-stage-1

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In the first stage, ten submissions were selected as semi-finalists, awarded a prize of \$10,000 each, and participated in semi-finalist workshop discussions. In the second stage, semi-finalists were charged with putting their ideas into practice by meeting a general level of performance, technically characterizing the metabolic ‘competence’ of their system, and functionally characterizing their system in pilot screens. The target requirements and success criteria of Stage 3 are to be determined.

Solution Type: Ideas; Technology demonstration; Scientific

Primary Goals: Solve a specific problem; Advance scientific research; Develop technology

Results: All 10 winners produced innovative concepts for retrofitting high-throughput screening HTS assays to include metabolic competence.

B.5.7 Visualize Your Water Challenge¹³³

Summary: As nutrient pollution is one of America’s most widespread and costly environmental problems, the EPA is seeking better tools to communicate this issue. This challenge engages high school students in the Great Lakes and Chesapeake Bay watershed states to create compelling visualizations about nutrient pollution using GIS software and water quality data collected by federal, state, and local efforts. In addition, the EPA aims to cultivate career-oriented skills in students, and have students learn about local nutrient pollution issues while encouraging environmental stewardship.

Solution Type: Creative; Visualizations; Other: Storytelling

Primary Goals: Inform and educate the public; Engage new people and communities

Results: A total of 88 high school students entered complete submissions to the competition. There were six awardees, all of whom created compelling visualizations of nutrient pollution. A total of \$7,500 in cash prizes were awarded. The grand prize winner, first place Chesapeake Bay winner, and first place Great Lakes winner each received a \$2,500 award.

¹³³ www.challenge.gov/challenge/visualize-your-water

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B.6 National Aeronautics and Space Administration

B.6.1 3D Printed Habitat¹³⁴

Summary: NASA and its partners are holding a \$2.5 million competition to build a 3D-printed habitat for deep space exploration, including the agency's journey to Mars. The multi-phase challenge is designed to advance the construction technology needed to create sustainable housing solutions for Earth and beyond.

Shelter is among the most basic and crucial human needs, but packing enough materials and equipment to build a habitat on a distant planet would take up valuable cargo space better used for other life-sustaining provisions. The ability to manufacture a habitat using indigenous regolith, the layer of loose, rocky material covering bedrock, in combination with material that would otherwise be waste from the spacecraft would be invaluable.

Solution Type: Creative; Technology demonstration and hardware

Primary Goals: Solve a specific problem; Develop technology; Stimulate a market

Results: This challenge has not yet been competed, however, a partnership with Bradley University that included three sponsors (Caterpillar, Bechtel, and Brick & Mortar Ventures) has been secured. Level 2 registration opened October 2016 through January 2017. Five teams are currently registered. There are 4 International Teams and 5 U.S. teams. Respectively, registrants include: Richard Bettridge (Canada), Joginderpal Singh (India), Raja Sekhar (India), BIOME (Malaysia), CTL Group Mars (IL), Peter Castelanos (CA), Thomas Alan Kell (FL), Purdue University (IN), and University of Colorado, Boulder (CO).

B.6.2 AGU Visual Based Scientific Storytelling Competition¹³⁵

Summary: NASA's American Geophysical Union (AGU) competition aims to provide advanced visualization experience to college STEM students. Visual storytelling is a powerful means for explaining NASA scientific research and aspects of NASA satellite and model data products available to the scientific community. While high-impact animations and graphics can provide a deeper level of engagement with the data and subject matter, most undergraduate and graduate-level scientists have relatively little experience in the use of advanced visualizations.

Solution Type: Creative; Ideas; Scientific

¹³⁴ 3dpchallenge.tumblr.com

¹³⁵ education.agu.org/grants/data-visualization-storytelling-competition

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Primary Goals: Advance scientific research; Inform and educate the public; Engage new people and communities

Results: AGU announced the winners of the contest in October 2016. Five grand prize winners received a \$2,500 grant and complimentary registration to attend the 2016 AGU Fall Meeting, complimentary registration to the \$2,500 grant to attend and Earth and space meeting in 2017, \$1,000 travel stipend to visit a NASA center to collaborate with NASA scientists in 2017, and the opportunity to present their project at the 2016 AGU Fall Meeting and other AGU affiliated meetings. Five runner-up winners received a \$1,000 grant and complimentary registration to attend the 2016 AGU Fall Meeting.

B.6.3 Asteroid Grand Challenge Video¹³⁶

Summary: The Asteroid Grand Challenge is focused on identifying threats posed by asteroids to human populations. Estimates suggest less than 10% of objects smaller than 300 meters in diameter and less than 1% of objects smaller than 100 meters in diameter in space have been discovered. Therefore, it will take a global effort with innovative solutions to accelerate the survey of potentially hazardous asteroids. For this challenge, NASA seeks to develop a suite of videos to inform the public about the Asteroid Grand Challenge (AGC) program. The AGC aims to engage the broadest audience possible to help accelerate the hunt for hazardous asteroids. The AGC team is targeting a creative community of artists, designers, filmmakers, and visual communicators to develop exciting visual content to be shared through the AGC website and associated social media. This visual content will be used to help enlist an entirely new community in the cause of planetary defense.

Solution Type: Creative (design & multimedia)

Primary Goals: Solve a specific problem; Engage new people and communities

Results: NASA, through Tongal, received over 600 ideas, which were narrowed down to 4 possible pitch concepts. Cascadium Pictures of Brooklyn, NY, submitted the winning pitch to produce the final video.

B.6.4 Big Idea Challenge¹³⁷

Summary: The primary objective of the FY 2016 BIG Idea competition was to engage the university community in a real-world NASA challenge which seeks novel and robust applications of hypersonic inflatable Aerodynamic deceleration (HIAD) technology to generate lift. Future

¹³⁶ tongal.com/project/NASAAsteroidGrandChallenge

¹³⁷ bigidea.nianet.org

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Mars missions could greatly benefit from HIAD-based entry vehicles as they would provide additional mission flexibility.

To participate in the FY 2016 challenge, university teams of 3-5 students submitted white papers on ideas for generating lift using Hypersonic Inflatable Aerodynamic Decelerator (HIAD) technology. Based on a review of the white papers, 10 teams were selected submit full technical papers on their concept. After reviewing the technical papers, the BIG Idea judges selected four final teams to present their concepts to the judges at the 2016 BIG Idea Forum, held at the NASA Langley Research Center, April 18-19, 2016.

