IMPLEMENTATION OF FEDERAL PRIZE AND CITIZEN SCIENCE AUTHORITY: FISCAL YEARS 2017–18

A Report by the
OFFICE OF SCIENCE & TECHNOLOGY POLICY

In Response to the Requirements of the
America COMPETES Reauthorization Act of 2010 *and the*
Crowdsourcing and Citizen Science Act

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About this Document

This document presents the sixth report on the use of prize competitions and challenges conducted by Federal agencies to spur innovation, engage citizen solvers, address tough problems, and advance their core missions. It also presents the first report on crowdsourcing and citizen science activities conducted by Federal agencies.

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Department, Agency, Office, and Division Abbreviations

ACF	Administration for Children & Families (part of HHS)
AFRL	Air Force Research Laboratory (part of DOD)
AHRQ	Agency for Healthcare Research and Quality (part of HHS)
ARS	Agricultural Research Service (part of USDA)
ASPR	Office of the Assistant Secretary for Preparedness and Response (part of HHS)
BOEM	Bureau of Ocean Energy Management (part of DOI)
CDC	Centers for Disease Control and Prevention (part of HHS)
CNCS	Corporation for National and Community Service
CPSC	U.S. Consumer Product Safety Commission
CTTSO	Combatting 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
DOT	Department of Transportation
ED	Department of Education
EPA	Environmental Protection Agency
EERE	Office of Energy Efficiency and Renewable Energy (part of DOE)
FDA	Food and Drug Administration (part of HHS)
FEMA	Federal Emergency Management Agency (part of DHS)
FMC	Federal Maritime Commission
FNS	Food and Nutrition Service (part of USDA)
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 (part of ODNI)

MCHB	Maternal and Child Health Bureau (part of HHS-HRSA)
NASA	National Aeronautics and Space Administration
NASEM	National Academies of Sciences, Engineering, and Medicine
NCATS	National Center for Advancing Translational Sciences (part of HHS-NIH)
NCEI	National Centers for Environmental Information (part of DOC-NOAA)
NCI	National Cancer Institute (part of HHS-NIH)
NEA	National Endowment for the Arts
NEH	National Endowment for the Humanities
NEI	National Eye Institute (part of HHS-NIH)
NIA	National Institute on Aging
NIAAA	National Institute on Alcohol Abuse and Alcoholism (part of HHS-NIH)
NIAID	National Institute of Allergy and Infectious Diseases (part of HHS-NIH)
NIBIB	National Institute of Biomedical Imaging and Bioengineering (part of HHS-NIH)
NIDA	National Institute on Drug Abuse (part of HHS-NIH)
NIDCR	National Institute of Dental and Craniofacial Research (part of HHS-NIH)
NIFA	National Institute of Food and Agriculture (part of USDA)
NIH	National Institutes of Health (part of HHS)
NIMH	National Institute of Mental Health (part of HHS-NIH)
NIST	National Institute of Standards and Technology (part of DOC)
NLM	National Library of Medicine (part of HHS-NIH)
NMFS	National Marine Fisheries Service (part of DOC-NOAA)
NNCO	National Nanotechnology Coordination Office
NOAA	National Oceanic and Atmospheric Administration (part of DOC)
NPS	National Park Service (part of DOI)
NSA	National Security Agency
NSF	National Science Foundation
NWS	National Weather Service (part of DOC-NOAA)
ODNI	Office of the Director of National Intelligence
OIG	Office of Inspector General (part of HHS)
OMB	Office of Management and Budget
ONC	Office of the National Coordinator for Health Information Technology (part of HHS)
OSTP	Office of Science and Technology Policy

SBA	Small Business Administration
SI	Smithsonian Institution
State	Department of State
Treasury	Department of the Treasury
USAID	United States Agency for International Development
USBR	Bureau of Reclamation (part of DOI)
USCG	United States Coast Guard (part of DHS)
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service (part of USDA)
USGS	U.S. Geological Survey (part of DOI)
USSOCOM	U.S. Special Operations Command (part of DOD)
VA	Department of Veterans Affairs

Executive Summary

The America COMPETES Reauthorization Act of 2010 (COMPETES) updated the Stevenson-Wydler Technology Innovation Act of 1980 with a new provision on prize competitions (Section 24) that granted broad authority to all Federal agencies to conduct competitions to spur innovation and ingenuity. Under this authority, Federal agencies can offer incentives to invite fresh perspectives, novel approaches and participation from everyday citizen solvers, entrepreneurs, businesses, students, schools, nonprofits, and others who lend their collective problem-solving to improve aspects of public and private sector function. The passage of the COMPETES legislation solidified the use of crowdsourcing[1] in the Federal Government. Growing support for prize competitions helped open the door for the expansion of open innovation[2] in government, such as collaborative ideation, citizen science, bug bounties and hacking-for-good, code-sharing, and other activities in which motivated solvers participate to improve, secure, and enhance missions of Federal agencies.

In the 2 years since the Fiscal Year (FY) 2016 Prize Authority Progress Report, the total number of federally sponsored prize competitions catalogued on Challenge.gov has climbed from 744 to more than 875. Prize competitions have not only sparked successful start-up ventures and stimulated emerging markets, but have also offered a critical mass of examples and case studies for sharing across the Prizes and Challenges Federal Community of Practice.

In January 2017, the American Innovation and Competitiveness Act (AICA) became law. Section 402 of the AICA, the Crowdsourcing and Citizen Science Act, gave Federal agencies broad authority to use crowdsourcing—and specifically citizen science—to advance agency missions and facilitate broader public participation in the innovation process. The legislation highlighted the unique benefits of citizen science, "including accelerating scientific research, increasing cost effectiveness to maximize the return on taxpayer dollars, addressing societal needs, providing hands-on learning in science, technology, engineering, and math (STEM), and connecting members of the public directly to federal science missions and to each other." In addition, the AICA simplified and/or eliminated several of the COMPETES requirements for federally sponsored competitions, and formally introduced the term crowdsourcing into law. Importantly, the Crowdsourcing and Citizen Science Act supported a movement already building in the Federal Government and supported by the Federal Community of Practice for Crowdsourcing and Citizen Science. Since the act was signed into law, the CitizenScience.gov catalog has expanded the number of documented federally sponsored projects by more than 25%.

Crowdsourcing initiatives continue to expand across the public sector, gaining visibility and sponsorship at the highest levels of government. In March 2018, the White House convened a panel of government, industry, and philanthropic thought-leaders at the apex of water, energy, and prize competitions. Today, the Challenge.gov and CitizenScience.gov programs continue to encourage and document the applications and benefits of citizen engagement with the Federal Government, working closely with the White House Office of Science and Technology Policy (OSTP) and other executive offices to explore and document open innovation programs.

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[1] Crowdsourcing, as defined by the Crowdsourcing and Citizen Science Act, is a method to obtain needed services, ideas, or content by soliciting voluntary contributions from a group of individuals or organizations, especially from an online community.

[2] Open innovation, as defined by the Government Accountability Office, encompasses activities and technologies to harness the ideas, expertise, and resources of those outside an organization to address an issue or achieve specific goals.

OSTP is required to submit a biennial report to the Committee on Commerce, Science, and Transportation of the Senate and the Committee on Science, Space and Technology of the House of Representatives on the activities carried out under these authorities. This report compiles prize competition data for FY17 and FY18, and for the first time, includes data on federally conducted crowdsourcing and citizen science projects.

This report includes detailed descriptions of the 92 prize competitions that were active in FY17 and FY18 under the prize authority provided by COMPETES (as reported by Federal agencies to OSTP) and summarizes 77 prize competitions conducted under other authorities voluntarily reported by Federal agencies to OSTP. These 169 prize competitions were conducted by 18 Federal departments and independent agencies.

In FY17, 18 agencies offered prize competitions enabled by the authority provided by the COMPETES Act, including the U.S. Department of Agriculture (USDA)-Food and Nutrition Service (FNS); USDA-National Institute of Food and Agriculture (NIFA); Centers for Disease Control and Prevention (CDC); Department of Energy (DOE); Department of Health and Human Services (HHS); Department of Homeland Security (DHS); Department of State (State); Environmental Protection Agency (EPA); Federal Trade Commission (FTC); Food and Drug Administration (FDA); General Services Administration (GSA); Health Resources and Services Administration (HRSA); National Aeronautics and Space Administration (NASA); National Institutes of Health (NIH); National Institute of Standards and Technology (NIST); National Science Foundation (NSF); Small Business Administration (SBA); and U.S. Bureau of Reclamation (USBR). In FY18, 17 agencies offered prize competitions enabled by the authority provided by the COMPETES Act, including Agency for Healthcare Research and Quality (AHRQ); CDC; DOE; Department Of Transportation (DOT); DHS; EPA; GSA; HHS; HRSA; NASA; NIH; NIST; NSF; SBA; State; United States Agency for International Development (USAID); and USBR.

Total prize purses ranged from $0 to $20 million with a median prize purse of $50,000 in FY17 and $75,000 in FY18. Sixty-three percent of prize competitions were conducted by agencies in partnership with another organization. Approximately 52% of all prize competitions were conducted in partnership with at least one non-Federal organization, and 34% were conducted with at least one Federal partner. Many prize competitions had multiple partners.

This report also includes detailed descriptions of the 18 crowdsourcing and citizen science activities that were active in FY17 and FY18 under the Crowdsourcing and Citizen Science Act (as reported by Federal agencies to OSTP) and summarizes 68 crowdsourcing and citizen science activities conducted under other authorities voluntarily reported by Federal agencies to OSTP. These 86 activities were conducted and reported by 14 Federal departments and independent agencies. In FY17, the first year the Crowdsourcing and Citizen Science Act was in force, only one agency—NASA—conducted activities under its authority (NASA has a long history of crowdsourcing and citizen science under other authorities). In FY18, the number of agencies using the Crowdsourcing and Citizen Science Act grew to include the Federal Emergency Management Agency (FEMA); National Oceanic and Atmospheric Administration (NOAA); U.S. Forest Service (USFS); NIFA; and U.S. Geological Survey (USGS). Similar to prize competitions, 81% of all crowdsourcing and citizen science activities were conducted in partnership with another organization. Of the 86 crowdsourcing and citizen sciences activities reported, 71% had at least one non-Federal partner and 33% had at least one Federal partner. Forty-four of the reported activities were localized—i.e., focused at a particular geographic location—and the rest were implemented as distributed, online networks of participants. The localized activities took place at sites across the U.S. and most provided opportunities for participants to directly interact with Federal researchers and facilitators.

Prize Competitions

Introduction

The history of Federal prize competitions is well documented, beginning with the Office of Management and Budget's memorandum on the use of prize competitions in March 2010. This was followed by the passing of the America Creating Opportunities to Meaningfully Promote Excellence in Technology, Education, and Science (COMPETES) Reauthorization Act of 2010.[3] Prior to COMPETES, agencies could conduct prize competitions under multiple legal authorities. The National Aeronautics and Space Administration (NASA),[4] the Department of Defense (DOD),[5] and the Department of Energy (DOE)[6] all possessed independent authorities to directly administer prize competitions and use appropriated funds to provide prize purses. COMPETES expanded the authority of Federal agencies to conduct prize competitions to further their goals without affecting any existing prize authority already provided under any other law. COMPETES granted Federal agencies the authority to fund prize competitions through appropriations, gift funds from private entities, and as part of public-private partnerships.

Since the passing of COMPETES, the Federal Government has supported the use of prize competitions in many ways. In 2015, a Congressional Prize Caucus with bipartisan sponsorship was held to increase awareness and encourage the use of prize competitions. Numerous pieces of legislation supporting prize competitions to fuel medical research have also been passed (e.g., the 21st Century Cures Act[7] included a provision on EUREKA[8] Prize Competitions that authorized the National Institutes of Health (NIH) in the Department of Health and Human Services (HHS) to conduct prize competitions to fuel medical research). In January 2017, the American Innovation and Competitiveness Act (AICA)[9] was signed into law. The AICA made important updates to the broad prize authority previously granted to Federal agencies under COMPETES to encourage greater partnerships and eliminate unnecessary administrative burden, among other changes. In addition, the AICA provided Federal agencies with the ability to partner more broadly with the private sector and other government entities on incentive prize competitions, which could further expand their scope and sophistication. In March 2018, the White House convened a panel of government, industry, and philanthropic thought-leaders at the apex of water, energy, and prize competitions. The panel informed planning for prize competitions and grand challenges designed to catalyze innovation in critical water areas, including the Water Security Grand Challenge, a White House initiated, DOE-led effort to use prize competitions and other mechanisms to advance transformational technology and innovation to meet the global need for safe, secure, and affordable water.

Agencies use prize competitions 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. While prize competitions are not the right tool for every problem, they can serve as a mechanism for spurring and sourcing innovation if and when they are aligned with a broader strategy and used systematically within an

[3] Public Law 111-358
[4] 42 U.S.C. § 2459f-1
[5] 10 U.S.C. § 2374a
[6] 42 U.S.C. § 16396
[7] Public Law 114-255
[8] 42 U.S.C. 284et seq.
[9] Public Law 114-329

agency. Previous versions of the Federal Prize Authority Progress Report[10] laid out the potential benefits of prize competitions in the public sector. Federal prize competitions have catalyzed advances in areas such as autonomous transport and infectious disease forecasting, and stimulated research and investment in market sectors including solar energy and small business development.

Federal Community of Prizes and Challenges

All Federal agencies operating prize competitions and challenges are supported and assisted by the General Services Administration (GSA). In 2010, GSA launched Challenge.gov to deliver new tools and approaches to assist Federal agencies in advancing their core missions. Challenge.gov provides resources and collaborative opportunities to facilitate the use of prize competitions government-wide. In 2016, OSTP and Challenge.gov crowdsourced the expertise of Federal prize practitioners to launch an online Challenges and Prizes Toolkit,[11] a comprehensive resource that provides a guide to planning and executing Federal prize competitions.

The Challenge.gov platform hosts a variety of resources and tools developed and administered by GSA to assist Federal agencies in developing and executing successful competitions:

- **Resources for the Prizes Community of Practice.** Working in close coordination with agency prize leads and prize practitioners across government, the Challenge.gov program office develops trainings, case studies, and trend analyses for the Prizes and Challenges Federal Community of Practice, a network and active email list exchange of more than 730 current and prospective challenge managers in the Federal space. Monitoring the proliferation of State and local crowdsourcing initiatives, Challenge.gov expanded the email list to State and local government prize practitioners in 2018, inviting exchange and opening avenues for partnership.
- **In-person Training for Federal Prize Practitioners.** The Challenge.gov program has offered in-person and remote training (e.g., live-streams, recorded webinars) to more than 2,000 people across the Federal Government via GSA's DigitalGov University platform.[12]
- **Tools and Services for Contracting.** GSA maintains a contract vehicle—Sub-Schedule 541 4G, Challenges and Competitions Services—that provides agencies the ability to procure deeper technical expertise and dedicated services for their prize competitions. Contractors on the schedule offer agencies options for technical assistance, prize platforms, and access to communities of individual solvers 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.

As Federal agencies continue to use prize competitions, contests have increased in number and become increasingly ambitious, complex, and visionary. Today, the Challenge.gov platform features more than 875 prize competitions and challenges from over 100 Federal departments, agencies, and bureaus. Tens of thousands of solvers and innovators have participated in these competitions on Challenge.gov, with additional entrants joining the competitions through other means. In addition, several agencies have chosen to administer prize competitions through third-party contractors and many have conducted prize competitions under authorities other than COMPETES.

[10] Previous versions of the Implementation of Prize Authority Progress Report can be found at http://www.challenge.gov/toolkit/resources.

[11] More information about the Challenge.gov toolkit can be found at http://www.challenge.gov/toolkit.

[12] More information about the DigitalGov University platform can be found at http://www.digital.gov.

Federal agencies have worked to expand their capacity and institutional abilities to conduct prize competitions in a number of different ways (see Table 1), including issuing department-wide policy or guidance on the use of prize competitions and challenges. In addition to internal support, Federal agencies have also developed interagency centers for prize programs on shared topic areas.

Table 1. Department and Independent Agency Practices to Support Prize Competitions and Challenges.

Department and Independent Agency Practice	Agencies Implementing
Issuance of department- or agency-wide policy or guidance on the use of prize competitions and challenges	DHS, DOI, EPA, HHS, NASA, NIST, USAID, USDA
Common contract vehicles	DHS, ED, EPA, HHS, NASA
Internal communications tools	DHS, DOE, EPA, HHS, NASA, USAID
Coordinated external communications or webpage for prize competitions	DHS, EPA, NASA, USAID
Dedicated, central prize and challenge coordinator	DHS, EPA, HHS, NASA, USAID
Identified agency prize and challenge point-of-contact (not dedicated full-time to prize competitions)	AFRL, CTTSO, DOE, DOI, DOJ, NIST, NSF, IARPA, USDA
Distributed network or community of prize managers and points-of-contact within the agency	DOD, DOE, EPA, FTC, HHS, IARPA, NASA, USAID, USDA
Centralized training and design support for agency staff	DHS, HHS, NASA, NIST, USAID
Developing centers for interagency challenges in specific topic areas	DOI
Distributed network or community of project managers and/or resource people within the agency with expertise in prize competitions	CDC, DOE, EPA, FDA, NASA, NIH, NPS, NSF, SI, USAID, USDA, USGS

This report discusses how Federal agencies have used incentive prize competitions and innovation challenges, and highlights the prize competitions conducted in FY17 and FY18 under the COMPETES prize authority and other authorities. Reporting of prize competitions under authorities other than COMPETES is strictly voluntary and therefore not comprehensive in this report.

Highlights and Trends of Prize Competitions in FY17 and FY18

The total number of active prize competitions reported by Federal agencies in FY17 and FY18 was 169 under all authorities.[13] FY17 and FY18 prize competitions were categorized based on their status (launched, underway, or completed) in each fiscal year. If a prize competition reported any of the status options in both years, the prize competition was considered active and was counted in both years for trend analyses. This method was chosen to account for the contribution of prize competitions that continue over multiple years, rather than only counting during the year a prize is launched.[14] Appendix A lists the 92 prize competitions conducted under the authority granted by COMPETES, and Appendix B lists 77 voluntarily reported select activities conducted by agencies under other authorities.

[13] Note that information about the DOE American Inventions Made Onshore (AIM Onshore) prize was received after the submission deadline and was not included in the report analyses. However, AIM Onshore prize information is included in Appendix A.

[14] This method was not used for calculating aggregate prize purses and other monetary statistics so as to avoid double-counting.

Table 2. List of Federal Departments, Independent Agencies, and Agencies within Departments, that Reported Prize Competitions in FY17 and FY18 Conducted under COMPETES and Other Authorities.

Departments and Independent Agencies	Agencies within Departments	COMPETES		Other	
		FY17	FY18	FY17	FY18
Department of Agriculture (USDA)	Food and Nutrition Service (FNS)	✓			
	National Institute of Food and Agriculture (NIFA)	✓			
Department of Commerce (DOC)	National Institute of Standards and Technology (NIST)	✓	✓		
Department of Defense (DOD)	Defense Advanced Research Projects Agency (DARPA)			✓	✓
	United States Special Operations Command (USSOCOM)			✓	✓
Department of Energy (DOE)		✓	✓		
Department of Health and Human Services (HHS)		✓	✓		
	Administration for Children & Families (ACF)			✓	
	Agency for Healthcare Research and Quality (AHRQ)		✓		
	Centers for Disease Control and Prevention (CDC)	✓	✓	✓	✓
	Food and Drug Administration (FDA)	✓			
	Health Resources and Services Administration (HRSA)	✓	✓		
	National Institutes of Health (NIH)	✓	✓	✓	✓
Department of Homeland Security (DHS)		✓	✓		
	United States Coast Guard (USCG)				✓
Department of Interior (DOI)	Bureau of Reclamation (USBR)	✓	✓		
Department of State		✓	✓	✓	✓
Department of Transportation (DOT)	Bureau of Transportation Statistics (BTS)		✓		
Department of Veterans Affairs (VA)				✓	✓
Environmental Protection Agency (EPA)		✓	✓	✓	✓
Federal Trade Commission (FTC)		✓			
General Services Administration (GSA)		✓	✓		
National Aeronautics and Space Administration (NASA)		✓	✓	✓	✓
National Science Foundation (NSF)		✓	✓	✓	✓
Office of the Director of National Intelligence (ODNI)				✓	✓
Small Business Administration (SBA)		✓	✓		
United States Agency for International Development (USAID)			✓	✓	✓

Agency Use of Prize Authorities

In FY17, 18 agencies (Federal departments, independent agencies, and agencies within departments) offered prize competitions enabled by the authority provided by COMPETES. Twelve departments and agencies continued to administer prize competitions and challenges developed under other authorities. In FY18, 17 agencies offered prize competitions enabled by the authority provided by the

COMPETES Act and 12 departments and agencies administered prize competitions and challenges under other authorities (Table 2).

Federal agencies engaged a diverse population of citizen solvers and innovators who provided novel solutions that addressed a variety of problems and helped advance agency missions. For instance, innovators provided solutions that helped school districts better verify applications for free or reduced-price school meals (USDA, Box 1); encouraged the use of open data in biomedical and health applications (NIH, Box 2); helped address substance use disorders (NIH, Box 3); and solved the problem of solid waste disposal for astronauts in space suits (NASA, Box 4).

Goals of Prize Competitions

For the fifth consecutive year, the most common prize competition goal reported was *engage new people and communities*, reported by 71.4% and 73.2% of active prize competitions in FY17 and FY18, respectively. Three other goals were reported by more than 50% of active prize competitions in both FY17 and FY18: (1) *solve a specific problem,* (2) *develop technology,* and (3) *find and highlight innovative ideas.* In FY18, *advance scientific research* was also reported by just over 50% of active prize competitions, up from 43.8% in FY17. The goal *advance scientific research* has witnessed the largest growth rate in recent years; the percentage of prize competitions reporting this goal has grown from 16.5% in FY14 to 52% in FY18. Notably, the percentage of prize competitions reporting *improve government service and delivery* rose from 4.6% to 9.8% from FY16 to FY18; however, these rates still mark a decline from FY14 when 15.5% of prize competitions reported this goal. Similarly, the goal *build capacity* has witnessed minimal growth since FY14, with reporting percentages rising from 10.3% to 17.1% from FY14 to FY18. Table 3 presents a breakdown of the percentage of prize competitions reporting each goal between FY14 and FY18.

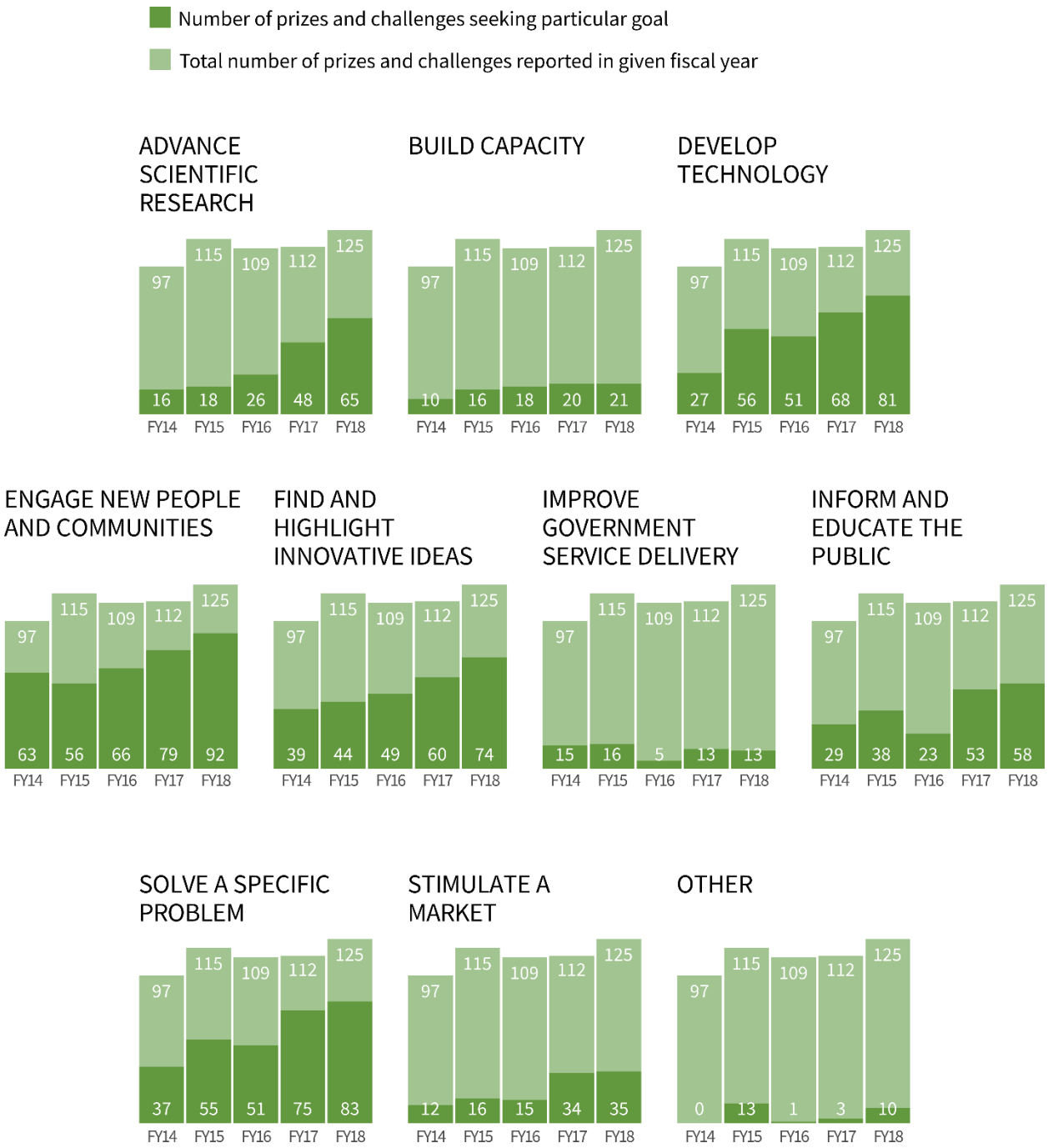
Table 3. Percentage of Prize Competitions Reporting Each Goal

Goals	FY14	FY15	FY16	FY17	FY18
Advance Scientific Research	16.5%	15.7%	23.9%	43.8%	52.0%
Build Capacity	10.3%	13.9%	16.5%	18.8%	17.1%
Develop Technology	27.8%	48.7%	46.8%	59.8%	63.4%
Engage New People and Communities	64.9%	48.7%	60.6%	71.4%	73.2%
Find and Highlight Innovative Ideas	40.2%	38.3%	45.0%	54.5%	60.2%
Improve Government Service Delivery	15.5%	13.9%	4.6%	11.6%	9.8%
Inform and Educate the Public	29.9%	33.0%	21.1%	48.2%	46.3%
Solve a Specific Problem	38.1%	47.8%	46.8%	66.1%	65.0%
Stimulate a Market	12.4%	13.9%	13.8%	30.4%	27.6%
Other	0.0%	11.3%	0.9%	2.7%	8.1%

The number of prize competitions reporting multiple goals has increased; 96.8% of FY18 awards reported more than one goal, representing a small increase over FY16 and FY17 (94.5% and 93.8%, respectively). The average number of goals reported per prize has also risen markedly in recent years, from 2.8 goals per prize in FY16 to 4.2 goals per prize in FY18. The most common goal in FY17 and FY18, *engage new people and communities*, was frequently reported alongside other common goals, including *develop technology* (co-reported in 45.1% of prize competitions), *solve a specific problem* (44.7%), and *find and highlight innovative ideas* (43.4%). Notably, the most commonly reported pair of goals in FY17 and FY18 was *solve a specific problem* and *develop technology*, co-reported in 52.3% of

prize competitions, the highest level of co-reported goals since documentation began in FY14. Figure 1 shows the number of and the goals of the prize competitions conducted between FY14 and FY18.

Figure 1. Goals Sought by Prize Competitions between FY14 and FY18.



Box 1. USDA National School Lunch and School Breakfast 2017 Verification Response Rate Challenge

School districts approve nearly five million household applications for free or reduced-price school meal benefits annually, and each year, they are required to identify a small percentage of those applications for verification. Continued eligibility is conditional on complying with the verification process. Households that do not respond to the request for verification lose their benefits, even if they are income-eligible.Many districts struggle to get even half of their households to respond, whereas others have created low-cost and creative strategies that allow them to exceed 70 (and even 80 or 90) percent response rates. The Verification Response Rate Challenge was a public forum to exchange ideas on how to increase household response in the annual verification process. Through this challenge, school district and state agency staff were able to share their success stories and generate creative ideas for increasing household responses to verification.
This challenge provided a fun and encouraging forum for school district staff to share their experience and expertise with other school districts in a collaborative fashion, where ideas could be proposed and expanded through discussion boards. The goal was to provide a number of options school districts might use to increase their verification response rates, reduce the time and expense associated with repeat follow-up reminders to households, and reduce the risk that eligible children lose access to program benefits. USDA's Food and Nutrition Service (FNS) used the challenge format to maximize school district staff engagement and discover the most effective solutions. It was equally important that school districts were provided an opportunity to highlight the work they do. The winning submissions were featured at the 2017 School Nutrition Association Annual National Conference in Atlanta. FNS also produced a verification toolkit that is available to all school districts in the country that highlights practices and ideas from contest participants. Because school districts vary, the opportunity to provide a range of solutions is very important and the challenge format allowed school district staff and others an opportunity to participate at essentially no cost.

https://www.challenge.gov/challenge/usda-school-meal-programs-verification-response-rate-challenge/

Solution Types Sought by Federal Agencies

The most common solution type reported in FY18 was *ideas,* reported by 46.4% of active awards. Table 4 presents a breakdown of the percentage of prize competitions reporting each type of solution between FY14 and FY18. *Ideas* has been the most common solution since FY14, except in FY17, when *software and apps* overtook *ideas* by a narrow margin (44.6% and 42.9%, respectively). *Technology, demonstration, and hardware* has grown significantly over the past few years from 15.5% in FY14 to 41.5% in FY18. Other solutions have witnessed moderate changes in recent years, including *analytics, visualizations, and algorithms*, which decreased from 20.6% in FY14 to 12.2% in 2015 and 16.5% 2016 but has since increased to 25.9% and 27.6% in FY17 and FY18, respectively. The solutions *creative* and *scientific* have both fluctuated around 15–25% between FY14 and FY18. Eight prize competitions reported the solution *nominations* from FY14 to FY16, and no prize competitions reported *nominations* in either FY17 or FY18. Figure 2 shows the types of solutions sought by Federal agencies for prize competitions reported between FY14 and FY18.

The number of prize competitions reporting multiple solutions has also grown steadily over the past 4 years, from 36.1% in FY14 to 62.8% in FY18. Similarly, the average number of solutions reported per prize has risen from 1.54 solutions per prize in FY14 to 2.3 in FY18.

Table 4. Percentage of Prize Competitions Reporting Each Solution Type

Solutions	FY14	FY15	FY16	FY17	FY18
Analytics, Visualizations, and Algorithms	20.6%	12.2%	16.5%	25.9%	27.6%
Business Plans	8.2%	11.3%	14.7%	8.9%	8.1%
Creative	20.6%	25.2%	22.0%	25.9%	26.0%
Ideas	34.0%	45.2%	47.7%	42.9%	46.4%
Nominations	4.1%	2.6%	0.9%	0.0%	0.0%
Scientific	14.4%	13.0%	21.1%	22.3%	22.0%
Software and Apps	34.0%	22.6%	26.6%	44.6%	43.1%
Technology, Demonstration, and Hardware	15.5%	26.1%	34.9%	37.5%	41.5%
Other	2.1%	8.7%	0.0%	8.0%	13.8%

Box 2. NIH Open Science Prize

The goal of this Challenge, which was a collaboration between the National Institutes of Health, the Wellcome Trust, and the Howard Hughes Medical Institute, was to stimulate the development of novel and ground-breaking tools and platforms to enable the reuse and repurposing of open digital data, publications, and other research outputs relevant to biomedical or health applications. The prize also aimed to forge new international collaborations to bring together open science innovators from the United States and abroad to co-develop services and tools of benefit to the global research community.

Of 435 submissions received from 45 countries, 6 finalists were chosen. These included a tool to store and process data related to the neural circuits of fruit fly brains (critical for modeling mental and neurological diseases in people); a website that makes it free and easy for families with rare Mendelian diseases to share health and genetic information with other families, clinicians, and researchers; a data platform to aggregate and provide timely information on air quality from around the globe; a web-based application to allow collaborative annotation, discovery, and analysis of publicly available brain imaging data; and a project to allow clinicians and researchers to access, search, and present information from otherwise unpublished clinical trials. The grand prize went to a project developing an integrated framework for real-time molecular epidemiology and evolutionary analysis of emerging epidemics, such as Ebola, MERS-CoV, and Zika. https://www.opensciencеprize.org/

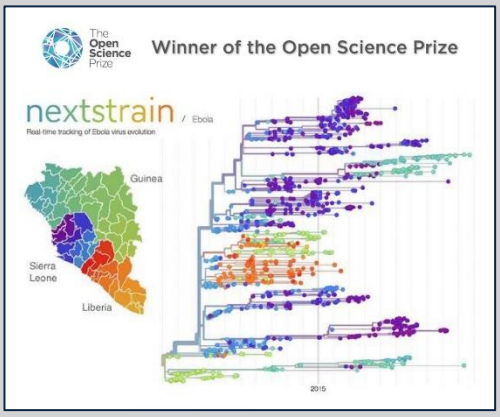
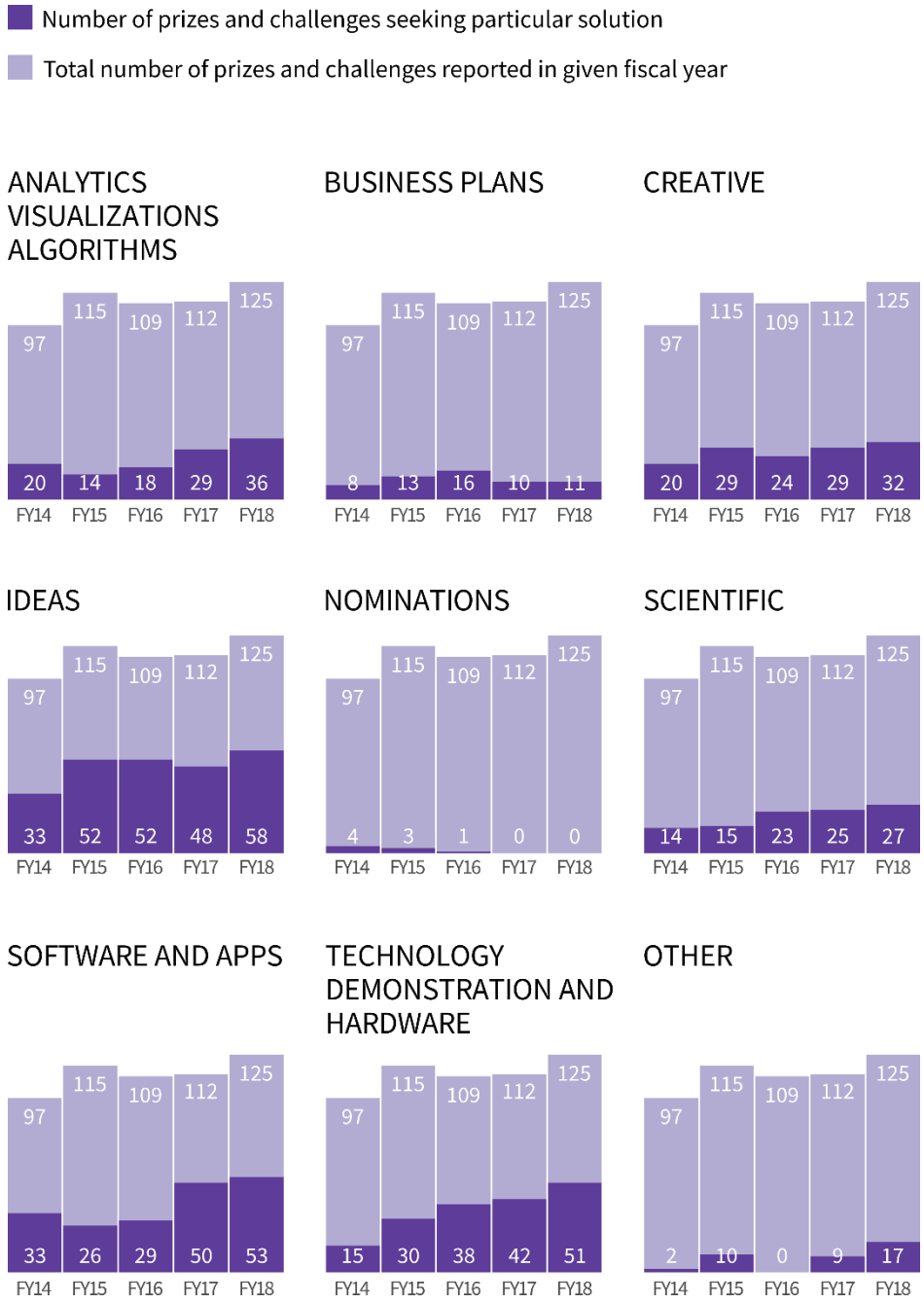


Image: NIH

Figure 2. Solutions Sought by Federal Agencies between FY14 and FY18.



Outreach Mechanisms and Submissions

Departments and agencies used a number of mechanisms to solicit entries for prize competitions in FY17 and FY18. The most common solicitation method was social media (89.3% and 94.4% for FY17 and FY18, respectively), followed closely by email (86.6% and 84% for FY17 and FY18, respectively).

The number of submissions received for prize competitions in FY17 and FY18 varied widely, depending on the nature of the competition, the desired pool of participants, and outreach mechanisms used, among other factors. The largest number of submissions for any prize in FY17 and FY18 was 9,339 for the DHS Passenger Screening Algorithm Challenge. The FY17 and FY18 reporting cycle was the first time data on outreach mechanism and submission number were collected from agencies.

Total Prize Purse Offered

Total prize purses ranged from $0 to $20 million with a median of $50,000 in FY17 and $75,000 in FY18 under all authorities. In both FY17 and FY18, the largest total purse came from the Antimicrobial Resistance, Rapid, Point-of-Need Diagnostic Test Challenge, run by HHS. The competition awarded ten semi-finalists $50,000 each during the first step of the challenge to develop innovative diagnostic tools. Teams then competed for additional prizes in the second and third step, including $19 million to be awarded to up to three winners in FY20. Although many prize purses were quite modest (less than $1,000), 12 competitions in FY17 and FY18 had totals of $1 million or more (typically awarded to multiple winners). In addition to monetary awards, departments and agencies also offered non-monetary incentives to challenge winners, such as mentoring or training, recognition in press or at events, publication in journals, or opportunities to present their findings to government officials or industry representatives, among others.

Agencies have used both COMPETES and non-COMPETES authority to execute competitions of various monetary value over time; there does not appear to be a trend in the use of COMPETES or other authorities over time. Among other agencies (i.e., those that have not reported more than 10 total competitions between FY14 and FY18),[15] the majority of prize competitions and those with the highest monetary value were conducted under COMPETES authority. These observations are consistent with prize competitions reported in previous years.

Partnerships with Other Organizations

Sixty-two percent of prize competitions were conducted by agencies in partnership with another organization. Approximately 53% were conducted in partnership with at least one non-Federal organization, and 34% were conducted with at least one Federal partner. Many prize competitions had multiple Federal or non-Federal partners. Federal partners included other agencies and federally funded research and development centers. Non-Federal partners included academic institutions, professional societies, State or local governments, private sector organizations, non-governmental organizations, foreign governments, journals, and contractors. Partners provided both monetary and non-monetary contributions to the prize competitions, including subject matter experts, competition judges, technical reviewers, administrative support, or access to resources such as event space, technical assistance, or outreach platforms.

[15] Other agencies include the CNCS, CPSC, DHS, DOJ, DOT, ED, FMC, FTC, GSA, HUD, NEA, NNCO, OMB, SBA, Treasury, USDA, and VA.

Box 3. NIH: The 2017 "$100,000 for Start a SUD Startup" Challenge

The Start a SUD Startup Challenge sought research ideas that could be the basis for new and successful startups to address Substance Use Disorders (SUD). The Challenge was intended to award "would-be" startups at a much earlier stage than most investors, incubators, or traditional modes of research funding (e.g., small business grants) and allowed scientists to test whether their research could be fostered into a biotech startup that could later compete for National Institute on Drug Abuse (NIDA) Small Business Innovation Research and Small Business Technology Transfer funding. A variety of innovators submitted ideas to the SUD Startup Challenge including U.S. academic institutions, newly formed small businesses, and members of the general public. Innovators were diverse in terms of age, level of education, gender, race, and understanding of commercialization and entrepreneurship. Importantly, about 60% of submitted ideas came from teams or individuals who had not previously applied for NIH grant funding, tapping a pool of talent and ideas that NIDA has never before interacted with. The total prize purse offered was $100,000, divided among 10 awards of $10,000 each. In addition, NIDA entrepreneurship experts provided winners with mentorship support to help them develop a minimum viable proof of their proposed products. Winning submissions included a platform for social rebuilding during recovery, a solution addressing neonatal abstinence syndrome, an opioid prescription awareness tool, and a means of detecting and reporting illicit online pharmacies selling controlled substances.
https://www.Challenge.gov/challenge/the-2017-100000-for-start-a-sud-startupchallenge/
Image: NIH

Trends in Prize Competitions from FY14 to FY18

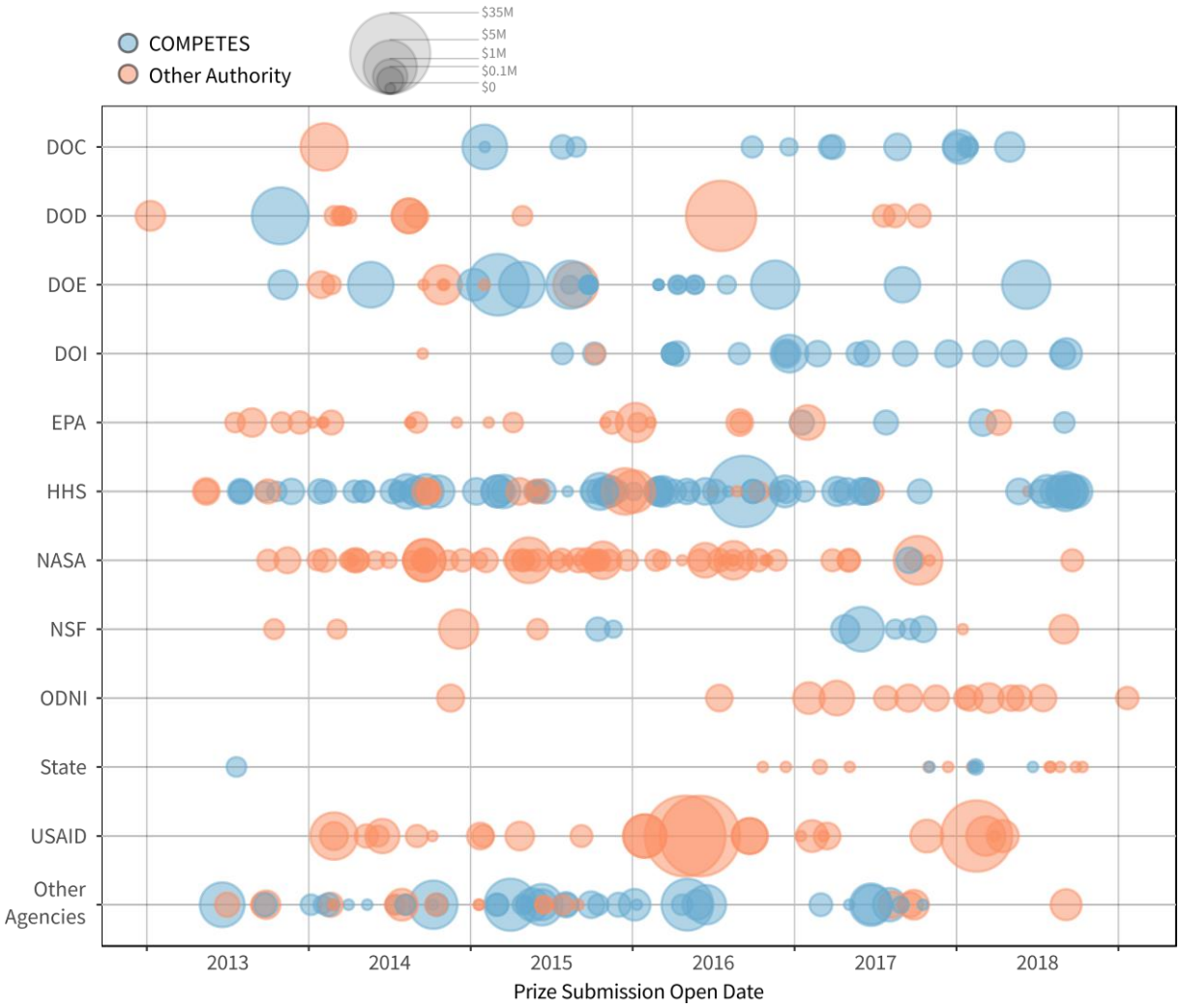
To examine the use of prize competitions by Federal agencies over time, the total number and magnitude of prize purses reported by Federal agencies under COMPETES and non-COMPETES authorities between FY14 and FY18 were tallied.[16] Figure 3 shows prize competitions arranged by agency over time from FY14 to FY18 by date of open submission. Each circle represents an individual prize competition, and the size of the circle corresponds to the size of the prize purse allocated.

Numerous agencies have increasingly leveraged the COMPETES authority to execute prize competitions in recent years, including DOC, DOE, DOI, and HHS. Since gaining the COMPETES authority, many of these agencies have stopped reporting prize competitions under any other authority while other agencies, such as EPA and State, continue to primarily use non-COMPETES authorities. Some agencies, such as ODNI, have never used COMPETES and rely exclusively on other authorities to execute prize competitions.

Overall, the total number of prize competitions reported increased steadily from 97 in FY14 to 121 in FY18 (see Table 5 for a breakdown of prize competitions conducted between FY14 and FY18). Nine agencies account for the bulk of competitions and prize money offered between FY14 and FY18: HHS and NASA have both funded over 100 competitions since FY14 and DOE, DOD, DOI, EPA, NSF, ODNI, and USAID have each sponsored over 20. The proportion of prize competitions conducted under the COMPETES authority varies through time from a low of 32% in FY14 to a high of 58% in FY16.

[16] Trend analyses are limited to prize competitions reported from FY14 to FY18. Data collected for prize competitions prior to FY14 did not contain comparable information as those collected in later years.

Figure 3. Prize Competitions Reported since FY14.[17] Agencies that reported more than 10 total prize competitions between FY14 and FY18 are listed separately; all others are grouped as one entry. Circle size corresponds to total allocated prize purse.[18]



With respect to the magnitude of the prize purses offered, the total amount of all prize purses combined in any fiscal year increased by 116% from $32 million in FY14 to $69 million in FY18. Of the prize purses offered in FY17 and FY18, four agencies (DOD, DOE, HHS, and NSF) held competitions with total prize purses equal to or greater than $2 million. These four agencies all show an increase in total prize purses offered from FY14 to FY18 with the exception of DOE, which had a sharp drop in prize purses from over $18 million FY16 to $3 million in FY17 and $6.5 million in FY18. Two agencies had substantial increases in prize purses offered in recent years: DOD increased from $6.75 million in FY16 to $18.8 million and HHS went from $1.9 million in FY14 to $24 million in FY18.

[17] Figure 3 only shows agencies that have reported more than 10 prize competitions. Agencies that have conducted 10 or fewer total prize competitions between FY14 and FY18 are grouped together under *Other Agencies*. See Footnote 14 for a list of other agencies.

[18] Forty-six reported prizes are not included because they did not list a submission open date. Due to a difference in data collection, the total prize value in 2014 and 2015 may refer to the total prize allocated or awarded.

Table 5. Number of Prize Competitions Reported by Federal Departments and Agencies from FY14 through FY18. Numbers in parentheses were conducted under the authority granted by the COMPETES Act. Gray shading indicates agencies combined into the "other agencies" category in Figure 3.

Department/Agency	FY14	FY15	FY16	FY17	FY18
CNCS	0 (0)	1 (1)	0 (0)	0 (0)	0 (0)
CPSC	2 (2)	1 (1)	0 (0)	0 (0)	0 (0)
DHS	2 (0)	2 (1)	2 (2)	1 (1)	3 (2)
DOC	1 (0)	5 (4)	3 (2)	5 (5)	6 (6)
DOD	10 (1)	6 (1)	1 (1)	3 (0)	3 (0)
DOE	7 (4)	14 (9)	22 (18)	2 (2)	4 (4)
DOI	0 (0)	2 (1)	7 (5)	11 (11)	15 (15)
DOJ	5 (1)	5 (1)	0 (0)	0 (0)	0 (0)
DOT	1 (1)	0 (0)	0 (0)	0 (0)	1 (1)
ED	2 (0)	2 (0)	0 (0)	0 (0)	0 (0)
EPA	12 (0)	3 (0)	7 (0)	6 (3)	6 (4)
FMC	0 (0)	1 (1)	0 (0)	0 (0)	0 (0)
FTC	1 (1)	2 (2)	0 (0)	1 (1)	0 (0)
GSA	2 (2)	1 (1)	2 (2)	1 (1)	1 (1)
HHS	22 (18)	25 (18)	29 (25)	26 (22)	21 (19)
HUD	2 (2)	1 (1)	0 (0)	0 (0)	0 (0)
NASA	17 (0)	24 (0)	23 (0)	23 (0)	17 (0)
NEA	1 (1)	0 (0)	0 (0)	0 (0)	0 (0)
NNCO	0 (0)	2 (0)	0 (0)	0 (0)	0 (0)
NSF	3 (0)	3 (0)	3 (2)	6 (5)	6 (4)
ODNI	1 (0)	2 (0)	0 (0)	6 (0)	13 (0)
OMB	0 (0)	1 (1)	0 (0)	0 (0)	0 (0)
SBA	0 (0)	5 (5)	3 (3)	2 (2)	1 (1)
State	1 (1)	0 (0)	0 (0)	8 (3)	20 (8)
Treasury	0 (0)	0 (0)	1 (1)	0 (0)	0 (0)
USAID	5 (0)	8 (0)	4 (0)	6 (0)	6 (1)
USDA	0 (0)	1 (1)	2 (2)	2 (2)	0 (0)
VA	0 (0)	4 (0)	0 (0)	3 (0)	3 (0)
Total	97 (34)	115 (49)	109 (63)	112 (58)	125 (63)

The magnitude of the total Federal prize purse issued under the COMPETES authority has increased over time from $25 million in FY14 to $38 million in FY18. The median prize purse per competition conducted under the COMPETES authority has risen sharply from $27,000 in FY14 to $82,000 in FY18.

Under the "other agencies" category, the total prize purse of prize competitions active in each year has fluctuated between $1.5 and $4 million. The number of prize competitions included in this category has declined from 18 in FY14—representing 9 different agencies—to 8 in FY18, representing 5 agencies. At the same time, the median prize purse per competition in this category has increased over time from $15,000 in FY14 to $226,000 in FY18.

Box 4. NASA's Space Poop Challenge

Space is an extremely inhospitable environment that requires robust protection of human explorers. Astronauts wear space suits during extravehicular activity, but they are also worn to protect personnel from unforeseen circumstances during launch and entry of spacecraft and during activities inside space vehicles. Depending on circumstances, astronauts could find themselves in their suits for up to 10 hours during launch or landing or up to 6 days if something catastrophic were to happen during a mission. The current solution for managing solid waste in space suits is to equip astronauts with diapers, but this is a low-tech and temporary solution that does not provide a healthy or protective option longer than 1 day. The goal of the Space Poop Challenge was to find viable concepts and designs for a urine and fecal management system for space suits that could be used over a continuous duration of 144 hours in the event of cabin depressurization or other unforeseen circumstance during a mission to the Moon. To maximize the range of innovative technical solutions, NASA chose a crowdsourced competition, working with the company HeroX, with a total prize purse of $30,000, which attracted over 20,000 registrants and 5,170 submissions from around the world. One of the top three solutions included a mini airlock and tool based on laparoscopic surgical instruments that would allow the removal of waste, entry of wipes and underwear, and manipulation required for cleaning in the space suit. Another concept included a design for self-inflating air pumps to help dry the skin that was based on emergency air bag technology to save power and complexity while providing a high rate of air flow. The winning submission included a compact wiping mechanism that provided a novel approach to skin cleaning and infection prevention. NASA is using these solutions to help develop future space suit designs.
https://herox.com/SpacePoop
Image: NASA

Trends in Prize Competitions for Select Agencies

DOD, DOE, and HHS accounted for 20% to 48% of competitions active from FY14 to FY18 and 48% to 74% of the prize money offered by Federal agencies in those years. However, the number, size, and authority used to fund prize competitions by these three agencies changed substantially in this same period.

The number of prize competitions offered by DOE increased from 7 in FY14 to 22 in FY16, but decreased to just 2 in FY17 and 3 in FY18. Of the prizes reported, DOE uses the COMPETES authority for the majority of competitions from FY14 to FY16 and for all competitions that were active in FY17 and FY18.

HHS has reported the most prize competitions of any Federal agency (ranging between 21 and 29 active competitions in any year from FY14 to FY18) and the highest use of the COMPETES authority: 72% to 90% of reported HHS prize competitions in any given year were offered under the COMPETES authority. The median HHS prize purse has steadily increased from $46,000 in FY14 to $130,000 in FY18.

Crowdsourcing and Citizen Science

Introduction

As part of the American Innovation and Competitiveness Act (AICA), Congress passed the Crowdsourcing and Citizen Science Act (15 USC § 3724)[19], which grants Federal agencies the direct, explicit authority to use crowdsourcing and citizen science to stimulate and facilitate broader public participation in the advancement of Federal agency missions. The Crowdsourcing and Citizen Science Act defines citizen science as "a form of open collaboration in which individuals or organizations participate voluntarily in the scientific process in various ways, including— (A) enabling the formulation of research questions; (B) creating and refining project design; (C) conducting scientific experiments; (D) collecting and analyzing data; (E) interpreting the results of data; (F) developing technologies and applications; (G) making discoveries; and (H) solving problems." It further defines crowdsourcing as "a method to obtain needed services, ideas, or content by soliciting voluntary contributions from a group of individuals or organizations, especially from an online community." Crowdsourcing engages participants in a wide range of activities and topics from digitizing archives to satellite image analysis; citizen science is a form of crowdsourcing that allows participants to become directly involved in the scientific process through data collection, logistical support, and many other direct contributions to research. The Federal Government supports them jointly because of their many shared elements, including mechanisms for organizing and engaging both online and on-the-ground communities.

While the Crowdsourcing and Citizen Science Act has only recently codified these practices for Federal agencies, the Federal Government has a long history of engaging citizens in the scientific process. For example, Thomas Jefferson collected and shared weather observations and planned to establish a network of weather observers by providing a thermometer to one dependable deputy for each county of Virginia to collect twice-daily observations of temperature and wind direction. In 1890, the Organic Act created what is now the National Weather Services' Cooperative Observer Program,[20] which supports thousands of volunteers in the collection of observational meteorological data.

The use of volunteer reports and observations by professionals is a long-standing model of citizen science that continues to have an impact on research carried out by Federal agencies to advance their missions. For example, volunteer water quality monitoring has shaped the EPA's understanding of the environment, and reports from the public have improved the USGS's analysis of earthquakes.

In response to increasing public interest in recent years, Federal agencies have sought to facilitate community-based participation in their missions by preserving and improving access to scientific collections, data, and other research products. At the same time, technological advances have made it easier for both researchers and the public to gather and contribute valuable data and observations. With the dropping cost of sensors and greater access to the internet and smartphones, the collection and reporting of field-based measurements by both research specialists and citizen scientists has become increasingly streamlined. The past decade has also seen the emergence of online projects that involve participants in data and image analysis, sometimes through gaming interfaces. Such projects offer new pathways for the public to participate and can attract individuals outside the reach of more traditional models of scientific engagement. These trends help make crowdsourcing and citizen science more efficient as a means for Federal agencies to carry out their missions and engage the public.

[19] More information on the Crowdsourcing and Citizen Science Act can be found at https://www.govinfo.gov/content/pkg/USCODE-2016-title15/pdf/USCODE-2016-title15-chap63-sec3724.pdf.

[20] More information about the Cooperative Observer Program can be found at https://www.weather.gov/coop/.

Federal Crowdsourcing and Citizen Science Community of Practice

As implementation of crowdsourcing and citizen science entered a period of rapid growth, a nucleus of Federal officials who had been considering how to employ these methods came together. As early as 2012, Federal employees from various agencies began meeting as an informal discussion group, which led to the establishment in 2014 of the Federal Community of Practice for Crowdsourcing and Citizen Science[21] (FedCCS). These efforts are amplified by the work of the Agency Citizen Science and Crowdsourcing Coordinators, a group of Federal employees designated by their agency leaders to be responsible for implementing tasks to advance crowdsourcing and citizen science. FedCCS works within and across Federal agencies to address a unique challenge: How Federal agencies can engage the public directly and creatively as partners to enhance agencies' diverse missions. This community is growing rapidly, including almost 400 people from more than 60 Federal agencies in 2018.

Working together, the FedCCS increases efficiency, efficacy, and innovation across the Federal Government by sharing resources and expertise, methods and strategies, and identifying shared opportunities and needs. CitizenScience.gov is the Federal Government's central hub for crowdsourcing and citizen science efforts. It provides essential resources, including:

- **The Federal Crowdsourcing and Citizen Science Catalog:** A vetted catalog of projects at the Federal level that helps improve collaboration among Federal agencies and reveals opportunities for new high-impact projects.
- **The Federal Crowdsourcing and Citizen Science Toolkit:** A comprehensive toolkit to assist Federal Crowdsourcing and Citizen Science practitioners by providing how-to process steps, case studies, a resource library, and legal and policy resources to aid Federal agencies in setting up and managing their own projects.
- **The Federal Community of Practice for Crowdsourcing and Citizen Science:** A group of practitioners who share skills, resources, and experiences among themselves and with others to help expand and improve public participation across the government.