Solution Type: Ideas; Analytics, visualizations, algorithms; Scientific

Primary Goals: Find and highlight innovative ideas; Solve a specific problem; Engage new people and communities

Results: Thirteen teams entered the competition from universities from across the country. Six students went on to accept a summer internship offer at NASA's Game Changing Development Program (GCD). The winning submission, "Cable-Controlled Aeroshell Deceleration System," was submitted by Aerospace Engineering students at the University of Illinois at Urbana-Champaign. Team members included: Sashank Gummella (sophomore), Steven Kosvick (sophomore), Austin Scott (sophomore), Jose Tuason (senior), and Sam Wywrot (sophomore). Their faculty advisor was Zachary Putnam, Assistant Professor of Aerospace Engineering.

B.6.5 Bio-Inspired Advanced Exercise Concepts¹³⁸

Summary: NASA's Orion spacecraft, or Multi-Purpose Crew Vehicle (MPCV), is designed to hold four astronaut crewmembers for up to 21 days and will take humans farther than they've ever gone before. During space missions, the astronaut crews' health is a key priority which requires regular resistive and aerobic training, even on short missions. With this challenge, NASA seeks to expand the trade space of options and exploit potential bio-inspired approaches which have not been traditionally employed. The winning proposal developed a solution inspired by structures underlying a chameleon's tongue.

Solution Type: Ideas; Scientific

Primary Goals: Find and highlight innovative ideas; Advance scientific research; Engage new people and communities

¹³⁸ www.innocentive.com/ar/challenge/9933803

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Results: The winning submission, "Bio-Inspired Micro-Gravity Exercise Concept" (BIMGEC), was developed in Ireland and awarded \$15,000. The solution was inspired by the spiral structure of a chameleon's tongue that stores energy. BIMGEC is a collagen catapult structure that uses constant torque springs. BIMGEC consists of 3 major systems: Force Generation, Force Variation, and Load Profile Variation. The design met the weight, size, and range of motion requirements along with providing aerobic and resistive exercises. BIMGEC runs on a lithium polymer battery.

B.6.6 CineSpace 2016: NASA Imagery - Your Vision¹³⁹

Summary: NASA makes publicly available film that it has collected over 50 years of exploring the universe. This competition offers film makers from around the world a chance to share their work inspired by and using that imagery to foster content that highlights the intersection of art and science. Selected submissions were shown to audiences at the 2016 Houston Cinema Arts Festival (HCAF) hosted by the Houston Cinema Arts Society (HCAS). The challenge exceeded its planned measures of success and drew in artists from a range of backgrounds.

Solution Type: Creative (design & multimedia)

Primary Goals: Solve a specific problem; Engage new people and communities

Results: CineSpace 2016 had 133 pre-registrations, 904 registered competitors, 13 teams, and 459 submissions from a pool of 68 countries with registered competitors and 50 countries with submissions. This more than double the 2015 CineSpace entries. The challenge community had diverse backgrounds ranging from middle school students to professional filmmakers and the majority identify themselves as artists.

The 2016 winners in first, second, and third place respectively are "1950DA" by Sébastien Tulard (France), "Music of Spheres" by Joe Bougher and Kohl Threlkeld (U.S.), and "Voyager" by Loïc Mager and Roman Veiga (France). "Exploration" by Ryan J Thompson (U.K.) received an Honorable Mention.

B.6.7 Cube Quest Challenge¹⁴⁰

Summary: The Cube Quest competition offers a total of \$5.0 million to teams that meet the challenge objectives of designing, building and delivering flight-qualified, small satellites capable of advanced operations near and beyond the moon. Cube Quest teams have the opportunity to compete for a secondary payload spot on the first mission of NASA's Orion spacecraft, which will launch atop the agency's Space Launch System (SLS) rocket.

¹³⁹ www.nasa.gov/feature/cinespace-nasa-imagery-your-vision-2016

¹⁴⁰ www.nasa.gov/directorates/spacetech/centennial_challenges/cubequest/index.html

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The competition includes three stages: Ground Tournaments, Deep Space Derby, and Lunar Derby. Teams may compete in any one of the four Ground Tournaments and those rated high on mission safety and probability of success can receive incremental awards. The Ground Tournaments will be held every four to six months, leading to an opportunity to earn a spot on the first integrated flight of Orion and SLS. The Deep Space Derby focuses on finding innovative solutions to deep space communications using small spacecraft, and the Lunar Derby focuses on advancements in small spacecraft propulsion and near-Earth communications. Together, these competitions contribute to opening deep space exploration to non-government spacecraft. This challenge is ongoing.

Solution Type: Technology demonstration and hardware

Primary Goals: Develop technology; Engage new people and communities

Results: Ten teams participated in the second Ground Tournament competition with 5 winners awarded \$30,000 each. Through the first two Ground Tournaments, 7 teams qualified for the Exploration Mission-1 launch opportunity and 6 remain in the competition. The teams were a mix of university and industry groups from all over the U.S. All 6 remaining teams qualified for Exploration Mission-1, including the 5 winners of the second Ground Tournament which plan to compete in the third.

Exploration Mission-1 qualified teams include: CIS Lunar Explorers, Cornell University (NY); MIT KitCube, MIT (MA); SEDS Titeria, University of California, San Diego (CA); CU Earth Escape Explorer (CU-E3), University of Colorado, Boulder (CO); Team Miles, Fluid & Reason LLC (FL); and Ragnarok, Ragnarok Industries, (DE).

B.6.8 Experiment Attachment System (EAS) Challenge¹⁴¹

Summary: In support of the Logistics Reduction project, NASA challenged the GrabCAD Community to design an Experiment Attachment System (EAS), a mechanism to attach a future experiment to the International Space Station (ISS) that meets logistics reduction, mass, and assembly requirements.

The main goal of the NASA Logistics Reduction project is to decrease the dependence on earth resupply for space missions. This can be done via direct mass reduction, re-purposing logistics, and conversion of waste into useful by-products (gases, water, and solids) in order to maximize the use of items, and create new uses beyond an item's original purpose. Logistics includes crew consumables (food, packaging, clothing, etc.), automation of logistics management, and waste

¹⁴¹ grabcad.com/challenges/nasa-experiment-attachment-system-eas-challenge

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management. Logistics reduction is of particular benefit for the ISS, where, in a remote, zero gravity environment, adapting mechanisms and devices to manage components of an experiment can prove challenging.