This centralized online resource opens opportunities for the Federal Government to pursue and strengthen interagency partnerships as well as to collaborate with industry, academia, and other organizations on crowdsourcing and citizen science initiatives. It also increases the ability of Federal practitioners to access resources for project development, gain top-level approval and support, and share lessons with fellow practitioners. By bringing together relevant resources and people in one place, CitizenScience.gov helps improve the FedCCS's impact without undercutting its practitioner-led organization.

[21] More information about the FedCCS can be found at https://digital.gov/communities/crowdsourcing-and-citizen-science/.

Crowdsourcing and Citizen Science Act

The Crowdsourcing and Citizen Science Act grants Federal agencies the direct, explicit authority to use crowdsourcing and citizen science. This authority supports efforts at the agency level to change perceptions about the validity of citizen science data as well as create infrastructure to support implementation. As momentum increases, agencies such as NSF have funded work on the science of citizen science focused on identifying effective approaches and developing empirically supported best practices. The FedCCS continues to help agencies overcome concerns that might hinder implementation—from data quality to privacy, liability, and cybersecurity—and FedCCS members work together to address policy challenges for the community. For example, many citizen science projects involve a Federal agency collecting information directly from the public, a process that is regulated by the Paperwork Reduction Act (PRA).[22] The PRA requires agencies to develop an Information Collection Request (ICR), which requires OMB approval and may require significant effort from multiple agency employees. However, agencies are finding ways to address this requirement while collecting data in a timely fashion. For example, EPA developed a generic ICR that covers all crowdsourcing and citizen science requests within the EPA, shortening the time required to get a citizen science project started. This resource is now available and has been emulated by other members of the FedCCS community. Table 6 demonstrates actions undertaken by Federal agencies within the FedCCS to increase their capacity to effectively use crowdsourcing and citizen science tools.

As described in the Crowdsourcing and Citizen Science Act, unique benefits of crowdsourcing and citizen science projects include "accelerating scientific research, increasing cost effectiveness to maximize the return on taxpayer dollars, addressing societal needs, providing hands-on learning in science, technology, engineering, and math (STEM), and connecting members of the public directly to Federal agency missions and to each other." Crowdsourcing and citizen science expand how government engages with the Nation, moving beyond working only with established entities (e.g., universities, private firms, non-governmental organizations) through contracts and grants to a collaborative approach involving broad public participation. Federal projects that use crowdsourcing and citizen science do not solely benefit the U.S. Government; they also have positive impacts on the citizens who participate in them.

Crowdsourcing and citizen science activities:

- **Enhance scientific research and monitoring:** There are multiple paths by which crowdsourcing and citizen science support scientific research and monitoring. In certain applications, volunteers are able to collect observations over geographic areas and/or time periods that would be impractical or impossible for Federal agencies, given personnel and resource constraints. In addition, volunteers can provide unique perspectives and local expertise for interpreting data.
- **Provide hands-on STEM learning and increase STEM literacy**: Crowdsourcing and citizen science help educate, engage, and empower students, educators, and the broader American public by applying their curiosity and contributing their talents to a wide range of real-world problems. Students have the opportunity to acquire lifelong enthusiasm for science, along with valuable skills in STEM. For students, working on real-world problems can make classroom learning experiences more engaging. For adults, working on crowdsourcing or citizen science projects can help advance their knowledge and skills while contributing to a larger scientific enterprise. A recent study from the National Academies of Sciences, Engineering, and Medicine (NASEM) found that "citizen science

[22] 44 U.S.C. 3501 et seq.

supports learning outcomes related to scientific practices, content, identity, agency, data, and reasoning."[23]

- **Address societal needs:** Crowdsourcing and citizen science can help address societal needs and Federal agency goals, ranging from enhancing the accuracy of prediction markets to tagging and transcribing national archive records. The ability to reach populations that may not previously have been engaged in scientific enterprises allows an influx of new ideas and insights. The study from NASEM also reported that "citizen science can create opportunities for communities, especially communities who have been marginalized, neglected, or even exploited by scientists, to collaborate with scientists and the science community."

Table 6. Department and Independent Agency Practices to Support Crowdsourcing and Citizen Science.

Department and Independent Agency Practice	Agencies Implementing
Issuance of department-wide policy or guidance on the use of crowdsourcing and citizen science	FDA, FEMA, NPS, SI, USDA
Inclusion of crowdsourcing and citizen science in agency-wide plans	FDA, FEMA, NOAA, SI, USDA
Articulated connections of how use of crowdsourcing and citizen science activities supports agency's mission	FDA, FEMA, NIH, USDA
Crowdsourcing and citizen science integrally or routinely used in certain agency science products	NOAA, USGS
Leverage existing platforms or tools	EPA, FEMA, NASA, NIH, NOAA, NPS, SI, USDA
Internal communications tools	CDC, EPA, FDA, FEMA, NASA, NIH, NOAA, NPS, SI, USDA
Coordinated external communications or webpage for crowdsourcing and citizen science	CDC, FEMA, NASA, NIH, NOAA, SI, USDA
Dedicated full-time crowdsourcing and citizen science coordinator	FDA, USGS
Identified crowdsourcing and citizen science point-of-contact (not dedicated full-time to crowdsourcing and citizen science)	CDC, EPA, FEMA, NASA, NIH, NIST, NOAA, NPS, NSF, SI, USDA
Distributed network or community of project managers and/or resource people within the agency with expertise in crowdsourcing and citizen science	CDC, EPA, FDA, NASA, NIH, NPS, NSF, SI, USDA, USGS
Centralized training and design support for agency staff	CDC, FEMA, USDA
Developed or developing generic ICR	EPA, NASA, USDA, USGS
Offer grant funding to support implementation of crowdsourcing and citizen science	NASA, NIH, NOAA, NSF, USDA

[23] *Learning Through Citizen Science: Enhancing Opportunities by Design*; available at https://www.nap.edu/catalog/25183/learning-through-citizen-science-enhancing-opportunities-by-design.

Highlights and Trends of Crowdsourcing and Citizen Science Activities in FY17 and FY18

The Crowdsourcing and Citizen Science Act encourages Federal agencies to use crowdsourcing and citizen science, where appropriate, to enhance research, education, monitoring, and program operations. This section of the report highlights the crowdsourcing and citizen science activities directly conducted by Federal agencies in FY17 and FY18 under the Crowdsourcing and Citizen Science Act as well as select activities conducted under other authorities.

The Federal Government supports many more crowdsourcing and citizen science activities than what is included here. Because agencies are required only to report activities conducted under the authority of the Crowdsourcing and Citizen Science Act, reported activities conducted under other authorities should be considered representative rather than comprehensive. Further, some agencies, including NSF and NIH, primarily support crowdsourcing and citizen science activities through grants, contracts, cooperative agreements, and other funding mechanisms to non-Federal entities. These federally-funded activities are not included in this report, which focuses only on activities directly carried out or overseen by Federal agencies.

Federal agencies and nongovernmental organizations have mobilized citizen scientists across the Nation to accomplish scientific work across a range of disciplines from monitoring wildlife populations such as American pikas in the Columbia River Gorge (USFS, Box 5) and surveying harmful algal blooms in North American waters (EPA, Box 6) to coordinating with digital volunteer networks to help the emergency management community during disasters (FEMA, Box 7) and collecting daily weather data (NWS, Box 8). These activities are just a small sample of the crowdsourcing and citizen science activities supported by the Federal Government, but they highlight the many ways that citizen scientists and volunteers are actively participating and helping Federal agencies better fulfill their missions and serve all Americans and their communities.

Box 5. USFS: Monitoring the Status of the Columbia River Gorge Pika Population after the Eagle Creek Fire

American pikas are charismatic small mammals that are considered important indicators of environmental change because of their extreme sensitivity to long periods of warm weather. The 2017 Eagle Creek Fire burned nearly the entire low-elevation territory of pikas on the Oregon side of the Columbia River Gorge (CRG), prompting widespread public interest in the fate of the CRG pikas, which live at lower elevations than any other pika population in the United States. Following the 2017 Eagle Creek Fire, citizens ranging from hikers and outdoor enthusiasts to K-12 students and teachers have joined the Cascades Pika Watch (CPW), a citizen science initiative supported by the United States Department of Agriculture Forest Service, Oregon Zoo, the Point Defiance Zoo and Aquarium, and several leading pika biologists. Over 1,000 citizen scientists have helped the CPW conduct pika surveys over the past 5 years. Many enthusiastically share pika pictures and stories with the larger volunteer community through the CPW's Facebook group. Citizen scientists who have participated in CPW have indicated that the project promotes a sense of stewardship and responsibility as well as a deepened awareness of the complexity of wildlife management and conservation. The wealth of data collected by citizen scientists helps inform management decisions and contributes to a better understanding of how CRG pikas respond to environmental changes and disturbances such as wildfires.
https://www.oregonzoo.org/cascades-pika-watch
Image: https://www.oregonzoo.org/cascades-pika-watch

In FY17 and FY18, Federal agencies reported 86 active crowdsourcing and citizen science projects. These activities illustrate how volunteers have contributed to a diverse array of projects conducted across the Federal Government, at local to global scales, and engaged participants from elementary school students to senior citizens. In addition, projects are designed with different purposes and contribute to all parts of the scientific process, including defining research questions, conducting experiments, gathering and analyzing data, interpreting results, making new discoveries, developing new technologies and applications, and solving complex problems. Appendix C lists the 18 crowdsourcing and citizen science projects conducted under the Crowdsourcing and Citizen Science Act, and Appendix D lists 68 voluntarily reported projects conducted under other authorities.

Departments and agencies that reported crowdsourcing and citizen science activities in FY17 and FY18 include USFS, NIFA, and ARS in the Department of Agriculture; NOAA in the Department of Commerce; DOE; NIH; FEMA; BOEM, USBR, NPS, and USGS in the Department of Interior; EPA; NASA; and the Smithsonian Institution. Table 7 provides a breakdown of the authorities used in FY17 and FY18 by departments and independent agencies to conduct crowdsourcing and citizen science activities.

Table 7. List of Federal Departments, Independent Agencies, and Agencies within Departments That Reported Running Crowdsourcing and Citizen Science Projects in FY17 and FY18 Conducted under the Crowdsourcing and Citizen Science Act and Other Authorities.

Departments and Independent Agencies	Agencies within Departments	Crowdsourcing and Citizen Science Act		Other Authorities	
		FY17	FY18	FY17	FY18
Department of Agriculture (USDA)	U.S. Forest Service (USFS)		✓		
	National Institute of Food and Agriculture (NIFA)		✓		
	Agricultural Research Service (ARS)			✓	✓
Department of Commerce (DOC)	National Oceanic and Atmospheric Administration (NOAA)		✓	✓	✓
Department of Energy (DOE)				✓	✓
Department of Health and Human Services (HHS)	National Institute of Health (NIH)			✓	✓
Department of Homeland Security (DHS)	Federal Emergency Management Agency (FEMA)		✓		
Department of Interior (DOI)	Bureau of Ocean Energy Management (BOEM)			✓	✓
	U.S. Bureau of Reclamation (USBR)			✓	✓
	National Park Service (NPS)			✓	✓
	U.S. Geological Survey (USGS)		✓	✓	✓
Environmental Protection Agency (EPA)				✓	✓
National Aeronautics and Space Administration (NASA)		✓	✓	✓	✓
Smithsonian Institution (SI)				✓	✓

Box 6. Cyanoscope: EPA Collaborative Partnership on Monitoring Harmful Algal Blooms

Harmful algal blooms (HABs) occur when colonies of algae grow out of control while producing toxic or harmful effects on people, fish, shellfish, marine mammals, and birds. Algal toxins in water can cause fish kills, beach closures, and unsafe drinking water supplies that endanger human and animal health. HABs are a national concern because they affect not only the health of people and marine ecosystems, but also the health of local and regional economies. The Cyanoscope program aims to monitor and manage harmful algal and cyanobacterial blooms by educating the public on HABs; monitoring and providing surveillance to better understand the dynamics of HABs; and collecting key data to assist in determining trends, hotspots, and other important aspects of HABs. Crowdsourcing and citizen science is the most cost effective way to collect data on HABs. Participants collect cyanobacteria and take microscopic images using equipment provided in a Cyanoscope kit. The images plus location information and fluorometric data are uploaded to the iNaturalist.org website for identification and become part of a public database of algal blooms throughout North America. As HABs can be transitory in nature, having a large collaborative network of individuals over a broad area provides better coverage and monitoring opportunities than a typical research study that is limited in duration and geographic coverage.
https://cyanos.org/

Agency Use of Crowdsourcing and Citizen Science Authorities

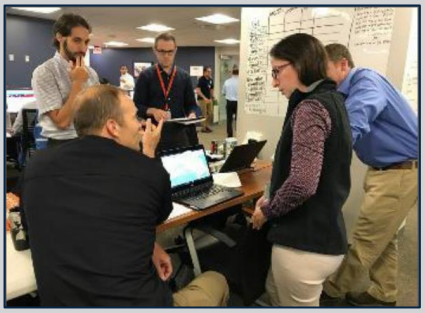
Numerous Federal agencies have a long history of crowdsourcing and citizen science under a variety of authorities prior to the passage of the Crowdsourcing and Citizen Science Act in 2017. In its first year, FY17, only one project sponsored by NASA cited the authority provided by the new act (although NASA continued to support numerous other crowdsourcing and citizen science activities using other authorities). In the following year, FY18, NASA was joined by FEMA, NOAA, NIFA, USFS, and USGS in using the authority of the Crowdsourcing and Citizen Science Act, although many agencies initiated or continued to administer activities developed under other authorities, including BOEM, DOE, EPA, NASA, NIH, NOAA, NPS, SI, USBR, ARS, and USGS in both FY17 and FY18.

Participation in Federal Crowdsourcing and Citizen Science Activities

The number of participants involved in crowdsourcing and citizen science activities in FY17 and FY18 varied widely, depending on the nature of the activity, the desired pool of participants, and outreach mechanisms used, among other factors. The largest number of participants reported in FY17 or FY18 was the over 700,000 virtual players involved in NIH's Applying Protein Databases to Crowdsourcing Structural Protein Design project.

Although crowdsourcing is often associated with online communities, more than half of the activities reported by Federal agencies involved activities tied to a particular place or time. Of the 86 crowdsourced and citizen science activities included in this report, 44 were localized, and although many included a digital component, they required engagement by participants at particular geographic locations. Table 8 and Figure 4 list and map localized activities in the United States. Table 9 lists activities that were geographically distributed—i.e., not restricted to participation at a particular place. These activities were predominantly online, allowing participation from anywhere across the U.S. or the world.

Box 7. FEMA Crowdsourcing Unit and Playbook for Emergency Management



One of the primary challenges facing first responders during natural disasters is obtaining timely and accurate information about where help is needed. To promote faster and more efficient responses during disasters, the FEMA Crowdsourcing Unit coordinated with digital volunteers to gather and synthesize critical information from social media and other non-traditional channels provided by citizens impacted by disasters. During recent emergencies, FEMA found that information posted on social media by informal, online networks has proved to be accurate, timely, and useful. As a result, FEMA has invested in a Crowdsourcing Unit and is developing a playbook outlining how to leverage spontaneously emerging crowdsourcing networks to support decision-making and response during disasters at all levels of emergency management. The playbook provides a roadmap on how to efficiently gather and disseminate different types of information needed by different constituencies in a timely manner. During response activities to Hurricanes Maria, Lane, Florence, and Michael, the FEMA Crowdsourcing Unit facilitated a daily coordination call that served as a collaborative forum for participant volunteers to share activities, data collection methodology, and products across the group. FEMA, among others, used these products to assist in cross-validating official information and supporting data-driven decision making.

Overall, localized citizen science activities were carried out by six departments and agencies: DOC, DOI, EPA, HHS, SI, and USDA. Some of the activities lasted as little as 1 day or are episodic, such as those related to earthquake response. In contrast, others are ongoing, multi-year efforts monitoring local habitats, animal populations, and environmental conditions for both people and wildlife. Localized projects took place across the United States, including Puerto Rico, but to some degree, their distribution reflects where Federal agencies have scientists and facilities physically located. For example, the majority of the Smithsonian Institution's numerous local citizen science activities take place near Washington, DC, where the Smithsonian museums are located. The USDA reported over a dozen citizen science efforts throughout the country, but most are associated with National Forests or other federally managed land. Although localized projects led by Federal scientists at a site are effective at directly engaging members of the public, such activities can be limited in the number of people they can include due to constraints on the availability of Federal resources. In contrast, distributed online activities are commonly open to anyone in the world, greatly increasing the number of potential participants, and often allow participants to work largely independently with little or no interaction with the project facilitators.

Partnerships with Other Organizations

Under all authorities in FY17 and FY18, 85% of all crowdsourcing and citizen science activities were conducted in partnership with another organization. Of the 86 crowdsourcing and citizen science activities reported, 71% had at least one non-Federal partner, and 33% had at least one Federal partner. Federal partners included other agencies, interagency working groups, and regional councils. Non-Federal partners included academic institutions, professional societies, State or local governments, tribal associations, non-profit or private sector organizations, regional councils or coalitions, and foundations. Partners provided both monetary and non-monetary contributions to the crowdsourcing and citizen science activities, including subject matter experts, technical reviewers, administrative support, or access to resources such as event space, supplies, data management, or online platforms.

The Diversity of Crowdsourcing and Citizen Science Projects

It is difficult to make generalizations about the nature of Federal crowdsourcing and citizen science activities due to the great variety of approaches used, number of people engaged, and scope of the science addressed. The number of people participating in each activity varied widely, from fewer than 10 to over 700,000. Duration of activities also covered a large range from less than a day to many decades. Nevertheless, a few broad patterns do emerge. First, reported crowdsourcing and citizen science activities are equally divided into projects that focused on localized activities (Table 8) versus those where involvement was geographically distributed and primarily online (Table 9). Many projects had both local and online components—for example, logging direct observations of the timing of the first appearance of different plants in spring in Acadia National Park using an app or logging into a website to analyze aerial photos of particular coastlines—but the primary distinction between localized and distributed projects was whether participation required being at a particular location or region. Both categories of projects can provide opportunities to directly interact with Federal scientists either in person or online; many localized activities are directly led by Federal scientists, giving citizen scientists the opportunity to interact face-to-face. Both localized and distributed projects were represented by 43 activities each, of which Crowdsourcing and Citizen Science Act authority was used for 13 localized projects and 9 distributed projects. In addition, some Federal agencies were more represented in one category or the other. Specifically, USFS and NPS were particularly well represented among localized projects because these are the agencies that manage the National Forests and National Parks where activities take place. In contrast, NASA was particularly well represented in distributed activities with the common thread being the analysis of remote sensing data, work that can be carried out by non-specialists but requires human attention to be done efficiently and effectively (in contrast to automating the process).

Box 8. National Weather Service Cooperative Observer Program

Long before the term *citizen science* was coined, the National Weather Service (NWS) relied on engaged citizen volunteers to collect and report basic meteorological and climate data from across the country. The NWS's Cooperative Observer Program (COOP) is a weather and climate observing network of, by, and for the people. More than 8,700 volunteers take observations on farms, in urban and suburban areas, National Parks, seashores, and mountaintops. The data are truly representative of where Americans live, work, and play and feed into the NWS mission of providing weather watch and warning information for protection of life and property. COOP has been in existence for over 125 years, since the first network of cooperative stations was formally codified in the Organic Act of 1890 that established the Weather Bureau, with informal participation at some sites reaching back 200 years. Many of the volunteers are multi-generational observers carrying on a long American tradition of weather observation dating all the way back to George Washington, Thomas Jefferson, and Benjamin Franklin, all of whom maintained weather records. Because of its many decades of relatively stable operation, high station density, and high proportion of rural locations, the COOP Network has been recognized as the most definitive source of information on U.S. climate trends for temperature and precipitation. In addition to NWS, FEMA relies on COOP rainfall and snowfall data as a primary information source for disaster declaration and relief efforts, and USDA risk management models get 80% of their data from COOP for agricultural disaster relief.
https://www.weather.gov/coop/

Although every crowdsourcing and citizen science project had a specific objective, several common themes are evident in the activities included in this report. First, a large number of crowdsourcing and citizen science activities included an educational aim, directly targeting either students or the broader public. In addition, many projects, both localized and distributed, focused on environmental monitoring or environmental stewardship, either by deploying citizen scientists to carry out regular observations in the field (for example, meteorological measurements or animal population observations) or having them process information from the field online (for example, satellite images). Another use of citizen science, particularly by the Smithsonian Institution's Transcription Center, was to enlist the public to digitize old analog records (e.g., field notebooks from scientific expeditions and photograph collections of specimens), increasing their scientific and historical value by making them accessible and searchable.

Overall, crowdsourcing and citizen science is particularly well suited for projects that require human effort but can be carried out with minimal training. Despite advances in computer analysis and artificial intelligence, analysis of much scientific data has not been efficiently or successfully automated. The rise of widespread internet connectivity, however, provides a means for leveraging the efforts of numerous participants as a force multiplier by automatically compiling and collating their contributions, amplifying the usefulness of engaging citizen scientists and volunteers in carrying out various agencies' missions.

Figure 4. Localized Federal Citizen Science and Crowdsourcing in the U.S.

Labels correspond to project codes in Appendices C and D (see Table 8 for project titles)

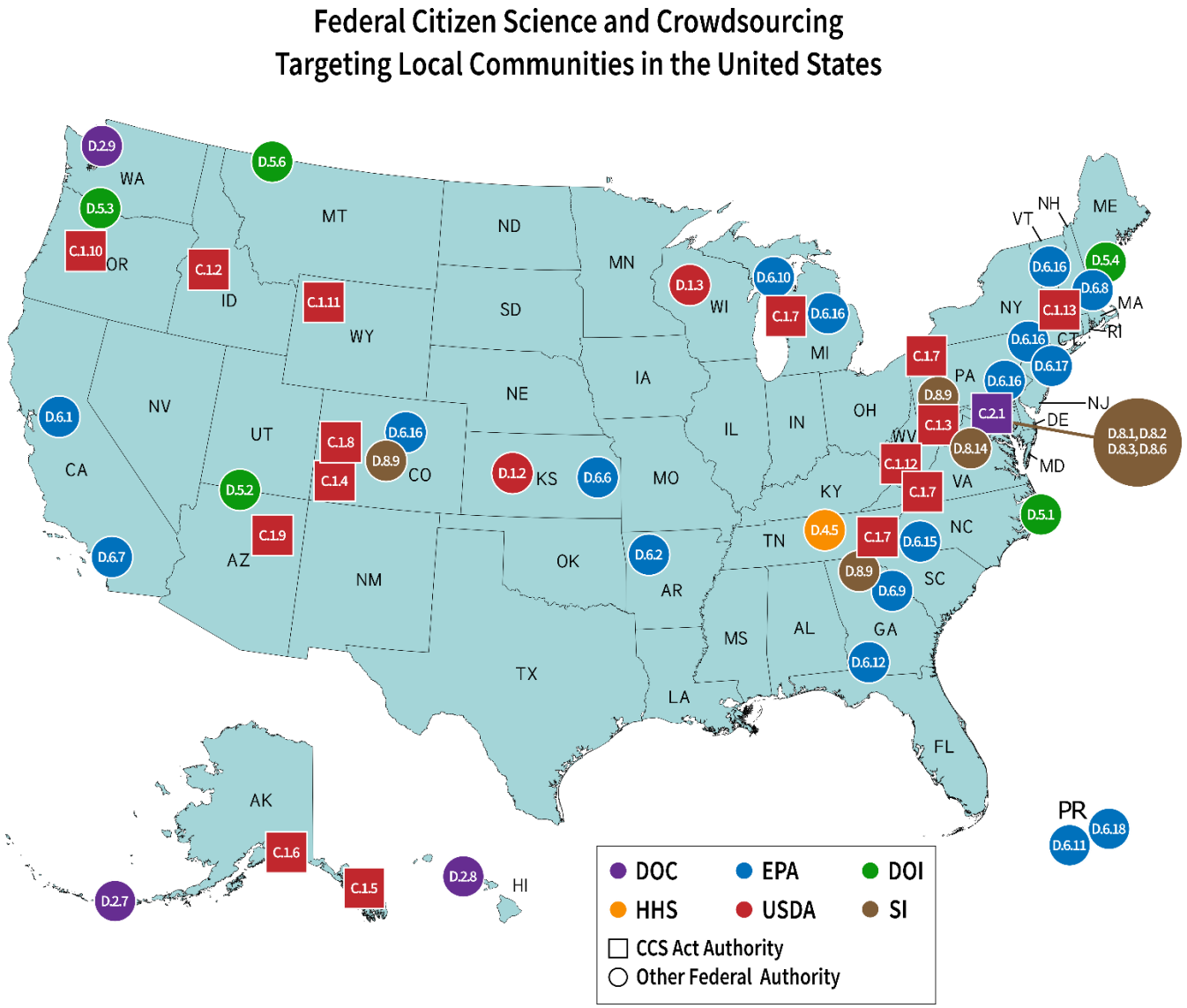


Table 8. Localized Federal Citizen Science and Crowdsourcing Activities in the U.S.

Crowdsourcing and Citizen Science Act (Appendix C)

Project Code	Agency	Project
C.1.2	USDA	Boise Multi-Party Monitoring, Boise, ID
C.1.3	USDA	Científicos en Familia: A Program to Engage Diverse Communities in Citizen Science and Stewardship
C.1.4	USDA	Citizen Science for Rangeland Health: Engaging Ranchers in Science
C.1.5	USDA	Collaborative Investigations at Admiralty Cove
C.1.6	USDA	Culturally Responsive Citizen Science Development with FIA in Interior Alaska
C.1.7	USDA	Engaging Angler Scientists to Help Prioritize and Monitor the Effectiveness of Stream Reconnection Projects
C.1.8	USDA	Engaging Citizen Scientists in Field Research on American Pika, an Indicator Species for Alpine Ecosystem Integrity
C.1.9	USDA	Location of Plants Traditionally Used by American Indian Tribes to Improve Management of Federal Lands on the Four Forest Restoration Initiative
C.1.10	USDA	Monitoring the Status of the Columbia River Gorge (CRG) Pika Population After the Eagle Creek Fire
C.1.11	USDA	Neighbors to Nature: Cache Creek Study
C.1.12	USDA	Potomac Highlands Cooperative Weed and Pest Management Area Non-Native Invasive Species Citizen Science Program
C.1.13	USDA	Tracking the Vernal Window with a Low-Cost Instrumentation Suite
C.2.1	DOC	Urban Heat Island Mapping Campaign

Other Agency Authorities (Appendix D)

Project Code	Agency	Project
D.1.2	USDA	Collaborative Adaptive Rangeland Management
D.1.3	USDA	FarmLab
D.2.7	DOC	Steller Watch
D.2.8	DOC	Hawaii Bottomfish Heritage Project: Tracing Traditions and Preserving Culture
D.2.9	DOC	Cooperative Research Provides New Data for ESA-listed Rockfish in Puget Sound, WA
D.4.5	HHS	Community Mapping Project: Engaging Students in Citizen Science for Safe Routes to School
D.5.1	DOI	Battle of the Atlantic Expedition
D.5.2	DOI	Aquatic Insect Monitoring in Grand Canyon
D.5.3	DOI	Archaeology Citizen Science at Fort Vancouver
D.5.4	DOI	Biodiversity Discovery and Phenology in Acadia National Park
D.5.6	DOI	Glacier National Park Common Loon Citizen Science
D.6.1	EPA	Building Capacity to Measure Air Pollution Mitigation Strategies at Schools
D.6.2	EPA	Crowdsourcing to Monitor Private Wells and Assess Contaminant Sources
D.6.6	EPA	Kansas City Transportation and Local Scale Air Quality Study (KC TRAQS)
D.6.7	EPA	Marine/Water Contact Sanitary Survey Workshops in California
D.6.8	EPA	Measuring Coastal Acidification in New England Estuaries
D.6.9	EPA	Micro CSI-Urban Edition: A Microbial Citizen Science Initiative in Urban Watersheds
D.6.10	EPA	Using Citizen Science to Analyze Underwater Videos in the Great Lakes
D.6.11	EPA	Using Citizen Science to Improve Drinking Water Epidemiology Studies in Puerto Rico
D.6.12	EPA	Low Cost Sensors for Real-time Continuous Water Quality Monitoring in Georgia
D.6.15	EPA	Community-led Air Sensor Evaluation in North Carolina
D.6.16	EPA	Regional Sensor Loan Program
D.6.17	EPA	Ironbound Neighborhood Air Monitoring
D.6.18	EPA	The Efficacy of Citizen Science Air Monitoring for Building Public Awareness of Exposures in a US Caribbean Urban Neighborhood Impacted by Heavy Industrial Contamination
D.8.1	SI	City Nature Challenge DC 2018
D.8.2	SI	Chesapeake Bay Parasite Project
D.8.3	SI	Environmental Archaeology at the Smithsonian Environmental Research Center
D.8.6	SI	Global Change Research Wetland Plant Census
D.8.9	SI	Neighbor Nestwatch
D.8.14	SI	Virginia Working Landscapes: Grasslands Biodiversity Survey

Table 9. Distributed Federal Citizen Science and Crowdsourcing Activities

Crowdsourcing and Citizen Science Act (Appendix C)

Project Code	Agency	Project
C.1.1	USDA	4-H Guide for NASA GLOBE Observer Clouds
C.3.1	DHS	FEMA Crowdsourcing Unit and Playbook for Emergency Management
C.4.1	DOI	Project eTrout
C.5.1	NASA	Backyard Worlds: Planet 9
C.5.2	NASA	Landslide Reporter
D.7.3	NASA	Aurorasaurus
D.7.4	NASA	Disk Detective
D.7.5	NASA	Globe Observer
D.7.6	NASA	Image Detective

Other Agency Authorities (Appendix D)

Project Code	Agency	Project
D.1.1	USDA	Invasive Mosquito Project
D.2.1	DOC	Cyclone Center
D.2.2	DOC	Meteorological Phenomena Identification Near the Ground
D.2.3	DOC	Old Weather
D.2.4	DOC	Community Collaborative Rain, Hail and Snow (CoCoRaHS) network
D.2.5	DOC	CrowdMag
D.2.6	DOC	Crowdsourced Bathymetry
D.2.10	DOC	NWS Cooperative Observer Program
D.3.1	DOE	The Open PV Project
D.4.1	HHS	Crowdsourcing Optimal Cancer Treatment Strategies that Maximize Efficacy and Minimize Toxicity
D.4.2	HHS	Applying Protein Databases to Crowdsourcing Structural Protein Design
D.4.3	HHS	OMics Compendia Commons
D.4.4	HHS	NIDCR 2030: Envisioning the Future, Together
D.4.6	HHS	NNLM Wikipedia Edit-a-thon
D.5.5	DOI	Dragonfly Mercury Project: Engaging Citizens with Resource Conservation
D.5.7	DOI	Did You Feel It? (DYFI)
D.5.8	DOI	iCoast - Did the Coast Change?
D.5.9	DOI	Nature's Notebook
D.5.10	DOI	The National Map Corps (TNMCorps)
D.6.3	EPA	Cyanoscope: EPA collaborative partnership on monitoring harmful algal blooms
D.6.4	EPA	EPA/US Coast Guard Auxiliary Partnership for HAB monitoring
D.6.5	EPA	HiveScience: A Citizen Science Project for Beekeepers
D.6.13	EPA	Smoke Sense
D.6.14	EPA	Air Sensor Toolbox
D.7.1	NASA	Globe Program
D.7.2	NASA	Students' Cloud Observations on-Line (S'cool)
D.8.4	SI	eMammal
D.8.5	SI	Fossil Atmospheres
D.8.7	SI	Invader ID
D.8.8	SI	Leafsnap
D.8.10	SI	Smithsonian Transcription Center
D.8.11	SI	Smithsonian Transcription Center - Biodiversity Collection Records and Specimen Labels
D.8.12	SI	Smithsonian Transcription Center - Project PHaEDRA: Preserving Harvard's Early Data and Research in Astronomy
D.8.13	SI	Smithsonian Transcription Center - Transcription of Science-related Archival Documents

Summary

The America COMPETES Act of 2010 and the Crowdsourcing and Citizen Science Act of 2017 are encouraging open innovation, generating new Federal partnerships with the private sector, creating educational opportunities for young and old alike, and bringing new and diverse perspectives to bear on a variety of societal issues.

Federal prize competitions reported in FY17 and FY18 under the COMPETES Act and other authorities demonstrate a continuing upward trend in engagement between Federal and non-government entities to address societal needs and improve return on taxpayer dollars. These initiatives are engaging solvers and innovators in the development of new technologies and tackling problems that impact lives domestically and abroad.

The results presented in this report show that agencies are leveraging the prize authority to accomplish a wider variety of goals than in previous years, ranging from developing technology to educating the public to stimulating markets. In addition, FY17 and FY18 saw an increase in solutions particularly focused on information technology ranging from creating software and mobile apps to advancing the development of hardware to the analysis and visualization of data. These trends—wider and more creative use of prize competitions and solutions focused on information technology—are expected to continue in the near future. Overall, the number and diversity of prize competitions indicate that they are having the positive effect intended by Congress when it passed the COMPETES Act in 2010.

Although Federal agencies had been active in the crowdsourcing and citizen science arena before its enactment, the Crowdsourcing and Citizen Science Act gave them a new authority to directly tap the creativity, innovation, and curiosity of the American public. Crowdsourcing and citizen science is being used to develop and expand research efforts, support education initiatives, and address societal needs.

This report is the first effort to collate the Federal Government's diverse engagement in crowdsourcing and citizen science since the Crowdsourcing and Citizen Science Act was enacted in 2017. Agencies have customized their crowdsourcing and citizen science efforts in terms of duration and scope to help accomplish their missions, including leveraging short-term field campaigns, multi-year monitoring efforts, and global online networks. Through localized crowdsourcing and citizen science programs, thousands of Americans across the country and its territories directly engage with Federal scientists to conduct research and improve the quality of life in their own neighborhoods and communities. Distributed online programs, which have no physical boundaries to participation, expand the impact of crowdsourcing and citizen science to allow millions more to participate. Unlike prize competitions, the Crowdsourcing and Citizen Science Act has not been in place long enough to analyze trends in how these activities have been used over time, but they are proving particularly beneficial in applications that cannot be easily automated but instead require human intelligence and understanding to efficiently and correctly sort and analyze complex observations. The snapshot of current crowdsourcing and citizen science programs captured by this report will provide a baseline to track how the number and variety of projects changes over time to help identify best practices and ensure that they have the greatest positive impact on the American people.

Summary of Prize Competitions Active in Fiscal Years 2017 and 2018 Conducted Under COMPETES Authority

Agency	Name	Solution Type(s)	Primary Goal(s)	Date Open	Date Complete	Entry #s	Prize #s	Total Prize Purse
USDA	National School Lunch and School Breakfast 2017 Verification Response Rate Challenge	Creative; Ideas	Improve service delivery; Highlight ideas; Solve specific problem; Engagement	5/4/2017	6/15/2017	36	7	$0
	2017 Innovations in Food and Agricultural Science and Technology (I-FAST) Prize Competition	Software; Ideas; Hardware	Advance science; Develop technology; Engagement; Stimulate market	9/15/2017	10/6/2017	4	3	$400,000
DOC	2017 RAMP: Reusable Abstractions of Manufacturing Processes	Software; Analytics; Other	Improve service delivery; Highlight ideas; Advance science; Engagement; Stimulate market	12/19/2016	4/17/2017	14	8	$3,250
	2018 RAMP: Reusable Abstractions of Manufacturing Processes	Software; Analytics; Other	Improve service delivery; Highlight ideas; Advance science; Engagement; Stimulate market	1/29/2018	4/21/2018	9	6	$3,250
	Agile Robotics for Industrial Automation Competition (ARIAC)	Ideas; Analytics; Scientific	Highlight ideas; Solve specific problem; Advance science; Develop technology	1/26/2018	5/17/2018	50	3	$17,500
	Federal Impact Assessment Challenge	Ideas; Analytics; Economic impact assessment	Improve service delivery; Highlight ideas; Educate public; Engagement	9/27/2016	5/31/2017	1	0	$20,000
	NIST the Future of Public Safety Technology 100K Video Series Challenge	Creative; Ideas	Educate public; Engagement	8/24/2017	12/22/2017	107	6	$100,000

Agency	Name	Solution Type(s)	Primary Goal(s)	Date Open	Date Complete	Entry #s	Prize #s	Total Prize Purse
DOC	NIST Virtual Public Safety Test Environment Challenge	Ideas; Hardware	Highlight ideas; Advance science; Develop technology; Engagement; Stimulate market	3/28/2017	5/3/2017	21	5	$50,000
	PerfLoc: Performance Evaluation of Smartphone Indoor Localization Apps	Software; Analytics; Scientific	Highlight ideas; Solve specific problem; Advance science; Develop technology	3/22/2017	1/17/2018	16	1	$35,000
	The Unlinkable Data Challenge: Advancing Methods in Differential Privacy	Software; Ideas; Analytics; Concept papers	Highlight ideas; Solve specific problem; Advance science; Engagement; Stimulate market	5/1/2018	5/6/2019	11	5	$190,000
	The Unmanned Aerial Systems Flight and Payload Challenge	Ideas; Hardware	Solve specific problem; Advance science; Develop technology; Stimulate market	1/8/2018	1/29/2018	30	11	$432,000
	Virtual Reality Heads-Up Display Navigation Challenge	Creative; Hardware	Highlight ideas; Advance science; Engagement; Stimulate market	1/2/2018	1/29/2018	18	6	$125,000
DOE	Cleantech University Prize (Cleantech UP)	Business plans	Highlight ideas; Develop technology; Engagement	9/1/2017	3/1/2018	250	13	$570,000
	Solar in your Community Challenge	Ideas; Business plans	Highlight ideas; Educate public; Engagement; Build capacity; Stimulate market	11/18/2016	3/17/2017	201	35	$3,000,000
	The American-Made Solar Prize	Software; Ideas; Hardware; Business plans; Scientific	Highlight ideas; Develop technology; Engagement; Build capacity; Stimulate market	6/7/2018	10/5/2018	N/A	N/A	$3,000,000

Agency	Name	Solution Type(s)	Primary Goal(s)	Date Open	Date Complete	Entry #s	Prize #s	Total Prize Purse
DOE	American Inventions Made Onshore (AIM Onshore)	Software; Creative; Ideas; Business plans; Scientific	Improve government service delivery; Find and highlight innovative ideas; Solve a specific problem; Develop technology; Inform and educate the public; Engage new people and communities; Build capacity; Stimulate a market	2/6/2018	N/A	20	4	$950,000
DOI	Saving the ʻŌhiʻa – Hawaiʻi's Sacred Tree	Ideas; Hardware; Scientific	Highlight ideas; Solve specific problem; Advance science; Develop technology; Educate public; Engagement; Build capacity; Stimulate market	8/28/2018	4/1/2019	N/A	1	$70,000
	Arsenic Sensor – Stage 1	Ideas	Highlight ideas; Solve specific problem; Advance science; Engagement	12/13/2016	3/13/2017	39	5	$50,000
	Colorado River Basin Data Visualization	Analytics	Improve service delivery; Solve specific problem; Advance science; Develop technology; Educate public; Engagement	9/7/2017	11/17/2017	24	9	$60,000
	DataApp: A Mobile App Framework for Field Data Capture	Ideas	Solve specific problem; Advance science; Develop technology; Engagement	5/23/2017	7/6/2017	24	7	$30,000
	Detecting Leaks and Flaws in Water Pipelines - Stage 1	Ideas	Solve specific problem; Advance science; Develop technology; Engagement;	3/8/2018	5/8/2018	54	5	$75,000

Agency	Name	Solution Type(s)	Primary Goal(s)	Date Open	Date Complete	Entry #s	Prize #s	Total Prize Purse
DOI	Detecting the Movement of Soils (Internal Erosion) Within Earthen Dams, Canals, Levees and their Foundations	Ideas	Solve specific problem; Advance science; Develop technology; Engagement;	3/31/2016	5/10/2016	29	5	$20,000
	Downstream Fish Passage at Tall Dams	Ideas	Solve specific problem; Advance science; Develop technology; Engagement	3/31/2016	5/10/2016	44	4	$20,000
	Eradication of Invasive Mussels in Open Water - Stage 1	Ideas; Hardware; Scientific	Solve specific problem; Advance science; Develop technology; Engagement	12/14/2017	2/28/2018	67	3	$100,000
	Indirect Estimates of Reservoir Water Storage	Hardware	Solve specific problem; Advance science; Develop technology; Engagement	2/22/2017	5/22/2017	20	1	$75,000
	Long-Term Corrosion Protection of Existing Hydraulic Steel Structures – Stage 1	Ideas	Solve specific problem; Advance science; Develop technology; Engagement	6/13/2017	9/5/2017	30	5	$75,000
	More Water, Less Concentrate - Stage 1	Ideas	Highlight ideas; Solve specific problem; Advance science; Develop technology	12/13/2016	3/13/2017	66	8	$150,000
	Pathogen Monitoring - Stage 1	Ideas	Highlight ideas; Solve specific problem; Advance science; Engagement	5/10/2018	8/8/2018	N/A	N/A	$40,000
	Powering Electronic Instruments on a Rotating Shaft - Stage 1	Ideas; Hardware; Scientific	Solve specific problem; Advance science; Develop technology; Engagement; Stimulate market	9/6/2018	12/6/2018	N/A	N/A	$250,000
	Preventing Rodent Burrows in Earthen Embankments	Ideas	Solve specific problem; Advance science; Develop technology; Engagement	8/29/2016	10/11/2016	75	5	$20,000

Agency	Name	Solution Type(s)	Primary Goal(s)	Date Open	Date Complete	Entry #s	Prize #s	Total Prize Purse
DOI	Sub-Seasonal Climate Forecast Rodeo	Analytics	Solve specific problem; Advance science; Develop technology; Engagement	12/20/2016	5/3/2018	N/A	N/A	$800,000
HHS	AHRQ Step Up App Challenge: Advancing Care Through Patient Assessments	Software	Highlight ideas; Solve specific problem; Advance science; Develop technology; Engagement; Stimulate market	8/13/2018	9/9/2019	N/A	N/A	$250,000
	2017 Million Hearts® Hypertension Control Challenge	Ideas	Highlight ideas	N/A	N/A	98	24	$0
	2018 Million Hearts® Hypertension Control Challenge	Ideas	Highlight ideas	N/A	N/A	23	N/A	$0
	The Healthy Behavior Data Challenge	Software; Ideas	Highlight ideas; Solve specific problem	4/29/2017	1/31/2018	9	7	$100,000
	2016 FDA Naloxone App Competition	Software	Highlight ideas; Engagement	N/A	N/A	N/A	N/A	$40,000
	Bridging the Word Gap Challenge	Software; Creative; Ideas; Hardware	Highlight ideas; Solve specific problem; Develop technology; Educate public; Engagement; Stimulate market	11/9/2015	3/26/2017	80	16	$300,000
	Addressing Opioid Use Disorder in Pregnant Women and New Moms	Software; Creative; Ideas; Hardware	Highlight ideas; Solve specific problem; Advance science; Develop technology; Educate public; Engagement; Stimulate market	9/19/2018	N/A	79	N/A	$375,000

Agency	Name	Solution Type(s)	Primary Goal(s)	Date Open	Date Complete	Entry #s	Prize #s	Total Prize Purse
HHS	Care Coordination for Children with Special Health Care Needs (CSHCN)	Software; Hardware; Analytics	Highlight ideas; Solve specific problem; Develop technology; Engagement; Stimulate market; Improve health care delivery and experiences of health care	8/30/2018	N/A	60	N/A	$375,000
	Remote Pregnancy Monitoring	Software; Creative; Ideas; Hardware	Highlight ideas; Solve specific problem; Advance science; Develop technology; Engagement; Stimulate market	9/1/2018	N/A	76	N/A	$375,000
	Using Technology to Prevent Childhood Obesity in Low-Income Families and Communities	Software; Creative; Ideas; Hardware; Analytics; Other	Highlight ideas; Solve specific problem; Develop technology; Educate public; Engagement; Build capacity; Stimulate market; Improve health care delivery and experiences of health care	7/24/2018	N/A	76	N/A	$375,000
	Rare Diseases are not Rare! Challenge	Software; Creative; Ideas	Highlight ideas; Advance science; Educate public; Engagement	9/30/2018	10/31/2018	N/A	N/A	$5,000
	NEI 3-D Retina Organoid Challenge (3-D ROC)	Ideas; Scientific	Highlight ideas; Solve specific problem; Develop technology; Engagement	6/1/2017	8/1/2017	13	1	$100,000
	NEI 3-D Retina Organoid Challenge (3-D ROC) 2020	Scientific	Solve specific problem; Advance science; Develop technology; Engagement; Stimulate market	9/4/2018	3/2/2020	N/A	N/A	$1,000,000

Agency	Name	Solution Type(s)	Primary Goal(s)	Date Open	Date Complete	Entry #s	Prize #s	Total Prize Purse
HHS	Improving Care for People with Alzheimer's Disease and Related Dementias using Technology (iCare-AD/ADRD) Challenge	Software	Develop technology	9/1/2018	6/1/2019	N/A	N/A	$400,000
	Open Science Prize	Software; Ideas; Hardware; Analytics; Scientific	Highlight ideas; Advance science; Develop technology; Educate public; Engagement; Build capacity; Stimulate market	10/20/2015	12/1/2017	96	7	$710,000
	Storytelling About Wellness in Tribal Communities	Creative	Educate public; Engagement	11/28/2016	1/31/2017	32	5	$10,000
	A Wearable Alcohol Biosensor: A Second Challenge	Software; Hardware; Analytics	Solve specific problem; Advance science; Develop technology; Stimulate market	12/10/2016	5/15/2017	5	1	$300,000
	Design by Biomedical Undergraduate Teams (DEBUT)	Creative; Hardware	Highlight ideas; Develop technology; Engagement; Build capacity; Educate Biomedical Engineering Students	N/A	5/31/2017; 5/31/2018	77	10	$130,000
	The 2017 "$100,000 for Start a SUD Startup" Challenge	Ideas; Business plans; Scientific	Highlight ideas; Educate public; Engagement; Build capacity;	6/9/2017	12/22/2017	18	10	$100,000
	Follow that Cell	Scientific	Highlight ideas; Solve specific problem; Advance science; Develop technology	3/17/2015	3/30/2017	10	2	$400,000

Agency	Name	Solution Type(s)	Primary Goal(s)	Date Open	Date Complete	Entry #s	Prize #s	Total Prize Purse
HHS	Antimicrobial Resistance, Rapid, Point-of-Need Diagnostic Test Challenge	Hardware; Scientific	Solve specific problem; Advance science; Develop technology; Engagement; Stimulate market	9/8/2016	1/3/2020	74	10	$20,000,000
	The Simple Extensible Sampling Tool Challenge	Software	Solve specific problem; Educate public	9/29/2016	5/15/2017	8	1	$40,000
	Blockchain in Healthcare Code-a-Thon	Software; Creative; Hardware	Develop technology; Educate public; Engagement; Stimulate market	1/23/2017	3/7/2017	83	10	$15,000
	CHPL Data Challenge	Software; Creative	Highlight ideas; Solve specific problem; Develop technology; Educate public	7/10/2018	10/31/2018	N/A	N/A	$40,000
	Consumer Health Data Aggregator Challenge	Software; Analytics	Highlight ideas; Solve specific problem; Educate public; Engagement; Build capacity; Stimulate market	3/1/2016	11/7/2016	25	6	$175,000
	Easy EHR Issues Reporting Challenge	Software; Analytics	Solve specific problem; Develop technology	5/22/2018	10/15/2018	N/A	N/A	$80,000
	Move Health Data Forward Challenge	Software; Hardware; Business plans	Highlight ideas; Solve specific problem; Develop technology	5/10/2016	9/8/2016	31	17	$250,000
	Oh, the Places Data Goes: Health Data Provenance Challenge	Ideas; Hardware	Highlight ideas; Solve specific problem; Develop technology; Stimulate market	4/6/2017	1/22/2018	19	6	$180,000
	Patient Matching Algorithm Challenge	Analytics; Scientific	Advance science; Educate public; Engagement; Stimulate market	6/12/2017	10/12/2017	7000	6	$75,000

Agency	Name	Solution Type(s)	Primary Goal(s)	Date Open	Date Complete	Entry #s	Prize #s	Total Prize Purse
HHS	Privacy Policy Snapshot Challenge	Software; Analytics	Improve service delivery; Solve specific problem; Educate public	12/13/2016	4/10/2017	6	3	$35,000
	Provider User Experience Challenge	Software; Analytics	Improve service delivery; Highlight ideas; Solve specific problem; Educate public; Engagement; Build capacity; Stimulate market	3/1/2016	11/7/2016	34	6	$175,000
	Proving the Potential: A Health Data and Standards Code-a-Thon	Software; Creative; Hardware	Develop technology; Educate public; Engagement; Stimulate market	4/11/2017	4/21/2017	N/A	3	$15,000
	Secure API Server Showdown Challenge	Software; Ideas; Hardware	Solve specific problem; Develop technology; Educate public; Engagement; Stimulate market	10/10/2017	1/15/2018	2	2	$50,000
	HHS Opioid Code-a-Thon	Software; Hardware	Highlight ideas; Engagement	12/7/2017	12/7/2017	50	3	$30,000
DHS	Hidden Signals Challenge-"Can you Identify Biothreats in Real-Time?"	Hardware; Analytics	Improve service delivery; Highlight ideas; Solve specific problem; Engagement	10/17/2017	4/13/2018	37	7	$300,000
	Passenger Screening Algorithm Challenge	Software; Analytics	Improve service delivery; Highlight ideas; Solve specific problem; Advance science; Develop technology; Engagement	6/22/2017	12/15/2017	9,339	8	$1,500,000

Agency	Name	Solution Type(s)	Primary Goal(s)	Date Open	Date Complete	Entry #s	Prize #s	Total Prize Purse
State	AIT FY18 Fishackathon	Software; Creative; Ideas; Hardware; Analytics	Highlight ideas; Solve specific problem; Advance science; Develop technology; Educate public; Engagement; Build capacity	N/A	N/A	N/A	N/A	$10,000
	FY17 and FY18 NASA Hackathon	Software; Creative; Ideas; Hardware; Analytics	Highlight ideas; Solve specific problem; Advance science; Develop technology; Educate public; Engagement; Build capacity	N/A	N/A	N/A	N/A	$23,350
	Boldline P3 Accelerator – Cohort 1	Ideas; Other	Improve service delivery; Highlight ideas; Develop technology; Educate public; Engagement; Build capacity; Build public-private partnerships	11/1/2017	11/21/2017	52	9	N/A
	Boldline P3 Accelerator for Religious Freedom (RF) – Cohort 2	Ideas; Other	Improve service delivery; Highlight ideas; Develop technology; Educate public; Engagement; Build capacity; Build public-private partnerships	6/22/2018	8/23/2018	31	6	N/A
	DOS Fishackathon	Software; Ideas	Highlight ideas; Solve specific problem; Develop technology; Educate public; Engagement;	2/10/2018	2/11/2018	3,500	1	$200,000
	Competition for the President's Day	Ideas	Educate public; Engagement	N/A	N/A	N/A	10	$100
	3-2-1 GO!	Analytics	Educate public	N/A	N/A	N/A	N/A	N/A

Agency	Name	Solution Type(s)	Primary Goal(s)	Date Open	Date Complete	Entry #s	Prize #s	Total Prize Purse
State	E-Farmer Support App	Software; Other	Solve specific problem; Develop technology; Build capacity; Stimulate market	N/A	N/A	N/A	N/A	$100,000
	Centennial Logo Competition	Creative; Ideas	Improve service delivery; Highlight ideas; Solve specific problem; Educate public; Engagement	2/13/2018	3/4/2018	34	1	$912.74
DOT	Solving for Safety Visualization Challenge	Hardware; Analytics	Highlight ideas; Solve specific problem; Develop technology; Educate public; Engagement	6/14/2018	N/A	54	N/A	$350,000
EPA	Advanced Septic System Nitrogen Sensor Challenge	Ideas; Hardware; Analytics; Scientific	Highlight ideas; Solve specific problem; Advance science; Develop technology; Stimulate market	1/17/2017	2/21/2020	18	6	$55,000
	Campus RainWorks Challenge	Creative; Ideas; Hardware; Scientific	Solve specific problem; Advance science; Develop technology; Educate public; Engagement	1/30/2018	12/14/2018	N/A	4	$16,000
	Nutrient Sensor Action Challenge - Stage I	Creative; Ideas; Hardware; Analytics; Scientific	Highlight ideas; Solve specific problem; Advance science; Develop technology; Engagement; Stimulate market	7/26/2017	9/20/2017	29	5	$50,000
	Nutrient Sensor Action Challenge - Stage II	Creative; Ideas; Hardware; Business plans; Analytics; Scientific	Highlight ideas; Solve specific problem; Advance science; Develop technology; Engagement; Stimulate market	3/1/2018	1/31/2019	7	2	$100,000

Agency	Name	Solution Type(s)	Primary Goal(s)	Date Open	Date Complete	Entry #s	Prize #s	Total Prize Purse
FTC	IoT Home Inspector Challenge	Software; Creative; Ideas	Highlight ideas; Solve specific problem; Educate public; Stimulate market	3/1/2017	5/22/2017	N/A	2	$34,000
GSA	Student Design Competition: New San Francisco Federal Building Plaza	Creative; Ideas	Improve service delivery; Highlight ideas; Solve specific problem; Educate public; Engagement	10/18/2017	6/14/2018	63	3	$1,750
NASA	Earth & Space Air Prize	Hardware	Solve specific problem; Develop technology	9/9/2017	1/31/2018	20	3	$250,000
NSF	2017-2018 Community College Innovation Challenge	Software; Ideas; Hardware; Business plans; Scientific	Highlight ideas; Advance science; Educate public; Engagement; Build capacity	10/18/2017	2/14/2018	41	10	$81,700
	Engineering Research Centers (ERC)-Wide Perfect Pitch Competition	Creative	Engagement; Build capacity	8/16/2017	9/29/2017	15	3	$8,000
	Generation Nano: Superheroes Inspired by Science	Creative	Educate public; Engagement	9/18/2017	1/10/2018	388	9	$14,880
	NSF Wireless Innovation for a Networked Society (WINS)	Software; Hardware; Business plans	Highlight ideas; Solve specific problem; Develop technology; Educate public; Engagement	6/1/2017	11/15/2018	20	8	$2,000,000
	NSF-Hearables Challenge	Software; Analytics	Highlight ideas; Solve specific problem; Develop technology; Educate public; Engagement; Build capacity; Stimulate market	4/25/2017	6/30/2017	7	4	$145,000

Agency	Name	Solution Type(s)	Primary Goal(s)	Date Open	Date Complete	Entry #s	Prize #s	Total Prize Purse
SBA	InnovateHER 2017 Challenge	Creative; Ideas; Business plans	Highlight ideas; Solve specific problem; Engagement; Build capacity	12/29/2016	6/23/2017	N/A	3	$70,000
	Growth Accelerator Fund Competition	Other	Engagement; Build capacity; Stimulate market	6/23/2017	7/21/2017	63	20	$1,000,000
	#SmallBusinessWeek Hackathon	Software	Improve service delivery; Highlight ideas; Solve specific problem; Develop technology; Educate public	4/27/2018	4/27/2018	75	4	$24,000
USAID	Sign on For Literacy Prize	Software; Hardware	Highlight ideas; Solve specific problem; Develop technology; Engagement	11/8/2017	2/16/2018	104	5	$500,000

Summary of Prize Competitions Active in Fiscal Years 2017 and 2018 Conducted Under Authority Other than COMPETES

Agency	Name	Solution Type(s)	Primary Goal(s)	Date Open	Date Complete	Entry #s	Prize #s	Total Prize Purse	Authority
DOD	DARPA Spectrum Collaboration Challenge (SC2)	Software; Hardware; Scientific	Highlight ideas; Solve specific problem; Advance science; Develop technology; Engagement; Stimulate market	7/19/2016	1/11/2019	152	23	$18,750,000	10 USC 2374a
	CubeSat Challenge	Creative; Ideas; Scientific	Highlight ideas; Advance science	8/15/2017	10/18/2017	35	7	$35,000	10 USC 2374a
	Technology Challenges and Opportunities to SOF in 2027	Ideas	Highlight ideas	7/21/2017	8/10/2017	108	18	$25,000	10 USC 2374a
	Urban 3D Challenge	Software; Analytics	Highlight ideas; Solve specific problem; Develop technology	10/9/2017	12/4/2017	790	8	$34,500	10 USC 2374a
HHS	Domestic Violence Awareness Month YouTube Challenge	Ideas	Highlight ideas; Solve specific problem; Educate public; Engagement; Build capacity	10/12/2016	11/2/2016	26	3	$10,000	15 U.S.C. § 3719 and 42 U.S.C. § 10401(a)(1)
	Challenges in Computational Precision Medicine (CPM) 2018	Software; Ideas; Analytics; Scientific	Highlight ideas; Solve specific problem; Advance science; Develop technology; Educate public; Engagement	6/12/2018	8/16/2018	819	12	$0	HHS-NCI statutory authority

Agency	Name	Solution Type(s)	Primary Goal(s)	Date Open	Date Complete	Entry #s	Prize #s	Total Prize Purse	Authority
HHS	ICGC-TCGA DREAM Somatic Mutation Calling - RNAChallenge (SMC-RNA)	Software; Scientific	Solve specific problem; Advance science; Develop technology; Engagement	6/29/2016	5/12/2017	11	N/A	$0	HHS-NCI statutory authority
	NCI-CPTAC DREAM Proteogenomics Challenge	Software; Analytics; Scientific	Solve specific problem; Advance science; Engagement; Stimulate market	6/26/2017	11/20/2017	504	3	$25,000	HHS-NCI statutory authority
	PROSTATEx Challenge	Software; Ideas; Analytics; Scientific	Highlight ideas; Solve specific problem; Advance science; Develop technology; Educate public; Engagement	11/21/2016	6/23/2017	N/A	N/A	$0	HHS-NCI statutory authority
DHS	The U.S. Coast Guard Ready for Rescue Challenge	Ideas; Hardware; Analytics	Improve service delivery; Highlight ideas; Solve specific problem; Advance science; Develop technology; Educate public	9/5/2018	10/15/2018	N/A	N/A	$255,000	Procurement Authority
State	Diplomacy Lab	Ideas; Research	Improve service delivery; Engagement	N/A	N/A	N/A	N/A	$0	N/A
	Almaty Mini Maker Faire—Pitching Challenge	Software; Creative; Ideas; Hardware; Scientific	Highlight ideas; Solve specific problem; Develop technology; Engagement	N/A	N/A	12	3	$6,000	N/A
	Spelling Bee	Creative; Ideas	Engagement; Build capacity	N/A	N/A	20	5	$0	N/A
	World Tourism Day Quiz	N/A	Educate public; Engagement; Stimulate market; Other	9/27/2018	9/28/2018	7	5	$0	N/A

Agency	Name	Solution Type(s)	Primary Goal(s)	Date Open	Date Complete	Entry #s	Prize #s	Total Prize Purse	Authority
State	Impact Video Competition	Creative	Highlight ideas; Educate public	10/30/2017	12/8/2017	30	3	$0	Foreign Assistance Act
	"150 Years of Cooperation and Friendship" Logo Contest	Creative; Ideas	Solve specific problem; Engagement	2/27/2017	3/16/2017	182	1	$271	Fulbright-Hays Act
	#MEthroughUSeyes	Other	Educate public; Engagement	5/5/2017	5/25/2017	120	10	$0	State Department
	#OscarsME2018	Other	Educate public; Engagement	2/5/2018	2/26/2018	400	5	$0	State Department
	#USElections2016 - Official Trivia Contest Rules	N/A	Educate public	10/21/2016	10/31/2016	450	10	$0	State Department
	GIFT O'CLOCK 2016 - #MEholidaysWithUS	Other	Educate public; Engagement	12/12/2016	12/22/2016	30	10	$0	State Department
	Montenegrin Summer in the States #USalumniMNE	Other	Educate public; Engagement	8/1/2018	9/10/2018	231	13	$0	State Department
	Tis the season 2017 - #MEholidaysWithUS	Other	Educate public; Engagement	12/13/2017	12/26/2017	45	5	$0	State Department
	U.S. Embassy Podgorica: Give Away #1	Other	Educate public; Engagement	7/30/2018	8/1/2018	68	1	$0	State Department
	U.S. Embassy Podgorica: Give Away #2	Other	Educate public; Engagement	8/23/2018	8/28/2018	64	1	$0	State Department
	U.S. Embassy Podgorica: Give Away #3	Other	Educate public; Engagement	10/12/2018	10/17/2018	36	1	$0	State Department

Agency	Name	Solution Type(s)	Primary Goal(s)	Date Open	Date Complete	Entry #s	Prize #s	Total Prize Purse	Authority
VA	PseudoVet	Software	Solve specific problem; Develop technology	8/8/2017	2/1/2018	542	75	$95,000	Space Act/Pro-curement Authority
	VA Gun Safety Matters Challenge	Software; Creative; Ideas; Hardware	Highlight ideas; Solve specific problem; Educate public; Engagement	9/19/2017	1/8/2018	40	3	$60,000	Space Act/Pro-curement Authority
	Veterans Online Memorial Challenge	Software	Improve service delivery; Solve specific problem; Develop technology	9/27/2017	6/30/2018	76	22	$197,373	Space Act/Pro-curement Authority
EPA	Smart City Air Challenge	Other	Highlight ideas; Engagement; Stimulate market	8/30/2016	10/28/2016	22	2	$100,000	Clean Air Act Amendments, Section 103
	Tox Test Challenge Stage II	Hardware; Scientific	Highlight ideas; Solve specific problem; Advance science; Develop technology; Engagement; Build capacity; Stimulate market	1/30/2017	8/31/2017	9	5	$500,000	Toxic Sub-stances Control Act (TSCA)
	Wildland Fire Sensors Challenge	Hardware	Improve service delivery; Highlight ideas; Solve specific problem; Advance science; Develop technology; Educate public; Engagement; Stimulate market	N/A	1/5/2018	27	2	$60,000	Clean Air Act, Section 103, 42 USC 7403

Agency	Name	Solution Type(s)	Primary Goal(s)	Date Open	Date Complete	Entry #s	Prize #s	Total Prize Purse	Authority
NASA	3D-Printed Habitat Challenge (Phases 2&3)	Creative; Ideas; Hardware; Scientific; Other	Highlight ideas; Solve specific problem; Advance science; Develop technology; Educate public; Engagement; Stimulate market	N/A	May, 2019	38	18	$1,100,000	51 USC § 20144
	Breakthrough, Innovative, and Game-Changing (BIG) Idea Challenge	Ideas; Analytics; Scientific	Highlight ideas; Solve specific problem; Develop technology; Engagement; Build capacity; Educate public	N/A	N/A	45	N/A	$0	31 USC § 6301, et seq.
	CineSpace Film Competition	Creative	Educate public	N/A	N/A	931	10	$26,000	31 USC § 6301, et seq.
	Cube Quest Challenge	Hardware	Highlight ideas; Solve specific problem; Advance science; Develop technology; Educate public; Engagement; Stimulate market	N/A	N/A	13	N/A	$5,000,000	51 USC § 20144
	Future Engineers 3D Design Challenges	Creative; Hardware	Highlight ideas; Solve specific problem; Educate public	N/A	N/A	1310	61	$0	51 USC § 20113(e)
	High Performance Fast Computing Architecture Challenge	Software; Ideas	Solve specific problem; Develop technology	5/3/2017	9/30/2017	335	N/A	$35,000	31 USC § 6301, et seq.
	High Performance Fast Computing Ideation Challenge	Software; Ideas	Solve specific problem; Develop technology	5/3/2017	6/16/2017	4,808	N/A	$20,000	31 USC § 6301, et seq.

Agency	Name	Solution Type(s)	Primary Goal(s)	Date Open	Date Complete	Entry #s	Prize #s	Total Prize Purse	Authority
NASA	REALM User Interface Challenge	Software	Solve specific problem	9/16/2016	12/2/2016	51	9	$11,025	31 USC § 6301, et seq.
	Human Exploration Rover Challenge	Creative; Ideas; Hardware	Highlight ideas; Educate public; Engagement	N/A	N/A	600	31	$25,300	51 USC § 20113(e)
	International Space Apps Challenge	Software; Creative; Ideas; Hardware; Analytics; Scientific	Highlight ideas; Advance science; Develop technology; Educate public; Engagement; Build capacity	N/A	N/A	2000	N/A	$0	51 USC § 20113(e)
	RASC-AL Special Edition: Mars Ice Challenge	Ideas; Hardware; Analytics	Highlight ideas; Solve specific problem; Advance science; Develop technology; Engagement; Build capacity	N/A	N/A	46	N/A	$0	31 USC § 6301, et seq.
	NASA Tournament Lab Micro-Purchase Challenges	Software; Creative; Ideas	Highlight ideas; Solve specific problem; Advance science; Develop technology; Educate public; Engagement	N/A	N/A	1,514	35	$44,800	31 USC § 6301, et seq.
	Open MCT Notebook Challenge	Software	Solve specific problem; Develop technology	9/28/2017	11/13/2017	35	3	$12,900	31 USC § 6301, et seq.
	Partnership Agreement Maker (PAM) Graphical User Interface (GUI) Updates	Software	Improve service delivery; Solve specific problem	11/21/2016	4/3/2017	60	12	$15,684	31 USC § 6301, et seq.

Agency	Name	Solution Type(s)	Primary Goal(s)	Date Open	Date Complete	Entry #s	Prize #s	Total Prize Purse	Authority
NASA	REALM Location Tracking Algorithm Challenge	Analytics	Solve specific problem; Develop technology	N/A	N/A	N/A	0	$26,500	31 USC § 6301, et seq.
	Rice Business Plan Competition	Ideas; Hardware; Business plans	Highlight ideas; Advance science; Educate public; Engagement; Stimulate market	11/1/2016	3/15/2018	1150	2	$70,000	31 USC § 6301, et seq.
	Robonaut 2 Tool Localization Challenge	Analytics	Solve specific problem; Develop technology	2/23/2016	10/19/2017	222	9	$19,250	31 USC § 6301, et seq.
	Robotic Mining Competition	Software; Hardware; Scientific	Solve specific problem; Develop technology; Educate public; Engagement	N/A	N/A	94	45	$34,000	51 USC § 20113(e)
	Space Poop Challenge	Design	Solve specific problem; Develop technology	10/11/2016	12/20/2016	5,170	3	$30,000	31 USC § 6301, et seq.
	Space Robotics Challenge	Software; Analytics	Highlight ideas; Solve specific problem; Develop technology; Educate public; Engagement; Stimulate market	N/A	N/A	405	20	$900,000	51 USC § 20144
	Student Launch Initiative	Hardware	Solve specific problem; Advance science; Develop technology; Educate public; Engagement	8/15/2016	4/24/2017	143	38	$19,000	51 USC § 20113€

Agency	Name	Solution Type(s)	Primary Goal(s)	Date Open	Date Complete	Entry #s	Prize #s	Total Prize Purse	Authority
NASA	Swarmathon	Software; Creative; Hardware	Solve specific problem; Advance science; Develop technology; Educate public; Engagement; Build capacity	N/A	N/A	114	55	$32,000	FAR
	Vascular Tissue Challenge	Hardware; Analytics; Scientific; Other	Highlight ideas; Solve specific problem; Advance science; Develop technology; Educate public; Stimulate market; Provide lifesaving medical advances	6/13/20186	9/30/2019	12	N/A	$500,000	51 USC § 20144
NSF	The NSF 2026 Idea Machine	Ideas; Scientific	Highlight ideas; Advance science; Engagement	8/31/18	N/A	801	N/A	$164,000	NSF Act of 1950, as amended
	The Vizzies Challenge	Software; Creative; Hardware; Analytics; Scientific	Educate public; Engagement	1/15/2018	4/18/2018	372	8	$11,250	NSF Act of 1950, as amended
ODNI	3D Multi-View Stereo Challenge	Analytics	Highlight ideas; Advance science; Develop technology; Educate public; Engagement	July, 2016	October, 2016	40	13	$100,000	National Security Act, 50 USC 3024(n)
	Disguised Faces in the Wild Competition	Software	Solve specific problem; Advance science; Develop technology; Benchmark state of the art	1/20/2018	5/1/2018	12	6	$25,500	National Security Act, 50 USC 3024(n)

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ODNI	Functional Map of the World (FMOW) Challenge	Analytics	Highlight ideas; Advance science; Develop technology; Educate public; Engagement	September, 2017	December, 2017	1408	10	$112,500	National Security Act, 50 USC 3024(n)
	Fusion of Face Recognition Algorithms (FOFRA)	Software	Solve specific problem; Advance science; Develop technology	5/23/2018	8/6/2018	1	0	$70,000	National Security Act, 50 USC 3024(n)
	Geopolitical Forecasting Challenge	Analytics	Highlight ideas; Solve specific problem; Advance science	N/A	N/A	17	46	$200,000	National Security Act, 50 USC 3024(n)
	Mercury Challenge	Ideas; Analytics	Highlight ideas; Solve specific problem; Advance science; Engagement	8/7/2018	1/31/2019	N/A	N/A	$100,000	National Security Act, 50 USC 3024(n)
	MORGOTH'S CROWN (Modeling of Reflectance Given Only Transmission of High-Concentration Spectra for Chemical Recognition over Widely-Varying Environments)	Software	Highlight ideas; Solve specific problem; Advance science; Develop technology; Educate public; Engagement; Build capacity	7/26/2017	9/20/2017	664	7	$50,000	National Security Act, 50 USC 3024(n)
	Nail-to-Nail (N2N) Fingerprint Challenge	Software	Solve specific problem; Advance science; Develop technology; Engagement; Stimulate market	2/2/2017	9/22/2017	15	7	$290,000	National Security Act, 50 USC 3024(n)

Agency	Name	Solution Type(s)	Primary Goal(s)	Date Open	Date Complete	Entry #s	Prize #s	Total Prize Purse	Authority
ODNI	OpenCLIR (Open Crosslingual Information Retrieval)	Software; Ideas; Scientific	Advance science; Develop technology	3/11/2019	3/29/2019	N/A	N/A	$30,000	National Security Act, 50 USC 3024(n)
	The ODNI-OUSD(I) Xamine Challenge: Machine Verification of Collected Information	Software; Ideas; Analytics	Highlight ideas; Advance science; Develop technology; Educate public; Engagement	5/4/2018	7/2/2018	15	N/A	$75,000	N/A
	The ODNI-OUSD(I) Xpress Challenge: Machine Generation of Analytic Products	Software; Hardware; Analytics	Highlight ideas; Advance science; Develop technology; Educate public; Engagement	4/6/2017	7/5/2017	15	2	$500,000	N/A
	The ODNI-OUSD(I) Xtend Challenge: Machine Evaluation of Analytic Products	Software; Ideas; Analytics	Highlight ideas; Advance science; Develop technology; Educate public; Engagement	11/16/2017	1/15/2018	18	3	$75,000	N/A
	UG2 Prize Challenge	Software	Solve specific problem; Advance science; Develop technology; Other	1/31/2018	4/15/2018	12	4	$75,000	National Security Act, 50 USC 3024(n)
USAID	EduApp4Syria Prize Competition	Software	Highlight ideas; Solve specific problem; Develop technology; Engagement	1/29/2016	4/1/2016	78	5	$1,700,000	N/A
	Book Boost: Access for All Challenge	Software; Hardware; Business plans	Highlight ideas; Solve specific problem; Build capacity; Stimulate market	N/A	N/A	15	6	$360,000	ADS 302.3.4.13 Grants Under Contracts (GUCs)

Agency	Name	Solution Type(s)	Primary Goal(s)	Date Open	Date Complete	Entry #s	Prize #s	Total Prize Purse	Authority
USAID	Data-Driven Farming Prize	Software; Hardware; Business plans	Solve specific problem; Develop technology; Build capacity; Stimulate market	2/9/2017	4/6/2017	143	4	$300,000	Department of State, Foreign Operations, and Related Programs Appropriations Act at P.L. 115-131
	Fall Armyworm Tech Prize	Software; Creative; Hardware; Business plans; Analytics	Highlight ideas; Solve specific problem; Develop technology; Educate public; Engagement; Build capacity	3/28/2018	5/14/2018	228	5	$400,000	Department of State, Foreign Operations, and Related Programs Appropriations Act at P.L. 115-131
	Global Lighting and Energy Access Partnership (Global LEAP) Off-Grid Refrigerator Competition	Hardware; Business plans	Highlight ideas; Solve specific problem; Develop technology; Educate public; Engagement; Stimulate market	9/22/2016	1/20/2017	55	2	$600,000	Department of State, Foreign Operations, and Related Programs Appropriations Act at P.L. 115-131
	No Lost Generation Prize Competition	Software; Creative	Solve specific problem; Educate public; Engagement; Stimulate market	March, 2017	4/25/2017	6	2	$100,000	ADS 302.3.4.13 Grants Under Contracts (GUCs)
	Tracking and Tracing Books Prize Competition	Software; Hardware	Improve service delivery; Solve specific problem; Develop technology; Engagement	1/23/2015	4/1/2015	10	2	$100,000	ADS 302.3.4.13 Grants Under Contracts (GUCs)
	WomenConnect Challenge	Software; Creative; Hardware	Solve specific problem	3/8/2018	5/20/2018	531	9	$1,000,000	ADS 302.3.4.13 Grants Under Contracts (GUCs)

Summary of Crowdsourcing and Citizen Science Activities in Fiscal Years 2017 and 2018 Conducted Under Crowdsourcing and Citizen Science Act

Agency	Name	Submissions	Data Availability
USDA	4-H Guide for NASA GLOBE Observer Clouds	Images of sky through GLOBE Observer mobile app	https://vis.globe.gov/clouds
	Boise Multi-Party Monitoring, Boise, ID	N/A	Boise Forest Coalition website; the Idaho Forest Restoration Partnership website
	Científicos en Familia: A Program to Engage Diverse Communities in Citizen Science and Stewardship	Geotagged photos of plants and animals in the iNaturalist app	iNaturalist
	Citizen Science for Rangeland Health: Engaging Ranchers in Science	N/A	public will have the opportunity to engage in data interpretation via open meetings
	Collaborative Investigations at Admiralty Cove	Interview planning, digital recordings of interviews, interview catalogues, and partial transcriptions at National Records Center	Archaeological data will be shared with Tribal Council and Alaska State Office of History and Archeology. Participants will complete the project by designing an interpretive sign
	Culturally Responsive Citizen Science Development with Forest Inventory Analysis in Interior Alaska	N/A	www.globe.gov; https://apps.fs.usda.gov/fia/datamart/
	Engaging Angler Scientists to Help Prioritize and Monitor the Effectiveness of Stream Reconnection Projects	N/A	data entered on developed by Southeastern Aquatic Resources Partnership (SARP) mobile app uploaded to their Regional Barrier Inventory
	Engaging Citizen Scientists in Field Research on American Pika, an Indicator Species for Alpine Ecosystem Integrity	Observations, data collection, and images	CitSci.org
	Location of Plants Traditionally Used by American Indian Tribes to Improve Management of Federal Lands on the Four Forest Restoration Initiative	N/A	open-access for USFS employees, selected researchers, and tribal members through the iNaturalist platform
	Monitoring the Status of the Columbia River Gorge Pika Population After the Eagle Creek Fire	wildlife observations and site data	Data freely available to management agencies following peer-reviewed publication

Agency	Name	Submissions	Data Availability
USDA	Neighbors to Nature: Cache Creek Study	data on plant phenology and wildlife sightings	Friends of Pathways database; USA National Phenological Network database; Wildflower Watch database; Nature Mapping Jackson Hole database
	Potomac Highlands Cooperative Weed and Pest Management Area Non-Native Invasive Species Citizen Science Program	N/A	EDDMapS application
	Tracking the Vernal Window with a Low-Cost Instrumentation Suite	N/A	Snow depth and phenophase data available at www.cocorahs.org and www.naturesnotebook.org, respectively; vernal window indicators centralized in a single GitHub repository
DOC	Urban Heat Island Mapping Campaign	75,000 data points from thermocouple devices mounted on participants' cars	data will be freely shared
DHS	FEMA Crowdsourcing Unit and Playbook for Emergency Management	FEMA's Crowdsourcing Unit facilitated a daily coordination call	Still under development
DOI	Project eTrout	data on fish abundance, behavior, and habitat use from 360-degree underwater videos	N/A
NASA	Backyard Worlds: Planet 9	online classifications of image sets from Wide-Field Infrared Survey Explorer (WISE) mission and Near Earth Asteroid-WISE (NEOWISE) project	publication in scientific literature; public archive of useful false positives
	Landslide Reporter	location, date, time, description, type, trigger, fatalities and injuries, and surrounding environment of a landslide	Landslide Viewer (https://landslides.nasa.gov/viewer)

Summary of Crowdsourcing and Citizen Science Activities in Fiscal Years 2017 and 2018 Conducted Under Authorities Other than the Crowdsourcing and Citizen Science Act

Agency	Name	Authority	Submissions	Data Availability
USDA	Invasive Mosquito Project	7 U.S.C. 2272 (Volunteers for Department of Agriculture Programs)	participant observation data, mosquito eggs, mosquito larvae, and adult mosquito samples	maintained as paper records
	Collaborative Adaptive Rangeland Management (CARM)	7 U.S.C. 2272 (Volunteers for Department of Agriculture Programs)	observations of cattle behavior, grassland birds, and vegetation	https://www.ars.usda.gov/plains-area/fort-collins-co/center-for-agricultural-resources-research/rangeland-resources-systems-research/docs/near-real-time-data/
	FarmLab	7 U.S.C. 2272 (Volunteers for Department of Agriculture Programs)	(1) bluebird monitoring; (2) invasive species management; (3) heirloom apple inventory and stewardship; (4) farm biomass models	to be made available to the public
DOC	Cyclone Center	Weather Service Organic Act, 15 U.S.C. § 313	participants view tropical cyclone images and respond to prompts/questions	data available to public upon request
	Meteorological Phenomema Identification Near the Ground	Weather Service Organic Act, 15 U.S.C. § 313	precipitation type, flooding severity, wind damage severity, hail size, visibility restrictions, and tornado and waterspout observations	data available publicly via web display or a public API key
	Old Weather	Weather Service Organic Act, 15 U.S.C. § 313	transcribed marine-meteorolgical data and other environmental observations from U.S. Federal ship logs	data are available from ICOADS (Deck 710) and ISPD. Primary source images are integrated into the National Archives digital catalog https://www.archives.gov/research/catalog
	Community Collaborative Rain, Hail and Snow (CoCoRaHS) Network	Weather Service Organic Act, 15 U.S.C. § 313	primary data are 24-hour precipitation measurements (rain, hail, and snow); additional options include real-time hail and intense precipitation reports, evapotranspiration, drought condition monitoring, soil moisture, frost, optics (e.g., rainbows), thunder, and snowflake type	data are made available to the public online (www.cocorahs.org)

Agency	Name	Authority	Submissions	Data Availability
DOC	CrowdMag	Coast and Geodetic Survey Act, 33 U.S.C. § 883a et seq.	time stamp, lat-long location, location accuracy, magnetic data, and phone's make	data saved at NCEI-CO internal database; data provided to public via ESRI web-maps
	Crowdsourced Bathymetry	Coast and Geodetic Survey Act of 1947	observations of water depth/bathymetry, location, and time	the International Hydrographic Organization (IHO) Data Centre for Digital Bathymetry (DCDB) Data Viewer (https://maps.ngdc.noaa.gov/viewers/iho_dcdb/)
	Steller Watch	Endangered Species Act	classifications of images	imagery and classification information collected from participants is public; selected images can be viewed on the Steller Watch website
	Hawaii Bottomfish Heritage Project: Tracing Traditions and Preserving Culture	MSA NS-8; MSRA Section 318, Regional Priorities and Management Needs	N/A	web story and blog series has been initiated at https://www.fisheries.noaa.gov/feature-story/hawaii-bottomfish-heritage-project; Videos will be available through the "Voices from the Fisheries" website: https://www.st.nmfs.noaa.gov/humandimensions/voices-from-the-fisheries/index
	Cooperative Research Provides New Data for ESA-listed Rockfish in Puget Sound, WA	Magnuson Stevens Act Sec 318 (Sec 318, MSA, 16 USC 1867)	anglers were asked to catch fish	raw genetic data has been published on the website of the National Center for Biotechnology Information (https://www.ncbi.nlm.nih.gov/bioproject/PRJNA451040)
	NWS Cooperative Observer Program	Organic Act of 1890	weather observations of daily maximum and minimum temperatures and/or daily precipitation, as well as snowfall in some locations	data available via National Center for Environmental Information websites
DOE	The Open PV Project	Unknown	information about participants' solar installations	https://openpv.nrel.gov/search
HHS	Crowdsourcing Optimal Cancer Treatment Strategies that Maximize Efficacy and Minimize Toxicity	NIH UH2 Exploratory/Developmental Cooperative Agreement	N/A	N/A

Agency	Name	Authority	Submissions	Data Availability
HHS	Applying Protein Databases to Crowdsourcing Structural Protein Design	NIH UH2 Exploratory/Developmental Cooperative Agreement	participants fold digital models of protein structures	N/A
	OMics Compendia Commons	Public Health Services Act	participants annotate samples in published gene expression studies (e.g., cell types) and create comparison groups between case and control samples	data available at https://omicc.niaid.nih.gov/ Initial results of analyses published at https://f1000research.com/articles/5-2884/v1. Articles about OMiCC
	NIDCR 2030: Envisioning the Future, Together	Unknown	requested ideas, comments, and votes on what it will take to reach specific NIDCR research and training goals	https://nidcr2030.ideascale.com/a/index
	Community Mapping Project: Engaging Students in Citizen Science for Safe Routes to School	NLM operating budget	Students tracked and mapped safe routes to school and neighborhood libraries using GIS and Mappler mobile app	http://www.immappler.com/srtsnashville/
	NNLM Wikipedia Edit-a-thon	Unknown	N/A	available on the NNLM Wikipedia Edit-a-thon project page
DOI	Battle of the Atlantic Expedition	National Historic Preservation Act (NEPA)	observations, data, video, still photography, historical research, and drawings of sites by recreational SCUBA divers	https://marinecadastre.gov/espis/#/search/study/100056 and https://oceanexplorer.noaa.gov/explorations/16battlefield/
	Aquatic Insect Monitoring in Grand Canyon	Organic Act of 1879; The Grand Canyon Protection Act of 1992 (Public Law 102-575)	light trap samples of emergent aquatic insects	available at https://www.sciencebase.gov/catalog/item/570fe1a6e4b0ef3b7ca3580c
	Archaeology Citizen Science at Fort Vancouver	54 U.S.C. 100101, 54 U.S.C. 100301, 54 U.S.C. 100701-706, and 54 U.S.C. 103102(4)	223 digital excavation level and feature forms, 21 iDraw digital excavation profiles, 248 digital cemetery headstone recording forms, 1,666 digital images, and 4,937 archaeological laboratory recording form lines of data	parties interested in the results may contact the park cultural resources branch

Agency	Name	Authority	Submissions	Data Availability
DOI	Biodiversity Discovery and Phenology in Acadia National Park	National Park Service Organic Act	observations on species occurrence and information on timing of seasonal life cycle events	public databases managed by iNaturalist, eBird, USA National Phenology Network, and Hawk Count (Hawk Migration Association of North America)
	Dragonfly Mercury Project: Engaging Citizens with Resource Conservation	NPS Organic Act (54 U.S.C. 100101(1916))	4,270 dragonfly larvae samples for mercury analysis, 300 field data forms, and 30 observations on iNaturalist	https://www.nps.gov/articles/dragonflymercury-map.htm; summary data release at https://doi.org/10.5066/P9TK6NPT; other data products at: https://irma.nps.gov/DataStore/Collection/Profile/4082
	Glacier National Park Common Loon Citizen Science	National Park Service Organic Act	178 observational data and images submitted	National Park service Integrated Resource Management Applications (IRMA) data portal: https://irma.nps.gov/DataStore/Reference/Profile/2194764; full dataset provided to interested parties upon request
	Did You Feel It? (DYFI)	Organic Act of 1879; The National Earthquake Hazards and Reduction Program (NEHRP), 42 U.S.C § 7701	participants answered up to 15 questions about earthquake experience and provided information on their location during and the time of the earthquake	The DYFI data is available at: https://earthquake.usgs.gov/data/dyfi/ and is integrated into other official earthquake data data at https://earthquake.usgs.gov through the USGS Earthquake Program Comprehensive Earthquake Catalog (ComCat).
	iCoast - Did the Coast Change?	Organic Act of 1879; National Climate Program Act of 1978; Coastal Zone Management Act of 1976	image comparison pre- and post-Hurricane Sandy or Hurricane Joaquin	A Data Release containing the Hurricane Sandy iCoast classifications is available at https://coastal.er.usgs.gov/data-release/doi-P93A9MPE/. iCoast data for Hurricane Joaquin will be made available in the future
	Nature's Notebook	Organic Act of 1879	on-the-ground observations and locations of plants and animals	https://www.usanpn.org/data/observational and are also accessible via the Phenology Observation Portal
	The National Map Corps (TNMCorps)	Organic Act of 1879	participants update and verify locations, names, and addresses for geospatial structures data	https://www.usgs.gov/core-science-systems/national-geospatial-program/national-map

Agency	Name	Authority	Submissions	Data Availability
EPA	Building Capacity to Measure Air Pollution Mitigation Strategies at Schools	Clean Water Act (Section 103)	N/A	N/A
	Crowdsourcing to Monitor Private Wells and Assess Contaminant Sources	N/A	water quality data	data will be made available to public as confirmed by the owners of the wells
	Cyanoscope: EPA collaborative partnership on monitoring harmful algal blooms	N/A	images of harmful algal blooms; microscopic images of individual organisms; fluorometric data	image data posted at https://www.inaturalist.org/projects/cyanoscope and https://www.citsci.org/CWIS438/Browse/Project/Project_Info.php?ProjectID=822&WebSiteID=7
	EPA/US Coast Guard Auxiliary Partnership for HAB Monitoring	N/A	physical observations and data from CyanoScope HAB identification	data will be made available using existing Cyanobacteria Monitoring Collaborative webpage
	HiveScience: A Citizen Science Project for Beekeepers	N/A	survey using mobile app about and honey sample from individual hives	some data available on Geoplatform public webpage
	Kansas City Transportation and Local Scale Air Quality Study (KC TRAQS)	N/A	data collected using AirMapper air monitoring package	data to be made available on website
	Marine/Water Contact Sanitary Survey Workshops in California	Beaches Environment Assessment and Coastal Health (BEACH) Act	N/A	current app allows user to collect and export sanitary survey data, but EPA does not collect this information
	Measuring Coastal Acidification in New England Estuaries	N/A	water samples to be analyzed for total alkalinity; instrument readings of pH	EPA plans to utilize existing resources such as NECAN, Northeastern Regional Association of Coastal Ocean Observing Systems, and the Ocean Acidification Information Exchange
	Micro CSI-Urban Edition: A Microbial Citizen Science Initiative in Urban Watersheds	Clean Water Act	water samples shipped or delivered to the EPA	data from each site available through website of local partner

Agency	Name	Authority	Submissions	Data Availability
	Using Citizen Science to Analyze Underwater Videos in the Great Lakes	Clean Water Act § 104, 33 U.S.C. § 1254	participants answered three questions about images from 52 sites	https://www.zooniverse.org/projects/USEPA/deep-lake-explorer
	Using Citizen Science to Improve Drinking Water Epidemiology Studies in Puerto Rico	N/A	198 participants will provide stool/saliva at start of study and when gastrointestinal illness occurs	data will be made publicly available when study is complete
	Low Cost Sensors for Real-time Continuous Water Quality Monitoring in Georgia	Clean Water Act	observations on equipment, ease of use, durability, and technical issues	data shared at discretion of cooperating organizations
	Smoke Sense	N/A	participants report smoke observations and symptoms	summary statistics are shown in the Smoke Sense app under weekly statistics and posted online at https://www.epa.gov/air-research/smoke-sense
EPA	Air Sensor Toolbox	Clean Air Act	N/A	https://www.epa.gov/air-sensor-toolbox
	Community-led Air Sensor Evaluation in North Carolina	Clean Air Act	tabulated data documenting sensor measurements and technical feedback on tools	https://www.epa.gov/air-sensor-toolbox/evaluation-emerging-air-pollution-sensor-performance
	Regional Sensor Loan Program	Clean Air Act	planning sensor collocation and deployment locations, deploying and operating sensors, weekly data retrievals, and/or data analysis and interpretation	data to be released in FY19
	Ironbound Neighborhood Air Monitoring	Clean Air Act	air quality data weekly from four sensor pods	https://edg.epa.gov/metadata/catalog/search/resource/details.page?uuid=%7BDFEDA959-0DBB-434C-B736-0249DD083473%7D and the paper can be accessed at https://doi.org/10.23719/1407516

Agency	Name	Authority	Submissions	Data Availability
EPA	The Efficacy of Citizen Science Air Monitoring for Building Public Awareness of Exposures in a US Caribbean Urban Neighborhood Impacted by Heavy Industrial Contamination	Clean Air Act	weekly data collected from air quality sensor pods and weather monitors at selected sites	data will be obtainable at the EPA environmental dataset gateway at https://edg.epa.gov; the dataset can be retrieved by searching for The Peñuelas Project-SCID:A-K99b
NASA	Globe Program	51 USC § 20111, et seq.	measurements of atmosphere, biosphere, hydrosphere, and pedosphere	GLOBE web portal
	Students' Cloud Observations on-Line (S'COOL)	51 USC § 20111, et seq.	cloud observations	https://scool.larc.nasa.gov/database.html shows cloud observations with corresponding satellite cloud retrievals
	Aurorasaurus	N/A	the time/date/location/photo of aurora	https://zenodo.org/record/1255196#.W79tlxNKjs0
	Disk Detective	51 USC § 20111, et seq.	classifications of movie images	https://mast.stsci.edu
	Globe Observer	51 USC § 20111, et seq.	observations, location, and photographs	https://datasearch.globe.gov/
	Image Detective		(1) the geographic coordinates for the centerpoint of a given astronaut photograph of Earth; (2) an estimation of the cloud cover percentage in the image; and (3) the geographic metadata for features visible in the image	Gateway to Astronaut Photography of Earth (https://eol.jsc.nasa.gov/)
SI	City Nature Challenge DC 2018	N/A	22,931 images and sound files were submitted on 1,808 identified species	data available through the iNaturalist City Nature Challenge DC 2018, iNaturalist, and Global Biodiversity Information Facility websites
	Chesapeake Bay Parasite Project	N/A	data and observations	available upon request

Agency	Name	Authority	Submissions	Data Availability
SI	Environmental Archaeology at the Smithsonian Environmental Research Center	N/A	data and observations	available upon request
	eMammal	N/A	Images and associated metadata	eMammal website
	Fossil Atmospheres	N/A	classified images of leaf cells	results will be shared online at Zooniverse
	Global Change Research Wetland Plant Census	N/A	data and observations	available on the project website
	Invader ID	N/A	48,542 classifications	preliminary data shared upon request
	Leafsnap	N/A	N/A	N/A
	Neighbor Nestwatch	N/A	observations on bird nests and color-banded birds	technical data are not made available until such data are analyzed, published, and disseminated online
	Smithsonian Transcription Center	N/A	transcriptions and reviews of digitized Smithsonian archival, library, and museum collections	transcribed content available at transcription.si.edu
	Smithsonian Transcription Center - Biodiversity Collection Records and Specimen Labels	N/A	transcriptions and reviews of digitized specimen labels and collection information	transcribed content available at transcription.si.edu
	Smithsonian Transcription Center - Project PHaEDRA: Preserving Harvard's Early Data and Research in Astronomy	N/A	transcriptions and reviews of digitized log books and notes of the Harvard-Smithsonian Center for Astrophysics	transcribed content available at transcription.si.edu
	Smithsonian Transcription Center - Transcription of Science-related Archival Documents	N/A	transcriptions and reviews of digitized archival materials related to science and biodiversity	transcribed content available at transcription.si.edu

Agency	Name	Authority	Submissions	Data Availability
SI	Virginia Working Landscapes: Grasslands Biodiversity Survey	N/A	ecological monitoring data, photographs, and plant and animal specimens collected from the field	Data are not released due to sensitive nature of private property; published aggregated data will be released with associated publication

A. Prizes and Challenges under the COMPETES Reauthorization Act of 2010

This Appendix provides agency-submitted summaries of prizes and challenges conducted in FY17 and FY18 under the prize authority provided in COMPETES and does not include any prizes and challenges conducted under other authorities. Please note that agency plans for the upcoming two fiscal years are notional and subject to the availability of funding. It should also be noted that the DOE American Inventions Made Onshore (AIM Onshore) prize is included as part of Appendix A but was not included in the report analyses as it was received after the submission deadline.

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A.1 Department of Agriculture (USDA)

A.1.1 National School Lunch and School Breakfast 2017 Verification Response Rate Challenge[1]

Lead Sponsoring Agency: Food and Nutrition Service (FNS)

Status: This competition was completed in FY17.

[1] The website for the National School Lunch and School Breakfast 2017 Verification Response Rate Challenge can be viewed at https://www.challenge.gov/challenge/usda-school-meal-programs-verification-response-rate-challenge/.

Competition Goals: School districts approve around five million household applications for free or reduced-price school meal benefits each year. Each year, school districts are required to identify a small percentage of those applications for verification. The identified households must send proof of income so the school districts can verify the student's eligibility status. Households that do not respond to verification are changed to paid status. We know that some households that fail to respond are eligible for benefits. Even so, many districts struggle to get even half of their households to respond, and for some it is even fewer. Other districts have identified low-cost and creative strategies that allow them to exceed 70 (and even 80 or 90) percent response rates. The Verification Response Rate Challenge was a public forum to exchange ideas on how to increase household response in the annual verification process. Through this challenge, school district and state agency staff were able to share their verification success stories and/or were encouraged to build on others' submissions with constructive feedback and suggestions.

Goal Types: Improve government service delivery; Find and highlight innovative ideas; Solve a specific problem; Engage new people and communities

Justification for Using Prizes and Challenges: This Challenge was intended to generate creative ideas for increasing household response to verification. The prizes were intended to be fun and to encourage friendly competition among school districts across the country. Rather than monetary prizes, challenge winners were announced at the 2017 School Nutrition Association Annual National Conference in front of their peers and other interested parties at a session devoted to the verification process. FNS believes that the challenge model provided access to the talents of individuals that it would have been unlikely to reach through traditional methods. FNS was looking to develop a series of unique verification response solutions, which left a great deal of room for creativity. A traditional data collection contract would have been a more expensive (the challenge incurred no cost to the government) and less efficient way to tap school districts representing different geographic locations, different student populations, and facing different challenges.

Cash Prize Purses and/or Non-Cash Prize Awards: There were no monetary prizes for this challenge. The contest offered non-monetary recognition on the contest website and at the 2017 School Nutrition Association (SNA) annual conference in the following categories: "Potential Game Changer" (up to 3), "Popular Choice," "Best Documented," "Honorable Mention" (up to 2).

Solicitation of Submissions: FNS worked with its Office of Chief Communications Officer (OCCO) and with the SNA to promote the challenge. OCCO used social media and press announcements while SNA reached out to its membership through its newsletter and emails. Additionally, FNS used its network of contacts with school district staff to let them know about the challenge and asked those contacts to further spread the word about the challenge. The challenge was also featured on the FNS rotating banner on its website. FNS' impression is that SNA's communication with its members and using the network to spread the word about the challenge were the most effective methods of communication. FNS discovered that school districts developed small competitions among themselves to see which district would have the best solution. The lessons learned suggest that for this type of challenge, tapping informal networks and using personal contacts to engage school district staff were the most effective ways to publicize the challenge.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies)

Participation Requirements: The only requirement for participation was to have an idea about how to encourage households to respond to verification. Thus while the majority of those who entered the challenge were school districts, some private individuals also submitted solutions.

Evaluation of Submissions: FNS staff reviewed all of the challenge submissions to narrow the pool down to the top ten submissions. The top ten solutions were presented to the judging panel which consisted of two FNS career staff and the president of the SNA. The criteria for both reviews were the same. Each solution was judged on demonstrated effectiveness (35%), research and creativity (35%), and presentation, clarity, and persuasiveness (30%). For each solution, judges awarded up to 35 points for the strength of evidence provided in support of the solution's impact on household response (e.g., evidence of documented changes in response rates after the district implemented its solution), 35 points for solutions that made effective use of independent research and creativity (e.g., solutions that revealed insight into the barriers to household response and offered creative approaches to overcome those barriers), and 30 points for presentation, clarity, and persuasiveness (designed specifically for untested solutions or ones where the impact on household response was difficult to prove). The two-tiered judging process proved to be effective—narrowing the pool to the top ten solutions provided for more focused judging of only the best submissions.

Results: Of the 36 entries submitted between May 4 and June 15, 2017, seven prizes were awarded to five winners.

Budget and Resources: FNS estimates that the work to create the challenge, including developing and overseeing the challenge and writing the materials necessary for the challenge required one month of staff time (1/12 FTE). This challenge did not require a budget as all of the prizes were non-monetary and there were no third party vendors. The judging panel volunteered to judge the contest submissions, and the time allocated for the two FNS judges to review the submissions is included in the FTE estimate.

Partnerships: FNS did not partner with any outside organization. However, because the intended participants were local education agency officials who manage the school meal programs, FNS reached out to the SNA to promote the challenge.

Advancement of Agency Mission: School districts are actively involved in finding effective ways of getting households to respond to verification requests. This challenge provided a forum for school district staff to share their experience and expertise with other school districts in a collaborative fashion, where staff could propose ideas and those ideas could be expanded through discussion boards. The goal of this effort was to provide a number of options schools districts might use to increase their verification response rates, reduce the time and expense associated with repeat follow-up reminders to households, and reduce the risk that eligible children lose access to program benefits. FNS used the challenge format to maximize school district staff engagement and uncover the most effective solutions. It was equally important that school districts were provided with an opportunity to highlight their work. At the end of the challenge, USDA featured the winning submissions at the 2017 SNA's Annual National Conference in Atlanta. FNS also produced a verification tool-kit that is available to all school districts nationwide that highlights practices and ideas from contest participants. Because school districts vary, the opportunity to provide a range of solutions is very important and the challenge format allowed school district staff (and others) an opportunity to participate at essentially no cost. The Agency's mission was advanced not only through the identification of different ways to attack the problem of non-response, but also in providing an opportunity for school districts to actively participate in the identification of those solutions.

Solution Types: Creative (design & multimedia); Ideas

Plan for Upcoming 2 FYs: The FNS office that developed this challenge is not considering additional challenges at this point (this was the second challenge run from this office). However, FNS' experiences with both challenges have been positive, and FNS may look into opportunities for future challenges.

A.1.2 2017 Innovations in Food and Agricultural Science and Technology (I-FAST) Prize Competition[2]

Lead Sponsoring Agency: National Institute of Food and Agriculture (NIFA)

Status: This competition was completed in FY17.

Competition Goals: NIFA announced the I-FAST prize competition to develop and implement the Innovations in Food and Agricultural Science and Technology (I-FAST) Program. NIFA partnered with the National Science Foundation (NSF) Innovation Corps (I-Corps) to provide entrepreneurship training to NIFA grantees under this I-FAST pilot program. The goals were to identify valuable product opportunities that can emerge from NIFA-supported academic research. Selected NIFA I-FAST project teams participated in the educational programs with NSF I-Corps Program. Over a period of twelve months the NIFA-supported teams in the I-FAST program learned what is needed to achieve an economic impact with their particular innovation. The final goal of the I-FAST Competition was to facilitate technology transfer of innovations that can make an impact in the marketplace and the global economy.

Goal Types: Advance scientific research; Develop technology; Engage new people and communities; Stimulate a market

Justification for Using Prizes and Challenges: Given the length of time for this prize (one year) and the travel requirements for team members to participate in the three-day kick off and lessons-learned training by the NSF I-Corps program, a prize competition was used to facilitate the teams to complete this requirement. The teams were also required to take several trips throughout the year of the prize competition to conduct customer interviews and discover their technology's market.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered was $400,000, or $50,000 for up to eight teams, and the total amount awarded was $150,000, as only three teams were selected to participate in the final program. Non-monetary incentives included mentoring and training.

Solicitation of Submissions: The prize competition was published on the Federal Register and also e-mailed to the agency's listservs as a solicitation of submissions. The agency is exploring additional sources as solicitation methods to increase the pool of applicants in future competitions.

Solicitation Types: Email (e.g., listservs); Press release

Participation Requirements: The Competition had a two-phase selection process. Teams initially submitted a pre-application to the competition via www.Challenge.gov and by email to contest@nifa.usda.gov. The pre-application had to contain a three-page executive summary that described the following: Composition of the team and roles of the members proposing to undertake the commercialization feasibility research, including the entrepreneurial lead, principal investigator, and mentor; Point of contact information for all of the members; Relevant current/previous NIFA award(s) including award number, project title, and the NIFA program the award was funded under; Brief description of the potential commercial impact and commercialization plans. From the pre-applications, NIFA conducted phone interviews and selected teams that were invited to submit full applications. From the full applications, NIFA selected the winning teams.

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[2] The website for the 2017 Innovations in Food and Agricultural Science and Technology (I-FAST) Prize Competition can be viewed at https://www.Challenge.gov/challenge/2017-innovations-in-food-and-agricultural-science-and-technology-i-fast-prize-competition-only-selected-pre- applicants-are-eligible/.

Evaluation of Submissions: NIFA screened all entries for eligibility and completeness. Entries from teams that did not meet the eligibility requirements and/or that failed to include required submission elements were not evaluated or considered for award. Eligible and complete entries were judged by a fair and impartial panel of individuals from NIFA and NSF. The Judging Panel evaluated the pre-application to determine the following: (1) Did the proposed technology receive past NIFA funding within the specified timeframe? (2) Did the team have the required team members and are the roles of each team member clearly described and meet the noted responsibilities? (3) Did the commercialization plan provide a good understanding of the team's knowledge of the current state of the art and how the technology could enter into a potential market? Following the evaluation, the Judging Panel conducted a phone interview with each selected team. This emphasized the required time commitment and availability of the entire team to complete the NSF I-CORPS program during one of the fall 2018 cohorts.

Results: Of the four entries submitted by 16 participants in the full application phase between September 15 and October 6, 2017, three prizes were awarded to nine winners.

Budget and Resources: The Small Business Innovation Research (SBIR) 3% administrative fund as authorized by Congress was used for this prize. In FY17 and FY18, $14,058 of funding and 0.25 FTEs were used each fiscal year.

Partnerships: Expertise from several members of NSF was used during the judging process of conducting phone interviews with the teams. During the required kick-off and lessons learned training, the NSF staff provided expert instructors and training modules.

Advancement of Agency Mission: The NIFA USDA mission is to invest in and advance agricultural research, education, and extension to solve societal challenges. As part of this mission, NIFA is charged with providing grant funding for research, education, and extension that addresses key problems of national, regional, and multi-state importance in sustaining all components of agriculture. 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. The purpose of the I-FAST Competition is to identify NIFA-funded research teams who will receive additional support, in the form of mentoring, training, and funding to accelerate the translation of knowledge derived from fundamental research into emerging products and services that can attract subsequent third-party funding. Leveraging experience and guidance from established entrepreneurs and a targeted curriculum within the NSF I-Corp program, NIFA I-FAST teams learned to identify valuable product opportunities that can emerge from NIFA supported academic research. The I-FAST competition helped create a stronger national ecosystem for innovation that couples scientific discovery with technology development to address agricultural and societal needs.

Solution Types: Software and apps; Ideas; Technology demonstration and hardware

Plan for Upcoming 2 FYs: The NIFA I-FAST program will be soliciting applications again for FY19 and FY20 to exhaust funds from previous years and if the SBIR 3% administrative fund is renewed by Congress.

A.2 Department of Commerce (DOC)

A.2.1 2017 RAMP: Reusable Abstractions of Manufacturing Processes[3]

Lead Sponsoring Agency: National Institute of Standards and Technology (NIST)

Status: This competition was launched and completed in FY17.

Competition Goals: The goal of this competition was to help familiarize the research community with a recent standard for modeling manufacturing processes developed by the American Society for Testing and Materials (ASTM) E60.13 Subcommittee on Sustainable Manufacturing, to provide an opportunity for participants to put this standard into practice in modeling processes of their own interest, and to share their experiences in applying the standard across a variety of manufacturing processes. Formal methods for acquiring and exchanging information about manufacturing processes will lead to consistent characterizations and help establish a mechanism for reuse of these models. Standard methods will ensure effective communication of computational analytics and sharing of sustainability performance data. In addition, the use of a reusable standard format is expected to further the models suitable for automated inclusion in a system analysis, such as a system simulation model or an optimization program.

Goal Types: Improve government service delivery; Find and highlight innovative ideas; Advance scientific research; Engage new people and communities; Stimulate a market

Justification for Using Prizes and Challenges: A prize-based approach enabled NIST to attract the attention and participation of a broad group of researchers by offering a modest cash prize and the opportunity to present their entry at a technical conference. Because the entry process is simple and easy to navigate, researchers could focus their efforts solely on the technical aspects of their competition entries.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered and total amount awarded was $3,250. Non-monetary incentives included the opportunity for finalists to present their entries to a judging panel in a session at the 2017 American Society of Mechanical Engineers (ASME) International Manufacturing Science and Engineering Conference held in Los Angeles, California. Partners of the Challenge provided award plaques and travel stipends.

Solicitation of Submissions: NIST used email, Challenge.gov, the NIST website and social media to announce the 2017 ASME International Manufacturing Science and Engineering Conference. The email announcements went to people who had previously expressed an interest in Reusable Abstractions of Manufacturing Processes (RAMP), as well as to a targeted list of university professors and departments involved in manufacturing-related work.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies); Other - Interactive webinar

Participation Requirements: The target audience for RAMP 2017 was students in engineering programs with a familiarity of manufacturing processes and interest in sustainability. To be eligible for a cash prize, the official representative (individual or team lead, in the case of a group project) had to be age 18 or older at the time of entry and a U.S. citizen or permanent resident of the United States. In the case

[3] The website for the 2017 Ramp: Reusable Abstractions of Manufacturing Processes can be viewed at https://www.Challenge.gov/challenge/ramp-reusable-abstractions-of- manufacturing-processes-2017/.

of a private entity, the business had to be incorporated in and maintain a primary place of business in the United States or its territories. Participants could not be a Federal entity or Federal employee acting within the scope of his or her employment. Eligibility excluded NIST employees and NIST Researcher Associates as well as direct recipients of NIST funding awards to collaborate on the development of the ASTM standard E3012-16. Employees of the National Science Foundation (NSF), the ASTM, and the ASME Manufacturing Science and Engineering Conference (MSEC) Conference Organizers were excluded from participating but members of these organizations were eligible to enter. Any other individuals or legal entities involved with the design, production, execution, distribution or evaluation of the RAMP Challenge were not eligible to participate.

Evaluation of Submissions: Subject matter experts consisting of NIST staff generated a rating on a scale of 0 to 100 and wrote a brief narrative for each entry using five equally weighted criteria: (1) Completeness: Submission follows the guidelines and includes all necessary components. All submissions must describe the approach taken to validate the work and provide both a graphical and formal representation of the Unit Manufacturing Process (UMP) information model. (2) Complexity: Model reflects the complexities of the manufacturing process, especially those which influence sustainability indicators such as energy and material consumption. (3) Clarity: Model is clear in describing the process and the process-related information. (4) Accuracy: Submission accurately models the process as shown through validation. (5) Novelty: Approach taken develops new techniques to advance model reusability or reliability. Using scores provided by the subject matter experts, the Challenge manager identified the top eight submissions. A panel of judges (four from academia, and one from industry), appointed by the Acting NIST Director, reviewed the entries and subject matter expert input. The panel of judges participated in a session at the 2017 ASME International Manufacturing Science and Engineering Conference where finalists gave a brief presentation. The judges ranked the finalists to determine winners using five weighted criteria: (1) Complexity, 10%; (2) Clarity, 10%; (3) Accuracy 35%; (4) Novelty, 35%; and (5) Presentation, 10%.

Results: Of the 14 entries submitted by 32 participants between December 19, 2016 and April 17, 2017, eight prizes were awarded to eight teams, with 21 individuals total.

Budget and Resources: In FY17, one FTE was used to support the design and management of the Challenge. The total funding for FY17 was $4,778, which included $3,250 designated for cash prizes and $1,528 for overhead costs on cash prizes. Funds for all costs provided in the budget were appropriated funds from the FY17 NIST Scientific Research and Technical Services account.

Partnerships: The ASME hosted the final portion of the competition at its Manufacturing Science and Engineering Conference. In addition, ASME provided subject matter experts and judges for the Challenge. The NSF provided travel funding for finalists, experts, and two of the competition judges. ASTM International provided access to the standard document, funding for award plaques, and subject matter expertise. The estimated value of partner contributions is $6,500. Travel stipends contributed by NSF totaled approximately $6,000 and award plaques provided by ASTM were valued at approximately $500.

Advancement of Agency Mission: NIST's mission is to promote U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology in ways that enhance economic security and improve our quality of life. The mission includes the development and dissemination of technical standards that support industrial competitiveness, such as those developed in ASTM E60.13. The 2017 RAMP Challenge not only serves to raise awareness and application of a manufacturing standard that NIST helped develop, but it lays a foundation of knowledge to aid development, collection, and reuse of manufacturing models. Formal methods for acquiring and exchanging information about manufacturing processes will lead to consistent characterizations and

help establish a collection for reuse of these models. Standard methods will ensure effective communication of computational analytics and sharing of sustainability performance data. Results of the competition assist NIST by demonstrating the use of a reusable standard format leading to models suitable for automated inclusion in a system analysis, such as a system simulation model or an optimization program.

Solution Types: Software and apps; Analytics, visualizations, algorithms; Other - Manufacturing process models conforming to ASTM E3012-16

Plan for Upcoming 2 FYs: NIST disseminated these sustainable manufacturing standards and hosted an additional RAMP challenge in 2018.

A.2.2 2018 RAMP: Reusable Abstractions of Manufacturing Processes[4]

Lead Sponsoring Agency: NIST

Status: This competition was launched and completed in FY18.

Competition Goals: The goal of the competition was to help familiarize the research community with a standard for modeling manufacturing processes that was developed by the ASTM E60.13 Subcommittee on Sustainable Manufacturing. NIST led the development of this standard working in partnership with ASTM International. The challenge provided an opportunity for participants to put those standards into practice in modeling processes of their own interest, and to share their experiences in applying the standards across a variety of processes. Formal methods for acquiring and exchanging information about manufacturing processes will lead to consistent characterizations and help establish a mechanism for reuse of these models. Standard methods will ensure effective communication of computational analytics and sharing of sustainability performance data. In addition, the use of a reusable standard format is expected to further the models suitable for automated inclusion in a system analysis, such as a system simulation model or an optimization program.

Goal Types: Improve government service delivery; Find and highlight innovative ideas; Advance scientific research; Engage new people and communities; Stimulate a market

Justification for Using Prizes and Challenges: A prize-based approach enabled NIST to attract the attention and participation of a broad group of researchers by offering a modest cash prize and the opportunity to present their entry at a technical conference. Because the entry process was simple and easy to navigate, researchers could focus their efforts solely on the technical aspects of their competition entries.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered was $3,250 and the total amount awarded was $2,850. The first place winner was awarded $1,000, the second place winner was awarded $750, the third place winner was awarded $500, and three runners up received $200 each. Non-monetary incentives included the opportunity for finalists to present their entries at the co-located ASME International Manufacturing Science and Engineering Conference 2018 and the 46th North American Manufacturing Research Institution of the Society of Manufacturing Engineers (NAMRI/SME) North American Research Conference in College Station, Texas. Award plaques were provided by ASTM International, and travel stipends were offered through NSF.

[4] The website for the 2018 Ramp: Reusable Abstractions of Manufacturing Processes can be viewed at https://www.Challenge.gov/challenge/ramp-reusable-abstractions-of- manufacturing-processes/.

Solicitation of Submissions: Email, Challenge.gov, the NIST website, and social media announcements were all used to promote this competition. NIST sent email announcements to people who had previously expressed an interest in the RAMP 2017 competition and a targeted list of university professors and departments involved in manufacturing-related work. The challenge partners notified their memberships and communities using email and other tools.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies); Other - Interactive webinar

Participation Requirements: The target audience for RAMP 2018 was students in engineering programs with a familiarity of manufacturing processes and interest in sustainability. A participant (whether an individual, team, or entity) must have registered to participate and complied with all of the requirements under section 3719 of title 15, United States Code. The official representative (individual or team lead, in the case of a group project) had to be age 18 or older at the time of entry and a U.S. citizen or permanent resident of the U.S. or its territories. In the case of a private entity, the business had to be incorporated in and maintain a primary place of business in the U.S. or its territories. Participants could not be a Federal entity or Federal employee acting within the scope of his or her employment. Eligibility excluded NIST employees and NIST Research Associates as well as direct recipients of NIST funding awards to collaborate on the development of the ASTM standard E3012-16. Employees of the NSF, the ASTM, the ASME MSEC Organizers, and the NAMRI/SME Organizers were excluded from participating but members of ASTM, ASME and SME were eligible to enter. Any other individuals or legal entities involved with the design, production, execution, distribution or evaluation of the RAMP 2018 Challenge were not eligible to participate. Participation was subject to all U.S. Federal, State and local laws and regulations.

Evaluation of Submissions: Finalists were selected by NIST subject matter experts applying five weighted criteria: (1) Completeness, 10%: Submission follows the guidelines and includes all necessary components. All submissions must describe the approach taken to validate the work and provide both a graphical and formal representation of the UMP information model. (2) Complexity, 15%: Model reflects the complexities of the manufacturing process, especially those which influence sustainability indicators such as energy and material consumption. (3) Clarity and adherence to the theme as described in the Challenge Rules, 30%: Model is clear in describing the process and the process related information and its contribution to advancing the theme. (4) Accuracy, 30%: Submission accurately models the process as shown through validation. (5) Novelty, 15%: Approach taken develops new techniques to address the theme and to advance model reusability or reliability. A panel of five judges appointed by NIST's Director (three from academia and two from NSF) determined the winners based on review of subject matter results, accounting for 75% of the score, along with presentation clarity, content, and quality conveyed during in-person presentations at a session of the co-hosted ASME International Manufacturing Science and Engineering Conference 2018 and the 46th NAMRI/SME North American Research Conference, which accounted for 25% of the score.

Results: Of the nine entries submitted by 32 participants between January 29 and April 21, 2018, six prizes were awarded to six teams, with 21 individuals total.

Budget and Resources: In FY18, one FTE was used to support the design and management of the Challenge, as well as to develop competition resources such as the Unit Manufacturing Process Builder, an online tool available for participants to use when creating their entries. The total funding for FY18 was $4,190, including $2,850 designated for cash prizes and $1,340 for overhead costs on cash prizes. Funds for the Challenge came from appropriated funds in the FY18 NIST Scientific Research and Technical Services account.