Solution Type: Scientific

Primary goals: Find and highlight innovative ideas; Solve a specific problem; Advance scientific research

Results: Five winning designs from 50 entries were selected, and will be used to inform final ISS designs. Designs included manufacturing considerations and stress analysis, system description, 3D models in Standard for the Exchange of Product model data (STEP)/Initial Graphics Exchange Specification (IGES) formats, renderings, load calculations, and assembly procedure.

The winning designs demonstrated a wide range of approaches to address requirements for stowage, crew assembly ease, and structural integrity. The creativity and diversity of approaches significantly increased the optimization of the design (and decreased the time and effort required to optimize the design).

B.6.9 Freelancer Micro Purchase Challenges

Summary: Following the success of a pilot conducted on the Freelancer platform in 2015, several new challenges were launched in FY16 via a government purchase card to acquire solutions that meet short-term needs for several NASA projects. NASA sought to provide the following results for the following NASA projects:

- Astronaut Smartwatch Application Development Task¹⁴²
- Design a Patch/Graphic for NASA's Center for Climate Simulation (NCCS)¹⁴³
- Design a Patch/Graphics for the In-Space Manufacturing (ISM) project¹⁴⁴
- Design a Patch/Graphics for NASA's RFID-Enabled Autonomous Logistics Management (REALM) project¹⁴⁵
- Design a User Interface Theme for NASA's Robotic Systems (Currently active, estimated values)¹⁴⁶

¹⁴² www.freelancer.com/projects/Mobile-Phone/Develop-NASA-Astronaut-Smartwatch/#/details

¹⁴³ www.freelancer.com/contest/NASA-Challenge-Create-a-Graphic-Design-for-NASA-Center-for-Climate-Simulation-NCCS-536887.html

¹⁴⁴ www.freelancer.com/contest/NASA-InSpace-Manufacturing-Logo-Challenge-376284.html

¹⁴⁵ www.freelancer.com/contest/contest.php?project_id=770728

¹⁴⁶ www.freelancer.com/contest/NASA-Contest-Robotic-Systems-User-Interface-Theme-766578.html

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- NASA System Architecture Study Challenge (Free Flyer Robotic Arm System Architecture Contest)¹⁴⁷
-

This challenge continues to show high value for NASA, with a large participant pool and a range of new solutions produced for small prize values.

Solution Type: Creative (design & multimedia); Software and apps; Analytics, visualizations, algorithms; Scientific

Primary Goals: Solve a specific problem; Engage new people and communities

Results: Micro-purchase challenges demonstrate potentially high value to NASA with savings as high as 85-95% when compared with traditional forms of acquiring similar products. NASA provides successful/winning submissions with awards ranging from \$3,000 to \$10,000.

Combined, these contests included over 4,200 participants from over 150 countries providing over 1,400 submissions. Winners included:

- Robotics UI Theme submitted by Sanja Zakovska (Macedonia)
- ISM graphic submitted by Franklin Corneau (Canada)
- NCCS graphic submitted by Mario Jon Atom (Indonesia)
- REALM graphic submitted by Switchedau (Australia)
- Smartwatch App submitted by Anton Bredykhin (Ukraine)
-

The products resulting from these challenges include:

- A complete user interface theme to be used for robotics controls displays
- Three different project graphics to be used on project patches and presentations
- A working smartwatch application with functioning displays for crew timeline, caution and warning, and communications status (and a data emulator to drive the smartwatch displays across a wireless network)
- Multiple sets of system architecture decompositions used to study novel and innovative approaches to traditional systems engineering approaches to systems architectural decomposition

B.6.10 Future Engineers 3D Design Challenges¹⁴⁸

Summary: Future Engineers 3-D Space Challenges are designed to inspire and involve the next generation of scientists and engineers with 3-D printing technology, space exploration, and digital

¹⁴⁷ www.freelancer.com/contest/contest.php?project_id=329981

¹⁴⁸ www.futureengineers.org

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design. The “Star Trek Replicator Challenge,” in collaboration with the 50th anniversary of Star Trek and the replicator technology, asks students to design a non-edible, food related object for astronauts to 3-D print by the year 2050. The “Think Out of the Box Container Challenge” asks students to design a useful object for astronauts on a future space exploration mission that could be expanded or assembled to be larger than available volume of a 3D printer.

Solution Type: Creative (design & multimedia)

Primary Goals: Find and highlight innovative ideas; Inform and educate the public; Engage new people and communities

Results: The Star Trek Replicator Challenge winner from the Teen Group (ages 13-19) was Kyle Corrette from Desert Vista High School in Phoenix, Arizona, who designed a Melanized Fungarium. The winner of the Junior Group (ages 5-12) was Sreyash Sola from Eagle Ridge Middle School in Ashburn, Virginia, who designed an Astro Mini Farm.

The Think Out of the Box Challenge winner from the Teen Group (ages 13-19) was the Expanding Pod designed by Thomas Salverson, of Gretna, Nebraska and currently a freshman at the University of Alabama in Huntsville. The winner of the Junior Group (ages 5-12) is the Space Anchor designed by Emily Takara of Cupertino, California.

B.6.11 Human Exploration Rover Challenge¹⁴⁹

Summary: The NASA Human Exploration Rover Challenge engages high school and college students in the design, construct, and testing of technologies for mobility devices for use in extraterrestrial environments. NASA challenged high school and college students to design and race human-powered rovers that could carry two students over a half-mile obstacle course of simulated extraterrestrial terrain including craters, boulders, ridges, inclines, crevasses, and depressions. In April 2016, teams convened with their constructed rovers at the US Space and Rocket Center to race and compete in optional challenges. The competition garnered participation from a large range of teams, seeing both new teams and improvements from teams that have participated in previous years.

Solution Type: Technology demonstration and hardware

Primary Goals: Find and highlight innovative ideas; Solve a specific problem; Build capacity

¹⁴⁹ www.nasa.gov/roverchallenge

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Results: A total of 67 teams of which 36 (48%) were college students and 31 (52%) were high school students participated in the 2016 Challenge, representing 18 states, Puerto Rico and five countries (India, Italy, Russia, Germany and Mexico). Eleven of the teams were new this year. The competition involved nearly 500 students and faculty, nearly 300 volunteers, and hundreds of community helpers and supporters.