Partnerships: NSF, ASTM International, ASME, and SME were supporting organizations on the Challenge, contributing in a variety of ways including providing the conference room for the finalist presentations; helping to promote the Challenge through their networks; and serving as judges or providing suggestions of academic experts to serve as judges. ASTM provided plaques for the winners (approximately $500 in value) and NSF offered travel stipends to finalists (approximately $5,000 in value). The partnership was effective in reaching a broader community of solvers and bringing greater attention to the importance of technical standards.

Advancement of Agency Mission: NIST's mission is to promote U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology in ways that enhance economic security and improve our quality of life. The mission includes the development and dissemination of technical standards that support industrial competitiveness, such as those developed in ASTM E60.13. The 2018 RAMP Challenge not only serves to raise awareness and application of a manufacturing standard that NIST helped develop, but it lays a foundation of knowledge to aid development, collection, and reuse of manufacturing models. Formal methods for acquiring and exchanging information about manufacturing processes will lead to consistent characterizations and help establish a collection for reuse of these models. Standard methods will ensure effective communication of computational analytics and sharing of sustainability performance data. Results of the competition assist NIST by demonstrating the use of a reusable standard format leading to models suitable for automated inclusion in a system analysis, such as a system simulation model or an optimization program.

Solution Types: Software and apps; Analytics, visualizations, algorithms; Other - Manufacturing process models conforming to ASTM E3012-16

Plan for Upcoming 2 FYs: NIST will continue to disseminate these sustainable manufacturing standards and may host additional RAMP challenges (to be determined).

A.2.3 Agile Robotics for Industrial Automation Competition (ARIAC)[5]

Lead Sponsoring Agency: NIST

Status: This competition was launched and completed in FY18.

Competition Goals: ARIAC is a simulation-based competition designed to address a critical limitation of robots used in industrial environments: they are not as agile as they need to be. Many robots are not able to quickly detect failures or recover from those failures. They are not able to sense changes in their environment and modify their actions accordingly. The goal of ARIAC is to enable industrial robots on workshop floors to be more productive, autonomous, and responsive to the needs of shop floor workers by utilizing the latest advances in artificial intelligence and robot planning.

Goal Types: Find and highlight innovative ideas; Solve a specific problem; Advance scientific research; Develop technology

Justification for Using Prizes and Challenges: The prize competition allowed NIST to gain a wider range of solutions to industrial challenges for a lower cost compared to traditional mechanisms such as grants or contracts, and helped grow awareness of the NIST research program in robotic systems for manufacturing. This competition resulted in six unique approaches to solving manufacturing robotic challenges that directly addressed the pain points experienced by industry. A contract to accomplish

[5] The website for the Agile Robotics for Industrial Automation Competition (ARAIC) can be viewed at https://www.Challenge.gov/challenge/ariac/.

the same task would have been much more expensive than the cash prize purse, and would not have had the same diversity of solutions.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered and the total amount awarded was $17,500. Non-monetary incentives included paid travel expenses for the winners to attend a workshop focusing on the theme of the competition.

Solicitation of Submissions: NIST solicited participation on Facebook and Twitter feeds, Challenge.gov, and relevant mailing lists. Over 50 teams registered for the competition and six teams made it to the finals.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs)

Participation Requirements: The target audience for ARIAC was scientists and engineers from industry and academia who are knowledgeable about robot control software. To be eligible for a cash prize, a participant—whether an individual, team, or legal entity—had to have registered to participate and complied with all of the requirements under section 3719 of title 15 United States Code. At the time of entry, the official representative (individual or team lead, in the case of a group project) had to be age 18 or older and a U.S. citizen or permanent resident of the United States or its territories. In the case of a private entity, the business had to be incorporated in and maintain a primary place of business in the United States or its territories. Participants could not be a Federal entity or Federal employee acting within the scope of his or her employment. NIST employees were not eligible to participate. In addition, interested participants who do not meet the eligibility requirements to win a prize (i.e., individuals who are neither a U.S. citizen nor a permanent resident of the United States or non-US-based entities) were encouraged to participate in the Competition. They were invited to register on the ARIAC website and download the training material. The performance obtained by these participants was displayed on the ARIAC website in the same manner as the performance obtained by participants who were eligible to win cash prizes.

Evaluation of Submissions: The winners were determined by a panel of three judges (one NIST employee and two individuals from industry) appointed by the NIST Director. The following judging criteria were used: (1) Overall performance based on scoring metrics described in the official rules of the Challenge (80 points). Using automated scoring metrics, the first place entry was awarded 80 points, the second place entry was awarded 70 points, the third place entry was awarded 60 points, and so on. (2) Novelty of approach and alignment with spirit of competition (20 points). At the judges' sole discretion, up to 20 points were awarded for entries that showed novel approaches to solving the agility challenges and whose approaches were consistent with the spirit of the competition of coming up with industrially-implementable approaches that will help industry make better use of their robotic platforms. Each entry was eligible for up to 20 points, and more than one entry could receive all 20 points (or any other value). This approach of combining an automated score with one assigned by judges provided an additional mechanism to award novel approaches and was an effective structure for a successful competition that rewarded high-performing entries aligned with the goals and spirit of the competition.

Results: A total of 50 teams participated in the Challenge between January 26, 2018 and May 17, 2018. Three prizes were awarded to three teams.

Budget and Resources: In FY18, one FTE supported the design and implementation of the Challenge. The total budget in FY18 for the Challenge was $160,270, of which $100,000 was for a contract with Open Source Robotics Foundation, $17,500 was for the prize purse, $23,500 was for travel expenses for the winners to attend a workshop, and $19,270 was for overhead costs. Funds for all costs provided in the budget were from the FY18 NIST Scientific Research and Technical Services account (appropriated funds).

Partnerships: A contract was awarded to Open Source Robotics Foundation to develop the infrastructure for the competition (e.g., building and hosting the competition's web platform) and assist with automated scoring.

Advancement of Agency Mission: NIST's mission is to promote U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology in ways that enhance economic security and improve quality of life. NIST staff involved in this competition worked closely with industry to understand their challenges in implementing robotic systems for manufacturing applications, and built the competition around these topics. By incentivizing research teams to address these industry challenges in the competition, NIST supports the development of technology solutions to help U.S. industry become more competitive in the global market.

Solution Types: Ideas; Analytics, visualizations, algorithms; Scientific

Plan for Upcoming 2 FYs: NIST intends to continue its research program on measurement science and standards for robotics in manufacturing, and will use challenges as appropriate to engage the community and drive innovative solutions to research problems in this space, whether ARIAC or another similar challenge.

A.2.4 Federal Impact Assessment Challenge[6]

Lead Sponsoring Agency: NIST

Status: This competition was launched and completed in FY17.

Competition Goals: Despite the proliferation of Federal research and the profound effect that many federally developed technologies have on our everyday life, more effort is needed to assess the impact of these technologies. The goal of this Challenge was to advance the methods for assessing impact and provide case studies of technologies transferred from Federal laboratories. The Challenge called on researchers to analyze a federally developed technology that has been transferred to the private sector, and present the results in a paper suitable for an archival publication.

Goal Types: Improve government service delivery; Find and highlight innovative ideas; Inform and educate the public; Engage new people and communities

Justification for Using Prizes and Challenges: A prize competition served as an incentive for graduate students and economic researchers to focus on assessing the impact of Federal technology transfer activities. NIST determined that the offer of a modest cash prize, opportunity for the article to be published, and the simple registration and participation process would incentivize participants and allow NIST to identify a new cadre of researchers interested in technology transfer.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered was $20,000. Non-monetary incentives included the opportunity for the winning papers to be published in the Journal of Technology Transfer. No awards were made for the Challenge because there were no eligible winners.

Solicitation of Submissions: The Challenge was issued on Challenge.gov. NIST gave a presentation of the Challenge to the Interagency Working Group on Technology Transfer, which informed all Federal agencies of the Challenge. In addition, NIST issued press releases, and distributed flyers to academic institutions, research organizations, and economic conferences. NIST also made a presentation on the Challenge at the 2016 Technology Transfer Society Annual Conference at Arizona State University.

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[6] The website for the Federal Impact Assessment Challenge can be viewed at https://www.Challenge.gov/challenge/federal-impact-assessment-challenge/.

Solicitation Types: Email (e.g., listservs); Press release; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies); Other - Presentation at conference

Participation Requirements: The target audience was economic researchers, including graduate students working on dissertations. The Federal Impact Assessment (FIA) Challenge was open to all individuals over the age of 18 who 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. In the case of private entities, either non-profit or for-profit, corporations and institutions shall have been incorporated in, and maintained, a primary place of business in the United States or its territories. An individual, whether participating singly or with a group, must be a citizen or permanent resident of the United States. Federal employees were not eligible to participate. Any individuals or legal entities that had received Federal funds for the development of any part of a submission were ineligible. Any other individuals or legal entities involved with the design, production, execution, distribution, or evaluation of the FIA Challenge were also not eligible to participate. A participant would 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 were made available to all participants on an equitable basis.

Evaluation of Submissions: Three subject matter experts reviewed each submitted paper, assigning a numerical score and providing a brief assessment of how well four evaluation criteria were met: (1) description of the technology (up to 20 points); (2) description of the demand environment (up to 30 points); (3) description of methodologies used to gather and assess impact data (up to 20 points); and (4) description of the economic and/or societal impacts that resulted from the technology transferred from the Federal agency (up to 30 points). The NIST Director appointed a panel of judges to review the papers and the corresponding reviews provided by subject matter experts. The panel consisted of three individuals (all Federal employees) with broad representation of relevant areas to the Challenge. The judges evaluated each paper using three equally weighted criteria: novelty of the approach, scope of the assessment, and quality of the paper. In this Challenge, only one paper was received. According to the processes outlined in the official rules of the Challenge, the paper was reviewed by subject matter experts and the judging panel determined the paper should receive an award. However, the submitting team was later determined to be ineligible and no prize was awarded. A lesson learned was that a more focused challenge may elicit greater participation. The theme of federal impact assessment was perhaps too broad for potential solvers. In the future, NIST may focus on a specific technology area or identify some transferred technologies so that the solvers can focus on their impact assessment.

Results: One entry was submitted by four participants between September 27, 2016 and May 31, 2017. No prizes were awarded.

Budget and Resources: In FY17, 0.5 FTE supported the design and execution of the Challenge, including addressing inquiries and conducting technical reviews of the submission.

Partnerships: The journal of Technology Transfer agreed to review the winners of the Challenge and consider them for publication in their journal.

Advancement of Agency Mission: NIST's mission is to promote U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology in ways that enhance economic security and improve quality of life. On behalf of the Department of Commerce, NIST has a unique role in promoting and reporting on the overall strength of Federal efforts in technology transfer, including delivering annual reports to the White House and Congress on the use of technology transfer by the Department of Commerce and across all agencies. The Challenge also supported a Presidential memorandum that called on Federal agencies to establish performance goals, metrics, evaluation

methods, and implementation plans to improve the effectiveness of Federal technology transfer activities. The Federal Impact Assessment Challenge was designed to encourage efforts to conduct research in the area of studies that assess the impact of technologies transferred from Federal laboratories.

Solution Types: Ideas; Analytics, visualizations, algorithms; Other - Economic impact assessment

Plan for Upcoming 2 FYs: There is a continuing need to assess the economic impact and/or return on investment for Federal research. Future challenges are possible mechanisms to stimulate research in this area.

A.2.5 NIST the Future of Public Safety Technology 100K Video Series Challenge[7]

Lead Sponsoring Agency: NIST

Status: This competition was launched and completed in FY17.

Competition Goals: The goal of the Challenge was to create a series of seven videos that explain open innovation and NIST's Public Safety Communications Research Open Innovation Accelerator program to the public, while covering each of the key public safety technology programs covered by the NIST Public Safety Research Communications (PSCR) Division. In addition to educating the audience, the videos also invited people and companies across America to participate in future crowdsourcing competitions.

Goal Types: Inform and educate the public; Engage new people and communities

Justification for Using Prizes and Challenges: For the creation of videos, a crowdsourced prize competition provided the opportunity for more diverse submissions, in a quick timeframe. The use of traditional contractual mechanisms (e.g., contracts, grants) would have limited entries and the ability for teams to be formed through the ideation phase. A phased prize competition allowed for more submissions in the concept phase with down-selection to follow-on phases, resulting in quality, production-ready end products in a short timeframe.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered was $100,000 and the total amount awarded was $100,000. Non-monetary incentives included access to PSCR researchers and public safety professionals during the Challenge. Winners were invited to attend the PSCR 2018 Public Safety Broadband Stakeholder Meeting.

Solicitation of Submissions: NIST PSCR employed the vendor, Tongal, through the NASA Center of Excellence for Collaborative Innovation (CoECI) blanket purchase agreement. Tongal reached out to its 120,000+ members with email blasts and postings on its website and social platforms. The vendor worked with NIST PSCR to announce and promote the project on the NIST website and social media pages (Facebook and Twitter), including a direct link to Tongal's project page. Lessons learned from the solicitation process included recognizing that crowdsourcing allowed for unique and powerful ideas; that timelines built into the process supported a quality product with oversight; that crowdsourcing allowed experts to team with new people using a collaborative website; and that social media and online communities attracted the right solvers.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs)

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[7] The website for the NIST the Future of Public Safety Technology 100K Video Series can be viewed at https://www.Challenge.gov/challenge/nist-the-future-of-public-safety- technology-100k-video-series/.

Participation Requirements: The target audience for the Challenge was video producers and cinematography artists with interest in public safety. To be eligible, individuals must have been age 13 or older at the time of entry and U.S. citizens or permanent residents of the United States. In the case of private entity, the business shall have been incorporated in, and maintained, a primary place of business in the United States or its territories. A minor (for these purposes, a person under the age of 18 years of age, or under 19 years of age if the individual is a resident in Nebraska or Alaska or under 21 years of age in Mississippi) submitting an entry for a project must have received his/her parent/legal guardian's permission and included his/her parent/legal guardian's name and contact information on the official entry form where indicated. Participants may not be a Federal entity or Federal employee acting within the scope of their employment. NIST Guest Researchers, as well as direct recipients of NIST funding awards through any Center for Excellence established by NIST, were also not eligible for entrance. Multiple individuals and/or legal entities may have collaborated as a group to submit a single entry, but a single individual from the group must be designated as an official representative for each entry. That designated individual was responsible for meeting all entry and evaluation requirements.

Evaluation of Submissions: The vendor, Tongal, reviewed all submissions to ensure they met the minimum requirements. Then, NIST PSCR utilized three types of evaluators - subject matter experts (SMEs), public safety focus groups, and a judge, appointed by the NIST Director. The SMEs reviewed the submissions and offered their expert opinions and recommendations to the judges. The SMEs and focus groups were a hybrid of NIST researchers and active first responders; the judge was a Federal employee. During each stage (concept, pitch, and video) of the challenge, Tongal evaluated the submissions for compliance with the objectives and the official rules of the contest. After it was determined the contestant complied with the objectives and official rules, SMEs and focus groups reviewed the submissions and offered recommendations to the judge. The appointed judge had sole discretion regarding the determination of awards in accordance with the rules for the Challenge. Key lessons learned during the evaluation process were that using active first responders for reviews brought operational accuracy to the end products; the use of video experts, along with NIST staff, provided critical feedback on the quality of the end products; designing the challenge with multiple stages, phased appropriately along a condensed timeline, ensured good engagement with the contestants and review teams; and regular meetings between the SMEs and the stage 2 winner provided quality and accuracy to the end solution.

Results: Of the 107 entries submitted by 200 participants, six prizes were awarded to five teams consisting of a total of 20 individuals. The Challenge was broken into four phases. Phase 1 (concept) had four winners. Phase 2 (the pitch) had one winner in which the most compelling pitch won. The winner of Phase 2 moved onto Phase 3 (pre-production) in which a script, storyboard, and headshots were submitted for approval. The winner of Phase 2 then moved onto Phase 4 (Video), in which 13 videos were created. Submissions were received between August 24, 2017 and December 22, 2017.

Budget and Resources: In FY17, 0.25 FTE was used to support the design and execution of the Challenge, and to manage the contract with the vendor. Excluding FTE, the total funding in FY17 was $171,600: $100,000 for the prize purse, $12,100 for overhead costs, $9,300 for travel, and $59,200 the vendor contract through NASA CoECI.[8] In FY18, 0.10 FTE was used to close out the Challenge. Funding for the Challenge came from the Public Safety Communications Trust Fund (006-55-0513); TAFS: 13-0513

[8] $51,800 of the total vendor contract through NASA CoECI were from FY16 obligations.

2012/2022 (for more information, see https://www.nist.gov/ctl/pscr/about-pscr). All funding used to support this Challenge was administered by NIST PSCR and came from a special appropriation.[9]

Partnerships: Federal partners included the National Telecommunications and Information Administration (NTIA) Institute for Telecommunication Sciences (ITS) and NTIA FirstNet. NTIA-ITS provided subject matter experts and NTIA FirstNet provided a judge for the Challenge. Collectively, Federal partners provided approximately 20 hours of expertise. Non-Federal partners came from various academic, private-sector, and public safety organizations, providing expertise in the areas of communication, public relations, marketing, law, and public safety. Collectively, non-Federal partners provided approximately 40 hours of expertise. The estimated value of all partner contributions is $6,000. For future challenges designed to supply production-ready videos, NIST PSCR recommends using a mix of consultants from various disciplines, such as, public relations, marketing, communications law, along with the true subject matter experts, the first responders.

Advancement of Agency Mission: NIST's mission is to promote U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology in ways that enhance economic security and improve our quality of life. NIST's Public Safety Communications Research Program (PSCR) drives innovation and advances public safety communication technologies through cutting-edge research and development. PSCR works directly with first responders and the solver community to address public safety's urgent need to access the same broadband communications and state-of-the-art technologies that consumers on commercial networks now expect. The 2017 NIST The Future of Public Safety Technology 100K Video Challenge advanced NIST and NIST's PSCR missions through the creation of videos to engage the public in solving technical, scientific, and creative problems to advance technologies that public safety workers use in their jobs.

Solution Types: Creative (design & multimedia); Ideas

Plan for Upcoming 2 FYs: Potential topical areas for NIST PSCR prize competitions during the upcoming two fiscal years are location-based services to locate, track, and inform first responders while indoors under difficult conditions; cybersecurity and device security issues with the understanding of critical applications and user interfaces required by first responders; improving the opportunity and ease of real-time public safety communications analytics; and increased and improved user interfaces targeting the public safety community.

A.2.6 NIST Virtual Public Safety Test Environment Challenge[10]

Lead Sponsoring Agency: NIST

Status: This competition was launched and completed in FY17.

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[9] In February 2012, the enactment of the Middle Class Tax Relief and Job Creation Act marked an unparalleled push toward next-generation technologies for public safety. The legislation contained landmark provisions for the development and build out of the Nationwide Public Safety Broadband Network (NPSBN), a dedicated, interoperable network for emergency responders. The Public Safety Trust Fund (PSTF) was established to support the design and implementation of the Network. The Act charged NIST with utilizing up to $300 million of PSTF allocations to establish a research and development program to support the development and deployment of NPSBN. PSCR established the Innovation Accelerator Program to drive research and development and transform public safety communications capabilities.

[10] The website for the NIST Virtual Public Safety Test Environment Challenge can be viewed at https://www.Challenge.gov/challenge/nist-virtual-public-safety-test- environment-challenge/.

Competition Goals: The purpose of the Challenge was to generate ideas and designs for measurement environments that use immersive virtual reality (VR) tools in conjunction with physical spaces to simulate first responder scenarios for accurate and repeatable testing of new first responder interfaces and technologies.

Goal Types: Find and highlight innovative ideas; Advance scientific research; Develop technology; Engage new people and communities; Stimulate a market

Justification for Using Prizes and Challenges: Prize competitions were selected to crowdsource and gain many ideas in a short period of time, as well as to initiate visibility and awareness for the public safety research mission. There is a lack of repeatable test environments available using virtual reality tools for first responders, which made contracting vehicles not practical. Likewise, many members of the gaming community and virtual reality design shops do not currently focus their user interfaces on first responders. Partnerships or memorandums of understanding (MOUs) with other entities were not considered as ideal. For example, the Department of Defense virtual reality prototypes/training environments do not fully reflect the requirements and have not been available to the public safety community. The prize competition also served as a preferred method to achieve NIST PSCR's mission to work with new innovators and individuals in the communication technology communities and encourage more rapid development of technology for the public safety community.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered was $50,000 and the total amount awarded was $50,000. Non-monetary incentives included attendance at the PSCR 2017 Public Safety Broadband Stakeholder Meeting to present their results and interact with over 500 meeting participants who represented all segments of the public safety community; and access to PSCR researchers and other challenge subject matter experts. The value of non-cash prizes awarded was $7,000.

Solicitation of Submissions: The vendor, HeroX/Topcoder, advertised the Challenge on their website, their social media accounts (Facebook, LinkedIn, Goggle+, Twitter), and on Challenge.gov. HeroX used their database of 5,000 contacts based on demographics of individuals and organizations who would likely participate in the Challenge. This targeted outreach resulted in approximately 250 click-throughs to the Challenge page. The vendor also included the competition in their March and April newsletters. The vendor had 14 forum posts throughout the course of the Challenge; the 14 posts spun off five threads that included questions and clarification on the challenge scope and guidelines. Lessons learned include extensive targeted outreach was important in building the participant community; forums helped to keep participants engaged during the competition; and repeated posts in social media helped spur interest in the Challenge.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies); Other - Vendor-directed outreach efforts

Participation Requirements: The target audience was individuals familiar with the needs of first responders and a familiarity with the capabilities of using virtual/immersive environments with physical spaces to create accurate first responder scenarios. To be eligible for the cash prizes, individuals must have been age 18 or older at the time of entry and a U.S. citizen or permanent resident of the United States, or its territories. In the case of a private entity, the business must have been incorporated in and maintained a primary place of business in the United States or its territories. Participants may not be a Federal entity or Federal employee acting within the scope of their employment. Participants, including individuals and private entities, must not have been convicted of a felony criminal violation under any Federal law within the preceding 24 months and must not have any unpaid Federal tax liability that has been assessed, for which all judicial and administrative

remedies have been exhausted or have lapsed, and that is not being paid in a timely manner pursuant to an agreement with the authority responsible for collecting the tax liability. Participants must not have been suspended, debarred, or otherwise excluded from doing business with the Federal Government. Multiple individuals and/or legal entities could collaborate as a group to submit a single entry and a single individual from the group must have been designated as an official representative for each entry.

Evaluation of Submissions: The vendor, HeroX, evaluated all 21 entries to ensure they met the minimum requirements. They determined that seven entries did not meet the minimum viability requirements of the Challenge. NIST PSCR utilized three types of evaluators: HeroX, subject matter experts (SMEs), and a judge. HeroX provided initial scoring and forwarded the 18 submissions with comments and scores to the NIST evaluation panel for review. The SMEs reviewed the submissions and offered their expert opinions and recommendations to the judge. The SMEs were a hybrid of NIST researchers and public technology officials; the PSCR Division Chief was appointed by the NIST Director to serve in the role of judge. PSCR evaluated the submitted documents/solutions for compliance with the objectives and the official rules of the contest. Key lessons learned during the evaluation process include public voting for the non-cash, honorable mention award was a benefit to improve crowdsourcing efforts and awareness for NIST PSCR research; the Challenge allowed NIST PSCR to launch a second VR challenge using concepts learned from this challenge; frequent feedback to contestants is crucial to maintain the lifecycle of prize competitions, government research interest, and involvement with the research topic.

Results: Of the 21 entries submitted by 60 participants between March 28, 2017 and May 03, 2017, five prizes were awarded to teams.

Budget and Resources: In FY17, 0.25 FTE was used to support the design and execution of the Challenge. Total funding for the Challenge, excluding FTE, was $66,000: $50,000 for the prize purse, $7,000 for non-cash awards in the form of travel support, and $9,000 for overhead costs. Funding for the vendor contract through NASA CoECI totaled $47,400 and came from FY16 obligations. Funding for the Challenge came from the Public Safety Communications Trust Fund (006-55-0513); TAFS: 13-0513 2012/2022 (for more information, see https://www.nist.gov/ctl/pscr/about-pscr). All funding used to support this challenge was administered by NIST PSCR and came from a special appropriation.[11]

Partnerships: The Department of Homeland Security provided approximately 25 hours of subject matter expertise for the Challenge. Non-Federal partners included public safety professionals and provided approximately 15 hours of subject matter expertise. Both Federal and non-Federal partners reviewed submitted concept papers, and provided the public safety, first-responder perspective during the review process. The estimated value of all partner contributions is $3,000.

Advancement of Agency Mission: NIST's mission is to promote U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology in ways that enhance economic security and improve quality of life. NIST's PSCR Program drives innovation and advances public safety communication technologies through cutting-edge research and development. PSCR

[11] In February 2012, the enactment of the Middle Class Tax Relief and Job Creation Act marked an unparalleled push toward next-generation technologies for public safety. The legislation contained landmark provisions for the development and build out of the Nationwide Public Safety Broadband Network (NPSBN), a dedicated, interoperable network for emergency responders. The Public Safety Trust Fund (PSTF) was established to support the design and implementation of the Network. The Act charged NIST with utilizing up to $300 million of PSTF allocations to establish a research and development program to support the development and deployment of NPSBN. PSCR established the Innovation Accelerator Program to drive research and development and transform public safety communications capabilities.

works directly with first responders and the solver community to address public safety's urgent need to access the same broadband communications and state-of-the- art technologies that consumers on commercial networks now expect. The 2017 Virtual Public Safety Test Environment Challenge advanced NIST and NIST's PSCR missions by involving a diverse community of virtual reality (VR) and augmented reality (AR) experts to conceptualize and produce ideas for physical measurement environments using virtual reality tools. This challenge test environment introduced new solvers—i.e. gaming industry communities, startups, and small business—to the public safety industry. The selected solutions will provide researchers with a controlled and repeatable environment for use with virtual reality tools specific to the public safety community. In addition, NIST PSCR will have increased test environments for public safety users.

Solution Types: Ideas; Technology demonstration and hardware

Plan for Upcoming 2 FYs: Potential topical areas for NIST PSCR prize competitions during the upcoming two fiscal years are location-based services to locate, track, and inform first responders while indoors under difficult conditions; cybersecurity and device security issues with the understanding of critical applications and user interfaces required by first responders; improving the opportunity and ease of real-time public safety communications analytics; and increased and improved user interfaces targeting the public safety community.

A.2.7 PerfLoc: Performance Evaluation of Smartphone Indoor Localization Apps[12]

Lead Sponsoring Agency: NIST

Status: This competition was launched in FY17 and completed in FY18.

Competition Goals: The goal of the Challenge was to incentivize the creation of the best possible indoor localization and tracking app for Android smartphones using NIST test data. Indoor localization is the capability to determine the location of an entity to be localized (or tracked), such as a person, a robot, or some other object equipped with an appropriate electronic device. While mapping apps on today's cellphones can provide some navigation capability, they usually rely on GPS or Wi-Fi signals and are often not very accurate, particularly in buildings and subterranean structures such as tunnels, caves, and underground mines. The goal of the Challenge was to spur the development of localization apps that can use the sensors available in a phone and the strength of other signals available, such as those from Wi-Fi access points and cellular base stations, to pinpoint a highly accurate location estimate. Localization and tracking, whether indoors or outdoors, has a wide range of applications, including emergency response and law enforcement.

Goal Types: Find and highlight innovative ideas; Solve a specific problem; Advance scientific research; Develop technology

Justification for Using Prizes and Challenges: The PerfLoc competition presented a daunting technical challenge to the localization and tracking community. A prize competition was used to incentivize as many solvers as possible to apply their expertise to this important technical challenge that can address needs in the public safety research communications community.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered was $35,000 and the total amount awarded was $20,000. Non-monetary incentives included inviting finalists to the NIST campus in Gaithersburg, Maryland, to conduct live tests during the App Demo Days where the winner was

[12] The website for the PerfLoc: Performance Evaluation of Smartphone Indoor Localization Apps can be viewed at https://perfloc.nist.gov.

determined; invitational travel funds for the winning team and the highest scoring team (not eligible for a cash prize) to showcase their results at an international conference; and attendance to the annual PSCR Public Safety Broadband Stakeholder Meeting. The value of the non-cash prize awards was $8,000.

Solicitation of Submissions: The Challenge was announced through several outlets. It was posted on Challenge.gov and NIST used social media (Linked In, Facebook) to promote the Challenge. The Challenge manager shared information about the Challenge with professional colleagues at scientific meetings and through scientific societies. The PSCR program also distributed information about the Challenge. Due to the highly technical nature of the competition, these methods for outreach were effective in identifying potential solvers. NIST held a webinar to provide details about PerfLoc that included a Q&A session, and the webinar was archived online.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs)

Participation Requirements: The target audience for the Challenge was experts in academia and the private sector with understanding of location-based sensing and tracking algorithms, and the ability to create an app using their algorithm. To be eligible for a cash prize, a participant (whether an individual, team, or legal entity) must have registered to participate and complied with all of the requirements under section 3719 of title 15 United States Code. At the time of entry, the official representative (individual or team lead) must have been 18 years of age or older and a U.S. citizen or permanent resident of the U.S. or its territories. In the case of a private entity, the business must have been incorporated in and maintained a primary place of business in the United States or its territories. Participants may not be a Federal entity or Federal employee acting within the scope of their employment. NIST employees and NIST Research Associates as well as direct recipients of NIST funding awards for NIST projects in the development of an Android app in the area of the Challenge were not eligible to participate. Any other individuals or legal entities involved with the design, production, execution, distribution, or evaluation of the PerfLoc Prize Competition were also not eligible to participate. In addition, interested participants who did not meet the eligibility requirements to win a prize (i.e., individuals who were neither a U.S. citizen nor a permanent resident of the United States or non-US-based entities) were encouraged to participate in the competition.

Evaluation of Submissions: The PerfLoc Performance Evaluation Portal generated a score for each uploaded entry. An entry consisted of a set of location estimates generated by the participant's app. The algorithm for evaluating these entries is described in detail in the official rules for the Challenge. Each entry was automatically assigned a score up to 80 points by the evaluation software, based on the methodology provided in the rules. The top three teams eligible for a cash prize were selected as finalists. Finalists were invited to the NIST campus to test their apps in live testing scenarios during App Demo Days. The winner was determined by the judge, the PSCR Director, appointed by the NIST Director. The judging criteria were as follows: (1) overall performance on the PerfLoc Performance Evaluation Portal (80 points maximum), and (2) Performance during App Demo Days at NIST, including localization accuracy and latency of the app (20 points maximum).

Results: Of the 16 entries submitted by 152 participants between March 22, 2017 and January 17, 2018, one prize was awarded to one team.

Budget and Resources: A total of 0.75 FTE was used in FY17 and FY18 to support the technical design and supervision of the Challenge. The total funding for FY17 was $101,500. It was used to support two NIST research associates (not Federal employees) to design and implement technical aspects of the Challenge (i.e., measurements for the NIST test data, website and scoring algorithm, monitoring entries, and live testing at App Demo Days). The total funding for FY18 was $161,100. Of the total, $101,500 was to support two NIST research associates to design and implement technical aspects of

the Challenge (i.e., measurements for the NIST test data, website and scoring algorithm, monitoring entries, and live testing at App Demo Days); $11,000 was for travel support for finalists to attend App Demo Days and an international conference; $25,000 was for surveying Wi-Fi access points on NIST's Gaithersburg campus; $20,000 was for the prize purse; and $3,600 was for overhead costs. Funding for the Challenge came from the Public Safety Communications Trust Fund (006-55-0513); TAFS: 13-0513 2012/2022 (for more information, see https://www.nist.gov/ctl/pscr/about-pscr). Funding used to support this challenge (i.e., travel, surveying, and cash prize) was administered by NIST PSCR, and came from a special appropriation.[13]

Partnerships: N/A

Advancement of Agency Mission: NIST's mission is to promote U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology in ways that enhance economic security and improve quality of life. NIST's Public Safety Communications Research Program (PSCR) drives innovation and advances public safety communication technologies through cutting-edge research and development. PSCR works directly with first responders and the solver community to address public safety's urgent need to access the same broadband communications and state-of-the-art technologies that consumers on commercial networks now expect. PSCR has identified a portfolio of key technology areas as part of its research and development program. The PerfLoc Prize Competition supports location-based services, one of the areas, which aims to advance technologies to seamlessly locate, track, and inform first responders while operating indoors.

Solution Types: Software and apps; Analytics, visualizations, algorithms; Scientific

Plan for Upcoming 2 FYs: Potential topical areas for NIST PSCR prize competitions during the upcoming two fiscal years are location-based services to locate, track, and inform first responders while indoors under difficult conditions; cybersecurity and device security issues with the understanding of critical applications and user interfaces required by first responders; improving the opportunity and ease of real-time public safety communications analytics; and increased and improved user interfaces targeting the public safety community.

A.2.8 The Unlinkable Data Challenge: Advancing Methods in Differential Privacy[14]

Lead Sponsoring Agency: NIST

Status: This competition was launched in FY18, and is underway in FY18.

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[13] In February 2012, the enactment of the Middle Class Tax Relief and Job Creation Act marked an unparalleled push toward next-generation technologies for public safety. The legislation contained landmark provisions for the development and build out of the Nationwide Public Safety Broadband Network (NPSBN), a dedicated, interoperable network for emergency responders. The Public Safety Trust Fund (PSTF) was established to support the design and implementation of the Network. The Act charged NIST with utilizing up to $300 million of PSTF allocations to establish a research and development program to support the development and deployment of NPSBN. PSCR established the Innovation Accelerator Program to drive research and development and transform public safety communications capabilities. Funds to support two research associates were from the FY 2018 NIST Scientific Research and Technical Services account (appropriated funds).

[14] The website for The Unlinkable Data Challenge: Advancing Methods in Differential Privacy can be viewed at https://www.Challenge.gov/challenge/the-unlinkable-data-challenge-advancing- methods-in-differential-privacy/.

Competition Goals: As the industry that serves public safety moves towards advanced analytics, the sharing of datasets is necessitating the ability to quickly and properly de-identify data sets with tested, validated, high-speed algorithms to ensure the protection of personally identifiable information (PII) for both public safety personnel and individuals in the community. The purpose of the Challenge is to incentivize solvers to develop algorithms that can protect PII while maintaining a dataset's utility, by increasing the efficiency and speed of robust data de-identification for public safety and differential privacy. The Challenge is designed to stimulate and grow the algorithm developer community and produce a viable mid-stage solution for data de-identification. Specifically, the Challenge is intended to develop enhanced versions of the multiplicative weights and exponential mechanism algorithm that will outperform the original algorithm by several orders of magnitude, to the point where the resulting algorithms will be of practical use for privacy-preserving data release.

Goal Types: Find and highlight innovative ideas; Solve a specific problem; Advance scientific research; Engage new people and communities; Stimulate a market

Justification for Using Prizes and Challenges: NIST opted to use prize competitions to crowdsource and gain many ideas in a short period of time, as well as to initiate visibility and awareness for the public safety research mission. For data de-identification, a prize competition was selected to quickly advance the development of algorithms to support data de-identification using differential privacy. Holding a prize competition in data science is a well-understood and effective way to crowdsource ideas and teams for solving problems. Because differential privacy is not a well-known concept or commonly tackled method to solve data de-identification, using a third party vendor to encourage involvement by new solvers outside of the academic community was important. Using a data science vendor was also valuable for outreach to the data science community and to host the coding platform on which to run the competition. Stage 2 of the Challenge requires an evaluation of the source code, which will be compiled and run on the host platform. The prize competition also served as a preferred method to achieve NIST PSCR's mission to work with new innovators and to encourage more rapid development of data de-identification for data analysts working on public safety issues.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered is $190,000 and the total amount awarded, to date, is $40,000. Non-monetary incentives included attendance to the PSCR 2019 Public Safety Broadband Stakeholder Meeting to present their results and interact with over 500 meeting participants who represent all segments of the public safety community; and access to NIST PSCR researchers and other challenge subject matter experts.

Solicitation of Submissions: The vendor, HeroX/Topcoder, advertised this challenge on their website, their social media accounts (Facebook, LinkedIn, Goggle+, Twitter) and NIST posted information on Challenge.gov. HeroX used their database of 5,000 contacts based on demographics of individuals and organizations who would likely participate in the challenge. For stage 1 of this competition, the vendor had six forum posts and more are anticipated as the Challenge progresses.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies); Other - HeroX and TopCoder outreach efforts

Participation Requirements: The target audience is innovators from various industries such as data security, data analysis, privacy protection, pseudonymization, health information technology, etc. To be eligible for a cash prize, a participant (whether an individual, team, or legal entity) must have registered to participate and complied with all of the requirements under section 3719 of title 15, United States Code. At the time of entry, the official representative (individual or team lead, in the case of a group project) must have been age 18 or older and a U.S. citizen or permanent resident of the United States or its territories. In the case of a private entity, the business shall have been incorporated in and

maintained a primary place of business in the United States or its territories. Participants may not be a Federal entity or Federal employee acting within the scope of their employment. NIST employees were 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 NIST Unlinkable Data Challenge: Advancing Methods in Differential Privacy Prize Competition if the Federal employees and facilities were made available to all Participants on an equitable basis.

Evaluation of Submissions: Stage 1 evaluation was completed in September 2018. The vendor, HeroX, evaluated all 11 entries to ensure they met the minimum requirements. NIST PSCR utilized three types of evaluators: vendor staff, subject matter experts (SMEs), and a judge, appointed by the NIST Director. The judge determined the winners of Stage 1. The SMEs were a hybrid of agency staff and non-Federal volunteers; the judge was a NIST employee.

Results: Of the 11 (Stage 1—concept paper) entries submitted between May 1, 2018 and August 2, 2018, five prizes were awarded to three teams. Stage 2, an algorithm coding contest based on concepts from Stage 1, is planned for October 2018 through May 6, 2019.

Budget and Resources: In FY17, 0.1 FTE was used to support the Challenge and $637,500 was spent on the third party vendor contracted through NASA CoECI. In FY18, 0.25 FTE was used to support the Challenge. Total funding for the Challenge in FY18 was $47,380, $40,000 of which was for the prize purse, $2,500 of which was for travel support, and $4,880 of which was for overhead costs. Funding for the Challenge came from the Public Safety Communications Trust Fund (006-55-0513); TAFS: 13-0513 2012/2022 (for more information, see https://www.nist.gov/ctl/pscr/about-pscr). Funding used to support this challenge (i.e., travel, surveying, and cash prize) was administered by NIST PSCR, and came from a special appropriation.[15]

Partnerships: The Department of Homeland Security and the U.S. Census Bureau provided subject matter experts for the Challenge. Non-Federal partners included volunteers from various academic and private-sector research organizations. They contributed approximately 80 hours for Stage 1 as subject matter experts, reviewing submitted concept papers and data sets. Non-Federal partners will provide the external expertise for differential privacy during the review process. The estimated value of all partner contributions was $8,000.

Advancement of Agency Mission: NIST's mission is to promote U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology in ways that enhance economic security and improve quality of life. NIST's Public Safety Communications Research Program (PSCR) drives innovation and advances public safety communication technologies through cutting-edge research and development. PSCR works directly with first responders and the solver community to address public safety's urgent need to access the same broadband communications and state-of-the-art technologies that consumers on commercial networks now expect. The Unlinkable Data Challenge, Advancing Methods in Differential Privacy, aims to advance NIST and NIST's PSCR missions by developing more advanced differential privacy methods that can substantially improve the privacy

[15] In February 2012, the enactment of the Middle Class Tax Relief and Job Creation Act marked an unparalleled push toward next-generation technologies for public safety. The legislation contained landmark provisions for the development and build out of the Nationwide Public Safety Broadband Network (NPSBN), a dedicated, interoperable network for emergency responders. The Public Safety Trust Fund (PSTF) was established to support the design and implementation of the Network. The Act charged NIST with utilizing up to $300 million of PSTF allocations to establish a research and development program to support the development and deployment of NPSBN. PSCR established the Innovation Accelerator Program to drive research and development and transform public safety communications capabilities.

protection of a dataset while maintaining the dataset's analytical usefulness. Advancement of differential privacy algorithms that redact personally identifiable information (PII) while retaining data utility will increase the number of available datasets for researchers who focus on public safety issues. Examples of public safety research issues are: identifying risks in aviation, identifying patterns of violence in local communities, contingency planning in disaster scenarios, and assisting in tracking contagious diseases. Developments coming out of this competition would help drive major advances in the practical applications of differential policy for public safety researchers.

Solution Types: Software and apps; Ideas; Analytics, visualizations, algorithms; Other - Concept papers

Plan for Upcoming 2 FYs: Potential topical areas for NIST PSCR prize competitions during the upcoming two fiscal years are location-based services to locate, track, and inform first responders while indoors under difficult conditions; cybersecurity and device security issues with the understanding of critical applications and user interfaces required by first responders; improving the opportunity and ease of real-time public safety communications analytics; and increased and improved user interfaces targeting the public safety community.

A.2.9 The Unmanned Aerial Systems Flight and Payload Challenge[16]

Lead Sponsoring Agency: NIST

Status: This competition was launched and completed in FY18.

Competition Goals: The Challenge supports the public safety community and its stakeholders by driving innovations in unmanned aerial systems (UAS), sometimes referred to as drones. One of the barriers for UAS use in a public safety realm is payload versus flight time. Vertical takeoff and landing (VTOL) UAS provide many different mission capabilities, but their flight time is limited. The payload capacity, energy source and flight time are linked through design trade-offs that can be optimized for efficiency and flexibility. The Challenge was designed to seek maximum UAS flight time, while carrying a set payload, for a reasonably-priced UAS. The ability to stay airborne in this manner can support first responders' communication technology on the ground while they conduct their search. The advancement of UAS research will help search and rescue operations support payloads for wireless communications or other life-saving goods to save lives.

Goal Types: Solve a specific problem; Advance scientific research; Develop technology; Stimulate a market

Justification for Using Prizes and Challenges: Existing research, development, testing and evaluation (RDT&E) of UAS does not focus on the needs of first responders. New RDT&E efforts on UAS were needed to adequately support first responders' needs such as long-term operation and performance in hazardous or remote environments. NIST used prize competitions to crowdsource and gain many ideas in a short period of time, as well as to increase visibility and awareness for the public safety research mission. Typical contracting vehicles, including partnerships with academic institutions, would not have provided the development and evaluation of multiple concepts, from a diverse submission audience, in a short time period. The prize competition also served as a preferred method to achieve NIST PSCR's mission to work with new innovators and to encourage more rapid development of UAS technology for first responders.

[16] The website for The Unmanned Aerial Systems Flight and Payload Challenge can be viewed at https://www.Challenge.gov/challenge/the-unmanned-aerial-systems-flight-and- payload-challenge/.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered was $432,000 and the total amount awarded was $250,000. Non-monetary incentives included attendance at the PSCR 2018 Public Safety Broadband Stakeholder Meeting to present results and interact with over 500 meeting participants who represent all segments of the public safety community and access to NIST PSCR researchers and other challenge subject matter experts. The value of non-cash prizes awarded was $22,000.

Solicitation of Submissions: NIST PSCR advertised this challenge on their website, in their newsletter, and on LinkedIn and Facebook, and used the support of the NIST Public Affairs Office to run and monitor paid advertisements in social media (Facebook and LinkedIn). A lesson learned for this type of challenge was that paid advertisement in Facebook, targeted at persons aged 35-64, was more productive (cost per click) than the LinkedIn paid advertisement. Another suggestion was to use Meetup groups, academic groups, and other regional groups to improve participant solicitation.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Other - Paid advertisements on Facebook and LinkedIn

Participation Requirements: The target audience was individuals with prior experience in building drones and/or unmanned aerial systems (UAS). To be eligible for the cash prizes, each contestant or team of contestants must have included an individual 18 years of age or older at the time of entry and a U.S. citizen or permanent resident of the United States or its territories. In the case of a private entity, the business must have been incorporated in and maintained a primary place of business in the United States or its territories. Contestants may not have been a Federal entity or Federal employee acting within the scope of their employment. NIST guest researchers, as well as direct recipients of NIST funding awards through any Center of Excellence established by NIST, were eligible to enter, but were not eligible to receive cash awards. Contestants, including individuals and private entities, must not have been convicted of a felony criminal violation under any Federal law within the preceding 24 months and must not have any unpaid Federal tax liability that has been assessed, for which all judicial and administrative remedies have been exhausted or have lapsed, and that is not being paid in a timely manner pursuant to an agreement with the authority responsible for collecting the tax liability. Contestants must not have been suspended, debarred, or otherwise excluded from doing business with the Federal Government.

Evaluation of Submissions: NIST PSCR used two types of evaluators: subject matter experts (SMEs) and judges. The SMEs reviewed the submissions and offered their expert opinions and recommendations to the judges. The SMEs were a hybrid of NIST researchers, active first responders, and public technology officials. A panel of judges appointed by the NIST Director consisted of two NIST employees and an expert from academia. During each stage of the challenge, NIST PSCR evaluated the submitted documents/solutions for compliance with the objectives and the official rules of the contest. After it was determined the contestant complied with the objectives and official rules, SMEs reviewed the solutions/submissions and offered recommendations to the judges. Points were assigned to each finalist submission based on the UAS flight and payload review criteria in the rules. The judges had sole discretion regarding the determination of awards in accordance with the rules for the challenge. A key lesson learned during the evaluation process was that in the final stage of the competition, teams began sharing information and benefiting from outside help. This was particularly problematic because official contestants were the only ones allowed to enter and win, and it was unclear what results were being achieved by which officially entered teams and thereby eligible for awards based on the rules. In the future, NIST may design into the end of the challenge a collaboration day for more free-form collaboration, to determine if better performance can be achieved by collaboration versus competition between teams.

Results: Of the 30 entries submitted by 55 participants between January 08, 2018 and January 29, 2018, 11 prizes were awarded. Ten teams won Stage 1 (concept paper contest), and one team won the final stage (live test and evaluation) of the Challenge.

Budget and Resources: One FTE was used to support the design and implementation of the Challenge; 0.25 FTE was used in FY17 and 0.75 FTE was used in FY18. The total funding, excluding FTE, for the Challenge was $402,200: $250,000 for the cash prize purse, $45,900 for materials for the live testing event, $40,700 to support travel, $39,600 for overhead costs, $22,000 for non-cash awards, and $4,000 on advertisements. Funding for the Challenge came from the Public Safety Communications Trust Fund (006-55-0513); TAFS: 13-0513 2012/2022 (for more information, see https://www.nist.gov/ctl/pscr/about-pscr). Funding used to support this challenge (i.e., travel, surveying, and cash prize) was administered by NIST PSCR, and came from a special appropriation.[17]

Partnerships: Non-Federal partners included public safety professionals. They provided approximately 60 hours of effort as subject matter experts who reviewed concept papers and final submissions. They also provided a critical public safety professional perspective on the relevance of the solutions. Non-Federal partners also provided approximately 240 hours for set-up, monitoring, and break-down of the live test and evaluation event. The estimated value of partner contributions is $25,000. For future events like this UAV challenge, we recommend including non-public safety UAV-experienced partners in addition to the public safety UAV experts.

Advancement of Agency Mission: NIST's mission is to promote U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology in ways that enhance economic security and improve quality of life. NIST's Public Safety Communications Research Program (PSCR) drives innovation and advances public safety communication technologies through cutting-edge research and development. PSCR works directly with first responders and the solver community to address public safety's urgent need to access the same broadband communications and state-of-the- art technologies that consumers on commercial networks now expect. The Unmanned Aerial Systems Flight and Payload Challenge advanced NIST and NIST's PSCR missions in assessing new technologies and their ability to support field operations for first responders. One of the barriers for UAS used in a public safety realm is payload versus flight time. Vertical takeoff and landing of a UAS provides many different mission capabilities, but their flight time is limited. The payload capacity, energy source and flight time are linked through design trade-offs that can be optimized for efficiency and flexibility. With these parameters in mind, this challenge was designed to help public safety operations by keeping a UAS and its payload airborne for the longest time possible with vertical and hovering accuracy. At a cost of less than $20,000 per UAS, first responders may someday have an affordable drone in their toolkit to carry wireless networks for search and rescue operations.

Solution Types: Ideas; Technology demonstration and hardware

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[17] In February 2012, the enactment of the Middle Class Tax Relief and Job Creation Act marked an unparalleled push toward next-generation technologies for public safety. The legislation contained landmark provisions for the development and build out of the Nationwide Public Safety Broadband Network (NPSBN), a dedicated, interoperable network for emergency responders. The Public Safety Trust Fund (PSTF) was established to support the design and implementation of the Network. The Act charged NIST with utilizing up to $300 million of PSTF allocations to establish a research and development program to support the development and deployment of NPSBN. PSCR established the Innovation Accelerator Program to drive research and development and transform public safety communications capabilities.

Plan for Upcoming 2 FYs: Potential topical areas for NIST PSCR prize competitions during the upcoming two fiscal years are location-based services to locate, track, and inform first responders while indoors under difficult conditions; cybersecurity and device security issues with the understanding of critical applications and user interfaces required by first responders; improving the opportunity and ease of real-time public safety communications analytics; and increased and improved user interfaces targeting the public safety community.

A.2.10 Virtual Reality Heads-Up Display Navigation Challenge[18]

Lead Sponsoring Agency: NIST

Status: This competition was launched and completed in FY18.

Competition Goals: The Challenge was motivated by the fact that augmented and virtual reality (AR/VR) technologies allow for testing in safe, controlled, measurable, and repeatable environments for first responders. However, there is a lack of AR/VR user interfaces focused on, and that align with the specific requirements of, the public safety community. NIST PSCR needed to expand the number of prototypes in their library to effectively test and measure AR/VR user interfaces for the public safety community. The goals of the challenge were to incentivize the creation of intuitive heads-up displays (HUD) for public safety officials within a VR environment; enable NIST PSCR to use these HUDs as a tool for testing and developing virtual reality user interfaces for first responders; engage new communities and identify stakeholders for NIST PSCR's user-interface, user-experience (UI/UX) research portfolio; and further develop HUDs with location-based capabilities in a virtual reality environment.

Goal Types: Find and highlight innovative ideas; Advance scientific research; Engage new people and communities; Stimulate a market

Justification for Using Prizes and Challenges: NIST selected a prize competition mechanism because the other main mechanisms available—contracts, grants, cooperative agreements, etc.—were not applicable and/or ideal. There is a lack of commercially available AR/VR user interfaces focused on the needs of first responders, which made contracting vehicles impractical. Likewise, many members of the gaming community and virtual reality design shops do not currently have readily available user interfaces or work for which a grant or cooperative agreement would align with the objective of securing multiple user interfaces for first responders. Partnerships or MOUs with other entities were also not considered appropriate; for example, the Department of Defense virtual reality prototypes/training environments have not been available to the public safety community or fully transitioned to reflect their requirements. In addition to not having other avenues to secure the virtual reality heads-up-display prototypes, the prize competition also served as a preferred method to achieve NIST PSCR's mission to work with new innovators and individuals in the communication technology communities to encourage more rapid development of technology for the public safety community.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered was $125,000 and the total amount awarded was $87,500. Non-monetary incentives included attendance to the PSCR 2018 Broadband Stakeholder Meeting by the finalists to present their results and interact with over 500 meeting participants who represent all segments of the public safety community and access to NIST PSCR researchers and other challenge subject matter experts. Value of the non-cash prizes awarded was $26,500.

[18] The website for the Virtual Reality Heads-Up Display Navigation Challenge can be viewed at https://www.Challenge.gov/challenge/virtual-reality-heads-up-display- navigation-challenge/.

Solicitation of Submissions: NIST PSCR advertised the Challenge on their website, LinkedIn, other social media, and their e-newsletter, and also purchased an advertisement in the monthly publication of the Virtual Reality/AR Association. Of the six prize recipients, five learned about the Challenge through the advertisement in the association newsletter, and only one of the six prize recipients saw notification of the Challenge on Challenge.gov. This served as the key lesson learned with solicitation of submissions—many of the solvers are not yet familiar with NIST or PSCR or Federal Government challenges; NIST needs to expand solicitation and communication channel beyond NIST, PSCR and Challenge.gov platforms. During the one-on-one debriefs, most of the prize winners suggested contacting applicable Meetup groups or other regional groups to advertise the challenge opportunity.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Other - Paid advertisement in Virtual Reality/AR Association's monthly publication

Participation Requirements: The target solver audience was the virtual reality and software coding communities. To be eligible for the cash prizes, each contestant or team of contestants had to include an individual who was 18 years of age or older at the time of entry and a U.S. citizen or permanent resident of the United States or its territories. In the case of a private entity, the business must have been incorporated in and have maintained a primary place of business in the United States or its territories. Contestants may not have been a Federal entity or Federal employee acting within the scope of their employment. NIST guest researchers, as well as direct recipients of NIST funding awards through any Center of Excellence established by NIST, were eligible to enter, but were not eligible to receive cash awards. Multiple individuals and/or legal entities may have collaborated as a group to submit a single entry and a single individual from the group must be designated as an official representative for each entry. That designated individual was responsible for meeting all entry and evaluation requirements.

Evaluation of Submissions: NIST PSCR utilized two types of evaluators: subject matter experts (SMEs), who reviewed the submissions and offered their expert opinions and recommendations to the judges, and a panel of two judges appointed by the NIST Director. The SMEs were a hybrid of NIST researchers, active first responders, and public technology officials. Both judges were government officials. During each stage of the challenge, NIST PSCR evaluated the submitted documents/solutions for compliance with the objectives and the official rules of the contest. After it was determined the contestant complied with the objectives and official rules, the SMEs reviewed the solutions/submissions and offered recommendations to the judges. The two appointed judges had sole discretion regarding the determination of awards in accordance with the rules for the challenge. For the first time for NIST, there was a tie for first place. Though it was allowed within the rules based on the advice of legal counsel, a key lesson learned during the evaluation process was that it would have been helpful for explicit guidelines to be included in the rules with regard to ties. Another key lesson learned regarded SMEs. NIST PSCR should continue to have active members of the public safety community involved (police, fire and/or EMT). NIST PSCR should ensure that SMEs with industry or technology expertise also participate and that they understand the context and appropriate conditions unique to first responders.

Results: Of the 18 entries submitted by 50 participants between January 02, 2018 and January 29, 2018, six prizes were awarded to six teams. The Challenge was broken into four stages: Stage 1 consisted of a concept paper; Stage 2 consisted of a working concept and HUD prototype; Stage 3 was a HUD prototype test; and Stage 4 was a live competition of HUD prototypes.

Budget and Resources: A total of 0.6 FTE was used to design and execute the Challenge (0.1 FTE was used in FY17, and 0.5 FTE was used in FY18). Total funding for the Challenge, excluding FTE, was $182,300: $87,500 for the cash prize purse, $46,500 for travel, $26,500 for non-cash awards, and $21,800

for overhead costs. Funding for the Challenge came from the Public Safety Communications Trust Fund (006-55-0513); TAFS: 13-0513 2012/2022 for more information, see https://www.nist.gov/ctl/pscr/about-pscr). Funding used to support this challenge (i.e., travel, surveying, and cash prize) was administered by NIST PSCR, and came from a special appropriation.[19]

Partnerships: For this competition, the National Telecommunications and Information Administration's FirstNet Authority provided approximately 20 hours for evaluating submissions. Non-Federal partners included public safety professionals and first responder organizations. They provided approximately 45 hours as subject matter experts who reviewed concept papers and final submissions and provided the critical public safety professional perspective on the relevancy of the solutions. The estimated value of partner contributions is $4,300. For any future challenges focused on user interfaces and user experiences of first responders, NIST hopes to involve collaborations/partnerships to obtain the subject matter expertise of commercial/private sector technology entities, such as hardware or software-based virtual reality/augmented reality companies. This inclusion would help further advance NIST's mission to propel forward communication technology for first responders.

Advancement of Agency Mission: NIST's mission is to promote U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology in ways that enhance economic security and improve quality of life. NIST's Public Safety Communications Research Program (PSCR) drives innovation and advances public safety communication technologies through cutting-edge research and development (R&D). PSCR works directly with first responders and the solver community to address public safety's urgent need to access the same broadband communications and state-of-the- art technologies that consumers on commercial networks now expect. The Virtual Reality Heads-Up Display Navigation Challenge advanced NIST and NIST's PSCR missions by involving the virtual reality design and gaming industry communities to collaborate with first responders and NIST researchers to create AR/VR user interfaces for the public safety community. The selected user interfaces can be utilized as safe, repeatable, and measurable training environments for the public safety community, meanwhile PSCR has increased its collection of public safety user interfaces to measure and test navigational and other included elements.

Solution Types: Creative (design & multimedia); Technology demonstration and hardware

Plan for Upcoming 2 FYs: Potential topical areas for NIST PSCR prize competitions during the upcoming two fiscal years are location-based services to locate, track, and inform first responders while indoors under difficult conditions; cybersecurity and device security issues with the understanding of critical applications and user interfaces required by first responders; improving the opportunity and ease of real-time public safety communications analytics; and increased and improved user interfaces targeting the public safety community.

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[19] In February 2012, the enactment of the Middle Class Tax Relief and Job Creation Act marked an unparalleled push toward next-generation technologies for public safety. The legislation contained landmark provisions for the development and build out of the Nationwide Public Safety Broadband Network (NPSBN), a dedicated, interoperable network for emergency responders. The Public Safety Trust Fund (PSTF) was established to support the design and implementation of the Network. The Act charged NIST with utilizing up to $300 million of PSTF allocations to establish a research and development program to support the development and deployment of NPSBN. PSCR established the Innovation Accelerator Program to drive research and development and transform public safety communications capabilities.

A.3 Department of Energy (DOE)

A.3.1 Cleantech University Prize (Cleantech UP)[20]

Lead Sponsoring Agency: DOE

Status: This competition was completed in both FY17 and FY18.

Competition Goals: Cleantech UP was 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 goals included: (1) catalyzing clean energy startup formation on college campuses; (2) supporting novel training and educational opportunities that equip the next generation of energy entrepreneurs and innovators across the country; (3) establishing a national-level training program and competition for America's top clean energy student entrepreneurs; and (4) creating a sustained and diverse community to support student entrepreneurs.

Goal Types: Find and highlight innovative ideas; Develop technology; Engage new people and communities

Justification for Using Prizes and Challenges: Business plan competitions like Cleantech UP are influential instruments of change because they mobilize participants and spur innovation to accelerate research. Aspiring student entrepreneurs often lack the business development skills, market exposure, and investor feedback they need to launch viable new businesses. 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. Serving as a springboard for new ventures, Cleantech UP enabled DOE to reach a wider audience of problem solvers to identify and devise creative approaches to energy challenges and increase collaboration and partnerships with public, private, and philanthropic communities. With the ingenuity and passion of student entrepreneurs, prize competitions are catalysts for the innovation needed in the cleantech ecosystem. In such a challenging environment, prize competitions can play a key role in helping startups become successful businesses by providing mentorship from other successful entrepreneurs and industry experts, expanding their networks and opening opportunities for partnerships, and lending credibility and national exposure that can be crucial to securing additional funding or finding the right strategic relationships.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered and awarded was $570,000. DOE directly sponsored the $50,000 prize for each of the eight regional competitions, totaling $400,000 for regional prizes. The funding was allocated through a cooperative agreement awarded in 2015. The top three teams from each of the eight regional Cleantech UP collegiate competitions were invited to compete at the National Competition. The total prize purse of the National Competition amounted to $170,000. DOE sponsored $135,000, and DoD sponsored $35,000. Non-monetary incentives included access to energy entrepreneurship and commercialization training, including instruction and guidance in preparation for the competitions and supplemental curriculum that

[20] The website for the Cleantech University Prize (Cleantech UP) can be viewed at http://www.cleantechup.org/.

focused on the creation and development of student businesses in cleantech, as well as one-on-one mentorship, pitch coaching, and networking opportunities.

Solicitation of Submissions: To attract entrants, each region executed their own outreach strategy. Regional organizers used multiple media methods to disseminate information about the competitions. Some conducted informational webinars or held in-person networking events. The regional competitions utilized online application platforms for entrants to submit applications, such as YouNoodle or F6S.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies)

Participation Requirements: As a program whose goals included the development of the next generation of entrepreneurs, Cleantech UP required that students be highly involved in each competition's management and execution. In order to participate in the Cleantech UP competitions, at least 50% of any participating team's formal team members had to be actively enrolled in an accredited U.S. university or college. Participants were also required to present business plans at the Cleantech UP competitions. All business plan proposals were required to fall within DOE's Office of Energy Efficiency and Renewable Energy (EERE) mission and technology portfolio.

Evaluation of Submissions: A general framework for the Cleantech UP National Competition eligibility requirements and judging criteria is outlined in a policy memo that has remained constant since the program's inception. At the regional level, each competition determines selections independently, with the guidelines instructed through the eligibility requirements developed by DOE. Independent experts hailing from multiple sectors serve as judges at the application and competition stages. At the competition stages, submissions are judged on the following components: (1) solutions/products (value proposition, market differentiation, barriers to competition, and technical feasibility), 30%; (2) go-to-market strategy (feasibility of go-to-market plan, customer access and traction, and scalability), 30%; (3) team plan (quality of business plan, commitment to enterprise, team chemistry, gaps and action plans), 20%; and (4) impact on EERE mission, 20%.

Results: Cleantech UP submission dates varied across each regional competition. Submission open dates ranged between September 2017 and February 2018, and submission close dates ranged between November 2017 and March 2018. Regional competitions were held between February and May 2018, and the National Competition was held in June 2018. Of the approximately 250 team applications submitted, 107 teams participated in the eight regional competitions, and 23 teams participated in the National Competition. In total, eight regional prizes and five national prizes were awarded.

Budget and Resources: Funding for FY17 and FY18 was obligated in FY15. In addition, 1 full-time equivalent (FTE) employee supported the program in FY17 and FY18. To execute the regional and national competitions, DOE released a competitive solicitation to determine the administrators of the competitions in 2015. In doing so, a National Hub and eight regional competitions were established. The Cleantech UP Hub organized the annual National Competition, developed an energy entrepreneurship training program, and facilitated a learning platform for best practices in energy entrepreneurship education. Each regional organizer supported the development of teams and their training by establishing and running an annual regional competition, which included recruiting applicants, mentors, judges, and other competition partners, developing an outreach and marketing plan, and promoting the event.

Partnerships: For the regional competitions and the National Competition, 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. The Department of

Defense (DoD) participated as a Federal partner and provided judges for the competition. Non-Federal partners included the California Institute of Technology, Carnegie Mellon University, Clean Energy Trust, Massachusetts Institute of Technology, Rice University, Rutgers University, University of California, Berkeley, University of Central Florida, and VentureWell. The DoD contributed $35,000 for a prize at the 2018 National Competition.

Advancement of Agency Mission: Startups and innovative technologies are critical to the growth of the clean energy economy in the United States. However, persistent gaps exist between innovative technology developers and entrepreneurs. Significant barriers in creating clean energy technology startups has led to a dearth of participants entering the energy entrepreneurship pipeline. Cleantech UP aims to inspire clean energy innovation across the country and close the existing gap in early-stage training.

Solution Types: Business plans

Plan for Upcoming 2 FYs: A third-party, independent impact evaluation of the Cleantech UP program is ongoing for the next two fiscal years. The evaluation will analyze commercialization outcomes and impacts, education and career trajectory outcomes and impacts, and where the most value is imparted to participants.

A.3.2 Solar in your Community Challenge[21]

Lead Sponsoring Agency: DOE

Status: This competition was launched in FY17 and is underway in FY18.

Competition Goals: The goal of this Challenge is to make solar significantly more accessible to low and moderate income (LMI) households, non-profits, and governmental organizations through replicable business and financial models. Through the demonstration of solar projects and programs in their communities, teams aim to design, plan, and pilot new and scalable business and financial models to overcome current market barriers that block access for these market segments. These projects and programs must directly benefit: (1) LMI households, with a minimum of 20% of the energy and benefits assigned to LMI households; or (2) non-profit organizations, state, local, or tribal governments, or community service organizations, with a minimum of 60% of the energy and benefits assigned to one of these types of entities (referred herein as “non-profits”).

Goal Types: Find and highlight innovative ideas; Inform and educate the public; Engage new people and communities; Build capacity; Stimulate a market

Justification for Using Prizes and Challenges: Community solar is a new method for providing individuals, businesses, and other customers without direct access to solar energy the opportunity to benefit from the technology. Community solar allows customers to purchase portions of much larger solar power plants and be credited the benefits from the solar energy generation. Community solar is enabled by rules developed at the local level and are not the same across the country; thus, the execution of a prize program allows for flexibility in the development of impactful solutions. Furthermore, a prize program allows for new and large groups of innovators to think beyond the regional level, leading to novel solutions that have the potential to improve individual communities and the nation.

[21] The website for the Solar in your Community Challenge can be viewed at http://solarinyourcommunity.org/.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered was $3 million including $2 million of seed prizes and $1 million for final grand prizes. The total amount awarded to date was $620,000. In addition, DOE allocated $3 million in non-monetary incentives for competing participants including $10,000 technical assistance vouchers to access the consultation services of over 100 Technical Assistance (TA) providers for on-demand and specialized support services. The program obligated $3 million in prior year funds to pay for these services, but the participants have access to these services in the form of vouchers, not cash. A $1 million set aside for final grand prizes is all prior year funds. A portion of the Seed prize funds have been provided using $620,000 in prior year funding.

Solicitation of Submissions: The program used a multichannel strategy to build momentum and engage a national network of innovators thinking about solar access. The strategy focused on direct engagement, partner engagement, and digital/social engagement supported by an outreach/media campaign. Direct engagement used the National Community Solar Partnership regional workshops, where the program cultivated relationships and highlighted challenges and opportunities in this area. The program also hosted a series of informational webinars and in-person presentations in industry anchor event workshops such as Solar Power International 2016. Partner engagement involved attending a dozen two-hour, in-person informational workshops organized by supporting organizations in 12 different cities. The goal of these sessions was to help teams form and inspire them to participate in the Challenge. Lastly, digital engagement included DOE's official press release, email blasts, social media posts on Twitter and LinkedIn, newsletter clips, and other online postings by staff and a dozen supporting organizations.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies)

Participation Requirements: The Challenge is open to citizens or permanent residents of the United States and private or non-Federal public entities, such as townships, tribes, corporations, or other organizations, that are incorporated in and maintain a primary place of business in the United States. DOE employees, employees of sponsoring organizations, members of their immediate families (spouses, children, siblings, parents), and persons living in the same household as such persons, whether or not related, are not eligible to participate in this competition. Federal entities and Federal employees, acting within the scope of their employment, are also not eligible to participate in any portion of this competition. A participant can join the Challenge as a member of a competing team (project-focused or program- focused), or exclusively as a TA provider to help the competition teams throughout the Challenge. An individual must choose to participate as either a member of a team or a TA provider. After an individual applies to one of the two options, they permanently lose their eligibility to participate in the Challenge in any other fashion. DOE, with written approval, may allow exceptions to this rule in rare cases or due to unanticipated extenuating circumstances. For full eligibility details, visit: https://www.solarinyourcommunity.org/en/page/applying-rules-en.

Evaluation of Submissions: DOE-appointed judges evaluate and score submissions based on the evaluation criteria detailed in the published rules: (1) impact, 40%; (2) innovation, 30%; and (3) team, 30%. Judges will score applications according to the criteria on a 1–5 scale. Each judge will score assigned applications independently and will recommend whether applicants should be admitted into the competition or not, and if so, whether they should receive seed awards and TA vouchers. DOE will make final selection decisions based on the final scores and may apply any of the listed program policy factors detailed in the rules.

Results: Of the 201 entries submitted between November 18, 2016 and March 17, 2017, 172 membered teams participated in the Challenge. The Challenge consisted of three phases: an initial seed round

phase, an 18-month performance period phase of additional seed round prizes, and a final prizes post performance period. Thirty-five individuals or organizations received seed awards based on progress, and these winners were announced April 28, 2017.

Budget and Resources: Funding for FY17 included $318,916 in FY17 funds along with prior year funds from FY12. Funding for FY18 was provided through regular staff salaries. In addition, two full-time equivalent (FTE) employees supported the Challenge in both fiscal years. FY17 funds are available for TA, seed funds and prize administration by a third party vendor. Of the $318,916, a total of $30,441 has been spent on prize administration. No other FY17 funds have been spent on this challenge.

Partnerships: There have been two different non-Federal prize administrators for this Challenge. The State University of New York Polytechnic Institute was in the role from April 2017 until March 2018. The International City/County Management Association has taken over the role and will remain the administrator until the end of the period of performance. The administrator manages all participant agreements and related paperwork, vouchers, and communications. In collaboration with the Solar Energy Technologies Office (SETO), the administrator also engaged with other entities and organizations to provide expertise and resources in the TA Marketplace, where over a hundred consultants created storefronts with services they can offer to teams with TA vouchers. Additional resources available to teams were generated with partnerships with General Technical Assistance consultants, who were separate from the Marketplace, and Solar Knowledge Bootcamps, which included in-person and webinar-style courses on different topics related to community solar. The total estimated value of partner contributions was between $250,000 and $300,000.

Advancement of Agency Mission: The SETO goals are to reduce the costs of solar energy technologies, safely and reliably integrate solar energy into the electric grid, and increase access to solar energy for all Americans. This aligns with DOE's mission of delivering reliable, resilient and affordable energy options to America's citizens, businesses and other energy consumers.

Solution Types: Ideas; Business plans

Plan for Upcoming 2 FYs: The Challenge is expected to end by March 2019 after announcing final prize winners.

A.3.3 The American-Made Solar Prize[22]

Lead Sponsoring Agency: DOE

Status: This competition was launched in FY18.

Competition Goals: The American-Made Solar Prize is designed to accelerate and sustain American solar innovation through a series of prize competitions while developing a diverse and powerful support network, the American-Made Network, that leverages national laboratories, energy incubators, and other resources from across the United States. Through a series of three progressive contests (Ready!, Set!, Go!) that are 90 days apart, the program will incentivize the Nation's innovators and entrepreneurs to rapidly discover, research, iterate, and deliver new solutions to market with the goal of expanding solar manufacturing in the United States. The program will also lower barriers American innovators face in reaching manufacturing scale by accelerating the cycles of learning and supporting partnerships that connect entrepreneurs to the private sector and the network of DOE's national laboratories.

[22] The website for the The American-Made Solar Prize can be viewed at https://americanmadechallenges.org/solarprize.html.

Goal Types: Find and highlight innovative ideas; Develop technology; Engage new people and communities; Build capacity; Stimulate a market

Justification for Using Prizes and Challenges: The Solar Prize utilizes a new program structure that is designed to strengthen and scale critical connections that accelerate and sustain American innovation through two intertwined tracks: prize competitions and the establishment of the American-Made Network. The unique American-Made Network takes a structured approach to bring diverse sources of support, such as DOE's national laboratories, business incubators, and prototype fabrication facilities, together under one umbrella. This approach is designed to be fast, agile, flexible, scalable, and extend beyond solar to other technology domains and sectors. Instead of investing in one-of-a-kind solutions or scaling "safe-bet" approaches with dated technologies, the Solar Prize will apply a resource-multiplying approach that not only invests in multiple new innovations but also creates a foundation for expanding support for future manufacturing growth. This will simultaneously enable the rapid development of technology and strengthen critical connections for commercialization. While global competitors are spending their resources scaling legacy technology, this program develops next-generation commercially viable solutions, planting the seeds for a U.S. manufacturing renaissance.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered is $3 million for technology development competitors. The remaining $1.5 million will be used for vouchers for competitors for use at National Laboratories and other fabrication locations and awards to members of the American-Made Network based on their engagement with winning teams. Funds have yet to be allocated to any awardees. Non-monetary incentives include dedicated support and mentorship from five members of the American-Made Network, referred to as Power Connectors, and vouchers to use at any of the DOE's 17 national labs and qualified private facilities for qualified winners. Remaining funds allocated to this round are for administration purposes.

Solicitation of Submissions: The program used a multichannel strategy to build and engage a community of solvers in the Solar Prize. The strategy focused on direct engagement, partner engagement, and digital /social engagement. Direct engagement included hosting a series of informational webinars, in-person presentations in industry anchor events such as Intersolar and key meetings (e.g DuraMat Annual Workshop), and a focus workshop during Solar Power International. Partner engagement involved members of the American Made Network, such as Cleantech San Diego, who hosted in-person, live streamed presentations to inform and support innovators in their local communities interested in competing in the Solar Prize. In addition to DOE's official press release featuring quotes from Secretary Perry, digital engagement utilized email blasts, social media posts on Twitter and LinkedIn, newsletter clips, and other online postings by staff and a dozen members of the American Made Network. Digital engagement was supported by an outreach/media campaign led by a National Renewable Energy Lab (NREL) team for more than 60 days prior the submission deadline in October 2018. NREL staff engaged in 30-day media/outreach campaign coordinating weekly with members of the American Made Network.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Live video streaming; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies)

Participation Requirements: Competitors are entrepreneurial individuals or teams legally residing or based in the U.S., including members of one or multiple organizations, students, university faculty members, small business owners, researchers, or anyone with the desire and drive to transform ideas to impactful realities. Individuals can compete alone or as a group. For the Ready! Contest, an individual prize competitor (who is not competing as a member of a group) must be a United States citizen or a permanent resident. A group of individuals, competing as one competitor, may win, provided that the

team captain responsible for the submission is a United States citizen or a permanent resident. Private entities must be incorporated in and maintain a primary place of business in the United States. Only winners of the Ready! Contest may compete in the subsequent Set! and Go! Contests. Set! and Go! contests are not open for submissions at the time of this report.

Evaluation of Submissions: For the Ready! Contest, the prize administrator screens all completed submissions and assigns subject matter expert judges to independently score the content of each submission. Judges score the submissions based on the content of a 90-second video and narrative answers to four questions about the problem, innovation, team, and plan. Judges evaluate submissions by agreeing or disagreeing with assigned 18 statements on a 1–6 scale, with 1 corresponding to "strongly disagree" and 6 corresponding to "strongly agree". These statements are the judging criteria as described in the Solar Prize rules document published online: https://americanmadechallenges.org/American-Made_Solar_Prize_Rules.pdf. The Ready! Contest is still open for submission.

Results: Ready! Contest submissions opened June 7, 2018 and closed October 5, 2018. Winners were announced in February 2019. Twenty teams were selected to compete in the Set! and Go! Contests and were awarded $50,000 each. The teams are actively competing now and will pitch their innovations to a panel of judges at the Set! Demo Day on June 6, 2019 at Greentown Labs. Winners of the Set! Demo Day have a chance to win up to $200,000, plus vouchers to be used at national laboratories. All 20 teams also have the opportunity to compete at the Go! Demo Day, which will take place on September 24, 2019 at Solar Power International (SPI), with a chance to win $500,000, plus additional vouchers to be used at national laboratories. Round 2 of the Solar Prize has been announced and all new Ready! submissions are due by July 16, 2019.

Budget and Resources: $5.3 million in total funding was authorized, excluding DOE Federal and contractor staff. The total funding for this round of the prize was funded from prior year funds. Note FY19 funds obligated by Congress for the prize will be used on round 2 to be released later in FY19. In addition, three FTE employees support the Prize for FY18. Expenditures in FY18 have totaled $385,121 and were used as follows: $341,209 for the prize administrator (NREL), $2,303 for the web platform (HeroX), and $41,609 for payments to connectors. As noted earlier, the funds expended in FY18 were from prior years.

Partnerships: NREL was the primary non-Federal partner and served as the prize administrator. The program also established the American-Made Network, currently consisting of 90 organizations, that includes DOE's 16 national labs and five strategic partners: Elemental Excelerator (CA, HI), Greentown Labs (MA), Nation of Makers (MD), Powerhouse (CA), and Wilton E. Scott Institute for Energy Innovation (PA). Dozens of incubators, private fabrication facilities, and industry partners constitute the remaining Network members. Partners are funded for their role by DOE, and most partner activities are underway. The list of members of the Network is online at: https://americanmadechallenges.org/network.html.

Advancement of Agency Mission: New energy technologies have begun to reshape the national and global energy landscape. Advanced electrification, digitization, and deployment of grid-connected distributed energy assets are changing the energy industry. The United States has been at the forefront of this transformation, and as technologies, markets, service, and capital providers have evolved over the past decade, there is a need to reinvigorate our entrepreneurs across all facets of the Nation's energy system to rapidly compete and shape these new frontiers. The Solar Prize empowers the country's entrepreneurs and innovators to utilize technologies and innovations developed through DOE's early-stage research and development, ultimately bringing new American-made products to market and achieving DOE's mission of creating and sustaining leadership in the transition to a global clean energy economy.

Solution Types: Software and apps; Ideas; Technology demonstration and hardware; Business plans; Scientific

Plan for Upcoming 2 FYs: The program design allows for one round to be run in a fiscal year. SETO plans to run future rounds in each of the next two fiscal years. FY19 funding was provided in FY19 Committee Language, and appropriations for FY20 are pending.

A.3.4 American Inventions Made Onshore (AIM Onshore)[23]

Lead Sponsoring Agency: DOE

Status: This competition was launched in FY18, and is underway.

Competition Goals: The American Inventions Made Onshore (AIM Onshore) is a prize competition designed to incentivize incubators, accelerators, and other intermediary organizations to help energy technology innovators close the manufacturing-readiness gap. Two critical issues prevent transformative energy technologies from being manufactured in the United States: (1) American scientists and engineers are often not taught the fundamentals of manufacturing, which can lead to errors that are prohibitively costly to correct downstream; and (2) American technology inventors and manufacturers are largely disconnected, causing many inventors to outsource their design and manufacturing to product design firms. By incentivizing intermediary organizations to provide manufacturing fundamentals training to American innovators and forge partnerships between innovators and domestic manufacturers, AIM Onshore seeks to create an interface between American innovators and manufacturers to ultimately make it easier for U.S. technologies to be manufactured domestically.

Goal Types: Improve government service delivery; Find and highlight innovative ideas; Solve a specific problem; Develop technology; Inform and educate the public; Engage new people and communities; Build capacity; Stimulate a market

Justification for Using Prizes and Challenges: DOE's AIM Onshore prize competition seeks creative, specific, and innovative proposals to deliver DOE's Build4Scale manufacturing training to innovators and create partnerships between U.S. innovators and U.S. manufacturers. Successful proposals had to include a sustainable revenue model to ensure the initiative will be viable past the point of government funding. Utilizing a prize structure allows DOE to make efficient use of government resources, offer a simplified application, and utilize a pay-for-performance structure to catalyze sustainable, resource-multiplying investments by the private sector. Through AIM Onshore, hardware innovators (scientists, engineers, inventors) will receive basic manufacturing training and form partnerships with domestic manufacturers for initial production. Small and medium-sized domestic manufacturers will be able to identify new business prospects—hardware innovators developing next-generation technologies with growth potential.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered is $950,000. Four organizations were selected for AIM Onshore's Initial Prize ($150,000 each). After one year, the two best-performing Initial Prize winners will receive the AIM Onshore Final Prize ($250,000 for first place; $100,000 for second place).

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[23] The website for American Inventions Made Onshore (AIM Onshore) can be viewed at http://build4scale.org/. The DOE American Inventions Made Onshore (AIM Onshore) prize was received after the submission deadline for this report. Although it has been included in Appendix A for completion, it was not counted in analyses.

Solicitation of Submissions: The program started building and engaging the targeted audience with the roll-out of DOE's Build4Scale training. Build4Scale offers the only online manufacturing training designed specifically for scientists and engineers developing energy hardware technology prototypes. Potential applicants had time to acquaint themselves with Build4Scale and how this resource could position them to apply for the prize. Once the prize competition was announced, DOE promoted the prize through direct engagement, engagement of the entrepreneurship community, and interagency and social media engagement. DOE engaged the challenge.gov community, the Small Business Administration, and the Commerce Department's Manufacturing Extension Partnership Centers, amongst others. The National Renewable Energy Lab (NREL), as prize administrator, also directed an outreach campaign, as did the entities involved in developing Build4Scale.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies)

Participation Requirements: Incubators, accelerators, universities, community and technical colleges, manufacturing institutions, and other intermediary organizations that serve hardware technology innovators were encouraged to apply for the AIM Onshore prize competition. The prize competition sought creative, specific, and innovative proposals for designing a credible plan to: (1) deliver Build4Scale training to innovators and (2) forge partnerships between innovators and domestic manufacturers. The proposal must show how the participant will execute the plan, and how (1) and (2) can be continued beyond the period of government funding via a financially sustainable revenue model, i.e. through recurring revenue streams.

Evaluation of Submissions: NREL initially screened submissions for compliance with the Official Rules. The screened submissions were then separately scored on multiple criteria by a panel of judges on a scale of 0-100 points (one hundred being the highest). The average score in each criterion was computed, and the average scores were combined to compute a total score. The entries with the highest final scores were recommended for selection for the Initial Prize. For the Initial Prize, three criteria were used for scoring: Potential for Impact (30 points); Quality of Plan (40 points); and Team Experience and Abilities (30 points). For the Final Prize, three criteria will be used for scoring: success in training innovators (30 points); success in forging partnerships between innovators and domestic manufacturers (30 points); and success in proving a viable, sustainable revenue model (40 points). Metrics of evaluation will include the depth and extent of training delivered, the number of contracts signed between innovators and domestic manufacturers, and the revenue obtained from recurring sources (i.e., non-grants) via the participant's revenue model.

Results: The submissions for the Initial Prize of AIM Onshore opened February 6, 2018 and closed April 4, 2018. The winners of the Initial Prize were announced on June 13, 2018 at the 2018 MForesight National Summit in Washington DC. Of the 20 entries submitted for the Initial Prize, four prizes were awarded. Submissions for the Final Prize opened May 30, 2019 and will close June 20, 2019. The winners of the Final Prize are expected to be announced on July 25, 2019.

Budget and Resources: NREL received $257,000 in FY18 to administer the award. In addition, 1.25 FTE employees support the prize for FY18.

Partnerships: NREL is the primary non-Federal partner for this prize and serves as the prize administrator.

Advancement of Agency Mission: AIM Onshore is part of a DOE initiative to close the gap between American innovators who develop new energy technologies and domestic manufacturers who produce them. The training equips American scientists and engineers with knowledge of basic manufacturing

processes, an understanding of product design for manufacturing, and the know-how to make and evaluate manufacturing-related decisions. By requiring winners to demonstrate a sustainable revenue stream to continue providing the training, DOE is leveraging a small initial federal investment in an initiative that will ultimately be sustained by the private sector.

Solution Types: Software and apps; Creative (design & multimedia); Ideas; Business plans; Scientific

Plan for Upcoming 2 FYs: There are no current plans to run additional prizes in this space.

A.4 Department of Interior (DOI)

A.4.1 Saving the ʻŌhiʻa – Hawaiʻi's Sacred Tree[24]

Lead Sponsoring Agency: Department of the Interior (DOI)

Status: This competition was launched in FY18, and is underway.

Competition Goals: The Rapid ʻŌhiʻa Death (ROD) disease is an extremely serious threat to Hawaiʻi's native forests, as well as the ecology, hydrology, economy, and cultures of Hawaiʻi. The fungal disease currently requires a $10+ million response through 2019 and could prove to be even more costly if it is not contained, eliminated, and prevented in the near future. The goal of the ʻŌhiʻa Challenge is to create new technologies to identify and eradicate the ROD disease. In particular, this challenge seeks tools and solutions to advance field-based detection of ROD in asymptomatic trees; detection of the fungus at the landscape level; and environmental pathway identification, including predictive assessment.

Goal Types: Find and highlight innovative ideas; Solve a specific problem; Advance scientific research; Develop technology; Inform and educate the public; Engage new people and communities; Build capacity; Stimulate a market

Justification for Using Prizes and Challenges: Limited funds require unlimited thinking. A well of unlimited thinking can be created by motivating individuals and organizations both in and outside of the traditional fungicide field to compete for these funds. Where, with a traditional grant or contract for $100,000, the Department might possibly get one or two people working on a very complex issue, with the challenge prize DOI can bring in multiple organizations who will compete both for the purse and distinction of winning the prize. Also, challenges only pay for successful performance of a task, which ensures the taxpayer only pays for results.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered was $70,000 and the anticipated total amount awarded is $70,000. Non-monetary incentives included recognition and networking.

Solicitation of Submissions: Applications will be solicited via Challenge.gov. The Department will have a better idea about the effectiveness and lessons learned after the competition has finished in FY19.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies)

Participation Requirements: This Challenge is being conducted by DOI under the authority of the America COMPETES Reauthorization Act of 2010 (15 U.S.C. § 3719) as amended by the American

[24] The website for Saving the ʻŌhiʻa – Hawaiʻi's Sacred Tree can be viewed at Challenge.gov, with additional information at https://conservationx.com/challenge/invasives/ohia.

Innovation and Competitiveness Act of 2017 (PL-114-329). Accordingly, cash prize purse awards for this Challenge may only be given to an individual that is a citizen or permanent resident of the United States, or an entity that is incorporated in and whose primary place of business is in the United States.

Evaluation of Submissions: A panel of experts from conservation, industry, and technological innovation sectors will judge the Challenge entries against several criteria. Primary criteria for selecting the winner(s) include scalability, ease of use, and cost efficacy. Secondary criteria include cultural acceptability, sustainability, feasibility, and expected contribution to solving the ROD problem.

Results: Of the entries submitted between August 28, 2018 and April 1, 2019, one prize will be awarded.

Budget and Resources: Total funding for the Challenge is $100,000, all from FY18 funds. Of this, $30,000 is obligated to be used to support the contract with Conservation X Labs (CXL) to help manage the Challenge, including proper formulation of the Challenge's public material, rules, and guidelines. In addition, the total activity will require 0.15 FTE with one-third each from the National Park Service (NPS), the National Invasive Species Council (NISC) Secretariat, and DOI. The above figures exclude any additional resources that may be obtained by CXL to support the prize activity. CXL's interest and potential to garner additional funding to support this activity was a factor in its selection as the contractor.

Partnerships: This Challenge brings together a range of Federal, State, and private stakeholders committed to battling Rapid ʻŌhiʻa Death. Panelists on the Challenge include members of the interagency ROD working group and the outreach and education group, specifically from the NPS, the U.S. Geological Survey (USGS), the U.S. Fish and Wildlife Service(USFWS), as well as the University of Hawaii and State of Hawaii Division of Forestry. DOI is reaching out to other partners, including Office of Hawaiian Affairs and University of Hawaii to leverage its efforts to promote the Challenge and find innovative solutions to this problem.

Advancement of Agency Mission: This Challenge meets the following Priorities of the DOI Secretary: (1) Creating a Conservation Stewardship Legacy Second Only to Teddy Roosevelt; (2) Restoring Trust with Local Communities; and (3) Generating Additional Revenues to Support DOI and National Interests. In relation to the first Priority, four National Parks and one Fish and Wildlife Refuge are already affected by ROD. Without immediate action, the fungi has the potential to spread to the rest of the Hawaiian Islands National Parks and Refuges as well as other natural areas. In relation to the second Priority, the ROD fungi know no borders. It is through partnerships with state and local government, private entities, and the Native Hawaiian Community, that these invasive fungi can be controlled and eventually eradicated from the Hawaiian Islands. In relation to the third Priority, according to the State of Hawaiʻi biosecurity plan, Koʻolau Mountain Watershed on Oʻahu provides $14B in economic and ecosystem services. ROD, which is currently limited to Hawaiʻi Island, if it migrates to Oʻahu would deeply affect the Koʻolau watershed.

Solution Types: Ideas; Technology demonstration and hardware; Scientific

Plan for Upcoming 2 FYs: ROD and other invasive species pose some of the greatest threats to the fulfillment of the NPS mission in Hawaiian parks. The potential losses due to ROD are irreversible and will threaten our economy and way of life. There is widespread support among Hawaii's land managers in NPS and other organizations of the threat posed by ROD, and a genuine willingness to cooperate and share information. ROD research and management is a top priority for scientists and land managers in NPS, USGS, and USFWS, and will remain so for the next decade unless a solution is found to eliminate this disease.

A.4.2 Arsenic Sensor – Stage 1[25]

Lead Sponsoring Agency: Bureau of Reclamation (USBR)

Status: This competition was launched in FY17 and completed in FY18.

Competition Goals: Measuring levels of arsenic in the environment and in drinking water is important for protecting human health. Drinking water and wastewater treatment facilities are subject to arsenic regulations in order to limit human exposure and environmental contamination. While current analytical methods are suitable for ensuring regulatory compliance, there is a need for rapid, low-cost monitoring of arsenic that would benefit water treatment plant operations, wastewater monitoring, contaminated site remediation, private well owners, scientific research and other interested parties.

Goal Types: Find and highlight innovative ideas; Solve a specific problem; Advance scientific research; Engage new people and communities

Justification for Using Prizes and Challenges: A prize competition was selected as a preferred method to achieve the aforementioned goals because it helps engage a non-traditional, national solver community while also complementing traditional research designed to target the most persistent science and technology challenges. Competitions also can incentivize the submission of solutions. They are made open to a national, non-Federal solver community including citizens, businesses, and other organizations. Reclamation selected a prize competition to address this technical challenge because it allowed the agency to pay only for results; established an important goal without having to limit approaches or teams that are most likely to succeed; increased the number and diversity of the individuals, organizations, and teams that would address the problem or challenge of national/international significance; can stimulate private sector investment that is many times greater than the cash value of the prize; and furthered Reclamation's mission by attracting more interest and attention to a defined program, activity, issue or concern.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered was $50,000. Cash prizes of $50,000 were distributed to six winning solvers as determined by the judging panel with one winner paid $10,000 by non-Federal partner, Xylem, Inc. Non-cash prize awards were not offered for this competition.

Solicitation of Submissions: Reclamation created a unique webpage as well as cross-posted at Challenge.gov and InnoCentive sites. A video was created and shared via YouTube to support social media outreach, while a webinar was hosted to accompany the launch news release. InnoCentive was the prize competition administrator. The advantage of contracting with InnoCentive was the ability to bundle and brand the portfolio of Reclamation's Water Prize Competition Center while leveraging InnoCentive's global network of 380,000+ individuals. Overall, the quality and types of proposed solutions varied significantly. Many submissions, any of whom could be a potential winner, proposed technologies or methods already in practice with little or no potential to improve existing capabilities. Others, although some might be considered novel or different, were judged to not meet solution requirements or not feasible. No new, ready-to-implement, "silver bullet" was found to solve this difficult problem; however Reclamation understands this is not a realistic expectation for a single-stage

[25] The websites for the Arsenic Sensor – Stage 1 are accessible at https://www.usbr.gov/newsroom/newsrelease/detail.cfm?RecordID=61730; https://www.usbr.gov/research/challenges/arsenicsensor.html; https://www.innocentive.com/ar/challenge/9933765; and https://www.challenge.gov/challenge/arsenic-sensor-challenge-stage-1/.

ideation prize completion. Five solutions were considered worthy of a prize award consistent with the stated prize competition rules and criteria. Lessons learned include the need for casting a wider solver net, as well as more support for the payments process. With this in mind, Reclamation is pursuing an Interagency Agreement with the National Aeronautics and Space Administration (NASA) Center of Excellence for Collaborative Innovation to allow access to trending models, infrastructure, expertise and multiple external competition crowdsourcing services.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies); Other - Advertisement in Reclamation's Knowledge Stream Research and Development (R&D) magazine

Participation Requirements: This prize competition targeted the Challenge.gov and InnoCentive solver communities. This challenge was conducted under the authority of the America COMPETES Reauthorization Act of 2010 (15 U.S.C.§ 3719). The Act states that awards for this Prize Competition may only be given to an individual that is a citizen or permanent resident of the United States, or an entity that is incorporated in and whose primary place of business is in the United States. Other restrictions were published in the Challenge Specific Agreement on the InnoCentive website. Nevertheless, submissions included all solvers regardless of whether they are U.S. citizens/entities. Meritorious submissions from non-U.S. citizens and entities, were recognized in publications issued by Reclamation announcing the results of the competition, such as press releases, as applicable.

Evaluation of Submissions: The prize competition was advertised as a "Theoretical Challenge." Submissions consisted of a written description and rationale for why the Solver believes the proposed solution would meet or exceed the criteria stated in the prize competition posting document. Submissions were evaluated by a Judging Panel composed of scientists, engineers, and other technical subject matter experts affiliated with Federal and State entities. The Panel had consultation access to technical experts outside of their expertise, as deemed necessary, to evaluate specific submissions. The judging was conducted by blind review as all submissions were identified solely by a number assigned by InnoCentive. Judges were provided with scoring sheets to be completed independently after reviewing each proposed solution. The judges assessed the merits of each solution by the degree upon which they meet the technical requirements. They also assessed the feasibility, flexibility, cost, and scalability of the proposed concept. At the end of the independent judging the individual scores were tallied and combined. The Panel convened through conference to discuss the strengths and weaknesses of each submission and arrive at a consensus judges opinion. Solutions that did not meet all criteria, but were deemed novel, interesting, and potentially worth pursuing, were eligible to win a partial prize.

Results: Of the 39 entries submitted by 217 participants between December 13, 2016 and March 13, 2017, five prizes were awarded to seven winners (one award paid by non-Federal partner, Xylem, Inc.).

Budget and Resources: In FY17, there was 0.12 FTE used. FTE reported is based on labor budget consumption during the indicated fiscal year. Work represents competition judging and final reporting. Budget reported excludes FTE staffing, and includes only purse payment; budget consumption by prize competition vendor service occurred prior to FY17.

Partnerships: Reclamation partnered with the U.S. Environmental Protection Agency (EPA) for design and judging; the Indian Health Service for design and judging; the National Institute of Standards and Technology (NIST) for design and judging; the Agricultural Research Service for design; the U.S. Agency for International Development for design; the USGS for design and judging; and Xylem, Inc. for judging and paying a $10,000 purse award to one winner.

Advancement of Agency Mission: Stage 1 of the Arsenic Sensor prize competition sought concepts for rapidly, accurately, and cost-effectively measuring arsenic in water through improved sensor technologies. Current analytical methods are suitable for ensuring regulatory compliance, but there remains a need for rapid, low-cost monitoring of arsenic. The selected ideas represent a positive step forward to better understand and manage water quality, potentially opening up more usable supplies for the West and the country.

Solution Types: Ideas

Plan for Upcoming 2 FYs: Future consideration to increase the effectiveness and efficiency of conducting prize competitions include: incorporating a methods for judges to quickly set aside solutions that have no merit, such as a quick initial reality check on the question, "Can this work?"; and in addition to the stated judging criteria, incorporate a free format field for each judge to characterize the merits of the solution in their own words based on the strengths and weaknesses they see. For prize competitions, such as this one, where a successful system needs to solve a suite of different problems to successfully meet system requirements, a separate prize for each piece of the problem should be considered. Alternatively, Reclamation could consider a competition that focuses only on the most difficult part of the system problem.

A.4.3 Colorado River Basin Data Visualization[26]

Lead Sponsoring Agency: USBR

Status: This competition was launched in FY17 and is underway in FY18.

Competition Goals: The Bureau of Reclamation plays a significant role in managing the Colorado River Basin (CRB), including operating dams and canals to deliver water and generate power, overseeing water allocations and water use, and protecting and restoring habitat for endangered and threatened species. Management of the CRB is governed by numerous compacts, laws, court decisions and decrees, and regulatory guidelines collectively known as the "Law of the River." Reclamation relies on a broad range of CRB data to support short-term water management and long-term planning, including data on historical, current, and projected weather and climate conditions, reservoir storage and releases, and streamflows and diversions. State and local agencies, water users, recreationists, researchers and other stakeholders and partners also rely on CRB data for a wide variety of uses. Reclamation is currently working to make CRB data open and accessible to both Reclamation and non-Reclamation users; however, better approaches to visualizing CRB data are needed to improve data exploration, analysis, interpretation, and communication by internal and external users. In particular, better visualization approaches are needed to improve understanding and communication of current and projected conditions in the basin and the water management actions that affect those conditions.The objective of the visualization tool is to support exploration and understanding of climate, hydrology, river, and reservoir conditions across the CRB, as well as how these conditions vary in space and time. The tool should also help users understand how fluctuations in river and reservoir conditions relate to user interests, such as water supply and recreation opportunities.

Goal Types: Improve government service delivery; Solve a specific problem; Advance scientific research; Develop technology; Inform and educate the public; Engage new people and communities

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[26] The websites for the Colorado River Basin Data Visualization are accessible at https://www.usbr.gov/research/challenges/datavis.html; https://www.innocentive.com/ar/challenge/9933882; and https://www.challenge.gov/challenge/colorado-river-basin-data-visualization-challenge/.

Justification for Using Prizes and Challenges: A prize competition was selected as a preferred method to achieve the aforementioned goals because it helps engage a non-traditional, national solver community while also complementing traditional research designed to target the most persistent science and technology challenges. Competitions also can incentivize the submission of solutions. They are made open to a national, non-Federal solver community including citizens, businesses, and other organizations. Reclamation selected a prize competition to address this technical challenge because it allowed the agency to pay only for results; established an important goal without having to limit approaches or teams that are most likely to succeed; increased the number and diversity of the individuals, organizations, and teams that would address the problem or challenge of national/international significance; can stimulate private sector investment that is many times greater than the cash value of the prize; and furthered Reclamation's mission by attracting more interest and attention to a defined program, activity, issue or concern.

Cash Prize Purses and/or Non-Cash Prize Awards: The cash prize purse was $60,000 and was funded via Reclamation's Science and Technology Program, Research and Development Office as per Federal Acquisition Regulation (FAR, as codified at Chapter 1 of Title 48 of the Code of Federal Regulations, 48 C.F.R.). Nine cash prizes of $60,000 were distributed to 12 winning solvers as determined by the judging panel. Non-cash prize awards were not offered for this competition.

Solicitation of Submissions: Reclamation created a unique webpage as well as cross-posted at Challenge.gov and InnoCentive sites. A video was created and shared via YouTube to support social media outreach, while a webinar was hosted to accompany the launch news release. InnoCentive was the prize competition administrator. The advantage of contracting with InnoCentive was the ability to bundle and brand the portfolio of Reclamation's Water Prize Competition Center while leveraging InnoCentive's global network of 380,000+ individuals. Overall, the quality and types of proposed solutions varied significantly. Many submissions, any of whom could be a potential winner, proposed technologies or methods already in practice with little or no potential to improve existing capabilities. Others, although some might be considered novel or different, were judged to not meet solution requirements or not feasible. No new, ready-to-implement, "silver bullet" was found to solve this difficult problem; however Reclamation understands this is not a realistic expectation for a single-stage ideation prize completion. Five solutions were considered worthy of a prize award consistent with the stated prize competition rules and criteria. Lessons learned include the need for casting a wider solver net, as well as more support for the payments process. With this in mind, Reclamation is pursuing an Interagency Agreement with NASA's Center of Excellence for Collaborative Innovation to allow access to trending models, infrastructure, expertise and multiple external competition crowdsourcing services.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Day-long event(s) prior to the competition; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies); Other - Advertisement in Reclamation's Knowledge Stream R&D magazine

Participation Requirements: This prize competition targeted the Challenge.gov and InnoCentive solver communities. This challenge was conducted under the authority of the America COMPETES Reauthorization Act of 2010 (15 U.S.C.§ 3719). The Act states that awards for this Prize Competition may only be given to an individual that is a citizen or permanent resident of the United States, or an entity that is incorporated in and whose primary place of business is in the United States. Other restrictions were published in the Challenge Specific Agreement on the InnoCentive website. Nevertheless, submissions included all solvers regardless of whether they are U.S. citizens/entities. Meritorious

submissions from non-U.S. citizens and entities, were recognized in publications issued by Reclamation announcing the results of the competition, such as press releases, as applicable.

Evaluation of Submissions: The prize competition was advertised as a "Theoretical Challenge." Competitors were required to submit a written proposal including a detailed description and rationale for why the proposed solution met or exceeded the performance criteria stated in the challenge posting. Submissions were evaluated by a Judging Panel composed of scientists, engineers, and other technical subject matter experts affiliated with Federal and State entities. The Panel had consultation access to technical experts outside of their expertise, as deemed necessary, to evaluate specific submissions. The judging was conducted by blind review as all submissions were identified solely by a number assigned by InnoCentive. Judges were provided with scoring sheets to be completed independently after reviewing each proposed solution. The judges assessed the merits of each solution by the degree upon which they meet the technical requirements. They also assessed the feasibility, flexibility, cost, and scalability of the proposed concept. At the end of the independent judging the individual scores were tallied and combined. The Panel convened several conference calls and then attended an all-day web conference to discuss the strengths and weaknesses of each submission and arrive at a consensus judges opinion. Solutions that did not meet all criteria, but were deemed novel, interesting, and potentially worth pursuing, were eligible to win a partial prize.

Results: Of the 24 entries submitted by 254 participants between September 7 and November 17, 2017, nine prizes were awarded to 12 winners.

Budget and Resources: In FY17 the funding was $15,134 and there was 0.59 FTE used. In FY18, the funding was $60,000 and there was 0.37 FTE used. FTE reported is based on labor budget consumption during the indicated fiscal year. Work represents competition judging and final reporting. Budget reported excludes FTE staffing, and includes only purse payment; budget consumption by prize competition vendor service.

Partnerships: USBR partnered with USGS for design and judging; National Oceanic and Atmospheric Administration (NOAA) for design and judging; U.S. Department of Agriculture for design and judging; and International Boundary and Water Commission for design and judging.

Advancement of Agency Mission: Successful development of innovative, interactive, and user-driven visualizations of CRB data will facilitate improved data analysis and decision making by Reclamation and non-Reclamation users. Integrated visualization of CRB data and ancillary information will improve interpretation and understanding of basin conditions, management actions that affect those conditions, and legal and regulatory factors that influence management actions. Reclamation anticipates implementing the winning solution(s) as part of a new web-based data analysis and visualization tool; a successful solution will help to make this tool a common platform for communication and collaboration between Reclamation and CRB stakeholders and partners.

Solution Types: Analytics, visualizations, algorithms

Plan for Upcoming 2 FYs: Future consideration to increase the effectiveness and efficiency of conducting prize competitions include: incorporating a method for judges to quickly set aside solutions that have no merit, such as a quick initial reality check on the question, "Can this work?"; in addition to the stated judging criteria, incorporate a free format field for each judge to characterize the merits of the solution in their own words based on the strengths and weaknesses they see. For prize competitions, such as this one, where a successful system needs to solve a suite of different problems to successfully meet system requirements, a separate prize for each piece of the problem should be considered. Alternatively, Reclamation could consider a competition that focuses only on the most difficult part of the system problem.

A.4.4 DataApp: A Mobile App Framework for Field Data Capture[27]

Lead Sponsoring Agency: USBR

Status: This competition was launched in FY17 and completed in FY18.

Competition Goals: Data collection is fundamental to water and environmental science and management. Streamflows, reservoir elevations, and flows in canals and conduits, for example, are continuously monitored to support water management decisions ranging from real-time operations to long-term planning. Data are routinely collected to monitor infrastructure conditions and identify maintenance priorities, and a wide range of environmental data are collected to characterize habitat conditions, monitor fish and wildlife populations, and support ecosystem restoration programs.Scientists, engineers, and technicians are increasingly using mobile devices such as tablets and smartphones to record measurements, document site locations via the Global Positioning System (GPS), and take photos and notes in the field. Although numerous apps are already available to support general data collection on mobile devices, these existing apps do not provide the functionality and flexibility needed to support the broad range of current water and environmental monitoring needs. More importantly, these existing apps do not support the development, integration, and sharing of new and unique features and functions to meet the specialized needs of individual data collection scenarios and communities of practice. DataApp Challenge Stage 1 was the first stage of a planned three-stage challenge seeking development of new and improved software application (app) frameworks to support electronic data collection and capture using mobile devices (i.e., smartphones and tablets) across a diverse range of water and environmental data collection situations.

Goal Types: Solve a specific problem; Advance scientific research; Develop technology; Engage new people and communities

Justification for Using Prizes and Challenges: A prize competition was selected as a preferred method to achieve the aforementioned goals because it helps engage a non-traditional, national solver community while also complementing traditional research designed to target the most persistent science and technology challenges. Competitions also can incentivize the submission of solutions. They are made open to a national, non-Federal solver community including citizens, businesses, and other organizations. Reclamation selected a prize competition to address this technical Challenge because it allowed the agency to pay only for results; established an important goal without having to limit approaches or teams that are most likely to succeed; increased the number and diversity of the individuals, organizations, and teams that would address the problem or challenge of national/international significance; can stimulate private sector investment that is many times greater than the cash value of the prize; and furthered Reclamation's mission by attracting more interest and attention to a defined program, activity, issue or concern.

Cash Prize Purses and/or Non-Cash Prize Awards: The cash prize purse was $30,000 and was funded via Reclamation's Science and Technology Program, Research and Development Office as per Federal Acquisition Regulation (FAR, as codified at Chapter 1 of Title 48 of the Code of Federal Regulations, 48

[27] The websites for the DataApp: A Mobile App Framework for Field Data Capture are accessible at https://www.usbr.gov/newsroom/newsrelease/detail.cfm?RecordID=62551; https://www.usbr.gov/research/challenges/dataapp.html; https://www.innocentive.com/ar/challenge/9933881; and https://www.challenge.gov/challenge/dataapp-a-mobile-app-framework-for-field-data-capture-stage-1/.

C.F.R.). Cash prizes of $30,000 were distributed to seven winning solvers as determined by the judging panel. Non-cash prize awards were not offered for this competition.

Solicitation of Submissions: Reclamation created a unique webpage as well as cross-posted at Challenge.gov and InnoCentive sites. A video was created and shared via YouTube to support social media outreach, while a webinar was hosted to accompany the launch news release. InnoCentive was the prize competition administrator. The advantage of contracting with InnoCentive was the ability to bundle and brand the portfolio of Reclamation's Water Prize Competition Center while leveraging InnoCentive's global network of 380,000+ individuals. Overall, the quality and types of proposed solutions varied significantly. Many submissions, any of whom could be a potential winner, proposed technologies or methods already in practice with little or no potential to improve existing capabilities. Others, although some might be considered novel or different, were judged to not meet solution requirements or not feasible. No new, ready-to-implement, "silver bullet" was found to solve this difficult problem; however Reclamation understands this is not a realistic expectation for a single-stage ideation prize completion. Five solutions were considered worthy of a prize award consistent with the stated prize competition rules and criteria. Lessons learned include the need for casting a wider solver net, as well as more support for the payments process. With this in mind, Reclamation is pursuing an Interagency Agreement with NASA's Center of Excellence for Collaborative Innovation to allow access to trending models, infrastructure, expertise and multiple external competition crowdsourcing services.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Day-long event(s) prior to the competition; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies); Other - Advertisement in Reclamation's Knowledge Stream R&D magazine

Participation Requirements: This prize competition targeted the Challenge.gov and InnoCentive solver communities. This Challenge was conducted under the authority of the America COMPETES Reauthorization Act of 2010 (15 U.S.C.§ 3719). The Act states that awards for this Prize Competition may only be given to an individual that is a citizen or permanent resident of the United States, or an entity that is incorporated in and whose primary place of business is in the United States. Other restrictions were published in the Challenge Specific Agreement on the InnoCentive website. Nevertheless, submissions included all solvers regardless of whether they are U.S. citizens/entities. Meritorious submissions from non-U.S. citizens and entities, were recognized in publications issued by Reclamation announcing the results of the competition, such as press releases, as applicable.

Evaluation of Submissions: The prize competition was advertised as an "Ideation Challenge." Competitors were required to submit a written proposal including a detailed description and rationale for why the proposed solution met or exceeded the performance criteria stated in the Challenge posting. Submissions were evaluated by a Judging Panel composed of scientists, engineers, and other technical subject matter experts affiliated with Federal and State entities. The Panel had consultation access to technical experts outside of their expertise, as deemed necessary, to evaluate specific submissions. The judging was conducted by blind review as all submissions were identified solely by a number assigned by InnoCentive. Judges were provided with scoring sheets to be completed independently after reviewing each proposed solution. The judges assessed the merits of each solution by the degree upon which they meet the technical requirements. They also assessed the feasibility, flexibility, cost, and scalability of the proposed concept. At the end of the independent judging the individual scores were tallied and combined. The Panel convened several conference calls and then attended an all-day web conference to discuss the strengths and weaknesses of each submission and

arrive at a consensus judges opinion. Solutions that did not meet all criteria, but were deemed novel, interesting, and potentially worth pursuing, were eligible to win a partial prize.

Results: Of the 24 entries submitted by 167 participants between May 23 and July 6, 2017, prizes were awarded to seven winners.

Budget and Resources: For FY17, the funding was $40,000 with 0.31 FTE used. For FY18, the funding was $30,000 with 0.02 FTE used. FTE reported is based on labor budget consumption during the indicated FY. Work represents competition judging and final reporting. Budget reported excludes FTE staffing, and includes only purse payment; budget consumption by prize competition vendor service occurred prior to FY17.

Partnerships: Partnered with the USGS for design and judging, and the NPS for judging.

Advancement of Agency Mission: Development of a flexible, extensible, and open source data collection app framework for GPS-enabled mobile devices will facilitate the use of mobile devices for field data collection, which in turn will improve data collection efficiency, lower data collection costs, and improve data quality, transparency, and dissemination for applications to management, decision making, and scientific discovery. Flexibility and extensibility will allow the use of mobile devices for across broader range of data collection situations, whereas use of open source software will allow data collection communities of practice to develop common protocols and standards for data collection, management, and sharing.

Solution Types: Ideas

Plan for Upcoming 2 FYs: Future consideration to increase the effectiveness and efficiency of conducting prize competitions include: incorporating a method for judges to quickly set aside solutions that have no merit, such as a quick initial reality check on the question, “Can this work?”; in addition to the stated judging criteria, incorporate a free format field for each judge to characterize the merits of the solution in their own words based on the strengths and weaknesses they see. For prize competitions, such as this one, where a successful system needs to solve a suite of different problems to successfully meet system requirements, a separate prize for each piece of the problem should be considered. Alternatively, Reclamation could consider a competition that focuses only on the most difficult part of the system problem.

A.4.5 Detecting Leaks and Flaws in Water Pipelines - Stage 1[28]

Lead Sponsoring Agency: USBR

Status: This competition was launched in FY18, and is underway.

Competition Goals: Reclamation’s water conveyance system includes over 20,000 miles of buried pipelines made of various materials including metal, plastic, concrete, and composite. Municipal water utility collaborators also have extensive transmission and distribution pipeline networks. Pipeline components, such as joints, fittings, valves, linings, and individual pipe sections are subject to leakage due to damage, corrosion, and other types of degradation. Detecting water loss from pipelines will trigger appropriate maintenance, allowing conservation of scarce water resources and more reliable service to clients. Presently, the available water pipeline leak detection techniques might be suitable

[28] The websites for the Detecting Leaks and Flaws in Water Pipelines - Stage 1 are accessible at https://www.usbr.gov/research/challenges/leakypipes.html; https://www.innocentive.com/ar/challenge/9933883; and https://www.challenge.gov/challenge/detecting-leaks-and-flaws-in-water-pipelines- stage-1/.

for determining general system delivery information or for close evaluation of small pipeline sections, none accommodate the needs to efficiently inspect thousands of miles of pipelines and to precisely determine leak location and severity. In addition, many of the techniques are unable to inspect the pipe while it is in service (pressurized, flowing water in pipe) or cannot overcome operational complications such as limited pipe entry points, diameter changes, elevation changes, or lateral bends.

Goal Types: Solve a specific problem; Advance scientific research; Develop technology; Engage new people and communities

Justification for Using Prizes and Challenges: A prize competition was selected as a preferred method to achieve the aforementioned goals because it helps engage a non-traditional, national solver community while also complementing traditional research designed to target the most persistent science and technology challenges. Competitions also can incentivize the submission of solutions. They are made open to a national, non-Federal solver community including citizens, businesses, and other organizations. Reclamation selected a prize competition to address this technical Challenge because it allowed the agency to pay only for results; established an important goal without having to limit approaches or teams that are most likely to succeed; increased the number and diversity of the individuals, organizations, and teams that would address the problem or challenge of national/international significance; can stimulate private sector investment that is many times greater than the cash value of the prize; and furthered Reclamation's mission by attracting more interest and attention to a defined program, activity, issue or concern.

Cash Prize Purses and/or Non-Cash Prize Awards: The cash prize purse was $75,000 and was funded via Reclamation's Science and Technology Program, Research and Development Office as per Federal Acquisition Regulation (FAR, as codified at Chapter 1 of Title 48 of the Code of Federal Regulations, 48 C.F.R.). Five cash prizes from the $75,000 were distributed to 12 winning solvers as determined by the judging panel. Non-cash prize awards were not offered for this competition.

Solicitation of Submissions: Reclamation created a unique webpage as well as cross-posted at Challenge.gov and InnoCentive sites. A video was created and shared via YouTube to support social media outreach, while a webinar was hosted to accompany the launch news release. InnoCentive was the prize competition administrator. The advantage of contracting with InnoCentive was the ability to bundle and brand the portfolio of Reclamation's Water Prize Competition Center while leveraging InnoCentive's global network of 380,000+ individuals. Overall, the quality and types of proposed solutions varied significantly. Many submissions, any of whom could be a potential winner, proposed technologies or methods already in practice with little or no potential to improve existing capabilities. Others, although some might be considered novel or different, were judged to not meet solution requirements or not feasible. No new, ready-to-implement, "silver bullet" was found to solve this difficult problem; however Reclamation understands this is not a realistic expectation for a single-stage ideation prize completion. Five solutions were considered worthy of a prize award consistent with the stated prize competition rules and criteria. Lessons learned include the need for casting a wider solver net, as well as more support for the payments process. With this in mind, Reclamation is pursuing an Interagency Agreement with NASA's Center of Excellence for Collaborative Innovation to allow access to trending models, infrastructure, expertise and multiple external competition crowdsourcing services.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies); Other - Advertisement in Reclamation's Knowledge Stream R&D magazine

Participation Requirements: This prize competition targeted the Challenge.gov and InnoCentive solver communities. This Challenge was conducted under the authority of the America COMPETES

Reauthorization Act of 2010 (15 U.S.C.§ 3719). The Act states that awards for this Prize Competition may only be given to an individual that is a citizen or permanent resident of the United States, or an entity that is incorporated in and whose primary place of business is in the United States. Other restrictions were published in the Challenge Specific Agreement on the InnoCentive website. Nevertheless, submissions included all solvers regardless of whether they are U.S. citizens/entities. Meritorious submissions from non-U.S. citizens and entities, were recognized in publications issued by Reclamation announcing the results of the competition, such as press releases, as applicable.

Evaluation of Submissions: The prize competition was advertised as a "Theoretical Challenge." Competitors were required to submit a written proposal including a detailed description and rationale for why the proposed solution met or exceeded the performance criteria stated in the Challenge posting. Submissions were evaluated by a Judging Panel composed of scientists, engineers, and other technical subject matter experts affiliated with Federal and State entities. The Panel had consultation access to technical experts outside of their expertise, as deemed necessary, to evaluate specific submissions. The judging was conducted by blind review as all submissions were identified solely by a number assigned by InnoCentive. Judges were provided with scoring sheets to be completed independently after reviewing each proposed solution. The judges assessed the merits of each solution by the degree upon which they meet the technical requirements. They also assessed the feasibility, flexibility, cost, and scalability of the proposed concept. At the end of the independent judging the individual scores were tallied and combined. The Panel convened several conference calls and then attended an all-day web conference to discuss the strengths and weaknesses of each submission and arrive at a consensus judges opinion. Solutions that did not meet all criteria, but were deemed novel, interesting, and potentially worth pursuing, were eligible to win a partial prize.

Results: Of the 54 entries submitted by 294 participants between March 8, 2018 and May 8, 2018, prizes were awarded to five winners.