NASA awarded the top three teams with the shortest course completion times in the high school and college divisions. In addition, NASA awarded the following specialty awards: Sample Retrieval Challenge Award, Neil Armstrong Best Design Award, Technology Challenge Award, Featherweight Award, Telemetry and Electronics Award, Crash and Burn Award, Spirit Award Rookie of the Year Award, Jesco von Puttkamer International Team Award, Best Report Award, Most Improved Award, and the International System Safety Society Award.

B.6.12 Improving NASA Enterprise Search Capabilities¹⁵⁰

Summary: In 2014, the NASA Office of the Chief Information Officer (OCIO) sponsored a challenge to develop a user interface for their new Enterprise Search Portal. The objectives were to (1) develop a search interface that was intuitive for beginner to advanced search users and (2) have an internal search interface that allows users to search against NASA's intranet as well as public internet data sets.

Participants successfully developed a prototype in a previous challenge that is integrated with the search.gov application programming interface (API), includes a responsive design, and is iPhone and iPad-friendly. The OCIO is now integrating a new search engine that will serve as a back-end to the Enterprise Search User Interface (UI) and aims to expand capabilities while enriching the overall NASA Enterprise Search experience.

Solution Type: Software and apps

Primary Goals: Improve government service delivery; Develop technology

Results: The Topcoder community successfully developed an enterprise search capability that utilizes SolrCloud as the search engine/index, integrates SolrCloud with the front-end web app, and implements a robust recommendation engine. The results included the development of functionality to support charts, tabs, content type search, geolocation filtering, date range filtering, and Section 508 compliance. The challenge also included a security review and vulnerability remediation.

¹⁵⁰ www.topcoder.com

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The OCIO was especially pleased with the innovation that resulted as part of the challenge process and the ability to tap into a nearly unlimited amount of potential solutions/approaches.

B.6.13 *In Situ* Materials Challenge¹⁵¹

Summary: *In situ* resource utilization (ISRU), or the harnessing of natural resources at mission destinations, has the potential to enhance the capabilities of future space exploration. To illustrate this, for every kilogram of native materials used on Mars, 11 kg of transportation propellant and spacecraft mass would be saved. The *In Situ* Materials Challenge aims to design and produce proof-of-concept modular structural elements that can be configured for multiple purposes, including: launch/landing pads and blast protection berms; roads and walkways; radiation, thermal, and micro-meteorite shielding insulation and structures; dust free hangars and equipment shelters; etc. The challenge engages the creativity of the scientific community in developing innovative advancements for the use of situ materials for regolith-based fabrication and construction techniques. Each of the winning designs provided features and elements that help to move this technology forward.

Solution Type: Scientific

Primary Goals: Find and highlight innovative ideas; Solve a specific problem; Advance scientific research

Results: This challenge received in 61 submissions from 26 countries, and three prizes were awarded. Behrokh Khoshnevis of the University of Southern California was awarded first place, and the submissions by Aronax Technologies Group, LLC of Spain and Patrick Donovan of the United States tied for 2nd place.

In reflection, NASA noted that the challenge format provided an excellent method to survey and connect with existing technology development efforts around the world. Given the advanced nature of this work, knowledge of these efforts provided a strategic advantage for NASA's future planetary systems development.

B.6.14 International Space Apps Challenge¹⁵²

Summary: NASA and the European Space Agency (ESA)'s International Space Apps Challenge is an open innovation incubator and hackathon that encourages innovation, creativity, and collaborative problem solving around open data and tools. Mission-relevant challenges are crafted with NASA and ESA subject matter experts who gather and clean up the data, and set citizens free

¹⁵¹ ninesights.ninesigma.com/web/nasa-hub

¹⁵² 2016.spaceappschallenge.org

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to create innovative data and hardware solutions. Teams form around like-minded interests and pull in complementary skills to craft a weekend project that is presented to local judges at each of the 161 cities across the globe at the conclusion of the event. Local judges present awards and forward to NASA two project nominees for global award, and one People's Choice nominee.

This year, over 15,000 citizens around the world donated a weekend (in addition to the 25,000 volunteer hours of local organizers of the event) to engage with NASA's data. The event has gotten larger every year, and citizens have reported a positive experience of taking part in this endeavor and feeling part of the NASA family.

Solution Type: Software and apps; Creative; Ideas; Technology demonstration and hardware; Nominations; Business plans; Analytics, visualizations, algorithms; Scientific

Primary Goals: Find and highlight innovative ideas; Solve a specific problem; Other: Make open data accessible and usable, and spur innovation at the local level

Results: The competition garnered 15,409 participants from 61 countries. Across 25 challenges 1,300 team solutions were entered. At the conclusion of the event NASA announced the following awards: Best Use of Data, Best Use of Hardware, Best Mission Concept, Galactic Impact, Most Inspirational, and People's Choice

B.6.15 Mars Ascent Vehicle (MAV)¹⁵³

Summary: When NASA returns samples from Mars, there will be a requirement for a special rocket system — the Mars Ascent Vehicle (MAV) — to launch capsules from Mars' surface into orbit and rendezvous with a spacecraft that will return them to Earth. The competition mimicked a MAV mission. Teams were asked to build a robot that can locate and collect a cache of samples and autonomously load a sample into a rocket. The rocket must then launch the load 5,280 feet into a simulated orbit around Mars. The MAV Prize was open to both academic and non-academic teams. This challenge produced a several unique solutions which met NASA's goals, and the top three teams were awarded prize money.

Solution Type: Technology demonstration and hardware

Primary Goals: Solve a specific problem; Develop technology; Engage new people and communities

¹⁵³ www.nasa.gov/directorates/spacetech/centennial_challenges/mav.html

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Results: Competitors from 17 universities and 1 high school team participated, with 11 returning to the competition from 2015. Roughly half of the teams successfully met the challenge goals and three were awarded prize money: Cornell University (\$25,000), Madison West High School (\$15,000), and Tarleton State (\$10,000).

B.6.16 Rice Business Plan Competition¹⁵⁴

Summary: NASA, through its various Human Health and Performance (HH&P) activities, is constantly seeking new ideas for health-related technologies that will improve medical care capabilities on Earth and have potential application to human spaceflight. The Rice Business Plan Competition provides another means to find new innovative technology ideas that complement current methods of addressing the health-related technology needs of NASA. In this challenge, participants are asked to prepare an Executive Summary and Business Plan and present their technology or innovation to judges. To win the HH&P award, teams must demonstrate (1) support to NASA's current or future mission, (2) how well the technology addressed an identified human systems risk, (3) when the technology would be ready for NASA's use, and (4) how realistic the technology would be for human spaceflight.

This competition has stimulated innovative technology development for the past 9 years. This year, the competition provided a solution for continuous blood pressure measurement, from a team from Northwestern University, with clear applications to NASA's mission.

Solution Type: Business plans

Primary Goals: Find and highlight innovative ideas; Advance scientific research; Engage new people and communities

Results: The HH&P team judged the first round of the competition in several categories based on Earth and space benefits. Bold Diagnostics, a team from Northwestern University, won based on their ability to obtain accurate, continuous blood pressure from a novel platform using pulse wave timing. This technology has immediate applications to clinical care and research within HH&P. Bold Diagnostics finished fourth in the overall competition out of the final 42 teams, taking home a total of \$125,000 in prize money.

¹⁵⁴ www.ricebusinessplancompetition.com

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B.6.17 Sample Return Robot (SRR)¹⁵⁵

Summary: The Sample Return Robot Challenge offers a total \$1.5 million to teams that could demonstrate an autonomous capability to locate and retrieve specific sample types from various locations over a wide and varied terrain and return those samples to a designated zone in a specified amount of time with limited mapping data. Demonstration of autonomous operation would be proof of concept and could open new mission operation scenarios (e.g., future sample return and planetary robotic exploration missions).

The competition is broken up into two levels. Level 1 takes place outdoors, over a large area with multiple courses, each with flat terrain and limited obstacles. For a team to advance to Level 2, the robot must return one undamaged, pre-cached sample and one easy sample within 30 minutes. A pool of \$50,000 will be split among all qualifying teams at the end of Level 1. Level 2 takes place outdoors, over a large area, with both open, rolling terrain and large immovable obstacles. Level 2 teams earn points based on the number of samples and the difficulty of samples retrieved by the robots. If applicable, only the top three scoring teams in Level 2 will be awarded prize money based on the number of points earned in the Level 2 competition. This is an annual competition that allows previous competitors to return for the Level 2 portion in subsequent years.

Solution Type: Technology demonstration and hardware; Software and apps

Primary Goals: Solve a specific problem; Develop technology; Engage new people and communities

Results: Five (5) teams qualified in the 2016 Level 1 competition while only 2 teams qualified in the previous 4 years. Team AL, Alabama Astrobotics, MAXed OUT, Mind and Iron, and Sirius won \$5000 in Level 1 and qualified to move on to Level 2. Winner: West Virginia University (qualified for Level 2 in FY 2015 competition) collected enough samples to win \$750,000 from the \$1,500,000 prize purse in the Level 2 competition.

B.6.18 Sky For All¹⁵⁶

Summary: The current U.S. airspace system handles roughly 10,000 vehicles per day with human control and is reaching saturation. The airspace of the future will be orders of magnitude more complex, with the envisioned load of around 10 million vehicles per day (personal air vehicles, passenger jets, unmanned vehicles of various sizes and speeds, stationary objects, space vehicles, etc.), with complexity and uncertainty due not only to high numbers and diversity of aircraft, but to autonomy of individual vehicles. A strictly evolutionary approach to the future transportation

¹⁵⁵ www.nasa.gov/directorates/spacetech/centennial_challenges/sample_return_robot/index.html

¹⁵⁶ herox.com/SkyForAll

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system would carry along the current architectural constraints and may not have the necessary scalability to support the airspace of 2035 and beyond. The Big Sky for All challenge is intended to solicit innovative ideas to support the development of clean-slate concepts of operations for the airspace in 2035 and beyond, at any appropriate level (aircraft, groups of aircraft, the entire system), to ensure system safety, robustness, and efficiency. Five teams were awarded prizes: three top place winners, and two honorable mentions. Winning entries integrated known methods and brought new perspective and articulation to the problem.

Solution Type: Ideas

Primary Goals: Find and highlight innovative ideas

Results: Five teams were awarded in this challenge.

- The first place team, Dávid Szirczák, György Bicsák and Aaron Latty from the United Kingdom was awarded \$10,000 for their entry entitled “Autonomous Hierarchical Adaptive Air Traffic Control System”, a dynamic, distributed control strategy based on the types of autonomous vehicles in the system.
- Second place (\$3,000) was awarded to a team from France. Thomas Dubot, Antoine Joulia and Judicaël Bedouet submitted “Clustered Self-Separation out of 4D Bubbles” which proposed integration of many known aspects of the system, including self-separation, clustering, and low-altitude traffic.
- The third place (\$2,000) team hailed from Australia. Jade and Kieren Chantrell proposed “DAS: Dynamic Airspace System” which considered a flocking approach to global flight organization, with reliance on segregated airspace constructs.
- Additionally, two \$500 honorable mentions were awarded to Eduardo Acosta of the United States for “ZenithNet: A New Foundation for the 2035 Airspace” and another U.S. team from The Vreeland Institute for “Airspace 2035: An Open, Distributed Network System”.

B.6.19 Space Robotics Challenge¹⁵⁷

Summary: NASA’s missions, including the Journey to Mars, will require increasing the autonomy of dexterous mobile robots—particularly those of humanoid format—so they can complete specific tasks in a dynamic environment. Eventually, these robots will be required to assist with tasks such as deploying and preparing habitats, power systems and other infrastructure on Mars before humans arrive, and disaster relief and industrial plant maintenance on our own planet. In this challenge, teams are asked to develop software to control a simulated, NASA-developed humanoid that could autonomously move on the surface of planet with gravity, called R5. The challenge seeks to push technologies that will advance the autonomy and dexterity of the R5 robot

¹⁵⁷ www.nasa.gov/directorates/spacetech/centennial_challenges/space_robotics/index.html

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for functioning in a dynamic environment, with special attention to the improvement of perception and manipulation. This challenge has not yet concluded.

Solution Type: Software and apps

Primary Goals: Develop Technology; Build Capacity

Results: Registration for this challenge closed on October 7, 2016. To date, 405 teams have registered from across the country and around the world.