Budget and Resources: For FY17, the funding was $15,134 with 0.3 FTE used. For FY18, there was no monetary funding, but there were seven FTE used. FTE reported is based on labor budget consumption during the indicated FY. Work represents competition judging and final reporting. Budget reported excludes FTE staffing, and includes only purse payment; budget consumption by prize competition vendor service.

Partnerships: The Design Team in-kind Partners were the San Diego County Water Authority, Southern Nevada Water Authority, and Isle Utilities. The Judging Team in-kind partners provided subject matter experts for the panel, and included USBR, U.S. Army Corps of Engineers (USACE), Calleguas Municipal Water District, Central Arizona Project, Denver Water, Great Lakes Water Authority, Isle Utilities, Southern Nevada Water Authority, and the San Diego County Water Authority. The estimated value of partner contributions was $30,000 in FY17 and $90,000 in FY18.

Advancement of Agency Mission: Reclamation seeks methods and technologies that can reliably and easily detect leaks and flaws in operating, pressurized water pipeline infrastructure regardless of size, depth of burial, pipe material or interior lining. Our primary focus is finding condition assessment solutions for 48-inch or greater pipe diameters and for steel and prestressed concrete cylinder pipe types, although solutions for all pipe types and diameters greater than 24 inches will be considered. This competition advances the agency's mission to reliably deliver water to our clients by allowing the agency to be proactive in pipeline leak detection and repair.

Solution Types: Ideas

Plan for Upcoming 2 FYs: Future consideration to increase the effectiveness and efficiency of conducting prize competitions include: incorporating a method for judges to quickly set aside solutions that have

no merit, such as a quick initial reality check on the question, "Can this work?"; in addition to the stated judging criteria, incorporate a free format field for each judge to characterize the merits of the solution in their own words based on the strengths and weaknesses they see. For prize competitions, such as this one, where a successful system needs to solve a suite of different problems to successfully meet system requirements, a separate prize for each piece of the problem should be considered. Alternatively, Reclamation could consider a competition that focuses only on the most difficult part of the system problem.

A.4.6 Detecting the Movement of Soils (Internal Erosion) Within Earthen Dams, Canals, Levees and their Foundations[29]

Lead Sponsoring Agency: USBR

Status: This competition was launched in FY17 and completed in FY18.

Competition Goals: The quality of life for many people around the globe depends on water storage behind earthen dams, water movement within earthen canals, and flood-protection behind levees. However, earthen dams, canals and levees are prone to internal erosion of soils caused by seepage, either through or under the structures. The internal erosion process is largely invisible as it occurs below the ground surface. By the time visible signs are present, damage has likely occurred to the structure that will require mitigation or repair. Earlier detection is required to increase the time available to intervene, and to decrease the extent and cost of repairs.While there are a number of specific erosion mechanisms, they all share a common feature: the erosion results in the movement of soils from an initiation point to an exit point. The distance from the initiation point to the exit point can be as small as a few meters, or as large as hundreds of meters. If soil movement can be detected earlier, problems can be corrected and damage avoided. The Bureau of Reclamation, in collaboration with the U.S. Army Corps of Engineers, is seeking new methods for detecting the movement (erosion) of soils in earthen structures and foundations. These methods may detect internal erosion either directly or indirectly (detecting properties that typically indicate internal erosion is taking place). The goal is to detect soil movement earlier than occurs by current visual inspection and instrumentation methods.

Goal Types: Solve a specific problem; Advance scientific research; Develop technology; Engage new people and communities

Justification for Using Prizes and Challenges: A prize competition was selected as a preferred method to achieve the aforementioned goals because it helps engage a non-traditional, national solver community while also complementing traditional research designed to target the most persistent science and technology challenges. Competitions also can incentivize the submission of solutions. They are made open to a national, non-Federal solver community including citizens, businesses, and other organizations. Reclamation selected a prize competition to address this technical Challenge because it allowed the agency to pay only for results; established an important goal without having to limit approaches or teams that are most likely to succeed; increased the number and diversity of the individuals, organizations, and teams that would address the problem or challenge of

[29] The website for Detecting the Movement of Soils (Internal Erosion) Within Earthen Dams, Canals, Levees and their Foundations are accessible at https://www.usbr.gov/newsroom/newsrelease/detail.cfm?RecordID=60541; https://www.usbr.gov/research/challenges/soilmovement.html; https://www.innocentive.com/ar/challenge/9933649; and https://www.challenge.gov/challenge/detecting-soil-movement-in-embankments/.

national/international significance; can stimulate private sector investment that is many times greater than the cash value of the prize; and furthered Reclamation's mission by attracting more interest and attention to a defined program, activity, issue or concern.

Cash Prize Purses and/or Non-Cash Prize Awards: The cash prize purse was $20,000 and was funded via Reclamation's Science and Technology Program, Research and Development Office as per Federal Acquisition Regulation (FAR, as codified at Chapter 1 of Title 48 of the Code of Federal Regulations, 48 C.F.R.). Cash prizes of $20,000 were distributed to five winning solvers as determined by the judging panel. Non-cash prize awards were not offered for this competition.

Solicitation of Submissions: Reclamation created a unique webpage as well as cross-posted at Challenge.gov and InnoCentive sites. A video was created and shared via YouTube to support social media outreach, while a webinar was hosted to accompany the launch news release. InnoCentive was the prize competition administrator. The advantage of contracting with InnoCentive was the ability to bundle and brand the portfolio of Reclamation's Water Prize Competition Center while leveraging InnoCentive's global network of 380,000+ individuals. Overall, the quality and types of proposed solutions varied significantly. Many submissions, any of whom could be a potential winner, proposed technologies or methods already in practice with little or no potential to improve existing capabilities. Others, although some might be considered novel or different, were judged to not meet solution requirements or not feasible. No new, ready-to-implement, "silver bullet" was found to solve this difficult problem; however Reclamation understands this is not a realistic expectation for a single-stage ideation prize completion. Five solutions were considered worthy of a prize award consistent with the stated prize competition rules and criteria. Lessons learned include the need for casting a wider solver net, as well as more support for the payments process. With this in mind, Reclamation is pursuing an Interagency Agreement with NASA's Center of Excellence for Collaborative Innovation to allow access to trending models, infrastructure, expertise and multiple external competition crowdsourcing services.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies); Other - Advertisement in Reclamation's Knowledge Stream R&D magazine

Participation Requirements: This prize competition targeted the Challenge.gov and InnoCentive solver communities. This Challenge was conducted under the authority of the America COMPETES Reauthorization Act of 2010 (15 U.S.C.§ 3719). The Act states that awards for this Prize Competition may only be given to an individual that is a citizen or permanent resident of the United States, or an entity that is incorporated in and whose primary place of business is in the United States. Other restrictions were published in the Challenge Specific Agreement on the InnoCentive website. Nevertheless, submissions included all solvers regardless of whether they are U.S. citizens/entities. Meritorious submissions from non-U.S. citizens and entities, were recognized in publications issued by Reclamation announcing the results of the competition, such as press releases, as applicable.

Evaluation of Submissions: The prize competition was advertised as an "Ideation Challenge." Competitors were required to submit a written proposal including a detailed description and rationale for why the proposed solution met or exceeded the performance criteria stated in the Challenge posting. Submissions were evaluated by a Judging Panel composed of scientists, engineers, and other technical subject matter experts affiliated with Federal and State entities. The Panel had consultation access to technical experts outside of their expertise, as deemed necessary, to evaluate specific submissions. The judging was conducted by blind review as all submissions were identified solely by a number assigned by InnoCentive. Judges were provided with scoring sheets to be completed independently after reviewing each proposed solution. The judges assessed the merits of each solution

by the degree upon which they meet the technical requirements. They also assessed the feasibility, flexibility, cost, and scalability of the proposed concept. At the end of the independent judging the individual scores were tallied and combined. The Panel convened several conference calls and then attended an all-day web conference to discuss the strengths and weaknesses of each submission and arrive at a consensus judges opinion. Solutions that did not meet all criteria, but were deemed novel, interesting, and potentially worth pursuing, were eligible to win a partial prize.

Results: Of the 29 entries submitted by 133 participants between March 31 and May 10, 2016, prizes were awarded to five winners.

Budget and Resources: For FY17, the funding was $20,000 with 0.05 FTE used. FTE reported is based on labor budget consumption during the indicated fiscal year. Work represents competition judging and final reporting. Budget reported excludes FTE staffing, and includes only purse payment; budget consumption by prize competition vendor service occurred prior to FY17.

Partnerships: USACE and the State of Colorado Dam Safety Program provided in-kind support for design and judging of the prize competition. The agencies also provided assistance with marketing and outreach. No monetary or non-cash awards were provided by partners. In 2017, the estimated value of partner contributions was $7,000.

Advancement of Agency Mission: This prize competition sought methods to detect the movement of material earlier than observable by currently used visual inspection and instrumentation methods. This could help prevent the loss of life, property and interruption of the service the infrastructure provides. Furthermore, the reliability of water infrastructure is improved.

Solution Types: Ideas

Plan for Upcoming 2 FYs: Future consideration to increase the effectiveness and efficiency of conducting prize competitions include: incorporating a method for judges to quickly set aside solutions that have no merit, such as a quick initial reality check on the question, “Can this work?”; in addition to the stated judging criteria, incorporate a free format field for each judge to characterize the merits of the solution in their own words based on the strengths and weaknesses they see. For prize competitions, such as this one, where a successful system needs to solve a suite of different problems to successfully meet system requirements, a separate prize for each piece of the problem should be considered. Alternatively, Reclamation could consider a competition that focuses only on the most difficult part of the system problem.

A.4.7 Downstream Fish Passage at Tall Dams[30]

Lead Sponsoring Agency: USBR

Status: This competition was launched in FY17 and completed in FY18.

Competition Goals: Reclamation sought new ideas for ensuring successful and cost-effective downstream passage of juvenile fish at tall (high-head) dams. The solutions addressed reducing: stress

[30] The websites for the Downstream Fish Passage at Tall Dams are accessible at https://www.usbr.gov/newsroom/newsrelease/detail.cfm?RecordID=59159; https://www.usbr.gov/research/challenges/fishpassage.html; https://www.innocentive.com/ar/challenge/9933648; and https://www.challenge.gov/challenge/downstream-fish-passage-at-tall-dams/.

(e.g. crowding, removal from water, disorientation); physical damage on fish; interference with the operation of the dam (flood control, energy, water distribution); and total costs.

Goal Types: Solve a specific problem; Advance scientific research; Develop technology; Engage new people and communities

Justification for Using Prizes and Challenges: A prize competition was selected as a preferred method to achieve the aforementioned goals because it helps engage a non-traditional, national solver community while also complementing traditional research designed to target the most persistent science and technology challenges. Competitions also can incentivize the submission of solutions. They are made open to a national, non-Federal solver community including citizens, businesses, and other organizations. Reclamation selected a prize competition to address this technical Challenge because it allowed the agency to pay only for results; established an important goal without having to limit approaches or teams that are most likely to succeed; increased the number and diversity of the individuals, organizations, and teams that would address the problem or challenge of national/international significance; can stimulate private sector investment that is many times greater than the cash value of the prize; and furthered Reclamation's mission by attracting more interest and attention to a defined program, activity, issue or concern.

Cash Prize Purses and/or Non-Cash Prize Awards: The cash prize purse was $20,000 and was funded via Reclamation's Science and Technology Program, Research and Development Office as per Federal Acquisition Regulation (FAR, as codified at Chapter 1 of Title 48 of the Code of Federal Regulations, 48 C.F.R.). Cash prizes of $20,000 were distributed to four winning solvers as determined by the judging panel. Non-cash prize awards were not offered for this competition.

Solicitation of Submissions: Reclamation created a unique webpage as well as cross-posted at Challenge.gov and InnoCentive sites. A video was created and shared via YouTube to support social media outreach, while a webinar was hosted to accompany the launch news release. InnoCentive was the prize competition administrator. The advantage of contracting with InnoCentive was the ability to bundle and brand the portfolio of Reclamation's Water Prize Competition Center while leveraging InnoCentive's global network of 380,000+ individuals. Overall, the quality and types of proposed solutions varied significantly. Many submissions, any of whom could be a potential winner, proposed technologies or methods already in practice with little or no potential to improve existing capabilities. Others, although some might be considered novel or different, were judged to not meet solution requirements or not feasible. No new, ready-to-implement, "silver bullet" was found to solve this difficult problem; however Reclamation understands this is not a realistic expectation for a single-stage ideation prize completion. Five solutions were considered worthy of a prize award consistent with the stated prize competition rules and criteria. Lessons learned include the need for casting a wider solver net, as well as more support for the payments process. With this in mind, Reclamation is pursuing an Interagency Agreement with NASA's Center of Excellence for Collaborative Innovation to allow access to trending models, infrastructure, expertise and multiple external competition crowdsourcing services.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Live video streaming; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies); Other - Advertisement in Reclamation's Knowledge Stream R&D magazine

Participation Requirements: This prize competition targeted the Challenge.gov and InnoCentive solver communities. This Challenge was conducted under the authority of the America COMPETES Reauthorization Act of 2010 (15 U.S.C.§ 3719). The Act states that awards for this Prize Competition may only be given to an individual that is a citizen or permanent resident of the United States, or an entity that is incorporated in and whose primary place of business is in the United States. Other restrictions

were published in the Challenge Specific Agreement on the InnoCentive website. Nevertheless, submissions included all solvers regardless of whether they are U.S. citizens/entities. Meritorious submissions from non-U.S. citizens and entities, were recognized in publications issued by Reclamation announcing the results of the competition, such as press releases, as applicable.

Evaluation of Submissions: The prize competition was advertised as an "Ideation Challenge." Competitors were required to submit a written proposal including a detailed description and rationale for why the proposed solution met or exceeded the performance criteria stated in the Challenge posting. Submissions were evaluated by a Judging Panel composed of scientists, engineers, and other technical subject matter experts affiliated with Federal and State entities. The Panel had consultation access to technical experts outside of their expertise, as deemed necessary, to evaluate specific submissions. The judging was conducted by blind review as all submissions were identified solely by a number assigned by InnoCentive. Judges were provided with scoring sheets to be completed independently after reviewing each proposed solution. The judges assessed the merits of each solution by the degree upon which they meet the technical requirements. They also assessed the feasibility, flexibility, cost, and scalability of the proposed concept. At the end of the independent judging the individual scores were tallied and combined. The Panel convened several conference calls and then attended an all-day web conference to discuss the strengths and weaknesses of each submission and arrive at a consensus judges opinion. Solutions that did not meet all criteria, but were deemed novel, interesting, and potentially worth pursuing, were eligible to win a partial prize.

Results: Of the 44 entries submitted by 180 participants between March 31 and May 10, 2016, prizes were awarded to four winners.

Budget and Resources: For FY17, the budget was $20,000 and there was 0.05 FTE used. FTE reported is based on labor budget consumption during the indicated fiscal year. Work represents competition judging and final reporting. Budget reported excludes FTE staffing, and includes only purse payment. Budget consumption by prize competition vendor service occurred prior to FY17.

Partnerships: USGS, NOAA-National Marine Fisheries Service, and USACE provided in-kind support for design and judging of the prize competition. The Federal agencies also provided assistance with marketing and outreach. One subject matter expect from State of California Department of Water Resources also provided in-kind design and judging assistance. No monetary or non-cash awards were provided by partners. The estimated value of partner contributions was $24,000.

Advancement of Agency Mission: Reclamation and other Federal, State, and local organizations have a stake in recovering threatened and endangered fish. This prize competition was developed to help migrating juvenile fish get over or around tall dams. Moving migrating juvenile fish past tall dams will ensure habitat connectivity that many threatened and endangered fish populations need to survive and reproduce.

Solution Types: Ideas

Plan for Upcoming 2 FYs: Future consideration to increase the effectiveness and efficiency of conducting prize competitions include: incorporating a method for judges to quickly set aside solutions that have no merit, such as a quick initial reality check on the question, "Can this work?"; in addition to the stated judging criteria, incorporate a free format field for each judge to characterize the merits of the solution in their own words based on the strengths and weaknesses they see. For prize competitions, such as this one, where a successful system needs to solve a suite of different problems to successfully meet system requirements, a separate prize for each piece of the problem should be considered. Alternatively, Reclamation could consider a competition that focuses only on the most difficult part of the system problem. For fish passage, this is likely the ability to guide fish through a reservoir and

successfully attract them to the fish collection and conveyance feature of the system. A tighter, sharper focus on the critical pieces of the problem may help solvers better focus and deliver.

A.4.8 Eradication of Invasive Mussels in Open Water - Stage 1[31]

Lead Sponsoring Agency: USBR

Status: This competition was launched in FY17 and completed in FY18.

Competition Goals: Two species of dreissenid mussels, Dreissena polymorpha (zebra mussel) and Dreissena rostriformis "bugensis" (quagga mussel), have become established in freshwater lakes, reservoirs, and rivers in the United States. Invasive dreissenid mussels pose significant challenges for Reclamation and all agencies and industries that manage water. Invasive mussels are prolific breeders and settle on or within water facility infrastructure such as water intakes, gates, diversion screens, hydropower equipment, pumps, pipelines, and boats. Infested water and hydropower infrastructure can fail or choke off water transmissions. Invasive mussels negatively impact the natural ecology, which can be detrimental to native and endangered species, including native fisheries. Maintaining and operating water supply and delivery facilities, water recreation, and other water dependent industries and economies in mussel infested water bodies are dramatically more expensive and complex. Public recreation may also be severely impacted by mussel infestations, from shell fragments degrading swim beaches to increased requirements and cost for boaters. Management of invasive mussel infestations can also lead to restricted public access, in some cases through a complete ban on public use of infested waters. Currently, no practical methods exist for large-scale eradication of invasive dreissenid mussel populations once they become widely established in a reservoir, lake, or river (referred to as "open water"). Reclamation sought innovative solutions for 100% eradication of zebra and quagga mussels in open water through direct mortality or through non-lethal treatment that lead to their eventual eradication. Proposed treatments must be specific to invasive mussels without significant harm to non-target organisms such as native mussels or threatened and endangered species.

Goal Types: Solve a specific problem; Advance scientific research; Develop technology; Engage new people and communities

Justification for Using Prizes and Challenges: A prize competition was selected as a preferred method to achieve the aforementioned goals because it helps engage a non-traditional, national solver community while also complementing traditional research designed to target the most persistent science and technology challenges. Competitions also can incentivize the submission of solutions. They are made open to a national, non-Federal solver community including citizens, businesses, and other organizations. Reclamation selected a prize competition to address this technical Challenge because it allowed the agency to pay only for results; established an important goal without having to limit approaches or teams that are most likely to succeed; increased the number and diversity of the individuals, organizations, and teams that would address the problem or challenge of national/international significance; can stimulate private sector investment that is many times greater than the cash value of the prize; and furthered Reclamation's mission by attracting more interest and attention to a defined program, activity, issue or concern.

[31] The websites for the Eradication of Invasive Mussels in Open Water - Stage 1 are accessible at https://www.usbr.gov/research/challenges/mussels.html; https://www.innocentive.com/ar/challenge/9933880; and https://www.challenge.gov/challenge/eradication-of-invasive-mussels-in-open-water- stage-1/.

Cash Prize Purses and/or Non-Cash Prize Awards: The cash prize purse of $100,000 was funded via Reclamation's Science and Technology Program, Research and Development Office as per Federal Acquisition Regulation (FAR, as codified at Chapter 1 of Title 48 of the Code of Federal Regulations, 48 C.F.R.).

Solicitation of Submissions: Reclamation created a unique webpage as well as cross-posted at Challenge.gov and InnoCentive sites. A video was created and shared via YouTube to support social media outreach, while a webinar was hosted to accompany the launch news release. InnoCentive was the prize competition administrator. The advantage of contracting with InnoCentive was the ability to bundle and brand the portfolio of Reclamation's Water Prize Competition Center while leveraging InnoCentive's global network of 380,000+ individuals. Overall, the quality and types of proposed solutions varied significantly. Many submissions, any of whom could be a potential winner, proposed technologies or methods already in practice with little or no potential to improve existing capabilities. Others, although some might be considered novel or different, were judged to not meet solution requirements or not feasible. No new, ready-to-implement, "silver bullet" was found to solve this difficult problem; however Reclamation understands this is not a realistic expectation for a single-stage ideation prize completion. Five solutions were considered worthy of a prize award consistent with the stated prize competition rules and criteria. Lessons learned include the need for casting a wider solver net, as well as more support for the payments process. With this in mind, Reclamation is pursuing an Interagency Agreement with NASA's Center of Excellence for Collaborative Innovation to allow access to trending models, infrastructure, expertise and multiple external competition crowdsourcing services.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies); Other - Advertisement in Reclamation's Knowledge Stream R&D magazine

Participation Requirements: This prize competition targeted the Challenge.gov and InnoCentive solver communities. This Challenge was conducted under the authority of the America COMPETES Reauthorization Act of 2010 (15 U.S.C.§ 3719). The Act states that awards for this Prize Competition may only be given to an individual that is a citizen or permanent resident of the United States, or an entity that is incorporated in and whose primary place of business is in the United States. Other restrictions were published in the Challenge Specific Agreement on the InnoCentive website.

Evaluation of Submissions: The judging was conducted by blind review as all submissions were identified solely by a number assigned by InnoCentive. Judges were provided with scoring sheets to be completed independently after reviewing each proposed solution against the criteria stated in the prize competition posting document.

Results: Of the 67 entries submitted by 238 participants between December 14, 2017 and February 28, 2018, three prizes were awarded to four winners.

Budget and Resources: In FY17, the funding was $15,134 and there was 0.01 FTE used. In FY18, the funding was $100,000 and there was 0.25 FTE used. FTE reported is based on labor budget consumption during the indicated fiscal year, divided by $200,000 per FTE; work represents finalizing design, launch support, competition judging and final reporting. Budget reported excludes FTE staffing, and includes purse payment and budget consumption by prize competition vendor service for design support.

Partnerships: USACE, USGS, and Molloy & Associates LLC provided in-kind support for design and judging of the prize competition. Partners also provided assistance with marketing and outreach. One subject matter expert from Portland State University also provided in-kind design and judging

assistance, but the university was not a full partner. No monetary or non-cash awards were provided by partners.

Advancement of Agency Mission: Invasive dreissenid mussels pose significant challenges for Reclamation and all agencies and industries that manage water. Invasive mussels are prolific breeders and settle on or within water facility infrastructure such as water intakes, gates, diversion screens, hydropower equipment, pumps, pipelines, and boats. Infested water and hydropower infrastructure can fail or choke off water transmissions. Invasive mussels negatively impact the natural ecology, which can be detrimental to native and endangered species, including native fisheries. Maintaining and operating water supply and delivery facilities, water recreation, and other water dependent industries and economies in mussel infested water bodies are dramatically more expensive and complex. Public recreation may also be severely impacted by mussel infestations, from shell fragments degrading swim beaches to increased requirements and cost for boaters to have their watercraft inspected and decontaminated, and potential impacts on populations of game fish. Management of invasive mussel infestations can also lead to restricted public access, in some cases through a complete ban on public use of infested waters. Eradication of invasive dreissenid mussels ensures Reclamation's ability to meet water and power deliveries now and into the future.

Solution Types: Ideas; Technology demonstration and hardware; Scientific

Plan for Upcoming 2 FYs: Future consideration to increase the effectiveness and efficiency of conducting prize competitions include: incorporating a methods for judges to quickly set aside solutions that have no merit, such as a quick initial reality check on the question, "Can this work?"; in addition to the stated judging criteria, incorporate a free format field for each judge to characterize the merits of the solution in their own words based on the strengths and weaknesses they see.

A.4.9 Indirect Estimates of Reservoir Water Storage[32]

Lead Sponsoring Agency: USBR

Status: This competition was launched in FY17 and completed in FY18.

Competition Goals: Water storage in reservoirs behind dams is a vital component for water management, and the amount available defines the delivery of benefits from reservoirs. Available water storage, over time, decreases as sediment deposition occurs, thus decreasing the capacity for storage. This sediment deposition, known as sedimentation, also adversely affects reservoir infrastructure operation and maintenance such as outlet works and water intakes. Assessing the loss of storage capacity currently is an expensive and time consuming process performed directly by in-field surveys. The Bureau of Reclamation, in collaboration with the U.S. Army Corps of Engineers, was seeking a cost effective method to indirectly estimate the storage capacity and/or sediment volume (storage loss) in reservoirs. This is a Reduction-to-Practice Challenge required written documentation, source code, and delivery of an executable application.

Goal Types: Solve a specific problem; Advance scientific research; Develop technology; Engage new people and communities

[32] The websites for the Indirect Estimates of Reservoir Water Storage are accessible at https://www.usbr.gov/research/challenges/waterstorage.html; https://www.innocentive.com/ar/challenge/9933766; and https://www.challenge.gov/challenge/estimating-reservoir-water-storage/.

Justification for Using Prizes and Challenges: A prize competition was selected as a preferred method to achieve the aforementioned goals because it helps engage a non-traditional, national solver community while also complementing traditional research designed to target the most persistent science and technology challenges. Competitions also can incentivize the submission of solutions. They are made open to a national, non-Federal solver community including citizens, businesses, and other organizations. Reclamation selected a prize competition to address this technical Challenge because it allowed the agency to pay only for results; established an important goal without having to limit approaches or teams that are most likely to succeed; increased the number and diversity of the individuals, organizations, and teams that would address the problem or challenge of national/international significance; can stimulate private sector investment that is many times greater than the cash value of the prize; and furthered Reclamation's mission by attracting more interest and attention to a defined program, activity, issue or concern.

Cash Prize Purses and/or Non-Cash Prize Awards: The cash prize purse was $75,000 and was funded via Reclamation's Science and Technology Program, Research and Development Office as per Federal Acquisition Regulation (FAR, as codified at Chapter 1 of Title 48 of the Code of Federal Regulations, 48 C.F.R.). A partial cash prize of $1,000 was distributed to 1 winning solver as determined by the judging panel. Non-cash prize awards were not offered for this competition.

Solicitation of Submissions: Reclamation created a unique webpage as well as cross-posted at Challenge.gov and InnoCentive sites. A video was created and shared via YouTube to support social media outreach, while a webinar was hosted to accompany the launch news release. InnoCentive was the prize competition administrator. The advantage of contracting with InnoCentive was the ability to bundle and brand the portfolio of Reclamation's Water Prize Competition Center while leveraging InnoCentive's global network of 380,000+ individuals. Overall, the quality and types of proposed solutions varied significantly. Many submissions, any of whom could be a potential winner, proposed technologies or methods already in practice with little or no potential to improve existing capabilities. Others, although some might be considered novel or different, were judged to not meet solution requirements or not feasible. No new, ready-to-implement, "silver bullet" was found to solve this difficult problem; however Reclamation understands this is not a realistic expectation for a single-stage ideation prize completion. Five solutions were considered worthy of a prize award consistent with the stated prize competition rules and criteria. Lessons learned include the need for casting a wider solver net, as well as more support for the payments process. With this in mind, Reclamation is pursuing an Interagency Agreement with NASA's Center of Excellence for Collaborative Innovation to allow access to trending models, infrastructure, expertise and multiple external competition crowdsourcing services.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Day-long event(s) prior to the competition; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies); Other - Advertisement in Reclamation's Knowledge Stream R&D magazine.

Participation Requirements: This prize competition targeted the Challenge.gov and InnoCentive solver communities. This Challenge was conducted under the authority of the America COMPETES Reauthorization Act of 2010 (15 U.S.C.§ 3719). The Act states that awards for this Prize Competition may only be given to an individual that is a citizen or permanent resident of the United States, or an entity that is incorporated in and whose primary place of business is in the United States. Other restrictions were published in the Challenge Specific Agreement on the InnoCentive website. Nevertheless, submissions included all solvers regardless of whether they are U.S. citizens/entities. Meritorious

submissions from non-U.S. citizens and entities, were recognized in publications issued by Reclamation announcing the results of the competition, such as press releases, as applicable.

Evaluation of Submissions: The prize competition was advertised as a "Theoretical Challenge." Competitors were required to submit a written proposal including a detailed description and rationale for why the proposed solution met or exceeded the performance criteria stated in the Challenge posting. Submissions were evaluated by a Judging Panel composed of scientists, engineers, and other technical subject matter experts affiliated with Federal and State entities. The Panel had consultation access to technical experts outside of their expertise, as deemed necessary, to evaluate specific submissions. The judging was conducted by blind review as all submissions were identified solely by a number assigned by InnoCentive. Judges were provided with scoring sheets to be completed independently after reviewing each proposed solution. The judges assessed the merits of each solution by the degree upon which they meet the technical requirements. They also assessed the feasibility, flexibility, cost, and scalability of the proposed concept. At the end of the independent judging the individual scores were tallied and combined. The Panel convened several conference calls and then attended an all-day web conference to discuss the strengths and weaknesses of each submission and arrive at a consensus judges opinion. Solutions that did not meet all criteria, but were deemed novel, interesting, and potentially worth pursuing, were eligible to win a partial prize.

Results: Of the 20 entries submitted by 280 participants between February 22 and May 22, 2017, a prize was awarded to one winner.

Budget and Resources: In FY17, there was $1,000 of funding and 0.09 FTE used. FTE reported is based on labor budget consumption during the indicated fiscal year. Work represents competition judging and final reporting. Budget reported excludes FTE staffing, and includes only purse payment; budget consumption by prize competition vendor service occurred prior to FY17.

Partnerships: USACE provided in-kind services for two subject matter experts to design and judge the prize competition including an in-person judges meeting. USACE also assisted with marketing and outreach. No monetary or non-cash prize awards were provided by partners.

Advancement of Agency Mission: Measurement of reservoir storage loss due to sediment accumulation is paramount in supporting Reclamation's mission. Reservoir sedimentation is a chronic problem that has become more visible and has continually increasing impacts with the aging of dams. Sediment deposition in reservoirs limits the active life of reservoirs by reducing reservoir storage capacity and impacting structures such as outlet works and water intakes. In order to determine the magnitude and rate of sedimentation to assess future impacts, direct measurements, such as a bathymetric (below water) survey in combination with a topographic (above water) survey are necessary. This process can be costly and time consuming. As of 2015, less than 40% of Reclamation reservoirs have had at least one resurvey since first filling to estimate storage loss as a result of sedimentation. The alternative to direct measurements of storage loss is indirect estimates of storage loss. Developing an efficient and accurate indirect estimate model of reservoir storage would result in a better, faster, and cheaper solution to support Reclamation in meeting water and power deliveries now and into the future.

Solution Types: Technology demonstration and hardware

Plan for Upcoming 2 FYs: Future consideration to increase the effectiveness and efficiency of conducting prize competitions include: incorporating a method for judges to quickly set aside solutions that have no merit, such as a quick initial reality check on the question, "Can this work?"; in addition to the stated judging criteria, incorporate a free format field for each judge to characterize the merits of the solution in their own words based on the strengths and weaknesses they see. For prize competitions, such as this one, where a successful system needs to solve a suite of different problems to successfully meet

system requirements, a separate prize for each piece of the problem should be considered. Alternatively, Reclamation could consider a competition that focuses only on the most difficult part of the system problem.

A.4.10 Long-Term Corrosion Protection of Existing Hydraulic Steel Structures – Stage 1[33]

Lead Sponsoring Agency: USBR

Status: This competition was launched in FY17 and completed in FY18.

Competition Goals: Common hydraulic steel structures such as hydroelectric penstocks and gates corrode, or degrade, without a properly applied corrosion control method. This degradation produces a localized or general thinning of material, which reduces the structure's ability to support load, carry water, etc. Failure of hydraulic steel structures can cause extensive downtime, loss of productivity, property damage, and even loss of life.The cost of maintenance and replacement of existing corrosion control systems has increased greatly in recent decades due to increasing health, safety, and environmental concerns associated with coatings that have performed well in the past as well as the decreased life cycles of commercially available alternative coatings. New long-term solutions to protect steel structures in water immersion service will help to reduce the high cost incurred to keep steel infrastructure reliable and functional.

Goal Types: Solve a specific problem; Advance scientific research; Develop technology; Engage new people and communities

Justification for Using Prizes and Challenges: A prize competition was selected as a preferred method to achieve the aforementioned goals because it helps engage a non-traditional, national solver community while also complementing traditional research designed to target the most persistent science and technology challenges. Competitions also can incentivize the submission of solutions. They are made open to a national, non-Federal solver community including citizens, businesses, and other organizations. Reclamation selected a prize competition to address this technical Challenge because it allowed the agency to pay only for results; established an important goal without having to limit approaches or teams that are most likely to succeed; increased the number and diversity of the individuals, organizations, and teams that would address the problem or challenge of national/international significance; can stimulate private sector investment that is many times greater than the cash value of the prize; and furthered Reclamation's mission by attracting more interest and attention to a defined program, activity, issue or concern.

Cash Prize Purses and/or Non-Cash Prize Awards: The cash prize purse was $75,000 and was funded via Reclamation's Science and Technology Program, Research and Development Office as per Federal Acquisition Regulation (FAR, as codified at Chapter 1 of Title 48 of the Code of Federal Regulations, 48 C.F.R.). Five cash prizes of $47,500 were distributed to seven winning solvers as determined by the judging panel. Non-cash prize awards were not offered for this competition.

Solicitation of Submissions: Reclamation created a unique webpage as well as cross-posted at Challenge.gov and InnoCentive sites. A video was created and shared via YouTube to support social media outreach, while a webinar was hosted to accompany the launch news release. InnoCentive was

[33] The websites for the Long-Term Corrosion Protection of Existing Hydraulic Steel Structures – Stage 1 are accessible at https://www.usbr.gov/newsroom/newsrelease/detail.cfm?RecordID=62570; https://www.usbr.gov/research/challenges/corrosion.html; https://www.innocentive.com/ar/challenge/9933879; and https://www.challenge.gov/challenge/long-term-corrosion-protection-of-existing-hydraulic-steel-structures-stage-1/.

the prize competition administrator. The advantage of contracting with InnoCentive was the ability to bundle and brand the portfolio of Reclamation's Water Prize Competition Center while leveraging InnoCentive's global network of 380,000+ individuals. Overall, the quality and types of proposed solutions varied significantly. Many submissions, any of whom could be a potential winner, proposed technologies or methods already in practice with little or no potential to improve existing capabilities. Others, although some might be considered novel or different, were judged to not meet solution requirements or not feasible. No new, ready-to-implement, "silver bullet" was found to solve this difficult problem; however Reclamation understands this is not a realistic expectation for a single-stage ideation prize completion. Five solutions were considered worthy of a prize award consistent with the stated prize competition rules and criteria. Lessons learned include the need for casting a wider solver net, as well as more support for the payments process. With this in mind, Reclamation is pursuing an Interagency Agreement with NASA's Center of Excellence for Collaborative Innovation to allow access to trending models, infrastructure, expertise and multiple external competition crowdsourcing services.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Day-long event(s) prior to the competition; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies); Other - Advertisement in Reclamation's Knowledge Stream R&D magazine

Participation Requirements: This prize competition targeted the Challenge.gov and InnoCentive solver communities. This Challenge was conducted under the authority of the America COMPETES Reauthorization Act of 2010 (15 U.S.C.§ 3719). The Act states that awards for this Prize Competition may only be given to an individual that is a citizen or permanent resident of the United States, or an entity that is incorporated in and whose primary place of business is in the United States. Other restrictions were published in the Challenge Specific Agreement on the InnoCentive website. Nevertheless, submissions included all solvers regardless of whether they are U.S. citizens/entities. Meritorious submissions from non-U.S. citizens and entities, were recognized in publications issued by Reclamation announcing the results of the competition, such as press releases, as applicable.

Evaluation of Submissions: The prize competition was advertised as an "Theoretical Challenge." Competitors were required to submit a written proposal including a detailed description and rationale for why the proposed solution met or exceeded the performance criteria stated in the Challenge posting. Submissions were evaluated by a Judging Panel composed of scientists, engineers, and other technical subject matter experts affiliated with Federal and State entities. The Panel had consultation access to technical experts outside of their expertise, as deemed necessary, to evaluate specific submissions. The judging was conducted by blind review as all submissions were identified solely by a number assigned by InnoCentive. Judges were provided with scoring sheets to be completed independently after reviewing each proposed solution. The judges assessed the merits of each solution by the degree upon which they meet the technical requirements. They also assessed the feasibility, flexibility, cost, and scalability of the proposed concept. At the end of the independent judging the individual scores were tallied and combined. The Panel convened several conference calls and then attended an all-day web conference to discuss the strengths and weaknesses of each submission and arrive at a consensus judges opinion. Solutions that did not meet all criteria, but were deemed novel, interesting, and potentially worth pursuing, were eligible to win a partial prize.

Results: Of the 30 entries submitted by 171 participants between June 13 and September 5, 2017, five prizes were awarded to seven winners.

Budget and Resources: In FY17, there was 0.21 FTE used. In FY18 there was $47,500 in funding. FTE reported is based on labor budget consumption during the indicated fiscal year. Work represents

competition judging and final reporting. Budget reported excludes FTE staffing, and includes only purse payment; budget consumption by prize competition vendor service occurred prior to FY17.

Partnerships: Reclamation partnered with the U.S. Army Engineer Research and Development Center for planning and judging; NIST for planning and judging; the Naval Facilities Engineering Command for planning and judging; and North Carolina State University for judging. The estimated value of partner contributions in FY17 was $70,000.

Advancement of Agency Mission: The annual estimated cost of corrosion in the U.S. is $451 billion or 2.7% of the Nation's GDP (IMPACT Study, NACE International, 2016). This enduring cost is in spite of the development of numerous technologies dedicated to providing corrosion protection. The Bureau of Reclamation is seeking new corrosion control methods or technologies to curb the rising costs of protecting its steel structures and ensure safe and reliable operation of its water infrastructure.

Solution Types: Ideas

Plan for Upcoming 2 FYs: Future consideration to increase the effectiveness and efficiency of conducting prize competitions include: incorporating a method for judges to quickly set aside solutions that have no merit, such as a quick initial reality check on the question, "Can this work?"; in addition to the stated judging criteria, incorporate a free format field for each judge to characterize the merits of the solution in their own words based on the strengths and weaknesses they see. For prize competitions, such as this one, where a successful system needs to solve a suite of different problems to successfully meet system requirements, a separate prize for each piece of the problem should be considered. Alternatively, Reclamation could consider a competition that focuses only on the most difficult part of the system problem.

A.4.11 More Water, Less Concentrate - Stage 1[34]

Lead Sponsoring Agency: USBR

Status: This competition was launched in FY17 and completed in FY18.

Competition Goals: Innovative solutions were sought to expand usable water supplies by maximizing fresh water production from inland desalination systems in a cost effective and environmentally sound manner. Currently, significant and desirable water supplies are trapped in concentrate streams that are a byproduct of desalination technologies. The cost to manage or dispose of concentrate is rather large and very limiting to utilization of desalination in inland applications. Solutions could be novel technologies or approaches that build upon existing technologies. Solutions should address one of the following objectives, 1) ways to improve overall system recovery of existing desalination technologies, 2) ways to treat concentrate streams to extract additional useable water and thus to increase overall system recovery, or 3) new high recovery desalination technologies or processes that increase overall system recovery beyond current desalination technologies.

Goal Types: Find and highlight innovative ideas; Solve a specific problem; Advance scientific research; Develop technology

[34] The websites for the More Water, Less Concentrate - Stage 1 are accessible at https://www.usbr.gov/newsroom/newsrelease/detail.cfm?RecordID=61912; https://www.usbr.gov/research/challenges/morewater.html; https://www.innocentive.com/ar/challenge/9933762; and https://www.challenge.gov/challenge/more-water-less-concentrate-stage-1/.

Justification for Using Prizes and Challenges: A prize competition was selected as a preferred method to achieve the aforementioned goals because it helps engage a non-traditional, national solver community while also complementing traditional research designed to target the most persistent science and technology challenges. Competitions also can incentivize the submission of solutions. They are made open to a national, non-Federal solver community including citizens, businesses, and other organizations. Reclamation selected a prize competition to address this technical Challenge because it allowed the agency to pay only for results; established an important goal without having to limit approaches or teams that are most likely to succeed; increased the number and diversity of the individuals, organizations, and teams that would address the problem or challenge of national/international significance; can stimulate private sector investment that is many times greater than the cash value of the prize; and furthered Reclamation's mission by attracting more interest and attention to a defined program, activity, issue or concern.

Cash Prize Purses and/or Non-Cash Prize Awards: The cash prize purse was $150,000 and was funded via Reclamation's Science and Technology Program, Research and Development Office as per Federal Acquisition Regulation (FAR, as codified at Chapter 1 of Title 48 of the Code of Federal Regulations, 48 C.F.R.). Cash prizes of $150,000 were distributed to ten winning solvers as determined by the judging panel. Non-cash prize awards were not offered for this competition.

Solicitation of Submissions: Reclamation created a unique webpage as well as cross-posted at Challenge.gov and InnoCentive sites. A video was created and shared via YouTube to support social media outreach, while a webinar was hosted to accompany the launch news release. InnoCentive was the prize competition administrator. The advantage of contracting with InnoCentive was the ability to bundle and brand the portfolio of Reclamation's Water Prize Competition Center while leveraging InnoCentive's global network of 380,000+ individuals. Overall, the quality and types of proposed solutions varied significantly. Many submissions, any of whom could be a potential winner, proposed technologies or methods already in practice with little or no potential to improve existing capabilities. Others, although some might be considered novel or different, were judged to not meet solution requirements or not feasible. No new, ready-to-implement, "silver bullet" was found to solve this difficult problem; however Reclamation understands this is not a realistic expectation for a single-stage ideation prize completion. Five solutions were considered worthy of a prize award consistent with the stated prize competition rules and criteria. Lessons learned include the need for casting a wider solver net, as well as more support for the payments process. With this in mind, Reclamation is pursuing an Interagency Agreement with NASA's Center of Excellence for Collaborative Innovation to allow access to trending models, infrastructure, expertise and multiple external competition crowdsourcing services.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Day-long event(s) prior to the competition; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies); Other - Advertisement in Reclamation's Knowledge Stream R&D magazine

Participation Requirements: This prize competition targeted the Challenge.gov and InnoCentive solver communities. This Challenge was conducted under the authority of the America COMPETES Reauthorization Act of 2010 (15 U.S.C.§ 3719). The Act states that awards for this Prize Competition may only be given to an individual that is a citizen or permanent resident of the United States, or an entity that is incorporated in and whose primary place of business is in the United States. Other restrictions were published in the Challenge Specific Agreement on the InnoCentive website. Nevertheless, submissions included all solvers regardless of whether they are U.S. citizens/entities. Meritorious

submissions from non-U.S. citizens and entities, were recognized in publications issued by Reclamation announcing the results of the competition, such as press releases, as applicable.

Evaluation of Submissions: The prize competition was advertised as an "Theoretical Challenge." Competitors were required to submit a written proposal including a detailed description and rationale for why the proposed solution met or exceeded the performance criteria stated in the Challenge posting. Submissions were evaluated by a Judging Panel composed of scientists, engineers, and other technical subject matter experts affiliated with Federal and State entities. The Panel had consultation access to technical experts outside of their expertise, as deemed necessary, to evaluate specific submissions. The judging was conducted by blind review as all submissions were identified solely by a number assigned by InnoCentive. Judges were provided with scoring sheets to be completed independently after reviewing each proposed solution. The judges assessed the merits of each solution by the degree upon which they meet the technical requirements. They also assessed the feasibility, flexibility, cost, and scalability of the proposed concept. At the end of the independent judging the individual scores were tallied and combined. The Panel convened several conference calls and then attended an all-day web conference to discuss the strengths and weaknesses of each submission and arrive at a consensus judges opinion. Solutions that did not meet all criteria, but were deemed novel, interesting, and potentially worth pursuing, were eligible to win a partial prize.

Results: Of the 66 entries submitted by 282 participants between December 13, 2016 and March 13, 2017, eight prizes were awarded to ten winners.

Budget and Resources: There was 0.14 FTE used in 2018. FTE reported is based on labor budget consumption during the indicated fiscal year. Work represents competition judging and final reporting. Budget reported excludes FTE staffing, and includes only purse payment; budget consumption by prize competition vendor service occurred prior to FY17.

Partnerships: Reclamation partnered with the EPA for design; USACE for design and judging; U.S. Army for design and judging; the Water Environment and Reuse Foundation for design, judging, and outreach; and Water Research Foundation for outreach

Advancement of Agency Mission: Currently, significant and desirable water supplies are trapped in concentrate streams that are a byproduct of desalination technologies. The cost to manage or dispose of concentrate is rather large and limiting to utilization of desalination in inland applications. This Challenge sought innovative concepts to expand usable water supplies by maximizing fresh water production from inland desalination systems, and thereby reduce the volume of concentrate.The National Academy of Sciences identified developing cost-effective approaches for concentrate management that minimize environmental impacts as one of their highest priority research topics to enable the more widespread use of desalination to expand water supplies in the United States.The demand for fresh water will be increasing, and we need to be able to develop new water supplies from non- traditional water sources, like brackish groundwater and surface water using desalination and novel technologies. The competition sought innovative concepts to expand usable water supplies by maximizing fresh water production from inland desalination systems in a cost-effective and environmentally sound manner.

Solution Types: Ideas

Plan for Upcoming 2 FYs: Future consideration to increase the effectiveness and efficiency of conducting prize competitions include: incorporating a method for judges to quickly set aside solutions that have no merit, such as a quick initial reality check on the question, "Can this work?"; in addition to the stated judging criteria, incorporate a free format field for each judge to characterize the merits of the solution in their own words based on the strengths and weaknesses they see. For prize competitions, such as

this one, where a successful system needs to solve a suite of different problems to successfully meet system requirements, a separate prize for each piece of the problem should be considered. Alternatively, Reclamation could consider a competition that focuses only on the most difficult part of the system problem.

A.4.12 Pathogen Monitoring - Stage 1[35]

Lead Sponsoring Agency: USBR

Status: This competition was launched in FY18, and is underway.

Competition Goals: As Western U.S. water demands grow and water supplies become more scarce, water reuse is becoming an increasingly important water management strategy. Wastewater is a drought-resistant and reliable water source that is readily available in urban centers for beneficial reuse. While advanced water treatment technologies exist to produce high quality, potable water from wastewater, there is a need to better ensure treatment process integrity through improved pathogen detection and monitoring. Waterborne pathogens (e.g., bacteria, viruses, protozoa, and helminths) are regulated due to the risk they pose to human health, and their presence must be limited in water intended for potable use.The Bureau of Reclamation, with financial support from Xylem, Inc, in collaboration with the Water Research Foundation and the EPA, are seeking the development of rapid, accurate, and preferably on-line/on-site monitoring techniques to provide added protection of public health and optimize the design and operations of advanced water treatment facilities. Success could result in reliable, effective pathogen detection technologies that can facilitate public and regulatory acceptance of direct potable reuse systems.

Goal Types: Find and highlight innovative ideas; Solve a specific problem; Advance scientific research; Engage new people and communities

Justification for Using Prizes and Challenges: A prize competition was selected as a preferred method to achieve the aforementioned goals because it helps engage a non-traditional, national solver community while also complementing traditional research designed to target the most persistent science and technology challenges. Competitions also can incentivize the submission of solutions. They are made open to a national, non-Federal solver community including citizens, businesses, and other organizations. Reclamation selected a prize competition to address this technical Challenge because it allowed the agency to pay only for results; established an important goal without having to limit approaches or teams that are most likely to succeed; increased the number and diversity of the individuals, organizations, and teams that would address the problem or challenge of national/international significance; can stimulate private sector investment that is many times greater than the cash value of the prize; and furthered Reclamation's mission by attracting more interest and attention to a defined program, activity, issue or concern.

Cash Prize Purses and/or Non-Cash Prize Awards: The cash prize purse of $40,000 was funded via Reclamation's Science and Technology Program, Research and Development Office as per Federal Acquisition Regulation (FAR, as codified at Chapter 1 of Title 48 of the Code of Federal Regulations, 48 C.F.R.). Xylem, Inc. offered $40,000 in partner contribution. Judging is in progress.

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[35] The websites for the Pathogen Monitoring - Stage 1 are accessible at https://www.usbr.gov/research/challenges/pathogen.html; https://www.usbr.gov/newsroom/newsrelease/detail.cfm?RecordID=62175; and https://www.innocentive.com/ar/challenge/9933767.

Solicitation of Submissions: Reclamation created a unique webpage as well as cross-posted at Challenge.gov and InnoCentive sites. A video was created and shared via YouTube to support social media outreach, while a webinar was hosted to accompany the launch news release. InnoCentive was the prize competition administrator. The advantage of contracting with InnoCentive was the ability to bundle and brand the portfolio of Reclamation's Water Prize Competition Center while leveraging InnoCentive's global network of 380,000+ individuals. Overall, the quality and types of proposed solutions varied significantly. Many submissions, any of whom could be a potential winner, proposed technologies or methods already in practice with little or no potential to improve existing capabilities. Others, although some might be considered novel or different, were judged to not meet solution requirements or not feasible. No new, ready-to-implement, "silver bullet" was found to solve this difficult problem; however Reclamation understands this is not a realistic expectation for a single-stage ideation prize completion. Five solutions were considered worthy of a prize award consistent with the stated prize competition rules and criteria. Lessons learned include the need for casting a wider solver net, as well as more support for the payments process. With this in mind, Reclamation is pursuing an Interagency Agreement with NASA's Center of Excellence for Collaborative Innovation to allow access to trending models, infrastructure, expertise and multiple external competition crowdsourcing services.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies); Other - Advertisement in Reclamation's Knowledge Stream R&D magazine

Participation Requirements: This prize competition targeted the Challenge.gov and InnoCentive solver communities. This Challenge was conducted under the authority of the America COMPETES Reauthorization Act of 2010 (15 U.S.C.§ 3719). The Act states that awards for this Prize Competition may only be given to an individual that is a citizen or permanent resident of the United States, or an entity that is incorporated in and whose primary place of business is in the United States. Other restrictions were published in the Challenge Specific Agreement on the InnoCentive website.

Evaluation of Submissions: Judging is in progress at the date of this report.The judging will be conducted by blind review as all submissions will be identified solely by a number assigned by InnoCentive. Judges will be provided with scoring sheets to be completed independently after reviewing each proposed solution against the criteria stated in the prize competition posting document.The prize competition was advertised as a "Theoretical Challenge." Submissions consist of a written proposal including a detailed description and rationale for why the proposed solution met or exceeded the performance criteria stated in the prize competition posting.

Results: Entries were submitted between May 10 and August 8, 2018, and prizes and winners have yet to be determined.

Budget and Resources: In FY17, there was $15,134 of funding and 0.21 FTE used. FTE reported is based on labor budget consumption during the indicated fiscal year, divided by $200,000 per FTE; work represents finalizing design, launch support, competition judging and final reporting. Budget reported excludes FTE staffing, and includes only budget consumption by prize competition vendor service for design support. Purse consumption will occur in FY19, where maximum purse will be $80,000 with 50% involving USBR budget consumption and 50% involving partner contribution by Xylem.

Partnerships: Reclamation partnered with the EPA for design and judging; Xylem, Inc. for design and judging; and the Water Research Foundation for design, judging, and outreach.

Advancement of Agency Mission: Relamation seeks to enable the development of rapid, more accurate, and preferably on-line/on-site monitoring techniques to provide added protection of public health and

optimize the design and operations of advanced water treatment facilities. Success could result in reliable, effective pathogen detection technologies that can facilitate public and regulatory acceptance of direct potable reuse systems.Stage 1 of the competition is seeking technical proposals for how to rapidly, accurately, and cost-effectively detect viruses in water reuse treatment plants. Reclamation will award an $80,000 prize purse ($40,000 of which is provided by Xylem Inc.), among winning eligible U.S. solvers. Winning eligible international solvers may receive meritorious recognition.

Solution Types: Ideas

Plan for Upcoming 2 FYs: Future consideration to increase the effectiveness and efficiency of conducting prize competitions include: incorporating a methods for judges to quickly set aside solutions that have no merit, such as a quick initial reality check on the question, "Can this work?"; in addition to the stated judging criteria, incorporate a free format field for each judge to characterize the merits of the solution in their own words based on the strengths and weaknesses they see.

A.4.13 Powering Electronic Instruments on a Rotating Shaft - Stage 1[36]

Lead Sponsoring Agency: USBR

Status: This competition was launched in FY18, and is underway.

Competition Goals: Reclamation's hydropower generating units are expected to safely and reliably produce the power that is delivered to the Western U.S. electric grid. Equipment monitoring techniques provide a critical advancement toward keeping these units operational and reducing costly outages. However, the monitoring equipment requires a continuous power source in order to keep it online and performing its key role. New solutions are needed to permanently install low power electronics on the generator's rotating shaft in order to collect continuous data pertinent to operation and performance of the machine. Presently, the available power sources for electronics on rotating shafts include batteries and contact solutions. Powering the electronic equipment with a battery does not provide continuous operation and requires downtime of the equipment to replace them, resulting in lost power generation. Existing contact solutions, such as slip rings, have unacceptable installation and maintenance requirements. Non-contact solutions include emerging technologies that may prove beneficial but are not yet explored for this application.

Goal Types: Solve a specific problem; Advance scientific research; Develop technology; Engage new people and communities; Stimulate a market

Justification for Using Prizes and Challenges: A prize competition was selected as a preferred method to achieve the aforementioned goals because it helps engage a non-traditional, national solver community while also complementing traditional research designed to target the most persistent science and technology challenges. Competitions also can incentivize the submission of solutions. They are made open to a national, non-Federal solver community including citizens, businesses, and other organizations. Reclamation selected a prize competition to address this technical Challenge because it allowed the agency to pay only for results; established an important goal without having to limit approaches or teams that are most likely to succeed; increased the number and diversity of the individuals, organizations, and teams that would address the problem or challenge of national/international significance; can stimulate private sector investment that is many times greater

[36] The websites for the Powering Electronic Instruments on a Rotating Shaft - Stage 1 are accessible at https://www.usbr.gov/research/challenges/shaft-power.html; https://www.usbr.gov/newsroom/newsrelease/detail.cfm?RecordID=63143; and https://www.innocentive.com/ar/challenge/9933885.

than the cash value of the prize; and furthered Reclamation's mission by attracting more interest and attention to a defined program, activity, issue or concern.

Cash Prize Purses and/or Non-Cash Prize Awards: The cash prize purse of $250,000 was funded via Reclamation's Science and Technology Program, Research and Development Office as per Federal Acquisition Regulation (FAR, as codified at Chapter 1 of Title 48 of the Code of Federal Regulations, 48 C.F.R.). The prize competition is open to solvers.

Solicitation of Submissions: Reclamation created a unique webpage as well as cross-posted at Challenge.gov and InnoCentive sites. A video was created and shared via YouTube to support social media outreach, while a webinar was hosted to accompany the launch news release. InnoCentive was the prize competition administrator. The advantage of contracting with InnoCentive was the ability to bundle and brand the portfolio of Reclamation's Water Prize Competition Center while leveraging InnoCentive's global network of 380,000+ individuals. Overall, the quality and types of proposed solutions varied significantly. Many submissions, any of whom could be a potential winner, proposed technologies or methods already in practice with little or no potential to improve existing capabilities. Others, although some might be considered novel or different, were judged to not meet solution requirements or not feasible. No new, ready-to-implement, "silver bullet" was found to solve this difficult problem; however Reclamation understands this is not a realistic expectation for a single-stage ideation prize completion. Five solutions were considered worthy of a prize award consistent with the stated prize competition rules and criteria. Lessons learned include the need for casting a wider solver net, as well as more support for the payments process. With this in mind, Reclamation is pursuing an Interagency Agreement with NASA's Center of Excellence for Collaborative Innovation to allow access to trending models, infrastructure, expertise and multiple external competition crowdsourcing services.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies); Other - Advertisement in Reclamation's Knowledge Stream R&D magazine

Participation Requirements: This prize competition targeted the Challenge.gov and InnoCentive solver communities. This Challenge was conducted under the authority of the America COMPETES Reauthorization Act of 2010 (15 U.S.C.§ 3719). The Act states that awards for this Prize Competition may only be given to an individual that is a citizen or permanent resident of the United States, or an entity that is incorporated in and whose primary place of business is in the United States. Other restrictions were published in the Challenge Specific Agreement on the InnoCentive website.

Evaluation of Submissions: The prize competition is open to solvers.The judging will be conducted by blind review as all submissions will be identified solely by a number assigned by InnoCentive. Judges will be provided with scoring sheets to be completed independently after reviewing each proposed solution against the criteria stated in the prize competition posting document.

Results: Entries were submitted between September 6 and December 6, 2018, and winners have yet to be determined.

Budget and Resources: In FY18 there was 0.35 FTE used. FTE reported is based on labor budget consumption during the indicated fiscal year, divided by $200,000 per FTE; work represents finalizing design, launch support, competition judging and final reporting.Budget reported excludes FTE staffing, and includes only budget consumption by prize competition vendor service for design support. Phase 1 purse consumption ($50,000 of the total $250,000 purse) will occur in FY19; Phase 2 purse consumption will occur in FY19 or FY20.

Partnerships: Reclamation partnered with USACE for judging and the Bonneville Power Administration for judging.

Advancement of Agency Mission: Reclamation and our collaborators seek novel methods and technologies to reliably provide direct current power for loads of up to twenty watts to electronics on rotating shafts. Proposed solutions must be applicable to rotating shafts that are 18- to 144-inch diameter, whether at rated speed (80 to 550 revolutions per minute), standstill, or when ramping up or down. Small, lightweight solutions are preferred, and could be achieved via multiple methods, including air movement, light, vibration, magnetic induction, kinetic motion, or wireless energy transfer. A successful solution would make online, continuous monitoring of hydropower generating units possible, which increases the reliability of power delivery and reduces costly outages.