B.6.20 Student Launch Challenge¹⁵⁸

Summary: The NASA Student Launch (SL) is a research-based, competitive, and experiential exploration project that provides relevant and cost-effective research and development to support the Space Launch System, or SLS. Additionally, SL connects learners, educators, and communities in NASA-unique opportunities that align with STEM Challenges under the NASA Education Science, Technology, Engineering, and Mathematics (STEM) Engagement line of business. The project involves reaching a broad audience of middle schools, high schools, informal organizations, colleges, and universities across the nation in an eight-month commitment to design, build, launch, and fly payloads and vehicle components that support NASA research on high-power rockets to an altitude of 5,280 feet above ground level. During launch week, teams visited Marshall Space Flight Center research and development facilities and demonstrate their project to NASA during the Rocket Fair and technical poster presentation. While the middle school/high school component was not a competition, the college/university challenge allowed teams to compete for various prizes including an overall grand prize of \$5,000 sponsored by Orbital ATK.

In addition to the development of a rocket and research requirements, SL teams were challenged to educate others in the areas of Science, Technology, Engineering, and Mathematics (STEM). Teams completed these project requirements in a variety of ways including classroom visits, presentations, rocketry challenges, and hands-on STEM activities with students and teachers in their communities. Although middle school students and educators were prioritized, participants of all grade levels are impacted by the team's Educational Engagement (EE) events. With 54 teams in 2016, this would equate to a minimum of 8,800 students or educators reached; however, our SL teams go above and beyond expectations each year, and reached over 46,113 in FY 2016.

Solution Type: Creative (design & multimedia); Ideas Research Technology demonstration and hardware; Analytics, visualizations, algorithms; Scientific

¹⁵⁸ www.nasa.gov/audience/forstudents/studentlaunch/home/index.html

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Primary Goals: Develop technology; Find and highlight innovative ideas; Solve a specific problem

Results: Orbital ATK provided participation trophies for each team. Additionally, trophies for best vehicle design, payload design, website award, educational engagement award, design review presentations, altitude award, rookie award, safety award, and two peer awards were given. The overall winner, Vanderbilt University in Nashville, TN, received a check for \$5,000 from Orbital ATK. This was the fourth year in a row Vanderbilt has earned the top prize in the NASA Student Launch challenge.

B.6.21 Swarmathon¹⁵⁹

Summary: Through a grant to the University of New Mexico, NASA Swarmathon is a challenge to develop cooperative robotics to revolutionize space exploration. Students from Minority Serving Institutions (MSIs) are challenged to develop search algorithms for robotic swarms. Swarmathon participation was designed to (1) improve students' skills in robotics and computer science and (2) further advance technology for future NASA space exploration missions. The Swarmathon project used small, robotic vehicles called Swarmies to challenge programming skills of students at select minority-serving institutions. Swarmies are small robotic vehicles equipped with a Wi-Fi antenna, GPS, webcam, and sensors. Inspired by observing the foraging behavior of ants, Swarmies were developed to "forage" for resources in a manner similar to that of ants and have the potential to be used in space exploration to search for resources.

With regard to engaging new people and communities, this competition has been extremely successful at engaging Minority Serving Institutions that have not previously participated in NASA-sponsored competitions, or other NASA education activities.

Solution Type: Algorithms written and uploaded by student teams; Technology demonstration of algorithms on robotics hardware provided by NASA

Primary Goals: Advance scientific research; Engage new people and communities; Build capacity

Results: In total, there were 24 teams (26 schools) that competed in the 2016 Swarmathon. 425 students participated in either the Physical or Virtual Swarmathon Competitions. These students represented 16 States.

The first, second, and third place winners of the Physical Competition were Fayetteville State University, Central New Mexico Community College, and Southwestern Indian Polytechnic University, respectively.

¹⁵⁹ nasaswarmathon.com

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The first, second, and third place winners of the Virtual Competition were Cabrillo College, Durham Tech, and Texas A&M International University, respectfully.

B.6.22 Textile Test Methods Challenge¹⁶⁰

Summary: Space suits used today offer multi-layered protection from harsh space environments. As NASA moves forward with human exploration, the outer protective layer's function must expand to withstand widely varying types of dirt in planetary environments like the moon, Mars, or large asteroids. To expand to handle these new environments, new tools will be required for assessing the viability of candidate space suit textiles. No repeatable/standard test methodology for assessing candidate environmental protection garment (EPG) textile lay-ups with respect to damage during use in planetary exploration currently exists. The goal of the Textile Test Methods Challenge is delivery of a standardized test protocol(s) to assess damage to any proposed EPG lay-up for lunar and Martian exploration environments along with documentation for the fabrication of any specialized equipment required for the proposed protocol(s). While none of the winning solutions completely fulfilled NASA's needs, each provided features of insight that may be of future value.

Solution Type: Scientific

Primary Goals: Solve a specific problem; Advance scientific research; Develop technology

Results: This challenge received 23 submissions from 7 countries. Three prizes of \$5,000 each were awarded to:

- Christopher Daniels from the University of Akron (U.S) with his proposal the "Cylindrical Abrasion Method."
- Ahilan Anantha Krishnan from India won with his proposal "Test Methodology for Evaluating Space Suit Textile Layup Abrasion."
- John Holler, a metal worker with Vinland Forge (U.S.) won with his proposal "A Complete System for Textile Abrasion Testing."

While none of the submissions provided a complete solution for NASA's needs, all of the selected designs provided features and elements that may help in developing a repeatable method for testing EVA suit materials.

¹⁶⁰ ninesights.ninesigma.com/web/nasa-eva-test

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B.6.23 Vascular Tissue Challenge¹⁶¹

Summary: NASA’s objective for the Vascular Tissue Challenge is to produce technologies capable of creating viable thick (>1cm) vascularized metabolic tissues that can be used to promote medical applications in space and on Earth. Successful development of these tissues would result in a significant breakthrough in the state of the art and would advance research on human physiology, fundamental space biology, and medicine taking place both on the Earth and the ISS National Laboratory. Specifically, technology innovations may enable the growth of de novo tissues and organs on orbit that may address the risks related to traumatic bodily injury, improve general crew health, and enhance crew performance on future, long-duration missions.

Success of the Vascular Tissue Challenge would result in a breakthrough in the state of the art described by some experts as the “Holy Grail” of tissue engineering. It would advance lifesaving medical research, especially related to organ diseases of the heart, lungs, liver, kidney, and muscles, and would offer important new tools in for medical research supporting NASA’s Journey to Mars, promote medical research on the International Space Station for terrestrial benefit, and promote partnerships with allied organizations.

The Vascular Tissue Challenge is a “first-to-demonstrate” challenge that is open through FY19 or until the challenge is met, whichever comes first.

Solution Type: Technology Demonstration

Primary Goals: Solve a specific problem; Engage new people and communities; Stimulate a market

Results: So far, this challenge has developed a partnership with the Methuselah Foundation’s New Organ Alliance, and hosted a successful workshop that focused on identifying new research directions, barriers to progress, new funding opportunities, new collaborative opportunities, and new directions for space research. Teams from 6 different universities have submitted “Intent to Compete” forms.

B.7 National Science Foundation

B.7.1 The Vizzies¹⁶²

Summary: As the need to increase science literacy grows more urgent, illustrations can provide immediate and influential connections between scientists and other citizens. Utilizing these

¹⁶¹ www.nasa.gov/directorates/spacetech/centennial_challenges/vascular_tissue.html

¹⁶² www.nsf.gov/news/special_reports/scivis/

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visualizations may be the best hope for nurturing popular interest, helping scientists explain complex problems, and demonstrating to the public the illustrative aspects of science and engineering. In the Vizzies challenge, NSF asked participants to submit creative, science visualizations that promote understanding of scientific and engineering research. These entries were submitted in one of five categories: photographs, illustrations, posters/graphics, videos or interactive media. The competition received 277 entries for this cycle consisting of both individual and team submissions from academia and private organizations, with winners across five categories awarded cash prizes totaling \$15,000. The images and visualizations from the Vizzies challenge are treasured by the foundation and are used to promote NSF and the research the agency funds beyond just advertising the next cycle of Vizzies. A new innovation, a moving .gif image of one of the winning videos, “Coral Bleaching: A Breakdown of Symbiosis,” has been featured prominently on the NSF Vizzies website—one of the first .gif images to be used on the site.

Solution Type: Creative (design and multimedia); Analytics, visualizations, and algorithms; Scientific

Primary Goals: Advance scientific research; Inform and educate the public; Engage new people and communities.

Results: The Vizzies competition received 277 entries for this cycle consisting of both individual and team submissions from academia and private organizations. The competition received entries from 36 states and nine countries. Sixty-six entries were self-identified by their submitter as being the result of NSF funded research. Team size varied from 2-19 members. NSF values the visualizations from the Vizzies competition and uses the submissions to promote NSF and NSF-funded research. Vizzies images have been featured on the covers of NSF brochures, in NSF directors’ speeches, and (with permission) as backdrops for foundation press and televised events. Winning images from the 2016 cycle as well as their titles and descriptions can be seen here: www.nsf.gov/news/special_reports/scivis/winners_2016.jsp.

B.8 United States Agency for International Development

B.8.1 EduApp4Syria^{163,164}

Summary: As part of USAID’s All Children Reading partnership program, the Norwegian Agency for Development Cooperation has partnered with USAID and the Norwegian University of Science and Technology to catalyze the development of a smartphone application that can significantly

¹⁶³ www.norad.no/en/front/thematic-areas/education/innovation/eduapp4syria

¹⁶⁴ allchildrenreading.org/challenge/grant_prizes

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increase literacy levels in Arabic and improve psychosocial wellbeing for children (aged 5-10) in Syrian households that use the application. The application is primarily meant to supplement the formal and non-formal educational programs that exist, even though it could also be used within these programs. This is important because the Syrian conflict is causing disruption to the education of millions of children, in addition to threatening their physical safety and psychosocial wellbeing. Almost three million Syrian children are out of school, which creates hurdles to achieving the reading and writing fluency (literacy) that is foundational for lifelong learning. As such, it is important to provide opportunities to develop this skill for children who may be transient and do not have the opportunity to learn in a classroom. Smartphones have been a key survival tool used by many refugees, and reports and findings from field trips indicate high availability of smartphones among Syrian refugees. A factor that compounds the learning challenge is that Syrian children, both inside and outside of school, and inside and outside of Syria, are living under the extreme stress of protracted conflict. Elevated and prolonged stress levels can impede brain development and result in learning disabilities, memory problems and emotional regulation difficulties.

Solution Type: Software and apps

Primary goals: Solve a specific problem; Develop technology; Find and highlight innovative ideas

Results: The competition had three finalists and two runners up from 78 submissions: Kukua (finalist), Cologne Game Lab (finalist), The Center for Educational Technology (finalist), Creative Associates International (runner-up), and Creuna (runner-up).

B.8.2 Off-Grid Refrigerator Competition¹⁶⁵

Summary: The Global LEAP Off-Grid Refrigerator Competition seeks to catalyze new technological and design advancements in high-efficiency, low-cost refrigeration solutions. By inspiring greater participation and innovation in the market, the competition will contribute to improving access to affordable refrigeration technology that is compatible with off-grid energy sources. Off-grid refrigeration holds unique potential to unlock economic and social progress for the billions of un- and under-electrified people globally. However, existing solutions are largely either too inefficient or too expensive to serve off-grid consumers and the market remains nascent. The competition asks for late-stage prototype or commercially available refrigerators or refrigerator/freezer combination units that are either compatible with off-grid energy systems such as solar home systems or mini-grids or solar direct drive refrigerators. Two prizes will be awarded after laboratory testing for Energy Efficiency and Overall Value. A subset of products will move onto to field testing, where they will be evaluated on the above criteria in a real-world setting, as well as additional user-oriented factors, including impact of the product, perceived value, and

¹⁶⁵ globalleap.org/refrigerators

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usability. A third prize for Appropriate Design and User Experience will be awarded based on the Field Testing outcomes.

Solution Type: Technology demonstration and hardware

Primary goals: Solve a specific problem; Develop technology; Stimulate a market

Results: As of November 1, 2016, 16 organizations have submitted applications, although not all are complete. The 16 applications have come from 10 different countries, including Uganda, Nigeria, Ghana, Cote d'Ivoire, and Bangladesh. Many other organizations have signaled an intent to participate, including one company which indicated while they originally planned to introduce a refrigeration product in 2-3 years, they are accelerating their development timeline in response to the competition. In addition, a small innovation-focused engineering and product design company, has mobilized a team of four engineers to fast-cycle development of a prototype product explicitly for the purposes of entering the competition. The competition partners had no pre-existing relationship with them—they heard about the competition via our general outreach.