Solution Types: Ideas; Technology demonstration and hardware; Scientific

Plan for Upcoming 2 FYs: Future consideration to increase the effectiveness and efficiency of conducting prize competitions include: incorporating a methods for judges to quickly set aside solutions that have no merit, such as a quick initial reality check on the question, "Can this work?"; in addition to the stated judging criteria, incorporate a free format field for each judge to characterize the merits of the solution in their own words based on the strengths and weaknesses they see.

A.4.14 Preventing Rodent Burrows in Earthen Embankments[37]

Lead Sponsoring Agency: USBR

Status: This competition was launched in FY17 and completed in FY18.

Competition Goals: Rodent burrows can fill with water when 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, 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 to "dig deeper" than the rodents and offer creative, cost effective, long-term solutions to this real and serious problem.

Goal Types: Solve a specific problem; Advance scientific research; Develop technology; Engage new people and communities

Justification for Using Prizes and Challenges: A prize competition was selected as a preferred method to achieve the aforementioned goals because it helps engage a non-traditional, national solver community while also complementing traditional research designed to target the most persistent science and technology challenges. Competitions also can incentivize the submission of solutions. They are made open to a national, non-Federal solver community including citizens, businesses, and other organizations. Reclamation selected a prize competition to address this technical Challenge because it allowed the agency to pay only for results; established an important goal without having to limit approaches or teams that are most likely to succeed; increased the number and diversity of the

[37] The websites for the Preventing Rodent Burrows in Earthen Embankments are accessible at https://www.usbr.gov/newsroom/newsrelease/detail.cfm?RecordID=60543; https://www.usbr.gov/research/challenges/rodentburrows.html; https://www.innocentive.com/ar/challenge/9933763; and https://www.challenge.gov/challenge/preventing-rodent-burrows-in-earthen-embankments/.

individuals, organizations, and teams that would address the problem or challenge of national/international significance; can stimulate private sector investment that is many times greater than the cash value of the prize; and furthered Reclamation's mission by attracting more interest and attention to a defined program, activity, issue or concern.

Cash Prize Purses and/or Non-Cash Prize Awards: The cash prize purse was $20,000 and was funded via Reclamation's Science and Technology Program, Research and Development Office as per Federal Acquisition Regulation (FAR, as codified at Chapter 1 of Title 48 of the Code of Federal Regulations, 48 C.F.R.). Cash prizes of $20,000 were distributed to five winning solvers as determined by the judging panel. Non-cash prize awards were not offered for this competition.

Solicitation of Submissions: Reclamation created a unique webpage as well as cross-posted at Challenge.gov and InnoCentive sites. A video was created and shared via YouTube to support social media outreach, while a webinar was hosted to accompany the launch news release. InnoCentive was the prize competition administrator. The advantage of contracting with InnoCentive was the ability to bundle and brand the portfolio of Reclamation's Water Prize Competition Center while leveraging InnoCentive's global network of 380,000+ individuals. Overall, the quality and types of proposed solutions varied significantly. Many submissions, any of whom could be a potential winner, proposed technologies or methods already in practice with little or no potential to improve existing capabilities. Others, although some might be considered novel or different, were judged to not meet solution requirements or not feasible. No new, ready-to-implement, "silver bullet" was found to solve this difficult problem; however Reclamation understands this is not a realistic expectation for a single-stage ideation prize completion. Five solutions were considered worthy of a prize award consistent with the stated prize competition rules and criteria. Lessons learned include the need for casting a wider solver net, as well as more support for the payments process. With this in mind, Reclamation is pursuing an Interagency Agreement with NASA's Center of Excellence for Collaborative Innovation to allow access to trending models, infrastructure, expertise and multiple external competition crowdsourcing services.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies); Other - Advertisement in Reclamation's Knowledge Stream R&D magazine

Participation Requirements: This prize competition targeted the Challenge.gov and InnoCentive solver communities. This Challenge was conducted under the authority of the America COMPETES Reauthorization Act of 2010 (15 U.S.C.§ 3719). The Act states that awards for this Prize Competition may only be given to an individual that is a citizen or permanent resident of the United States, or an entity that is incorporated in and whose primary place of business is in the United States. Other restrictions were published in the Challenge Specific Agreement on the InnoCentive website. Nevertheless, submissions included all solvers regardless of whether they are U.S. citizens/entities. Meritorious submissions from non-U.S. citizens and entities, were recognized in publications issued by Reclamation announcing the results of the competition, such as press releases, as applicable.

Evaluation of Submissions: The prize competition was advertised as an "Ideation Challenge." Competitors were required to submit a written proposal including a detailed description and rationale for why the proposed solution met or exceeded the performance criteria stated in the Challenge posting. Submissions were evaluated by a Judging Panel composed of scientists, engineers, and other technical subject matter experts affiliated with Federal and State entities. The Panel had consultation access to technical experts outside of their expertise, as deemed necessary, to evaluate specific submissions. The judging was conducted by blind review as all submissions were identified solely by a number assigned by InnoCentive. Judges were provided with scoring sheets to be completed

independently after reviewing each proposed solution. The judges assessed the merits of each solution by the degree upon which they meet the technical requirements. They also assessed the feasibility, flexibility, cost, and scalability of the proposed concept. At the end of the independent judging the individual scores were tallied and combined. The Panel convened several conference calls and then attended an all-day web conference to discuss the strengths and weaknesses of each submission and arrive at a consensus judges opinion. Solutions that did not meet all criteria, but were deemed novel, interesting, and potentially worth pursuing, were eligible to win a partial prize.

Results: Of the 75 entries submitted by 224 participants between August 29 and October 11, 2016, prizes were awarded to five winners.

Budget and Resources: In FY17, there was $20,000 in funding and 0.29 FTE used. FTE reported is based on labor budget consumption during the indicated fiscal year. Work represents competition judging and final reporting. Budget reported excludes FTE staffing, and includes only purse payment; budget consumption by prize competition vendor service occurred prior to FY17.

Partnerships: USACE and State of Colorado Natural Resources Dam Safety Branch provided in-kind support for design and judging of the prize competition. The agencies also provided assistance with marketing and outreach. No monetary or non-cash awards were provided by partners.

Advancement of Agency Mission: Rodents can burrow through both sides of an embankment providing a pathway for water to move through and erode the embankment, potentially causing serious issues for the surrounding communities. Burrows may also intersect or expose other anomalies in the embankment that may result in a failure of the embankment and interruption of water supply to clients. This prize competition advanced the agency's mission of reliable water delivery by proposing new solutions to solve failures of canal embankments due to rodent burrows.

Solution Types: Ideas

Plan for Upcoming 2 FYs: Future consideration to increase the effectiveness and efficiency of conducting prize competitions include: incorporating a method for judges to quickly set aside solutions that have no merit, such as a quick initial reality check on the question, "Can this work?"; in addition to the stated judging criteria, incorporate a free format field for each judge to characterize the merits of the solution in their own words based on the strengths and weaknesses they see. For prize competitions, such as this one, where a successful system needs to solve a suite of different problems to successfully meet system requirements, a separate prize for each piece of the problem should be considered. Alternatively, Reclamation could consider a competition that focuses only on the most difficult part of the system problem.

A.4.15 Sub-Seasonal Climate Forecast Rodeo[38]

Lead Sponsoring Agency: USBR

Status: This competition was launched in FY17 and is underway in FY18.

Competition Goals: Water managers need more skillful information on weather and climate conditions with lead-times ranging from 15 days to 45 days and beyond. Lacking skillful sub-seasonal information limits water managers' ability prepare for shifts in hydrologic regimes, such as the onset of drought or

[38] The websites for the Sub-Seasonal Climate Forecast Rodeo are accessible at https://www.usbr.gov/research/challenges/forecastrodeo.html; https://www.drought.gov/drought/sub-seasonal-climate-forecast-rodeo; https://www.innocentive.com/ar/challenge/9933764; and https://www.challenge.gov/challenge/sub-seasonal-climate-forecast-rodeo/.

occurrence of wet weather extremes. The challenge of sub-seasonal forecasting is that it encompasses the time frame where initial state information (e.g., coupled land-atmosphere processes) becomes less important and slowly varying long term states (e.g., sea surface temperatures, soil moisture, snow pack) become more important to prediction skill. This is a Reduction to Practice Challenge. Solvers will have three months to develop their system before the forecasting rodeo begins, at which point they are asked to provide forecasts every two weeks over a 13 month period, with the first month being a "pre-season" to become familiar with the submission and evaluation processes. Including judging, awarding of prizes, and identification of next steps, the expected completion is mid-2018. It is possible that another competition may be a recommended next step, perhaps focusing on extremes or a longer outlook. A variety of prizes may be awarded as part of this competition, the total of which is approximately $800,000. Prize categories are based on skill at two outlook timescales (weeks 3-4 and weeks 5-6) and for temperature as well as precipitation.

Goal Types: Solve a specific problem; Advance scientific research; Develop technology; Engage new people and communities

Justification for Using Prizes and Challenges: A prize competition was selected as a preferred method to achieve the aforementioned goals because it helps engage a non-traditional, national solver community while also complementing traditional research designed to target the most persistent science and technology challenges. Competitions also can incentivize the submission of solutions. They are made open to a national, non-Federal solver community including citizens, businesses, and other organizations. Reclamation selected a prize competition to address this technical Challenge because it allowed the agency to pay only for results; established an important goal without having to limit approaches or teams that are most likely to succeed; increased the number and diversity of the individuals, organizations, and teams that would address the problem or challenge of national/international significance; can stimulate private sector investment that is many times greater than the cash value of the prize; and furthered Reclamation's mission by attracting more interest and attention to a defined program, activity, issue or concern.

Cash Prize Purses and/or Non-Cash Prize Awards: The cash prize purse of $800,000 was funded via Reclamation's Science and Technology Program, Research and Development Office as per Federal Acquisition Regulation (FAR, as codified at Chapter 1 of Title 48 of the Code of Federal Regulations, 48 C.F.R.). Judging is in progress.

Solicitation of Submissions: Reclamation created a unique webpage as well as cross-posted at Challenge.gov and InnoCentive sites. A video was created and shared via YouTube to support social media outreach, while a webinar was hosted to accompany the launch news release. InnoCentive was the prize competition administrator. The advantage of contracting with InnoCentive was the ability to bundle and brand the portfolio of Reclamation's Water Prize Competition Center while leveraging InnoCentive's global network of 380,000+ individuals. Overall, the quality and types of proposed solutions varied significantly. Many submissions, any of whom could be a potential winner, proposed technologies or methods already in practice with little or no potential to improve existing capabilities. Others, although some might be considered novel or different, were judged to not meet solution requirements or not feasible. No new, ready-to-implement, "silver bullet" was found to solve this difficult problem; however Reclamation understands this is not a realistic expectation for a single-stage ideation prize completion. Five solutions were considered worthy of a prize award consistent with the stated prize competition rules and criteria. Lessons learned include the need for casting a wider solver net, as well as more support for the payments process. With this in mind, Reclamation is pursuing an Interagency Agreement with NASA's Center of Excellence for Collaborative Innovation to allow access

to trending models, infrastructure, expertise and multiple external competition crowdsourcing services.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Day-long event(s) prior to the competition; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies); Other - Advertisement in Reclamation's Knowledge Stream R&D magazine

Participation Requirements: This prize competition targeted the Challenge.gov and InnoCentive solver communities. This Challenge was conducted under the authority of the America COMPETES Reauthorization Act of 2010 (15 U.S.C.§ 3719). The Act states that awards for this Prize Competition may only be given to an individual that is a citizen or permanent resident of the United States, or an entity that is incorporated in and whose primary place of business is in the United States. Other restrictions were published in the Challenge Specific Agreement on the InnoCentive website.

Evaluation of Submissions: Judging is in progress.

Results: Entries were submitted between December 20, 2016 and May 3, 2018, and winners are yet to be determined.

Budget and Resources: In FY17, the funding was $64,757 and there was 0.3 FTE used. In FY18, the funding was $104,926 and there was 0.15 FTE used. FTE reported is based on labor budget consumption during the indicated fiscal year. Work represents competition judging and final reporting. Budget reported excludes FTE staffing, and includes only purse payment; budget consumption by prize competition vendor service.

Partnerships: NOAA co-led the design of this Challenge along with Reclamation. NOAA will also host the leaderboard and assist with evaluating the submissions. NOAA's mission includes science, service and stewardship. Specifically, NOAA aims to understand and predict changes in climate, weather, oceans, and coasts; to share that information and knowledge with others; and to conserve and manage coastal and marine ecosystems and resources (www.noaa.gov). USGS and USACE contributed subject matter experts to review and assist with the design of this Challenge. The mission of the USGS is to serve the Nation by providing reliable scientific information to describe and understand the Earth; minimize loss of life and property from natural disasters; manage water, biological, energy, and mineral resources; and enhance and protect our quality of life (www.usgs.gov). The mission of the USACE is to deliver vital public and military engineering services; partnering in peace and war to strengthen our Nation's security, energize the economy and reduce risks from disasters (www.usace.army.mil).

Advancement of Agency Mission: Techniques that outperform current forecast practices are expected to offer valuable insight as to how operational forecasts can be improved at the sub-seasonal timescale. This in turn will offer a variety of sectors—not just water management—much needed information to better manage resources and prepare for extreme events. A few examples include advanced emergency preparedness, enhanced water order scheduling, and wildfire management.

Solution Types: Analytics, visualizations, algorithms

Plan for Upcoming 2 FYs: Future consideration to increase the effectiveness and efficiency of conducting prize competitions include: incorporating a methods for judges to quickly set aside solutions that have no merit, such as a quick initial reality check on the question, "Can this work?"; in addition to the stated judging criteria, incorporate a free format field for each judge to characterize the merits of the solution in their own words based on the strengths and weaknesses they see.

A.5 Department of Health and Human Services (HHS)

A.5.1 AHRQ Step Up App Challenge: Advancing Care Through Patient Assessments[39]

Lead Sponsoring Agency: Agency for Healthcare Research and Quality (AHRQ)

Status: This competition was launched in FY18, and is underway.

Competition Goals: While patient-reported outcomes (PRO) data have proven useful to healthcare providers, they are not widely used in clinical settings. Existing PRO data collection methods can inconvenience busy patients and providers and make the data difficult to access and analyze due to a lack of standardization. Developing an easily adoptable tool that collects and shares standardized data should help solve this problem and advance the state of PRO usage. In this Challenge, AHRQ is looking for teams to design, develop, and pilot a user-friendly application that simplifies and standardizes the process of collecting, interpreting, aggregating, and sharing PRO data related to physical function outcomes in the ambulatory care setting.

Goal Types: Find and highlight innovative ideas; Solve a specific problem; Advance scientific research; Develop technology; Engage new people and communities; Stimulate a market

Justification for Using Prizes and Challenges: The prize competition furthers AHRQ's mission by generating innovative ideas to address agency goals. The hope is that attracting diverse teams via a challenge competition can bring innovation. The prize competition stimulates private sector investment that is many times greater than the cash value of the award. AHRQ can receive innovative solutions within a short time frame.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered is $250,000. In Phase one, AHRQ awarded ten winners with $12,000 each. In Phase two, three winners were awarded. The grand prize winner was awarded $35,000 and invited to pilot their app with MedStar Health. Second- and third-place winners received $30,000 and $25,000, respectively. The grand prize winner will receive another $40,000 after the pilot test.

Solicitation of Submissions: AHRQ promoted the Challenge through the Blue Button 2.0 Developer Conference, AHRQ's press release, blog, listserv, social media (e.g., Facebook, Twitter), and stakeholders outreach. The Office of the National Coordinator for Health Information Technology (ONC) also promoted the Challenge through their listserv.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Other - Blue Button 2.0 Developer Conference; Other - Webinar

Participation Requirements: Participants in the AHRQ Step Up Challenge are subject to the following requirements: (1) Shall have registered to participate in the Challenge under the rules promulgated by the Agency for Healthcare Research and Quality; (2) Shall have complied with all the stated requirements of the Step Up App Challenge; (3) 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; (4) May not be a Federal entity or Federal employee acting within the scope of their employment; (5) Shall not be an HHS employee working on their applications or Submissions during assigned duty hours; (6) Shall

[39] The website for the AHRQ Step Up App Challenge: Advancing Care Through Patient Assessments can be viewed at https://www.Challenge.gov/challenge/ahrq-step-up-app-challenge/ https://www.ahrq.gov/stepupappchallenge/index.html.

not be an employee of the Agency for Healthcare Research and Quality; (7) Federal grantees may not use Federal funds to develop COMPETES Act Challenge applications unless consistent with the purpose of their grant award; and (8) 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.

Evaluation of Submissions: Phase one evaluation criteria included team/participant capabilities (20%), impact (30%), feasibility (30%), and originality (20%). Phase two evaluation criteria includes technical merit (40%), usability and functionality (30%), and deployability (30%).

Results: In October 2018, ten winners were selected from Phase one to compete in Phase two (app development). In March 2019, three winners were selected from Phase two. The grand prize winner is partnering with MedStar Health to pilot test the winning app (Phase three). Phase three pilot testing is scheduled to complete in September 2019.

Budget and Resources: AHRQ received funding from the Secretary's portion (managed by ASPE) of the Patient Centered-Outcomes Research Trust Fund to manage a project to advance the collection and use of patient-reported outcome data through health information technology. AHRQ devoted $250,000 to hire a contractor to manage the Challenge and allocated another $250,000 as the total prize pot. AHRQ program staff manages the Challenge including being a COR on the contract to manage the Challenge, coordinating with Federal partners, and working with AHRQ's Office of Communications to promote the Challenge. AHRQ Office of Communications staff set up an AHRQ microsite for the Challenge and promoted the Challenge via different mechanisms such as social media and blog posts. Approximately 1 FTE was utilized.

Partnerships: The AHRQ Step Up App Challenge is one component within a PRO project funded by Secretary's portion (managed by the Office of the Assistant Secretary for Planning and Evaluation) of the Patient-Centered Outcomes Research Trust Fund. ONC received $2 million as a partner in the PRO project. ONC provides technical expertise and hired a contractor to develop the technical specifications that will be used in the AHRQ Step Up App Challenge. ONC also shares experience with hosting challenges and promoted AHRQ's Challenge through their listserv. NIH provides expertise and consultation regarding the Patient-Reported Outcomes Measurement Information System (PROMIS®) physical function measures that are used in the Challenge. They also connected AHRQ staff with the faculty member at Northwestern University who manages the PROMIS Assessment Center Application Program Interface (API). A faculty member at Northwestern University provides in-kind technical support regarding the use of the PROMIS Assessment Center API to Challenge participants.

Advancement of Agency Mission: AHRQ is the lead Federal agency charged with improving the safety and quality of America's health care system. AHRQ develops the knowledge, tools, and data needed to improve the health care system and help Americans, health care professionals, and policymakers make informed health decisions. The Step Up App Challenge is part of AHRQ's ongoing effort to help shape the Nation's digital health care ecosystem and realize its potential to improve outcomes through broader use of patient data. PRO data or patient self-assessments offer a complementary perspective to clinician assessments and are also used in research to explore patient perspectives about their treatments, health outcomes, and the quality of services they received. Having user- friendly apps that are capable of collecting standardized PRO data in various ambulatory settings can increase clinicians' ability to use the data or easily share these data across health systems for research or other purposes, including quality improvement.

Solution Types: Software and apps

Plan for Upcoming 2 FYs: AHRQ will be hosting at most two challenges in the form of a datathon or codeathon that focuses on increasing accessibility to data analytics and utilizing AHRQ's rich data resources to develop innovative and timely insights into the healthcare system to make data more accessible to the public. This will address AHRQ's mission to make health care safer, higher quality, more accessible, equitable, and affordable is understood and used.

A.5.2 2017 Million Hearts® Hypertension Control Challenge[40,41]

Lead Sponsoring Agency: Centers for Disease Control (CDC)

Status: This competition was completed in FY17.

Competition Goals: Heart disease and stroke are the first and fifth leading causes of death in the United States. High blood pressure, or hypertension, is a leading risk factor for both conditions with approximately 1.5 million heart attacks and strokes occurring in the U.S. annually. Yet, of the 75 million adults with hypertension only half have their blood pressure under control. The Million Hearts® Hypertension Control Challenge seeks to identify clinical practices and health systems that excel in hypertension control and to identify the successful strategies used by those who excel in hypertension control in order to broadly share and promote those strategies. Through past challenges, including the 2017 Challenge, CDC has identified 83 clinical practices and health systems who care for 5 million patients with hypertension. The average control rate among these champions is 79%.

Goal Types: Find and highlight innovative ideas

Justification for Using Prizes and Challenges: The Million Hearts® initiative, co-led by CDC and the Centers for Medicare and Medicaid, aims to prevent a million heart attacks and strokes and related conditions by 2022. In support of that goal, CDC was interested in gathering documentation from clinical practices and health systems regarding successful strategies that support hypertension control. The 2017 Hypertension Control Challenge was a way to recognize and promote clinicians who are excelling at hypertension control in their patient population and then using their successful strategies to encourage others to improve hypertension control.

Cash Prize Purses and/or Non-Cash Prize Awards: No prize purse or monetary incentives were offered for this Challenge. Champions received local and national recognition through the Million Hearts® and CDC websites, as well as national press releases congratulating the champions. Documentation of clinical systems and strategies champions adopted that support hypertension control are housed online and attributed to the champions.

Solicitation of Submissions: The Challenge was promoted through Challenge.gov, the Million Hearts® website, through social media (Facebook, Twitter), and by other Federal and non-Federal partners. All HHS agencies are Million Hearts® partners. The Challenge was also promoted through email to partners.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies); Other - Website

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[40] The website for the 2017 Million Hearts® Hypertension Control Challenge can be viewed at https://www.challenge.gov/challenge/2018-million-hearts-hypertension-control- challenge/.

[41] The 2017 Million Hearts® Hypertension Control Challenge was conducted under the COMPETES Reauthorization Act of 2010, as well as Public Health Service Act 42 USC 241.

Participation Requirements: The 2017 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. Participants were required to treat all adult patients with hypertension in the practice seeking care, not a select subgroup of patients; treat a minimum of 500 adult patients annually; have a hypertension control rate of at least 70% during the 12-month reporting period; have a data management system (electronic or paper) that allows for verification of data submitted; and be free from convictions or pending investigations of criminal and health care fraud offenses and must not have any serious sanctions for healthcare fraud or mis-prescribing of prescription medications.

Evaluation of Submissions: Applications were initially evaluated by CDC staff for completeness and plausibility and any areas of concern are noted. A contractor experienced in validating hypertension control rates completed a background check on the applicants. Data validation was done by the contractor to determine if proper methods were used in calculation the hypertension control rates and various patient population characteristics such as the prevalence of hypertension in their population. Applicants were required to submit documentation that a random sample of the hypertensive population (up to 30 patients) had a documented diagnosis of hypertension prior to the most recent blood pressure measurement. CDC reviewed all information from the contractor and submitted the findings to a panel of judges who were CDC FTEs for determination of whether the applicants satisfied the requirements for being a champion. In 2017, applicants were required to have at least a hypertension control rate of 70%.

Results: Of the 98 entries submitted by participants, prizes were awarded to 24 winners.

Budget and Resources: Agency resources included 5% FTE time; $40,000 cost to build the data collection website; and $179,000 contractor cost for data validation.

Partnerships: Non-Federal partners included the National Association for Chronic Disease Directors.

Advancement of Agency Mission: Hypertension is a leading risk factor for heart disease and stroke, the first and fifth leading causes of death in the U.S., respectively. Prevention of heart disease and stroke is a major focus for CDC's National Center for Chronic Disease Prevention and Health Promotion. The CDC and the Centers for Medicare and Medicaid co-lead the Million Hearts® initiative, with a mission to prevent a million heart attacks, strokes, and related conditions by 2022.

Solution Types: Ideas

Plan for Upcoming 2 FYs: The 2018 Million Hearts Hypertension Control Challenge is in the final stages and champions will be announced in November 2018. The 2019 Challenge is planned to launch in February 2019.

A.5.3 2018 Million Hearts® Hypertension Control Challenge[42,43]

Lead Sponsoring Agency: CDC

Status: This competition was underway in FY18.

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[42] The website for the 2018 Million Hearts® Hypertension Control Challenge can be viewed at https://www.challenge.gov/challenge/2018-million-hearts-hypertension-control- challenge/.

[43] The 2018 Million Hearts® Hypertension Control Challenge was conducted under the COMPETES Reauthorization Act of 2010, as well as Public Health Service Act 42 USC 241.

Competition Goals: Heart disease and stroke are the first and fifth leading causes of death in the United States. High blood pressure, or hypertension, is a leading risk factor for both conditions with approximately 1.5 million heart attacks and strokes occurring in the U.S. annually. Yet, of the 75 million adults with hypertension only half have their blood pressure is under control. The Million Hearts® Hypertension Control Challenge seeks to identify clinical practices and health systems that excel in hypertension control and to identify the successful strategies used by those who excel in hypertension control in order to broadly share and promote those strategies. Through past challenges, including the 2017 challenge, CDC has identified 83 clinical practices and health systems who care for 5 million patients with hypertension. The average control rate among these champions is 79%.

Goal Types: Find and highlight innovative ideas

Justification for Using Prizes and Challenges: The Million Hearts® initiative, co-led by CDC and the Centers for Medicare and Medicaid, aims to prevent a million heart attacks and strokes and related conditions by 2022. In support of that goal, CDC is interested in gathering documentation from clinical practices and health systems regarding successful strategies that support hypertension control. The 2018 Hypertension Control Challenge is a way to recognize and promote clinicians who are excelling at hypertension control in their patient population and then using their successful strategies to encourage others to improve hypertension control.

Cash Prize Purses and/or Non-Cash Prize Awards: No prize purse or monetary incentives are offered for this challenge. Champions will receive local and national recognition through the Million Hearts® and CDC websites, as well as national press releases congratulating the champions. Documentation of clinical systems and strategies champions adopted that support hypertension control will be housed online and attributed to the champions.

Solicitation of Submissions: The Challenge is promoted through challenge.gov, the Million Hearts® website, through social media (Facebook, twitter), and by other Federal and non-Federal partners. All HHS agencies are Million Hearts® partners. The Challenge was also promoted through email to partners.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies); Other - Website

Participation Requirements: 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. Participants are required to treat all adult patients with hypertension in the practice seeking care, not select a subgroup of patients; must treat a minimum of 500 adult patients annually; have a hypertension control rate of at least 80% during the 12-month reporting period; have a data management system (electronic or paper) that allows for verification of data submitted; and be free from convictions or pending investigations of criminal and healthcare fraud offenses and must not have any serious sanctions for healthcare fraud or mis-prescribing of prescription medications.

Evaluation of Submissions: Applications are initially evaluated by CDC staff for completeness and plausibility and any areas of concern are noted. A contractor experienced in validating hypertension control rates completes a background check on the applicants. Data validation is done by the contractor to determine if proper methods were used in calculation the hypertension control rate and various patient population characteristics such as the prevalence of hypertension in their population. Applicants must submit documentation that a random sample of the hypertensive population (up to 30 records) has a documented diagnosis of hypertension prior to the most recent blood pressure measurement. CDC reviews all information from the contractor and submits the findings to a panel of judges who are CDC FTEs for determination of whether the applicants have satisfied the requirements

for being a champion. In 2018, applicants were required to have at least a hypertension control rate of 80%.

Results: At the time of this report, the 2018 Million Hearts Hypertension Control Challenge had received 23 entries by participants. Champions will be announced in November 2018.

Budget and Resources: Agency resources included 5% FTE time; $40,000 cost to build the data collection website; $179,000 contractor cost for data validation.

Partnerships: Non-Federal Partners included the National Association for Chronic Disease Directors.

Advancement of Agency Mission: Hypertension is a leading risk factor for heart disease and stroke, the first and fifth leading causes of death in the U.S., respectively. Prevention of heart disease and stroke is a major focus for CDC's National Center for Chronic Disease Prevention and Health Promotion. The CDC and the Centers for Medicare and Medicaid co-lead the the Million Hearts® initiative, with a mission to prevent a million heart attacks, strokes, and related conditions by 2022.

Solution Types: Ideas

Plan for Upcoming 2 FYs: Challenges are planned to launch in February of 2019-2022.

A.5.4 The Healthy Behavior Data Challenge[44]

Lead Sponsoring Agency: CDC

Status: This competition was launched in FY17 and completed in FY18.

Competition Goals: The Healthy Behavior Data Challenge responds to the call for new ways to address the challenges and limitations of self-reported health surveillance information and tap into the potential of innovative data sources and alternative methodologies for public health surveillance. The Division of Population Health at the CDC wanted to explore new, innovative alternative approaches to gather key health-related information, data that are critical for effective and efficient public health program and policy planning and implementation. The Healthy Behavior Data Challenge supported the development and implementation of prototypes to use these novel methodologies and data sources (e.g., wearable devices, mobile applications, and/or social media) to enhance traditional chronic disease surveillance systems in the areas of nutrition, physical activity, sedentary behaviors, and sleep among the adult population aged 18 years and older.

Goal Types: Find and highlight innovative ideas; Solve a specific problem

Justification for Using Prizes and Challenges: The Behavioral Risk Factor Surveillance System (BRFSS) is the Nation's premier system of health-related telephone surveys that collect state data about U.S. residents regarding their health-related risk behaviors, chronic health conditions, and use of preventive services. Continued data collection methodological research is needed. In recent years, the reduced BRFSS funding did not allow for funding of innovative research in data collection methodology. Challenges and competitions enabled the Federal Government to tap into the expertise and creativity of the public in new ways. Challenges and competitions are high-risk, high-reward policy tools that can foster collaboration and participation in government activities through the process of co-creation. As an inducement of participation, challenges and competitions may offer a variety of prizes including

[44] The website for the The Healthy Behavior Data Challenge can be viewed at https://www.Challenge.gov/challenge/the-healthy-behavior-data-challenge/.

cash, recognition, or the deployment of a winning solution. Federal agencies have explicit statutory authority to conduct Challenges and award prizes through the America COMPETES Act.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered was $100,000 and the total amount awarded was $85,000. The Population Health Surveillance Branch (PHSB) awarded $5000 to each of the five Phase I winners. The Phase II winners were award $40,000 and $20,000 for first and second place, respectively. All prizes were awarded in FY18.

Solicitation of Submissions: The Healthy Behavior Data Challenge was a main stage announcement at the 2017 Health Datapalooza on April 29, 2017. The Challenge was posted on Challenge.gov, Twitter, CDC Govdelivery for those interested in BRFSS, and on the CDC Website.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Other - Announcement of the Challenge at the 2017 Health Datapalooza

Participation Requirements: N/A

Evaluation of Submissions: A committee of FTEs consisting of 13 staff members read and rated the submissions for Phase I. Each committee member provided an independent rating. The committee then met to achieve consensus on the winners of Phase I. A total of 6 FTEs reviewed the more limited submissions for Phase II. Each member provided independent reviews of each of the submissions and committee meetings were held to reach consensus.

Results: Phase I (prototype development) received nine submissions between April 29 and July 31, 2017 and awarded $5,000 each to five challenge winners. Phase II (prototype implementation) received four submissions between October 26, 2017 and January 31, 2018, and awarded $40,000 and $20,000 to the first and second place winners, respectively.

Budget and Resources: The Innovation Fund (IFund) supported the prize money costs associated with the Challenge. PHSB was awarded $100,000 through the IFund to research an innovative data collection methodology using wearable devices. PHSB awarded $5,000 to each of the five Phase I winners. The Phase II winners were award $40,000 for 1st place and $20,000 for 2nd place. There were 3 FTEs that participated in the meetings to design the implementation of the Challenge. There were 13 FTEs that reviewed and scored the Phase I submissions. There were 6 FTEs that reviewed and scored the Phase II finalist. FTEs were able to complete these tasks without additional budget.

Partnerships: PHSB partnered with HHS, the Public Health Agency of Canada, Canadian Institutes for Health Research, and MaRS Discovery District.

Advancement of Agency Mission: Public health information is essential to plan, fund and evaluate health program outcomes, and to understand population health status, use of preventive measures and risk behaviors. Population health surveillance has tracked self-reported health behaviors using a variety of data collection modes in the past. These include personal interviews, telephone surveys, paper and pencil questionnaires and web-based data collection. These methods are both costly and time consuming and are subject to measurement error related to recall and selective bias. Wearable devices track a number of health behaviors in a passive manner which eliminates bias. The ability to track data using wearable devices apps, and other social media has the potential to decrease costs and eliminate some bias. This project will advance understanding of whether wearable device information can be used to supplement surveillance data. This information will forward the goal of efficient data collections methods which can be used to track healthy behaviors such as adequate sleep, physical activity and nutritious food consumption.

Solution Types: Software and apps; Ideas

Plan for Upcoming 2 FYs: Development of a challenge aimed at discovering and testing novel ways to validate the fruits and vegetable questions from the BRFSS using wearable devices.

A.5.5 2016 FDA Naloxone App Competition[45]

Lead Sponsoring Agency: Food and Drug Administration (FDA)

Status: This competition was completed in FY17.

Competition 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 to foster the development of a multi-disciplinary community engaged in addressing this public health issue.

Goal Types: Find and highlight innovative ideas; Engage new people and communities

Justification for Using Prizes and Challenges: One of the goals was to spur innovation in this area and the opportunity to launch a crowd-sourced challenge best supported this goal.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered and awarded was $40,000. Non-monetary incentives included the opportunity to participate in a Code-A-Thon with background presentations by experts from NIH, National Highway Traffic Safety Administration (NHTSA), the Substance Abuse and Mental Health Services Administration (SAMSHA), and FDA.

Solicitation of Submissions: We used the Challenge.gov platform to receive submissions. Participants were asked to submit a brief synopsis of their idea and a video detailing their prototype design.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies);

Participation Requirements: N/A

Evaluation of Submissions: The judges were cross-agency. Prior to the in-person judging conference, all of the judges completed scoring sheets for the qualifying submissions. At the judging conference, each judge was provided the scores along with summary data on overall scoring for a submission. The judges reviewed any outliers and decided that the top six teams would move to the next phase of judging. Using a pairwise comparison for the top six submissions, the judges chose one winner.

Results: N/A

Budget and Resources: To execute this Challenge, there were 2 FTEs devoted to all aspects of designing, executing, and closing out the Challenge. This included creating the websites, managing the promotion/marketing of the competition, responding to inquiries from interested participants, organizing the Code-A-Thon, convening the judging panel and handling the budget and administrative aspects of the competition. FY17 funding was $40,000, with $20,000 from the Office of Public Health Strategy and Analysis (OPHSA) and $20,000 from the Patient Affairs and Stakeholder Engagement (PASE) staff.

[45] The website for the 2016 FDA Naloxone App Competition can be viewed at https://www.Challenge.gov/challenge/the-2016-fda-naloxone-app-competition/.

Partnerships: FDA received in-kind support from NIH, SAMSHA, and NHTSA in the form of presenters, judges, and participants at Code-A-Thon.

Advancement of Agency Mission: The 2016 FDA Naloxone App Competition aligned with agency's mission to promote the safe use of opioids.

Solution Types: Software and apps

Plan for Upcoming 2 FYs: The Commissioner recently released FDA's Strategic Policy Roadmap outlining four priority areas: (1) reduce the burden of addiction crises that are threatening American families; (2) leverage innovation and competition to improve health care, broaden access, and advance public health goals; (3) empower consumers to make better and more informed decisions about their diets and health; and expand the opportunities to use nutrition to reduce morbidity and mortality from disease; (4) strengthen FDA's scientific workforce and its tools for efficient risk management. There may be opportunities in these areas for challenge competitions.

A.5.6 Bridging the Word Gap Challenge[46]

Lead Sponsoring Agency: Health Resources and Services Administration (HRSA)

Status: This competition was completed in FY17.

Competition Goals: The word gap is the difference between the number of words children from low-income families are exposed to as compared to children from high-income families. By age three, children from low-income families are hearing 30 million fewer words than those from higher-income families. This is staggering and it can have serious consequences. It can influence how young children develop language skills and affect their future performance in school and ultimately in their careers. The main goal of the Challenge was 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. 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.

Goal Types: Find and highlight innovative ideas; Solve a specific problem; Develop technology; Inform and educate the public; Engage new people and communities; Stimulate a market

Justification for Using Prizes and Challenges: While HRSA and others are actively investing in research to better understand the word gap issue, approaches to develop tools to encourage parents and caregivers to better interact with their children and expose them to more words are also needed. The Challenge was crafted to attract a wide range of innovators and to encourage development of low-cost, scalable technology-based interventions. These interventions would not only immediately benefit children from low-income families, but serve as tools to further research. It would also encourage more diverse approaches to increase the odds of breakthrough solutions. HRSA selected the challenge mechanism to solicit creative solutions and to attract new thinking and new combinations of talent to this issue. Additionally, as opposed to a grant or contract where an agency pays for the final product at the initial time of award, the HRSA wanted to establish the three-phase structure where applicants would learn what was working and what was not working, continuously incorporate user feedback, and refine each iteration until the best possible innovation was developed. This structure was highly effective and resulted in the development of tested, improved, human-centered final solutions. Semi-finalists, who would otherwise have been ineligible for grants or contracts, echoed this unique

[46] The website for the Bridging the Word Gap Challenge is archived at: http://wordgap.capconcorp.com/.

opportunity to participate in a Federal program. Winners represented, among others, Silicon Valley start-ups, local non-profits, and a group of former teachers turned farmers. One feedback quote we received from a semi-finalist highlights the role the challenge mechanism can play: "I wish more of the Federal Government were like this. I've submitted super long grant applications with bizarre formatting requirements. Due to their sheer length, I now disregard most such programs. In contrast, I have nothing but positive things to say about this experience. If the government really wants to attract innovation from places like Silicon Valley this is how you should do it."

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered and awarded was $300,000. Non-monetary incentives included expert feedback, public recognition, access to one-on-one advisors, connections to stakeholders in the field, networking opportunities, and a live broadcast Demo Day.

Solicitation of Submissions: HRSA Maternal and child Health Bureau (MCHB), as well as the contractor, Sensis, used social media, email outreach, partnerships with outside organizations, and live video streaming of the Demo Day to market the competition as well to promote the winners of each phase. The solicitation strategy reached diverse populations outside of the normal reach of government to garner Phase 1 submissions, including technology sector, start-ups, and communities of solvers. The Challenge was also promoted 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. The help of these advisors was critical to the success of outreach efforts.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Live video streaming; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies)

Participation Requirements: The Challenge used the standard eligibility requirements as suggested in the HHS IDEA Lab guidance.

Evaluation of Submissions: A Federal judging panel, with input from the challenge advisors, made the judging decisions in all phases. For Phase 1, both qualitative and quantitative goals were set that allowed for a cohort of the highest-scoring submissions to be discussed and then evaluated based on these scores in addition to qualitative considerations. For Phases 2 and 3, 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 winners. These evaluation methods have been highly effective. More details on the evaluation criteria for each phase are available on the website, but included elements such as accessibility, measurability, sustainability, impact, implementation, and evidence-base.

Results: Of the 80 entries submitted for Phase 1 between November 9, 2015 and January 29, 2016, 10 winners were awarded $10,000 each. Of these 10 entries, five winners were awarded $25,000 each during Phase 2, which ran March 11 through August 11, 2016. One grand winner was awarded $75,000 in Phase 3 which ran September 26, 2016 through March 26, 2017.

Budget and Resources: HRSA MCHB worked with a contractor to implement the Challenge. Sensis was awarded an approximately $296,000 contract for 3 years in September 2014. In 2016, HRSA MCHB used $16,000 to fund the travel of the nine Phase 1 winners to attend and compete in the in-person Demo Day held at HHS, where the 5 winning teams were announced for Phase 2. These resources are separate and distinct from the prize purse. The Challenge utilized approximately 1.5 FTE. The source of funds is the Social Security Act, Title V, Special Projects of Regional and National Significance. Specifically, the

amount allocated is as follows: Appropriation: 75-15—0354 Allotment: HRMCHB49000 Allowance: 1650100089 Amount: $300,000 (obligated).

Partnerships: As mentioned before, nine expert advisors provided insight and guidance on all aspects of the Challenge, including design and evaluation criteria, and who also served as individual mentors to the Phase 1 winners and judges. HRSA partnered with other agencies to staff the Federal judging panel; Federal judges included staff from the Department of Education, the Office of the Assistant Secretary for Planning and Evaluation, and the Administration for Children and Families. The primary lesson learned from these partnerships is the incredible value of the perspectives of a diverse set of expert advisors whose feedback to the teams greatly improved the quality of their interventions as they developed.

Advancement of Agency Mission: The mission of HRSA is to improve health and achieve health equity through access to quality services, a skilled health workforce and innovative programs. As part of HRSA, the mission of MCHB is to improve the health of America's mothers, children, and families. The Challenge produced one grand winner and the seeding and support for five innovations that are available for widespread use through iTunes and Google Play, helping HRSA MCHB in addressing the word gap and in advancing the health and well-being of America's children.

Solution Types: Software and apps; Creative (design & multimedia); Ideas; Technology demonstration and hardware

Plan for Upcoming 2 FYs: N/A

A.5.7 Addressing Opioid Use Disorder in Pregnant Women and New Moms[47]

Lead Sponsoring Agency: HRSA, Maternal and Child Health Bureau (MCHB)

Status: This competition was launched in FY18.

Competition Goals: Women who are pregnant or are new mothers struggling with opioid use disorder face a variety of barriers in obtaining safe and effective care and treatment including limited access to quality care, significant stigma, interactions with the criminal justice system, and limited social supports. Women and families in rural and under-resourced communities are particularly affected. The Challenge's main goal is to improve access to quality health care, including substance use disorder and treatment, recovery, and support services for pregnant women with opioid use disorders, their infants, and families, especially those in rural and geographically isolated areas. The Challenge will solicit innovative technology solutions aimed at reducing the barriers to care experienced by pregnant women and new moms with opioid use disorder.

Goal Types: Find and highlight innovative ideas; Solve a specific problem; Advance scientific research; Develop technology; Inform and educate the public; Engage new people and communities; Stimulate a market

Justification for Using Prizes and Challenges: This Challenge will support the development and testing of low-cost, scalable tech innovations to improve access to quality health care for pregnant women and new moms with opioid use disorder. The goal is to reach a diverse audience of solvers, and those who are not traditional HRSA stakeholders or grantees. Additionally, HRSA hopes to accelerate the

[47] The website for the Addressing Opioid Use Disorder in Pregnant Women and New Moms can be viewed at https://mchbgrandchallenges.hrsa.gov/challenges/addressing-opioid-use-disorder- pregnant-women-and-new-moms.

proliferation of technology-based solutions in a more accelerated timeline than a contract or grant would allow.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered is $375,000, which will be awarded in three phases. Phase 1 will include seven to ten winners each of whom will be awarded up to $10,000 for design. Phase 2 will include three to five winners each of whom will be awarded up to $25,000 for development and small-scale testing. The grand winner will be awarded up to $150,000 in Phase 3. The source of funds is the Social Security Act, Title V, Special Projects of Regional and National Significance. Specifically, the amount allocated is as follows: Appropriation: 75-17-0354 Allotment: HRMCHB49000 Allowance: 1650100089 Amount: $375,000 (obligated). Non-monetary incentives included expert feedback, public recognition, access to one-on-one advisors, connections to stakeholders in the field, and networking opportunities.

Solicitation of Submissions: HRSA MCHB and the support contractor, Capital Consulting Corp, have used social media, email outreach, and partnerships with outside organizations to market the competition. MCHB also widely promoted the Challenge through existing grantee networks, with a goal of greater awareness of the challenge and submissions from academia. Ten challenge advisors widely promoted the Challenge through their professional networks, which include health systems, non-profit early childhood organizations, the technology field, and maternal and child health networks.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies)

Participation Requirements: Eligibility requirements are the standard requirements for HHS challenges.

Evaluation of Submissions: A Federal judging panel, with input from the challenge advisors will make the judging decisions in all phases. For each phase, the evaluation criteria will be adjusted, however the core subjects of accessibility, sustainability, impact, and innovation will be guides for the judging of submissions. Review criteria for all three Phases can be found at: https://mchbgrandchallenges.hrsa.gov/challenges/addressing-opioid-use-disorder-pregnant-women-and-new- moms/review-criteria.

Results: Phase 1 submissions were collected September 19 through November 19, 2018, and the Challenge is ongoing.

Budget and Resources: HRSA MCHB worked with a contractor to implement the Challenge. Capital Consulting Corp was awarded a $1,9013,755.34 contract for 3 years in September 2017. The contract funding supports managing all four challenges, as well as the prize money for all three phases. Additionally, approximately 2.5 FTEs have been involved in managing the project.

Partnerships: MCHB partnered with the National Institutes of Health (NIH) and the Centers for Medicare and Medicaid Services (CMS) to develop the Federal judging panel. The expert panel incorporated experts in the field of maternal and child health, including policy makers, providers, consumer of services and Federal representatives. These individuals provided insight on all aspects of the design and evaluation criteria and will serve as advisors to the Phase 2 challenge winners. Their involvement is invaluable to the success of this initiative. The primary lesson learned from our partnerships is the incredible value of a diverse set of expert advisors. They provide unique insights into multiple aspects of the process and their feedback to the teams will greatly improve the quality of their interventions as they proceed through each stage of the Challenge. The partnerships have assisted in the promotion of the Challenge in all phases, particularly in the initial phase in attracting high-quality applicants.

Advancement of Agency Mission: Spurring the use of technology to address barriers to treatment and care will help advance HRSA and MCHB missions to improve the health of women and children, as well

as achieve health equity through access to quality services. Along with the general population, there has been a rapid rise in opioid use among pregnant women in recent years resulting in a surge of infants born with Neonatal Abstinence Syndrome (NAS), increasing nearly fivefold nationally between 2000 to 2012. This increase has led to rising costs of care and gaps in services for this population. Medicaid payments to hospitals for NAS treatment services have increased from about $564 million to $1.2 billion nationwide, with more than 80 percent of NAS cases paid for by Medicaid. Despite this rising need, availability of services for pregnant and postpartum women is limited. Family-centered approaches to recovery address many of the barriers to care that women and families face, and research shows that women are more likely to seek and stay in treatment longer if they are able to maintain their caregiving role while in treatment, as well as either stay within the same treatment services or retain relationships with treatment providers throughout the provision of services. Technological innovations are poised to address these gaps and improve treatment and recovery services for pregnant women and new moms suffering from opioid use disorder.

Solution Types: Software and apps; Creative (design & multimedia); Ideas; Technology demonstration and hardware

Plan for Upcoming 2 FYs: Ten Phase 1 winners were chosen in Winter 2019, one winner dropped out. The Challenge is currently in Phase 2 with Demo Days scheduled for Fall 2019. Three to five Phase 2 winners will be announced on September 13, 2019 and will proceed to Phase 3.

A.5.8 Care Coordination for Children with Special Health Care Needs (CSHCN)[48]

Lead Sponsoring Agency: HRSA, MCHB

Status: This competition was launched in FY18.

Competition Goals: This Challenge will support the development and testing of low-cost, scalable, technology-based innovations to meet the needs of children with special health care needs (CSHCN) and their families. Innovations should improve the quality of care, enhance family engagement, and positively impact health care outcomes with the potential of saving costs to families, society, and to the health care system. An additional goal is to create partnerships between HRSA/MCHB and non-traditional partners to address issues through innovative technology solutions.

Goal Types: Find and highlight innovative ideas; Solve a specific problem; Develop technology; Engage new people and communities; Stimulate a market; Other - Improve health care delivery and experiences of health care

Justification for Using Prizes and Challenges: HRSA/MCHB sees the use of Federal prize challenges as a way to reach non-traditional partners—academics, entrepreneurs, private sector start-ups, research and development accelerators, non-profit organizations, the technology sector—to encourage new and different innovative approaches to address the need for cross-system information management for CSHCN in a way that our traditional grant programs would be unable to do. Given the complexity of the problem, solutions must come from multiple sources, involve multiple levels and sectors, and take into account the synergy of multiple strategies.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered is $375,000, which will be awarded in three phases. Phase 1 will include seven to ten winners each of whom will be awarded up to $10,000 for the Design. Phase 2 will include three to five winners each of whom will be awarded up to

[48] The website for the Care Coordination for Children with Special Health Care Needs (Cshcn) can be viewed at https://mchbgrandchallenges.hrsa.gov/challenges/care-coordination-cshcn/.

$25,000 for the Development and Small-Scale Testing. The final winner will be awarded up to $150,000 in Phase 3. The Challenge utilized approximately 0.5 FTE. The source of funds is the Social Security Act, Title V, Special Projects of Regional and National Significance. Specifically, the amount allocated is as follows: Appropriation: 75-17-0354 Allotment: HRMCHB49000 Allowance: 1650100089 Amount: $375,000 (obligated). Non-monetary incentives included expert feedback, public recognition, access to one-on-one advisors, connection to stakeholders in the field, and networking opportunities.

Solicitation of Submissions: HRSA/MCHB and Capital Consulting Corp have used social media, email outreach, and partnerships with outside organizations to market the competition. MCHB also widely promoted the Challenge through existing grantee networks and children with special health care needs stakeholder groups. The challenge advisors promoted the Challenge through their professional networks, which include health professional organizations, academia, family support and advocacy organizations, technology and health informatics fields, and maternal and child health networks.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies)

Participation Requirements: Eligibility requirements are the standard requirements for HHS challenges.

Evaluation of Submissions: A Federal judging panel, with input from the Challenge advisors will make the judging decisions across all phases. Review criteria for all three Phases are available at https://mchbgrandchallenges.hrsa.gov/care-coordination- cshcn/review-criteria.

Results: Entries were submitted from August 30 through October 30, 2018, and the Challenge is ongoing.

Budget and Resources: HRSA MCHB has worked with a contractor to implement the Challenge. Capital Consulting Corp was awarded a $1,913,755.34 contract for 3 years in September 2017. The contract funding supports managing all four challenges, as well as the prize money for all three phases. Additionally, multiple Federal staff members have been involved in managing the project.

Partnerships: MCHB partnered with other agencies to develop the Federal judging panel; Federal judges include staff from the ONC and the AHRQ. Partnerships with the expert panel and Federal judges have been invaluable. The expert advisors and Federal judges actively participated in the challenge development process. These individuals provided guidance in all aspects of the Challenge design, including the development of submission and review criteria. Their feedback and identification of resources greatly improved the quality of the Challenge solicitation. The partnerships have ensured vital stakeholders' views and needs are incorporated into the challenges, and wide promotion of the Challenge in stakeholder communities. Challenge advisors have donated time throughout the duration of the Challenge in-kind.

Advancement of Agency Mission: This Challenge addresses HRSA's mission which is to improve health and achieve health equity through access to quality services, a skilled health workforce and innovative programs. As part of HRSA, MCHB is committed to ensuring children with special health care needs, who account for approximately 19% of U.S. children, receive family-centered, community-based, coordinated care. This Challenge will address care coordination for CSHCN, particularly those with medical complexity, who often require complex and long-term health services, consume a disproportionate share of children's health care dollars, and experience disparities in accessing care. Effective care coordination and communication with the efficient flow of information across providers and settings have been demonstrated to improve the quality and experiences of care. However, for CSHCN, communication across systems of care is often fragmented and uncoordinated. HIT tools and low cost digital interfaces that enable consolidation and sharing of health information for use by families will contribute to care coordination across settings and providers for optimizing quality of care and experiences of these children and their families

Solution Types: Software and apps; Technology demonstration and hardware; Analytics, visualizations, algorithms

Plan for Upcoming 2 FYs: Phase 1 winners were chosen in Winter 2019. The Challenge is currently in Phase 2 with Demo Days scheduled for Fall 2019. Three to five Phase 2 winners will be announced on September 13, 2019 and will proceed to Phase 3.

A.5.9 Remote Pregnancy Monitoring[49]

Lead Sponsoring Agency: HRSA, MCHB

Status: This competition was launched in FY18.

Competition Goals: Many women who are low-income in both rural and urban communities face barriers in accessing prenatal care, many of which continue into the postpartum period (i.e., up to 3 months post-birth). Personal barriers (e.g., work, childcare, transportation, education, culture, and language), health system barriers (e.g., hours of operation, and lack of services), and environmental barriers (e.g., location, and connectivity or cell phone coverage) make it difficult to attend prenatal and postpartum care appointments. The current paradigm for prenatal care includes 15 face-to-face visits with providers. The content of those visits includes critical medical services, risk assessments, patient education, and building of trusting patient-provider relationships. The main goal of this Challenge is to solicit innovative solutions that increase remote and virtual access to quality care for low-income pregnant women. Such innovations may include alleviating barriers to quality care and improving communications among patients, providers and/or broader support networks. Solutions will empower pregnant women with knowledge and tools to take charge of their health and their care.

Goal Types: Find and highlight innovative ideas; Solve a specific problem; Advance scientific research; Develop technology; Engage new people and communities; Stimulate a market

Justification for Using Prizes and Challenges: This Challenge will support the development and testing of low-cost, scalable tech innovations to improve the ability of prenatal care providers to monitor the health and wellbeing of pregnant women, while helping pregnant women to monitor their own health and make informed decisions about care. The goal is to reach a diverse audience of solvers, and those who are not traditional HRSA stakeholders or grantees. Additionally, HRSA hopes to accelerate the proliferation of technology-based solutions in a more accelerated timeline than a contract or grant would allow.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered is $375,000 and has not yet been awarded. Phase 1 will include seven to ten winners, each of whom will be awarded up to $10,000 for design. Phase 2 will include three to five winners, each of whom will be awarded up to $25,000 for the development and small-scale testing. Phase 3 will award the final winner up to $150,000. The source of funds is the Social Security Act, Title V, Special Projects of Regional and National Significance. Specifically, the amount allocated is as follows: Appropriation: 75-17-0354 Allotment: HRMCHB49000 Allowance: 1650100089 Amount: $375,000 (obligated). Non-monetary incentives included expert feedback, public recognition, access to one-on-one advisors, connections to stakeholders in the field, and networking opportunities.

Solicitation of Submissions: HRSA MCHB and Capital Consulting Corp, have used social media, email outreach, and partnerships with outside organizations to market the competition. We also widely

[49] The website for the Remote Pregnancy Monitoring can be viewed at https://mchbgrandchallenges.hrsa.gov/challenges/remote-pregnancy-monitoring.

promoted the Challenge through existing grantee networks, with a goal of greater awareness of the challenge and submissions from academia. The ten challenge advisors widely promoted the challenge through their professional networks, which include non-profit early childhood organizations, the technology field, and maternal and child health networks.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies)

Participation Requirements: Eligibility requirements are the standard requirements for HHS challenges.

Evaluation of Submissions: A Federal judging panel, with input from the challenge advisors will make the judging decisions across all phases. For each phase, the evaluation criteria will be adjusted, however the core subjects of accessibility, sustainability, impact, and innovation will be guides for the judging of submissions. Review criteria for all three phases are available at https://mchbgrandchallenges.hrsa.gov/challenges/remote-pregnancy-monitoring/review-criteria.

Results: Entries were submitted between September and November 2018, and the Challenge is ongoing.

Budget and Resources: HRSA MCHB has worked with a contractor to implement the Challenge. Capital Consulting Corp was awarded a $1,913,755.34 contract for 3 years in September 2017. The contract funding supports managing all four challenges, as well as the prize money for all three phases. Additionally, multiple Federal staff members have been involved in managing the project. Approximately 2.5 FTEs were utilized in FY18.

Partnerships: HRSA partnered with other agencies to develop the Federal judging panel, which includes staff from NIH and CMS. The expert panel incorporated experts in the field of maternal and child health, including policy makers, providers, consumer of services and Federal representatives. These individuals provided insight on all aspects of the design and evaluation criteria and will serve as advisors to the Phase 2 challenge winners. Their involvement is invaluable to the success of this initiative. The primary lesson learned from these partnerships is the incredible value of a diverse set of expert advisors. They provide unique insights into multiple aspects of the process and their feedback to the teams will greatly improve the quality of their interventions as they proceed through each stage of the Challenge. The partnerships have assisted in the promotion of the Challenge in all phases, particularly in the initial phase in attracting high-quality applicants. Challenge advisors have donated time throughout the duration of the Challenge in-kind.

Advancement of Agency Mission: The mission of HRSA is to improve health and achieve health equity through access to quality services, a skilled health workforce and innovative programs. As part of HRSA, the mission of MCHB is to improve the health of America's mothers, children and families. Recent trends in hospital closures in rural America increase the need for technological innovations that support remote monitoring of pregnant women. Between 2004 and 2014, 179 rural counties (9% of all rural counties) lost access to in-county hospital obstetric services, and the percent of all rural counties in the U.S. that lacked hospital obstetric services increased from 45% to 54%, due to hospital and obstetric-unit closures. Many low-income women, in both rural and urban communities, do not access prenatal care. Technological advances have improved the ability of healthcare providers to monitor their patients from afar. Spurring the use of technology to address barriers to prenatal care will help advance HRSA and MCHB missions to improve the health of women and children, as well as achieve health equity through access to quality services.

Solution Types: Software and apps; Creative (design & multimedia); Ideas; Technology demonstration and hardware

Plan for Upcoming 2 FYs: Ten Phase 1 winners were chosen in Winter 2019, one winner dropped out. The challenge is currently in Phase 2 with Demo Days scheduled for Fall 2019. Three to five Phase 2 winners will be announced on September 13, 2019 and will proceed to Phase 3.

A.5.10 Using Technology to Prevent Childhood Obesity in Low-Income Families and Communities[50]

Lead Sponsoring Agency: HRSA, MCHB

Status: This competition was launched in FY18.

Competition Goals: The goal of this Challenge is to support the creation of multiple innovations to promote healthy weight for low-income children and families. The innovations will be community-driven, empowering to families, and technology-based. Potential areas of focus include (1) promoting access to healthy, affordable food, particularly for families and individuals who are food insecure or are living in food deserts; (2) supporting community-owned solutions that increase families' knowledge and skills related to healthy eating and nutrition; (3) finding innovative ways that increase physical activity, while accounting for social, cultural, and environmental barriers in low-income communities; and (4) empowering families to achieve healthy eating practices, healthy lifestyles (including reduced screen time, reduced sedentary behaviors, and good sleep hygiene), and sustainable changes in the home environment, while accounting for limited access to healthy foods and other barriers in low-income communities.