B.8.3 Tracking and Tracing Books¹⁶⁶

Summary: Books are essential to early grade reading instruction. However, often times when books (both textbooks and supplemental reading materials) are ordered for low income countries, they do not end up in the hands of the students who need them. Textbooks and materials can go astray at any stage in the delivery process--from the point-of-entry for imported textbooks, to central warehouses for nationally produced materials, to transportation across difficult and sometimes insecure routes or even during final distribution to regional offices and classrooms.

Experience in developing countries suggests that when parents, teachers, and other local stakeholders know what books are to be delivered and when, they will advocate for on-time delivery. But they rarely have this information and even when they do, they are not able to track books while in transit. Government and donor agency officials may discover that materials have not arrived at schools, but without the availability of tracking information, they do not know where they were lost in transit. The first step in solving this problem is to source innovations to track books in transit and trace them to their destination. As such, All Children Reading: A Grand Challenge for Development launched the Tracking and Tracing Books Prize Competition.

The Tracking and Tracing Books competition seeks innovations with four main components: a process for tracking and tracing books, associated software, associated hardware and devices, and a method for engaging/easily interfacing with users. Moreover, it is a requirement that the proposed solutions cover the whole supply chain – tracked from the point where the books are

¹⁶⁶ allchildrenreading.org/innovation/prize-winners/#tracking_tracing_books

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ordered to delivery in the classroom or early-learning center. The Track and Trace systems submissions that were considered were supply chain solutions comprised of software and hardware.

Solution Type: Software and apps; Technology demonstration and hardware

Primary goals: Find and highlight innovative ideas; Solve a specific problem; Develop technology; Improve coordination and communication; Improve government service delivery

Results: The Tracking and Tracing Books competition was completed in November 2016. Two winners were selected: Community Systems Foundation (CSF) and John Snow Inc. (JSI). CSF a non-profit organization, was awarded a total of \$110,000 for their open source solution, OpenEMIS Logistics, a software that tracks the delivery of textbooks to schools. JSI, a for profit company, was also awarded \$110,000 for their software system which uses simple barcodes to support tracking and tracing of textbooks by education officials throughout the system and enable parents, teachers, and local officials to receive up-to-date information on the status of books and materials.

The Tracking and Tracing Books team believes that both solutions should be available for Ministries of Education, multi-lateral and bi-lateral agencies, international non-government organizations. These two, independent systems allow for the desired end goal to be realized in more locations, since one solution might fare better than another in a particular country. In addition, competition between two solutions produced better and more cost effective products as both organizations learned from each other during the Scoping Trip and alpha testing in Malawi.

B.8.4 Wildlife Crime Tech Challenge¹⁶⁷

Summary: Wildlife trafficking endangers elephants, rhinos, sharks, and other wildlife species. Poachers are linked to international criminal networks that take advantage of weak laws and enforcement, porous borders, and corruption. Criminal activity and the loss of wildlife threaten nature-based tourism, an important source of revenue in many developing countries. Wildlife trafficking, including IUU fishing, is also linked to human trafficking and other illegal trade.

The Wildlife Crime Tech Challenge calls on participants to provide innovative challenges to the problem of wildlife crime. The Wildlife Crime Tech Challenge includes four concurrently run challenges addressing four critically important wildlife crime issues: detecting transit routes, strengthen forensic evidence, reducing consumer demand, and combating corruption. Success/evaluation metrics are equally divided between potential for impact and potential for scale.

¹⁶⁷ wildlifecrimetech.org/index

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All participants submitted a concept note based on a well-defined template requesting information on the proposed solution, its stage of innovation, potential for scale, and more. Finalists were asked to submit a full application expanding on the information requested in the concept note template. In addition to receiving a prize package—including financial support, recognition, and technical assistance awards—prize winners were also eligible to apply for “Grand Prize” of up to \$500,000.

Solution Type: Software and apps; Technology demonstration and hardware; Analytics, visualization and algorithms; and Scientific

Primary Goals: Find and highlight innovative ideas; Develop technology; Engage new people and communities

Results: The Wildlife Crime Tech Challenge received 300 applications from 52 countries, including 67% from outside the United States, 53% new to the issue of wildlife trafficking, and 86% new to working with USAID. The 16 Prize Winners represent 7 countries (38% from outside the United States), with 25% new to the issue of wildlife trafficking and 75% new to working with USAID.

The following is a list of the Prize winners and their winning project titles:

- Binomial Solutions Private Limited (India): "e-Eye ® (Electronic Eye): Real-time Anti-Poaching, Surveillance & Wildlife Tracking System."
- Bosque Antiguo (Mexico): "High Throughput STRs and Sequence Genotyping as Forensic Tools for Species Protection."
- For the Fishes (United States): "Tank Watch--The Good Fish/Bad Fish Tool for Saltwater Aquariums."
- New York University (United States): "Enforcement Gaps Interface."
- Kalev Hannes Leetaru (United States): "A Real-time Global Platform for Mapping, Forecasting, and Network Assessment of Wildlife Crime."
- Mars Omega Partnership Ltd (United Kingdom): "The JIGZAW Information Collaboration Project."
- National Whistleblowers Center (United States): "Secured Internet Wildlife Crime Reporting System."
- New England Aquarium (United States): "Live Digital Invoices for Real Time Data Analytics to Enhance Detection of Illegal Wildlife Trade."
- Paso Pacifico (United States): "The Trade of Endangered Sea Turtle Eggs: Detecting and Monitoring Regional Transit Routes."
- Planet Indonesia (United States): "Enhancing Bird Market Monitoring in Indonesia through Smartphone Technology."

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- University of Leicester (United Kingdom): "Universal Species Identification in the field by Rapid and Affordable Nanopore DNA Sequencing."
- University of Pretoria (South Africa): Internationalization of RhODIS® and eRhODIS®
- University of Technology Sydney (Australia): "Rapid Chemical Odor Profiling for Frontline Identification of Illegal Wildlife Products."
- University of Washington (U.S.): High Throughput Methods for Locating Source Populations in the Illegal Wildlife Trade."
- Yayasan Inisiasi Alam Rehabilitasi Indonesia (Indonesia): "Conservation of Threatened Indonesian Slow Lorises Using DNA-based Forensic Methods to Tackle Trade."
- Zoological Society of London (United Kingdom): "Instant Detect- Exposing the Movement of Poachers in Real Time."