Goal Types: Find and highlight innovative ideas; Solve a specific problem; Develop technology; Inform and educate the public; Engage new people and communities; Build capacity; Stimulate a market; Other - Improve health care delivery and experiences of health care

Justification for Using Prizes and Challenges: Innovative solutions and partnerships are necessary to tackle the many factors affecting childhood obesity in low-income families and communities. A challenge will maximize competition and spur innovation for and within communities in a cost-effective and accelerated timeframe. It will reach a broader stakeholder group and allow engagement of non-traditional partners who can bring new thinking to address this issue. Some examples include entrepreneurs, private sector start-ups, research and development accelerators, non-profit organizations, and the technology sector. A challenge will also provide support for the development of novel and innovative community-owned ideas through a pay-for-results mechanism, ultimately leading to the development of multiple scalable interventions. Childhood obesity is a complex and multi-faceted public health issue and solutions must come from multiple sources, involve multiple levels and sectors, and take into account the synergy of multiple strategies. By using a challenge mechanism, everyone can be a part of the solution and everyone has the potential to be a game changer.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered is $375,000 and has not yet been awarded. Phase 1 will include seven to ten winners each of whom will be awarded up to $10,000 for design. Phase 2 will include three to five winners each of whom will be awarded up to $25,000 for development and small-scale testing. Phase 3 will award the final winner up to $150,000. The source of funds is the Social Security Act, Title V, Special Projects of Regional and National Significance. Specifically, the amount allocated is as follows: Appropriation: 75-17-0354, Allotment: HRMCHB49000, Allowance: 1650100089, Amount: $375,000 (obligated). Non-monetary incentives

[50] The website for the using Technology to Prevent Childhood Obesity in Low-Income Families And Communities can be viewed at https://mchbgrandchallenges.hrsa.gov/challenges/preventing-childhood obesity.

included expert feedback, public recognition, access to one-on-one mentoring with Expert Advisors, connection to stakeholders in the field, and networking opportunities.

Solicitation of Submissions: HRSA MCHB and Capital Consulting Corp have used social media, email outreach, and partnerships with outside organizations to market the competition. We also widely promoted the Challenge through existing grantee networks and healthy weight stakeholder groups. The challenge advisors promoted the Challenge through their professional networks, which include health professional organizations, academia, non-profit organizations, technology and health informatics fields, and maternal and child health networks. The project lead also briefed policy makers and promoted the Challenge at the Back-to-School Congressional Workshop—Examining Solutions to Address Childhood Obesity: Policymaker and Community Perspectives. Coordinated by the Campaign to End Obesity, the workshop briefing convened thought leaders from Capitol Hill and the community to examine evidence-based solutions to address childhood obesity.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies); Other - Congressional Workshop; Other - presentations to stakeholders

Participation Requirements: Eligibility requirements are the standard requirements for HHS challenges.

Evaluation of Submissions: A Federal judging panel, with input from the challenge expert advisors will make all final decisions regarding winners across all Phases. Review criteria can be found at: https://mchbgrandchallenges.hrsa.gov/challenges/preventing-childhood-obesity/review-criteria.

Results: Entries were submitted between July 24 and September 18, 2018, and the Challenge is ongoing.

Budget and Resources: HRSA MCHB has worked with a contractor to implement the Challenge. Capital Consulting Corp was awarded a $1,913,755.13 contract for 3 years in September 2017. The contract funding supports managing all four challenges, as well as the prize money for all three phases. Multiple Federal staff members have been involved in managing the project. The Challenge utilized 0.5 FTE in FY18.

Partnerships: HRSA partnered with the Centers for Disease Control and Prevention/Division of Nutrition, Physical Activity, and Obesity and the National Heart, Lung, and Blood Institute to staff the Federal judging panel. HRSA partnered with non-Federal partners including Robert Wood Johnson Foundation, The Nemours Foundation, Alfred I. Dupont Hospital for Children, Northeastern University, Louisiana Department of Health, University of Minnesota School of Public Health, and Northwestern University Feinberg School of Medicine to staff the Expert Advisory Panel. Partnerships with the expert advisors and Federal judges have been invaluable. The experts and Federal judges actively participated in the challenge development process. These individuals provided guidance in all aspects of the challenge design, including the development of submission and review criteria. Their feedback and identification of resources greatly improved the quality of the challenge solicitation. The partnerships have ensured vital stakeholders' views and needs are incorporated into the challenges and wide promotion of the Challenge in stakeholder communities. Expert advisors will also provide mentoring to semi-finalist winners, providing a non-financial incentive for potential solvers. Challenge expert advisors have donated time throughout the duration of the Challenge in kind.

Advancement of Agency Mission: HRSA's mission is to improve health and achieve health equity through access to quality services, a skilled health workforce, and innovative programs. As part of HRSA, MCHB's mission is to improve the health of America's mothers, children, and families. Childhood obesity is a growing epidemic in the United States with low-income families and communities disproportionately affected. Individuals in low income communities are at increased risk for both food insecurity and obesity: they do not have sufficient opportunities to buy healthy, affordable food and this inequitable

access to healthy food is a major contributor to health disparities. Potential solutions from this Challenge will target both access to healthy foods as well as innovations around healthy weight behaviors, with the goal to empower families in low-income communities to achieve healthy weight behaviors and make sustainable changes in the home environment. This Challenge will address childhood obesity prevention, particularly those in low-income communities, and supports several of HRSA's goals: build healthy communities (goal 3), improve health equity (goal 4), and improve access to quality care and services (goal 1).

Solution Types: Software and apps; Creative (design & multimedia); Ideas; Technology demonstration and hardware; Analytics, visualizations, algorithms; Other - A new or enhanced service; Other - a new channel; Other - a new platform or network; Other - a new system design

Plan for Upcoming 2 FYs: Phase 1 winners will be selected in Fall 2018. Phase 2 winners will be selected in Spring 2019. The Phase 3 winner will be selected in Fall 2019.

A.5.11 Rare Diseases are not Rare! Challenge[51]

Lead Sponsoring Agency: National Institutes of Health (NIH), National Center for Advancing Translational Sciences (NCATS)

Status: This competition was launched in FY18.

Competition Goals: NCATS is seeking innovative ways to communicate with and educate people about rare diseases through social media or art. The goal of this Challenge, which is being led by NCATS' Office of Rare Diseases Research, is threefold: (1) raise awareness for all rare diseases in a collective manner, (2) bring attention to the many people with rare diseases, and (3) highlight the need for research and the development of new treatments.

Goal Types: Find and highlight innovative ideas; Advance scientific research; Inform and educate the public; Engage new people and communities

Justification for Using Prizes and Challenges: Challenge and prize competitions are an important, cost-effective tool in Federal agencies' innovation toolboxes. They identify and reward creative solutions to an array of problems by utilizing the talents of citizen solvers and crowdsourcing. These competitions use cash prizes and non-cash incentives to advance the mission, reaching beyond the usual suspects to inspire inventive approaches to issues, effective public engagement, and new ideas and technologies. Prizes offer the option of involving the public in judging, a feature that is especially important for competitions such as this.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered is $5,000 to be shared among three awardees. Additionally, the winners and ten honorable mentions will be posted on the NCATS website.

Solicitation of Submissions: NCATS uses the following vehicle to publicize the opportunity to increase the number and quality of submissions: (1) publish a notice in the NIH Guide to Grants and Contracts to announce the competition, (2) post the notice on the government-wide Challenge.gov site, (3) post the Challenge on the NCATS challenges website, (4) link to the Challenge page from the NCATS funding opportunities page, (5) announce the Challenge at professional meetings, (6) advertise via social media (Twitter, e-newsletters, etc.), and (7) announce the Challenge at NCATS Day.

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[51] The website for the Rare Diseases are not Rare! Challenge is accessible at https://challenge.gov/a/buzz/challenge/69/ideas/top.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release

Participation Requirements: N/A

Evaluation of Submissions: The evaluation will be conducted by a panel of Federal and non-Federal judges with expertise directly relevant to this Challenge. Entries will receive up to five points for each of the following criteria: (1) how creative and original is the entry?, (2) to what extent does the entry address rare diseases collectively?, and (3) how likely is it that the entry could be an effective communication vehicle? Will it appeal to a broad audience? Is it easy to disseminate?

Results: Entries were submitted between September 30 and October 31, 2018.

Budget and Resources: The Challenge utilized approximately 2.5 days of one FTE in FY18.

Partnerships: N/A

Advancement of Agency Mission: The general purpose of NCATS is to transform the translational process so that new treatments and cures for diseases can be delivered to patients faster by understanding the translational process to create a basis for more science-driven, predictive and effective intervention development for the prevention and treatment of all diseases. This Challenge will lead to innovative ways to communicate with others and to educate people about rare diseases through social media and/or art.

Solution Types: Software and apps; Creative (design & multimedia); Ideas

Plan for Upcoming 2 FYs: N/A

A.5.12 NEI 3-D Retina Organoid Challenge (3-D ROC)[52]

Lead Sponsoring Agency: NIH, National Eye Institute (NEI)

Status: This competition was completed in FY17.

Competition Goals: The goal of this Challenge was to develop innovative ideas to create human three-dimensional (3D) retinal tissues that can faithfully model ocular disease or develop drugs. The current animal models and cell lines used to screen drugs and model disease are of limited utility. Using advanced tissue engineering techniques in 3D bioprinting and microfluidics, these improved human retina models will allow new insights into the biology and pathology of various vision impairments and diseases. NEI expected the Challenge to nucleate multidisciplinary teams of bioengineers, materials scientists, chemists, and vision scientists and help breakdown silos in various sub-specialties and help transform the way vision research is conducted.

Goal Types: Find and highlight innovative ideas; Solve a specific problem; Develop technology; Engage new people and communities

Justification for Using Prizes and Challenges: House Appropriations FY 2016 Report language directed NEI "to create a challenge program to advance the speed of basic research to cure retina disease." Developing retinal organoids is an unmet research need that will speed basic and therapeutic research. The challenge vehicle would spur interest from researchers from outside the vision field especially from bioengineers, material scientists, stem cell biologists, and developmental biologists. It would also

[52] The website for the NEI 3-D Retina Organoid Challenge (3-D ROC) can be viewed at https://nei.nih.gov/content/3-d-roc-challenge-details.

encourage partnerships with industry in order to allow the commercialization of new 3D culture platforms that could promote the discovery of treatments to a variety of retinal diseases.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered was $100,000 and the total amount awarded was $90,000. The Challenge also offered the opportunity to be featured on the NEI website.

Solicitation of Submissions: NEI solicited submissions by attending several conferences including the annual meetings of the Tissue Engineering and Regenerative Medicine International Society, the Society of Developmental Biology, the Association for Research in Vision and Ophthalmology (ARVO), and a Cold Spring Harbor Laboratory course "Vision: A Platform for Linking Circuits, Behavior & Perception." After the Challenge launched, NEI ran an online advertising campaign which targeted articles from journals across the Nature Publishing Group platform and placed an announcement of the Challenge in an e-alert for Nature Cell Biology subscribers. NEI also had an active social media awareness campaign through the NEI Twitter account.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Live video streaming; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies); Other - Online advertising with the journal Nature

Participation Requirements: Although all researchers were eligible, NEI tried to attract bioengineers and other neuroscientists outside of the vision field. Participants were encouraged to form multidisciplinary teams via an online forum where they could have a profile and post their interests and expertise. Most teams that participated included at least one vision researcher.

Evaluation of Submissions: NEI used a technical review panel to help review the submissions and provide the expertise about the methods and technology proposed in the submissions. They provided comments on the submissions to the Federal judges who were drawn from a variety of institutes and other agencies, which included the National Science Foundation and the Department of Defense.

Results: Of the 13 entries submitted by 50 participants between June 1 and August 1, 2017, one prize was awarded to one winner.

Budget and Resources: A full time employee was recruited to manage the Challenge competition. A working group of about 6 NEI staff convened about twice a month to help with the activities of the Challenge such as developing advertising materials, coordinating outreach activities, and organizing review meetings. The initial amount obligated in FY17 was $100,000, which included $10,000 for a trainee category. The Challenge utilized 2 FTEs and funded $5162.52 for online and print advertising in FY17.

Partnerships: NEI partnered with ARVO for outreach purposes, as the majority of vision researchers are ARVO members. NEI sent information about the Challenge to ARVO members and gave a presentation at the ARVO annual meeting (estimated value: $1000).

Advancement of Agency Mission: NEI was established to protect and preserve the vision of the American people. As an institute under NIH, NEI conducts and supports research that helps prevent and treat eye diseases and other disorders of vision. This Challenge served to develop methodology and technology to advance the speed of basic research to treat retina disease.

Solution Types: Ideas; Scientific

Plan for Upcoming 2 FYs: From the submissions received through this initial ideation Challenge, the development of more robust retina organoids was deemed feasible to accomplish within two to three

years. This prompted the development of a follow-up challenge in FY18 that will go until March 2020 to spur the creation of retinal organoids that could better model disease and test drugs.

A.5.13 NEI 3-D Retina Organoid Challenge (3-D ROC) 2020[53]

Lead Sponsoring Agency: NIH, NEI

Status: This competition was launched in FY18, and is underway.

Competition Goals: The goal of the 3D Retinal Organoid Challenge 2020 is to stimulate research into making more robust and reproducible retinal organoids to better model retinal disease or to test drugs. NEI hopes to draw attention to this goal and to recruit researchers from outside the vision field. NEI encouraged support from companies to help the participants accomplish their research without Federal funding.

Goal Types: Solve a specific problem; Advance scientific research; Develop technology; Engage new people and communities; Stimulate a market

Justification for Using Prizes and Challenges: House Appropriations FY 2016 Report language directed NEI "to create a challenge program to advance the speed of basic research to cure retina disease." Developing retinal organoids is an unmet research need that will speed basic and therapeutic research. The challenge vehicle would spur interest from researchers from outside the vision field especially from bioengineers, material scientists, stem cell biologists, and developmental biologists. The Challenge would also encourage partnerships with industry in order to allow the commercialization of new 3D culture platforms that could promote the discovery of treatments to a variety of retinal diseases.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered is $1,000,000. In the first round, up to six awards of up to $100,000 were to be granted in Fall 2018. The final round of prizes will be awarded in Spring 2020 and will include up to three awards totaling $400,000 and may include any additional money not awarded from the first round. Non-monetary incentives included opportunities to work with companies and receive discounts on reagents, services, and equipment. Inventors also retain intellectual property on final products, which may have significant commercial and research value.

Solicitation of Submissions: NEI solicited submissions by attending or sending flyers or slides to numerous conferences and meetings. NEI also sent emails to various listservs, posted on social media and notified other relevant NIH grantees through program officers at other institutes.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Live video streaming; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies)

Participation Requirements: Although all researchers were eligible, NEI tried to attract bioengineers and other neuroscientists outside of the vision field. Participants were encouraged to form multidisciplinary teams via an online forum where they could have a profile and post their interests and expertise.

Evaluation of Submissions: NEI will use a technical review panel to help review the submissions and provide the expertise about the methods and technology proposed in the submissions. They will provide comments on the submissions to the Federal judges who will be drawn from a variety of institutes and other agencies involved in tissue engineering.

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[53] The website for the NEI 3-D Retina Organoid Challenge (3-D ROC) 2020 can be viewed at https://nei.nih.gov/content/2018-reduction-practice-challenge.

Results: First round entries were submitted between September 4 and October 1, 2018. Final submissions will be submitted between February 14 and March 2, 2020.

Budget and Resources: A full time employee managed the Challenge competition. A working group of about 6 NEI staff convened about once a month to help with the activities of the Challenge such as developing advertising materials, coordinating outreach activities, and organizing review meetings. The amount obligated in FY18 was $1,000,000. The Challenge utilized 2 FTEs in FY18.

Partnerships: NEI has developed informal partnerships with corporate sponsors who have pledged to offer discounts or in-kind contributions to challenge participants in terms of products, services, or consulting. Two companies have signed Memoranda of Understanding to pledge support that would be in excess of $50,000 to participants. In-kind services or resources have not yet been utilized by participants. Non-Federal partners did not give directly to prize funding.

Advancement of Agency Mission: NEI was established to protect and preserve the vision of the American people. As an institute under NIH, NEI conducts and supports research that helps prevent and treat eye diseases and other disorders of vision. This challenge program serves to catalyze technological and methodological advances that will improve our understanding of retinal disease and enable the development of treatments.

Solution Types: Scientific

Plan for Upcoming 2 FYs: No additional challenges are planned for this institute until this Challenge has completed.

A.5.14 Improving Care for People with Alzheimer's Disease and Related Dementias using Technology (iCare-AD/ADRD) Challenge[54]

Lead Sponsoring Agency: NIH

Status: This competition was launched in FY18.

Competition Goals: Navigating the complex U.S. healthcare system can be challenging for persons with dementia and their caregivers. They must pursue an uncertain course of care, of unknown duration, across different care settings and interact with many different types of care providers and interventions. This Challenge is intended to stimulate innovation in the use of technology to improve care coordination, navigation, and aid with the care experience, so that overall dementia care quality is improved. This Challenge invites solutions that involve the development of an IT system-level, computer, mobile, or other form of technology-based application. The solutions may involve creation of a new technology application, or modification or novel implementation of an existing technology. The solutions may be targeted at consumers (persons with dementia or caregivers), healthcare providers, healthcare service organizations, health systems, or community, local, and State governments. Specific methods for stimulating uptake and use of the solutions must be included with the proof-of-concept demonstrations.

Goal Types: Develop technology

Justification for Using Prizes and Challenges: Traditional mechanisms, such as grants and contracts, would not produce the desired innovation at such a speed. Additionally, this Challenge encourages

[54] The website for the Improving Care for People with Alzheimer's Disease and Related Dementias using Technology (iCare-AD/ADRD) Challenge can be viewed at https://nia.nih.gov/challenge-prize.

multi-stakeholder connections and adoption of the most relevant technological innovations to close the identified gap in dementia care quality.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered is $400,000. Up to three winners will be awarded. The first, second, and third-place winners will receive up to $250,000, $100,000, and $50,000, respectively. Additional solvers may be recognized with non-monetary awards. Awards are not expected to be distributed until FY19. The prize funds for this Challenge were obligated in FY18 from the National Institute on Aging's (NIA) annual appropriations.

Solicitation of Submissions: NIA promoted the iCare-AD/ADRD Challenge widely, to many public sectors and via a number of vehicles, including but not limited to outreach through the Advisory Council on Alzheimer's Research, Care, and Services; NIH-wide SBIR networks, which reached over 20,000 recipients; and through Challenge.gov's government-wide listserv. NIA also used its relationships with a number of stakeholder groups to publicize the challenge. NIA will consider the prize submissions generated (e.g., number, quality, relevance) to gauge the effectiveness of these outreach methods, and the institute will use this information to inform future prize activities.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies)

Participation Requirements: Examples of possible solvers include small businesses, individuals—including but not limited to people living with dementia and caregivers—midsize to large technology companies, health insurance companies, electronic health record (EHR) vendors, students working collaboratively across multiple disciplines, health systems, states, and counties implementing care coordination programs.

Evaluation of Submissions: A panel of Federal employees serving as judges will review the Challenge submissions using the following criteria: (1) creativity and innovation (20%), (2) rationale and potential impact (20%), (3) value to relevant stakeholders (20%), (4) usability (20%), and (5) functional product feasibility (20%)

Results: Entries will be submitted between September 2018 and June 2019.

Budget and Resources: In FY18, the only resource used for the iCare-AD/ADRD Challenge was FTE time, estimated at 0.048 FTE. This Challenge was launched at the end of FY18, thus most of the activities in FY18 included agency planning and promotion of the Challenge. Examples of activities include drafting challenge ideas, soliciting public input, analyzing public comments, obtaining agency clearance, and posting challenge information via the internet.

Partnerships: N/A

Advancement of Agency Mission: Per 42 U.S.C. 285e, the mission of NIA is to conduct and support biomedical, social, and behavioral research, training, health information dissemination, and other programs with respect to the aging process and the diseases and other special problems and needs of the aged. As many as 5.5 million Americans age 65 and older are estimated to be living with Alzheimer's disease, the most common form of dementia. Many more under age 65 are also affected. In addition, many thousands more have Alzheimer's disease-related dementias. Effective dementia care management has been shown to improve outcomes such as reducing behavioral and psychological symptoms of dementia and lower health care costs by reducing emergency department visits, inpatient hospitalizations, and some readmissions. Research based models of dementia care have evolved in recent years and have the potential to improve outcomes. This Challenge is intended to stimulate innovation in use of technology to improve care coordination and/or navigation so that overall dementia care quality is improved, thus advancing the NIA mission described above.

Solution Types: Software and apps

Plan for Upcoming 2 FYs: In the next two fiscal years, the field of Alzheimer's disease and related dementias will continue to present opportunities for prize competitions. NIA will gauge the benefits of utilizing this mechanism and more traditional funding sources when setting priorities and helping spur innovation in the field.

A.5.15 Open Science Prize[55]

Lead Sponsoring Agency: NIH

Status: This competition was completed in FY17.

Competition Goals: The goal of the Open Science Prize (OSP) was 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 aimed to forge new international collaborations to bring together open science innovators from the United States and abroad to co-develop services and tools of benefit to the global research community.

Goal Types: Find and highlight innovative ideas; Advance scientific research; Develop technology; Inform and educate the public; Engage new people and communities; Build capacity; Stimulate a market

Justification for Using Prizes and Challenges: The use of prize competitions as a funding mechanism has several advantages over traditional funding mechanisms, such as grants and contracts. Awards are only given to successful solutions, solvers can include anyone with the skills and knowledge to address the specified solution, and the time and expense to run a prize competition is typically much less than a traditional funding mechanism. For example, traditional NIH grants such as the Small Business Innovation Research and Small Business Technology Transfer or Research Project Grant (RO1) funding mechanisms tend to favor academic researchers (investigator background and research environment are two criteria in the peer-review process) and typically take a significant amount of time to produce results. The OSP was open to all interested solvers, and the entire process was completed in two years from conceptualization to awarding of the grand prize. Finally, co-funding collaborative projects with international funders using traditional government funding mechanisms can be complicated compared with prize competitions. The OSP provided an administrative mechanism through which three partnering agencies could share funding responsibilities and in-kind resources.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered was $710,000, including six first round prizes at $80,000 each and one grand prize of $230,000. The National Institutes of Health Big Data to Knowledge Initiative provided $355,000 and $355,000 came from its partner, the Wellcome Trust. A portion of the funds ($80,000) was contributed to the Wellcome Trust by the Howard Hughes Medical Institute (HHMI). The NIH funded the U.S. solvers only. The other partners funded the international solvers. The prize money from the NIH was awarded to the prize winners through a contract vehicle NIH established with the Capitol Consulting Corporation to oversee prize administration. Phase 1 prizes were awarded in May 2016. The NIH portion was $240,000 in FY16, awarded to U.S. the solvers by the contract vehicle. The Phase 2 grand prize was awarded in February 2017. The NIH portion was $115,000 in FY17, awarded to the U.S. solvers through the contract vehicle. All six finalists were invited to showcase their applications at a symposium held in Bethesda, MD in

[55] The website for the Open Science Prize can be viewed at https://www.opensciencеprize.org/.

December 2016. They were also invited to showcase their winning submissions on the Open Science Prize Website.

Solicitation of Submissions: The NIH utilized social media, email outreach, webinars, and press releases in its initial marketing of the prize. Solicitations occurred during FY16. During FY17, an important aspect of the outreach strategy has been showcasing results at public events that garner media attention. Also notably, in FY17, during Phase 2 of the prize competition, NIH showcased 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 utilized live streaming and social media as way of engaging diverse audiences. NIH and Wellcome Trust also utilized 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.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Live video streaming; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies)

Participation Requirements: The Prize was open to international teams, whose membership had to include at least one individual or group based in the United States, and at least one individual or group based in another country. There was no limit on the size of teams, and teams could include individuals and groups based at academic research institutions, not-for-profit bodies, and private sector organizations.

Evaluation of Submissions: Participants were given wide latitude to choose their project and build their prototype accordingly. Judging was based on the following criteria: (1) 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?, (2) Innovation: What level of creativity and technological innovation does the entrant demonstrate?, (3) 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)?, (4) Technological viability: Is the approach proposed viable? Can the proposed technology deliver?, (5) Resource feasibility: Does the team have the required skills and resources?, (6) 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 and Phase 2 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 solutions for Phases 1 and 2.

Results: Of the 96 Phase 1 submissions entries submitted by 435 solvers from 45 countries between October 20, 2015 and February 29, 2016, six prizes of $80,000 each were awarded to six teams consisting of 33 total individuals. In Phase 2 (May 9, 2016 through December 1, 2017), a single grand prize was awarded on February 29, 2017.

Budget and 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 tasks,

focusing particularly on development of the website and on- line tools such as the public voting site. NIH utilized a contractor to assist with the logistical aspects of the prize, including meeting coordination, webinars, travel of participants to events and payment of prizes to winning teams. NIH's share of the grand prize was $115,000. In addition, NIH established a multi-year contract with Capitol Consulting Corporation, spending approximately $50,000 for prize administration in FY17.

Partnerships: This Prize was a collaboration between the Wellcome Trust and HHMI. The partners provided substantial in-kind support, expert advice, marketing, and outreach. The Wellcome Trust maintained the voting and submissions portal. The partners co-authored an article detailing their lessons learned from the OSP (see https://doi.org/10.1371/journal.pbio.2002617). The seven findings were: 1) partnerships are always more time-consuming than first imagined; 2) a two-step funding model is an effective way to encourage innovation whilst minimizing the cost; 3) public participation is a good way to increase the reach of the competition and generate interest and enthusiasm for open data; 4) proposals at differing stages of development were received; 5) setting a broad remit allowed a wide-range of ideas to be proposed, but the six finalists naturally did not fully represent the breadth of the ideas proposed; 6) the international funding partnership increased both the global reach of the competition as well as the resources available; and 7) it is recommended that funders consider ways to incentivize the sustainability of tools and technologies that leverage open biomedical data to improve biomedical research and public health.

Advancement of Agency Mission: The importance of open data and open science for NIH is reflected in its strategic plan, which states, "NIH will serve as a focal point for catalyzing this historic research opportunity, continuing to leverage its roles as an influential convener and major funding agency to encourage rapid, open sharing of data and greater harmonization of scientific efforts." Wellcome Trust has long championed open scientific research, including open access to publications and, more recently, the sharing of research data sets and computer code. Similarly, HHMI has a long-standing policy that strongly encourages their investigators to make publications publicly available and make data and other research materials available to the other scientists. The Open Science Prize is strongly aligned with NLM's recently released Strategic Plan, titled "A Platform for Biomedical Discovery and Data-Powered Health," which includes a strategic goal to "reach more people in more ways through enhanced dissemination and engagement pathways" and a distinct objective to "foster open science policies and practices."

Solution Types: Software and apps; Ideas; Technology demonstration and hardware; Analytics, visualizations, algorithms; Scientific

Plan for Upcoming 2 FYs: While NLM has no imminent plans for a follow-up prize, the agency has a strong commitment to furthering open science policies and practice. It is conceivable that NLM may wish to engage in another open innovation activity with these or other partners given the success of this effort in advancing open science.

A.5.16 Storytelling About Wellness in Tribal Communities[56]

Lead Sponsoring Agency: NIH

Status: This competition was completed in FY17.

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[56] The website for the Storytelling About Wellness in Tribal Communities can be viewed at https://www.Challenge.gov/challenge/storytelling-about-wellness-in-tribal-communities/ ; https://www.federalregister.gov/documents/2016/11/28/2016-28497/announcement- of-requirements-and-registration-for-storytelling-about-health-and-wellness-in-american.

Competition Goals: The goal of this Challenge was to develop a brief digital story (i.e., a video) that communicates how traditions and heritage promote health in American Indians and Alaska Natives (AI/AN). The videos would augment the agency's ongoing efforts to inform a strengthened research portfolio that advances AI/AN research needs. This challenge was also designed to attract more interest and attention to the research needs of these communities and communicate these needs in a culturally appropriate manner.

Goal Types: Inform and educate the public; Engage new people and communities

Justification for Using Prizes and Challenges: To commemorate Native American Heritage Month, NIH celebrated the use of storytelling to convey stories of health and wellness. Use of this mechanism allowed the agency to reach out to non-traditional audiences that would not necessarily be immediately eligible for a grant or contract.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered and awarded was $10,000. The first place winner was invited to a meeting of the NIH Tribal Advisory Committee.

Solicitation of Submissions: The Challenge was announced in the Federal Register; on Challenge.gov; on the Division of Program Coordination, Planning, and Strategic Initiatives' website; a blog post from the NIH Director; and through flyers made available at meetings and downloaded from the internet. A number of groups further disseminated the Challenge to listservs and to interested parties.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs)

Participation Requirements: The NIH outlined eligibility requirements in the Federal Register and included, but not limited to U.S. citizens or businesses, an adult 18 years of age or older, not an employee of NIH, among other things. The announcement was clear that Tribal governments and employees, and community members, schools, organizations, and others were eligible to participate.

Evaluation of Submissions: NIH evaluated the submissions in accordance with judging criteria stated in the Federal Register announcement. Judges reviewed the submissions online and scored through an electronic scoring system. The approach generally worked well for the number of submissions received. This approach to judging may not necessarily be scalable to a larger number of submissions.

Results: Of the 32 entries submitted between November 28, 2016 and January 31, 2017, five prizes were awarded to five winners.

Budget and Resources: The NIH used approximately 0.1 FTE to design, announce, judge, and otherwise administer the challenge. In addition, NIH engaged a contractor to assist in developing the online scoring system. Their effort was approximately $1,000. Several NIH employees of varying grade levels were also involved in the judging panel.

Partnerships: N/A

Advancement of Agency Mission: This Challenge is consistent with the statutory authority of the Division of Program Coordination, Planning, and Strategic Initiatives, National Institutes of Health. The Division identifies research that represents important areas of emerging scientific opportunities, rising public health challenges, or knowledge gaps that deserve special emphasis and would benefit from conducting or supporting additional research that involves collaboration between two or more national research institutes or national centers, or would otherwise benefit from strategic coordination and planning. As part of this authority, the Division oversees the Tribal Health Research Office, whose function includes managing information dissemination related to tribal health research coordination. The winning videos submitted for this Challenge will help communicate about health and wellness of AI/AN communities. AI/AN communities have higher rates of diseases and disorders across several areas

of health such as: diabetes, chronic liver disease, certain cancers, mental health, and substance use. Factors known to contribute to health status and disparities are complex, and include social and historical factors, ethnicity, culture, historical trauma, socioeconomic status, gender/sex, age, geographical access to care, and levels of insurance as well as underlying biology, physiology, and genetics. The NIH hopes that this Challenge will incentivize the public to showcase the strengths and resilience of these communities, their heritage and traditions, and how their culture promotes their health and well-being.

Solution Types: Creative (design & multimedia)

Plan for Upcoming 2 FYs: NIH does not have any related plans in this area at the moment.

A.5.17 A Wearable Alcohol Biosensor: A Second Challenge[57]

Lead Sponsoring Agency: NIH, National Institute on Alcohol Abuse and Alcoholism (NIAAA)

Status: This competition was underway in FY17, and was completed in FY18.

Competition Goals: The goal of the Challenge was to produce a prototype of a sleek, unobtrusive smart electronic device incorporated into clothing or an accessory and capable of monitoring blood alcohol non-invasively and in real time. Highest priority was given to devices that used non-invasive technologies to measure alcohol concentration in blood or interstitial fluids, as opposed to detection of alcohol exuded through the skin in sweat or vapor. Such a device would significantly advance current alcohol monitoring capabilities. The envisioned wearable alcohol monitors would serve useful purposes in alcohol research and treatment settings, could play a role in public safety, and would be of interest in the consumer market to individuals interested in tracking personal health parameters. Designs could have emphasized any of these potential market subsets or sought to be broadly marketable.

Goal Types: Solve a specific problem; Advance scientific research; Develop technology; Stimulate a market

Justification for Using Prizes and Challenges: The prize competition provided a mechanism to enlist innovators and talented people who would not typically apply for a NIH grant and encourage them to present novel and innovative solutions to real-time alcohol measurement in humans. Enlisting individuals beyond the traditional NIAAA grantee community was especially beneficial for the biosensor challenge where engineering expertise was needed and is not typically found. The competitive nature of the Challenge broadened awareness about alcohol research needs within and beyond the alcohol research and treatment communities.

Cash Prize Purses and/or Non-Cash Prize Awards: A total of $300,000 was obligated from the unconditional gift funds for the purpose of a first ($200,000) and second prize ($100,000). After judging, NIAAA determined that only one entry met the requirements for an award. Following consultation with NIH general counsel, NIAAA confirmed its ability to award a lessor amount of $100,000 to the entrant who held the most promise for achieving the goals of the competition. The remaining $200,000 was de-obligated and returned to the unconditional gift fund.

Solicitation of Submissions: NIAAA issued a NIH press release, posted an announcement on the Challenge.gov website, published an announcement video on the NIAAA website, issued tweets from

[57] The website for the A Wearable Alcohol Biosensor: a Second Challenge can be viewed at https://www.Challenge.gov/challenge/wearable-alcohol-biosensor/.

the NIAAA twitter account, and notified contacts in media outlets from the first competition, academic institutions and engineering circles. Two NIAAA staff members attended conferences to publicize the availability of the Challenge and assess other potential technologies that might be useful in meeting the alcohol measurement goals. One member spoke at the Consumer Electronic Show and the technology portion of the South By South West conference. These activities resulted in promising contacts for future collaborations and introduced NIAAA and its mission to technologists and engineers, some of whom are considering applying for NIAAA small business grants.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Other - Presentations at conferences

Participation Requirements: America COMPETES Act requirements limit the Challenge to U.S. citizens and U.S.-based companies. Within those parameters, this Challenge was open to individuals, small businesses, academic groups, and non-profit organizations.

Evaluation of Submissions: Submitted solutions were judged on the following criteria: (1) achievement of real time-monitoring and quantification of blood alcohol level; (2) collection and interpretation of data; (3) elimination of as much of the biological and device-related delays as possible through innovative, validated, and verifiable techniques; (4) secure storage or wireless transmission of data to a smartphone or other device; (5) operation from a dependable and rechargeable power source; (6) plans for process of manufacture and likelihood of bringing the product to market; and (7) appeal and acceptability to wearers. The functionality of prototypes was evaluated by NIAAA in a laboratory setting. Judging was done by a panel of NIH employees selected by NIAAA with knowledge in alcohol pharmacokinetics, chemistry, engineering, information technology and system security, behavioral and social sciences, and wearables.

Results: Of the five entries submitted by between December 10, 2016 and May 15, 2017, one prize were awarded to one winner.

Budget and Resources: The NIAAA staff involved in the prize competition contributed approximately 248 hours of effort as this round of the competition was built upon the previous year's challenge. For this version of the competition, the largest amount of NIAAA staff time was dedicated to attending and presenting at technology conferences, estimated at $7107.33 in FY17. These activities raised awareness of the Challenge and the broader mission of NIAAA. The prize money was obligated from NIAAA's unconditional gift funds.

Partnerships: N/A

Advancement of Agency Mission: The mission of the NIAAA is to generate and disseminate fundamental knowledge about the effects of alcohol on health and well-being, and apply that knowledge to improve diagnosis, prevention, and treatment of alcohol-related problems, including alcohol use disorder, across the lifespan. The development of alcohol biosensors that can be worn and used by individuals in the course of their daily lives will advance NIAAA's mission by providing more accurate tools for alcohol researchers, clinicians, and therapists and individuals seeking healthy lifestyle choices. Current technologies for continuous alcohol monitoring, which are commonly used in the criminal justice system, are effective but cumbersome. Moreover, they only take readings every 30 minutes, and they reflect blood alcohol content as it was 60–90 minutes prior to assessment, not in real time. Recent developments in electronics, miniaturization, wireless technology, and biophysical techniques of alcohol detection in humans increase the likelihood of successful development of a useful real-time alcohol biosensor. The NIAAA believes that this Challenge will further stimulate investment from public and private sectors in the development of real-time alcohol biosensors that will be appealing to

individuals, treatment providers, and researchers and will continue to further NIAAA's mission to improve diagnosis, prevention, and treatment of alcohol related problems.

Solution Types: Software and apps; Technology demonstration and hardware; Analytics, visualizations, algorithms

Plan for Upcoming 2 FYs: NIAAA is looking for novel means to engage individuals and institutions in the miniaturization of a spectroscopic solution for blood alcohol monitoring; establishing biomarkers for alcohol research; and novel interventions through technology to assist persons with problem drinking.

A.5.18 Design by Biomedical Undergraduate Teams (DEBUT)[58]

Lead Sponsoring Agency: NIH, National Institute of Biomedical Imaging and Bioengineering (NIBIB)

Status: This competition was completed in both FY17 and FY18.

Competition Goals: The DEBUT Challenge was open to teams of undergraduate students working on projects that develop innovative solutions to unmet health and clinical problems, the proposed goals are: (1) 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; (2) 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; (3) to highlight and acknowledge the contributions and accomplishments of undergraduate students; and (4) to encourage students to think about the patentability, market potential, and economic feasibility of the solutions they developed.

Goal Types: Find and highlight innovative ideas; Develop technology; Engage new people and communities; Build capacity; Other - Educate Biomedical Engineering Students

Justification for Using Prizes and Challenges: Prizes offer a way to directly incentivize undergraduate students in biomedical engineering and physical science to participate in conceiving and developing unique bioengineering innovations. DEBUT also excites and invigorates biomedical engineering faculty and departments. Students and faculty take on increasingly sophisticated projects in the hopes of winning a prize. This cannot be easily accomplished by a traditional grant mechanism. The monetary prizes combined with the recognition of winning undergraduates teams at the annual meeting of the Biomedical Engineering Society provide encouragement to the teams to further advance their projects and take it to market where they have the potential to address unmet needs in healthcare.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered in FY17 was $65,000 ($45,000 from NIBIB and $20,000 from VentureWell) and the full amount was awarded. The total prize purse offered in FY18 was $65,000 ($45,000 from NIBIB and $20,000 from VentureWell) and is expected to be fully distributed in FY18. In both fiscal years, first, second, and third place prizes were $20,000, $15,000, and $10,000, respectively. VentureWell awarded two additional prizes, the Venture prize ($15,000) and the Design Excellence prize ($5,000). There were five honorable mentions in FY17 and six honorable mentions in FY18. The Challenge also offered commendation at a major annual scientific meeting (Biomedical Engineering Society) with a session dedicated to DEBUT.

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[58] The website for the Design by Biomedical Undergraduate Teams (DEBUT) can be viewed at https://www.nibib.nih.gov/training-careers/undergraduate-graduate/design-biomedical- undergraduate-teams-debut-challenge.

Solicitation of Submissions: In addition to NIBIB's social media and email outreach efforts, VentureWell contributed to publicizing the competition through direct mailing and social media. VentureWell also was in charge of the receipt of the entries and initial evaluation.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies)

Participation Requirements: DEBUT is geared toward undergraduate students in biomedical engineering (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.

Evaluation of Submissions: The NIBIB Director was responsible for the final designation of winners of the NIBIB prizes. This designation was based 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 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.

Results: In FY17, 41 eligible entries were received from 22 universities in 16 different states by the deadline on May 31, 2017, engaging 224 students. In FY18, 36 eligible entries were received from 25 universities in 15 different states by the deadline on May 31, 2018, engaging 180 students. Ten prizes were awarded.

Budget and Resources: Three members of NIBIB staff were mostly responsible for the management of the competition and the awarding of prizes. Eight other staff members were involved in the judging of the entries. $45,000 was distributed in total prizes yearly. FY17 and FY18 cash prizes were obligated to NIBIB's Direct Appropriation Account (TAFS 75-17-0898). VentureWell provided $20,000 in prizes yearly, bringing the challenge total for prizes to $65,000 annually.

Partnerships: Since 2016, NIBIB has been in 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 competition jointly held by NIBIB and VentureWell 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 informational and entry submission portal, VentureWell contributed to publicizing the competition as well as the receipt and initial evaluation of the entries. VentureWell also convened its own evaluation panel 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 estimated value of this partnership was $63,000 annually.

Advancement of Agency Mission: The mission of the NIBIB is to improve health by leading the development and accelerating the application of biomedical technologies. NIBIB is committed to integrating the physical and engineering sciences with the life sciences to advance basic research and medical care. This prize is designed to spark early undergraduate interest in the areas NIBIB supports. The underlying goals of the prize highlight and advance the agency's mission by: 1) providing undergraduate students valuable experiences such as working in teams, identifying unmet clinical needs, and designing, building and debugging solutions for such open-ended problems; 2) generating 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; and 3) highlighting and acknowledging the contributions of biomedical engineering to advancing healthcare.

Solution Types: Creative (design & multimedia); Technology demonstration and hardware

Plan for Upcoming 2 FYs: In FY19-20, the DEBUT Challenge will continue to be open to teams of undergraduate students working on projects that develop innovative solutions to unmet health and clinical problems. No major changes are currently planned for the Challenge.

A.5.19 The 2017 "$100,000 for Start a SUD Startup" Challenge[59]

Lead Sponsoring Agency: NIH, National Institute on Drug Abuse (NIDA)

Status: This competition was launched in FY17 and completed in FY18.

Competition Goals: The Challenge goal was to support research ideas that could be the basis for the development of new and potentially successful commercial applications. NIDA intended to fund the would be startup founders much earlier than most investors, incubators, or traditional models of research funding (e.g. small business grants). The Challenge allows scientists to test the hypothesis that their research idea can be fostered into a biotech startup, and that eventually these 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.

Goal Types: Find and highlight innovative ideas; Inform and educate the public; Engage new people and communities; Build capacity

Justification for Using Prizes and Challenges: NIDA issued the "$100,000 for Start a SUD Startup" Challenge in 2016, and re-issued it in 2017. In 2016, the idea-submitting teams were from U.S. academic institutions, newly formed small business companies, and members of the general public. The selected teams were diverse in terms of age, level of education, gender, race and understanding of commercialization and entrepreneurship. Importantly, only 25% of submitted ideas came from NIDA-funded researchers. About 60% of submitted ideas came from the teams or individuals that previously did not apply for NIH grant funding. Thus, this Challenge was the preferable method to identify potential startup founders and work with them on research idea development and preparation of successful SBIR grant applications.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered was $100,000. The Challenge offered up to ten awards of $10,000 each and provided mentorship support from NIDA entrepreneurship experts for development of a minimum viable proof (MVP) of the proposed product. No institutional indirect costs were allowed. The names of the winners and the titles of their submissions are posted on the NIDA web site.

Solicitation of Submissions: NIDA posted the Challenge at Challenge.gov and was responsible for the challenge outreach. The Challenge info, including the Challenge flyer, was disseminated to scientific and business communities including: NSF I-Corp Sites (46 universities); provosts of entrepreneurial universities (37 universities/contact sites); tech transfer offices of entrepreneurial universities (41 top NIDA-funded universities); 2017 Annual CPDD meeting (June 2017); 19th Annual HHS SBIR/STTR Conference (November 2017, WI); 2017 Annual Neuroscience Conference (November 2017); personal emails to all PIs who applied to RFA-DA-17-007 "Growing Great Ideas: Research Education Course in Product Development and Entrepreneurship for Life Science Researchers (R25)"; listserv of the Yale Entrepreneurial Institute; DHHS Opioid Symposium and Code-a-Thon (December 2017, DC); NIDA

[59] The website for the The 2017 " $100,000 for Start a SUD Startup" Challenge can be viewed at https://www.Challenge.gov/challenge/the-2017-100000-for-start-a-sud-startupchallenge/.

landing page rotator and NIDA challenge webpage; Academic mentors (active NIDA P01& P50 grantees); active NIDA CEBRA R21 grantees; small business companies and start-ups contacted NIDA and considered to apply to SBIR/STTR program.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Other - Targeted outreach of entrepreneurial organizations; Other - Presentations and flyers at scientific meetings and conferences

Participation Requirements: The Challenge was open to any individual 18 years of age or older. No prior startup experience was necessary.

Evaluation of Submissions: Submissions that were responsive and complied with the entry requirements were reviewed by a panel of judges consisting of NIDA Federal employees. The judging panel made recommendations to the award approving official based upon the following five criteria: (1) 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?; (2) 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?; (3) 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?; (4) Team expertise. Does the individual or team demonstrate high level of ability, perseverance and grit?; (5) Commercialization. Is there a clear path for the product or service to reach the market? Are the product users and purchasers clearly identified? Each criterion was scored with the maximum of ten points. Final recommendations are determined by a vote of the judges based on score. Scores from each criterion are weighted equally, but failure to meet a minimum standard for any one criterion might disqualify a submission.

Results: Of the 18 entries submitted by 39 participants between June 09, 2017 and December 22, 2017, ten prizes were awarded to ten teams.

Budget and Resources: NIDA Federal employees were solely responsible for solicitation and management of this Challenge. The panel of NIDA judges spent 50 FTE hours for review of submissions, scoring, and selection of the winners. The NIDA Office of Translations Initiative and Program Innovation (OTIPI) was responsible for challenge design, clearance, solicitation, management, outreach, communication with the participants and post-challenge activities. The winners of this Challenge were encouraged to use the prize funds to develop a MVP as quickly as possible and to obtain customer feedback to discover if the MVP meets the customer needs. If the product prototype was successfully validated, winners were encouraged to create or further advance their biotech startup no later than 6 months after the prize was awarded. OTIPI developed the curriculum for this post-challenge educational program and worked closely and intently with the teams to perform costumer discovery, identify product differentiation features, refine the overall value proposition, and put together competitive NIDA SBIR/STTR applications. As a result, within seven months of the post-challenge period, nine teams incorporated nine small businesses and worked to submit their SBIR /STTR applications in Fall 2018.

Partnerships: N/A

Advancement of Agency Mission: NIDA is the lead Federal agency supporting scientific research on drug use and its consequences. NIDA's mission is to advance science on the causes and consequences of drug use and addiction and to apply that knowledge to improve individual and public health. 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 (SUD). NIDA hopes that participation in the contest will enable scientists to test whether their research ideas can be fostered into a SUD biotech startup. The startup product could be the result of novel scientific discoveries, repurposing an existing technology for a new use, extending a research observation or discovery made in a different scientific area into SUD, devising a new business model or distribution or delivery channel that unlocks new value, or simply bringing a product or service to an underserved customer.

Solution Types: Ideas; Business plans; Scientific

Plan for Upcoming 2 FYs: Based upon the success of the "$100,000 for Start a SUD Startup" Challenge and the overwhelming positive feedback received from the teams, NIDA plans to re-issue the Challenge in 2019 and 2020.

A.5.20 Follow that Cell[60]

Lead Sponsoring Agency: NIH, National Institute of Mental Health (NIMH) and Office of Strategic Coordination

Status: This competition was completed in FY17.

Competition Goals: The goal of the Challenge was to develop new tools and methods that allow time-dependent measurements at the single-cell level in a complex tissue environment to assess functional changes, provide information on the health status of a given cell, and help guide diagnosis and therapeutic treatments related to human disease states. Technological breakthroughs in this arena could allow researchers and physicians to identify rare cells in a mixed population, such as individual cells that can transform and become cancerous, cells that are latently infected with a pathogenic virus, or cells that develop resistance to drugs over time.

Goal Types: Find and highlight innovative ideas; Solve a specific problem; Advance scientific research; Develop technology

Justification for Using Prizes and Challenges: The NIH Common Fund supported grants under the Single Cell Analysis Program (SCAP), the majority of which are associated with academic institutions. This Challenge, structured in two phases, was designed to strengthen and complement the existing SCAP grant portfolio by reaching out to a more diverse population of innovators and solvers, including not only those who are from academic institutions but also those who are from research and development communities in the private sector and those who are outside biomedical disciplines. The NIH believed this Challenge would stimulate investment from both public and private sectors in single-cell analysis research and product development, which, in turn, could lead to the development of more sensitive, robust, and cost-effective assay approaches, reagents, tools, and devices for basic research and clinical diagnosis.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered and awarded was $400,000. The first place individual winner was awarded $300,000 and $100,000 was split among three eligible members of the second place team. All funds were from the FY14 appropriation. Non-monetary incentives included the opportunity to present at the fifth annual Single Cell Analysis Principal Investigator Meeting.

Solicitation of Submissions: Phase 2 was a limited competition among the 16 winners and finalists from Phase 1. Phase 2 solvers were encouraged to partner with others as necessary to exercise their

[60] The website for the Follow that Cell can be viewed at http://commonfund.nih.gov/singlecell/challenge.

solutions. NIH conducted a webinar for all 16 potential solvers to answer questions about the Challenge and submission requirements. NIH kept in contact with potential solvers via direct email. Phase 1 was launched with a marketing strategy developed to define targeted methods that would be used to attract solvers at the launch and during the open period of the Challenge.The marketing plan was designed to attract a large number of varied solvers that could theorize innovative research tools, technologies or other breakthroughs that would allow identification, manipulation, or measurement of relevant biological changes at the single cell level. Outreach methods included the Federal Register Notice, NIH and contractor website postings, Nature website posting, emails, and social media.

Solicitation Types: Social media (e.g., Twitter, Facebook); Other - Webinar; Other - Direct email

Participation Requirements: The target solver audience was the community of investigators who could potentially provide solutions to the Challenge. Efforts were made to extend beyond the set of investigators already funded by NIH to pursue related areas of research. Specific eligibility requirements were posted in the Federal Register Notice.

Evaluation of Submissions: Ten solutions were submitted. InnoCentive, the contractor who hosted the platform for submission, screened for eligibility and completeness of solution. All ten solutions were forwarded to NIH for scientific evaluation. A technical evaluation panel consisting of NIH intramural investigators convened in-person to evaluate the submissions based on the criteria published in the Federal Register Notice. In parallel, NIH extramural staff reviewed top two submitted solutions for scientific alignment to SCAP, relevance to the NIH mission, and potential overlap with existing projects. Evaluation summaries were generated for all ten Phase 2 Solutions, which included the executive summary describing the research, technical evaluation panel discussion summary, and extramural staff summary. The SCAP Challenge team met to discuss the evaluation outcomes and to develop a rationale for recommending the selection of prize winners for Phase 2 competition. The judges and awarding official accepted the recommendation and approved the payment of prizes. NIMH was unable to develop a process or policy for ascertaining and managing conflict of interest of external individuals who could serve on the technical evaluation panel without limiting participation of solvers so NIMH chose to use Federal employees.

Results: Of the ten entries submitted by 27 participants between March 17, 2015 and March 30, 2017, two prizes were awarded.

Budget and Resources: Approximately 0.5 FTE was utilized to manage Phase 2 of the Challenge, including evaluation and approvals, recognition event and publicity, authorizing payment of prizes, and close-out reporting.

Partnerships: N/A

Advancement of Agency Mission: The NIH SCAP was searching for novel, robust methods for analysis of individual cells that could serve as the basis for predicting alterations in cell behavior and function over time. The ultimate goal was to develop new tools and methods that allow time-dependent measurements at the single cell level in a complex tissue environment to assess functional changes, provide information on the health status of a given cell, and help guide diagnosis and therapeutic treatments related to human disease states. Technological breakthroughs in this arena will allow researchers and physicians to identify rare cells in a mixed population, such as individual cells that may begin to transform and become cancerous; cells that are latently infected with a pathogenic virus; or cells that develop resistance to drugs over time.

Solution Types: Scientific

Plan for Upcoming 2 FYs: While other institutes at NIH are currently hosting challenges and have plans for the future, the NIH Common Fund Single Cell Analysis Program has sunset.

A.5.21 Antimicrobial Resistance, Rapid, Point-of-Need Diagnostic Test Challenge[61]

Lead Sponsoring Agency: NIH and Office of the Assistant Secretary for Preparedness and Response (ASPR), Biomedical Advanced Research and Development Authority (BARDA)

Status: This competition was underway in both FY17 and FY18, but has not concluded.

Competition Goals: The goals of the AMR Diagnostic Challenge are (1) to improve antibiotic stewardship and counter the increasing spread of antibiotic resistant microorganisms; (2) develop new, innovative, accurate, and cost-effective diagnostic tests to rapidly inform clinical treatment decisions, and be of significant clinical and public health utility to combat antimicrobial resistant pathogens; (3) incentivize a broad range of scientists, engineers, and innovators to develop diagnostic tests; and (4) development of unique diagnostics could facilitate the discovery of new antibiotics.

Goal Types: Solve a specific problem; Advance scientific research; Develop technology; Engage new people and communities; Stimulate a market

Justification for Using Prizes and Challenges: On September 18, 2014, the President issued Executive Order 13676 on Combating Antibiotic-Resistant Bacteria announcing the Administration would hold the Antimicrobial Resistance Diagnostic Challenge. The National Strategy for Combating Antibiotic Resistant Bacteria was released simultaneously with specific goals to address the increasing public health threat of antibiotic resistant microorganisms. An accompanying White House Fact Sheet called for NIH and ASPR/BARDA to hold a $20M challenge competition for the development of rapid, point-of-need diagnostic assays for combating antibiotic resistant pathogens. The National Action Plan for Combating Antibiotic-Resistant Bacteria issued in 2015 set three- and five-year goals for this NIH and ASPR/BARDA-sponsored competition.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered was $20,000,000. $50,000 was awarded to each of ten semi-finalists in Step 1 ($500,000 total), and up to $100,000 may be awarded to each semi-finalist in Step 2 ($1,000,000 total). The remaining funds ($18,500,000) will be awarded to up to three winners in FY20. Finalists will also receive public recognition.

Solicitation of Submissions: A Federal Register Notice (FRN) and a Notice in the NIH Guide for Grants and Contracts were used to initially announce the Challenge and request submissions. The Challenge is posted on the Challenge.gov website. The NIH support contractor maintains a website with frequently asked questions, which serves as the site for submissions. Amended FRNs and NIH Guide Notices were issued to provide updates for submissions for each Step of the competition. The NIH Director and ASPR issued a press release when the Challenge was announced. The NIH Director also issued a blog to encourage submissions. Emails are sent to key NIH academic, professional society, and industry partners at various stages of the Challenge soliciting submissions. A Twitter session was held with the NIH Director following announcement of the Step 1 semi-finalists. A YouTube session was held with the NIH coordinator for the Challenge. NIH and BARDA maintain websites encouraging submissions. The organizers of the U.K. Longitude Prize for an AMR diagnostic include announcements of the NIH/BARDA Challenge on their website.

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[61] The website for the Antimicrobial Resistance, Rapid, Point-of-Need Diagnostic Test Challenge can be viewed at https://www.Challenge.gov/challenge/antimicrobial-resistance-rapid-point-of-care- diagnostic-letter-of-intent/ and https://dpcpsi.nih.gov/AMRChallenge.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Day-long event(s) prior to the competition; Live video streaming; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies)

Participation Requirements: Step 1 and 2 submissions were open to all solvers; Step 3 is only open to the Step 2 semi-finalists. Solutions were welcome from individuals, teams, and entities from all U.S. sources including the public sector, private sector, and nonprofit groups. Members of the technical evaluation panel for Step 1 are not eligible to participate in or contribute to any proposal for Steps 2 and 3. Submissions are not eligible from any HHS (or its components) Federal employee. Employees of other Federal Government entities need to check with their ethics office to see if they can limit or accept the prize. Federal grantees are eligible to compete, but cannot use Federal funds to develop a submission unless consistent with purpose of their grant. Federal contractors are eligible to compete, but cannot use funds from a Federal contract to develop a submission. Solvers must be at least 18 years old and a U.S. citizen or resident. A team, led by a U.S. citizen or resident, can include international citizens, but the latter are not eligible for the cash prize. If an entity applies, it must be incorporated in the United States and maintain a primary place of business in the United States. An individual, entity, or team that is currently on the excluded parties list will not be selected as a semi-finalist or winner. An individual shall not be deemed ineligible if he or she uses a Federal facility or consults with Federal employees, as applicable, provided that such facilities and/or employees are made available on an equitable basis to all individuals or teams.

Evaluation of Submissions: All Step 1 submissions were subjected to an initial review by NIH scientific staff to ensure they are complete and within scope of the Challenge. Submissions that were incomplete were disqualified and not evaluated further. A three-tier review process was used including a technical evaluation panel, a programmatic assessment panel, and a judging panel. The technical evaluation panel, convened by the NIH Center for Scientific Review, included non-governmental scientific experts and a limited number of government scientific experts who evaluated and rated the submissions based on six criteria including: innovation; clinical significance; diagnostic performance; feasibility; time to test result; and setting and ease of use. The programmatic assessment panel, including NIH, BARDA, and FDA scientific staff, reviewed the highly rated submissions for scientific alignment with the National Action Plan for Combating Antibiotic Resistant Bacteria. The judging panel, consisting of three senior leadership members from NIH and BARDA, used the technical and programmatic evaluations to determine the semi-finalists based on innovation advancing existing clinical diagnostics and relevance to NIH's and BARDA's missions. Step 2 submissions will be subjected to similar evaluation by a technical evaluation panel based on four criteria: innovation; clinical significance; diagnostic performance and feasibility; and sample matrix/setting and ease of use/throughput. Step 3 prototype submissions will be evaluated by two independent CLIA-certified laboratories for usability, stated time to result, analytical sensitivity and specificity, as well as confirmation of analytical performance as stated in the Step 2 data submitted by the solver. The results of the CLIA laboratory testing will be submitted to a technical evaluation panel followed by review by the programmatic assessment panel, and finally submitted to the judging panel for their determination of a winner(s).

Results: A total of 74 submissions were received and 10 prizes awarded in Step 1, which opened on September 8, 2016. Twenty submissions were received and up to 10 prizes awarded will be awarded in Step 2. Up to 10 participants will submit Step 3 entries by January 3, 2020 and up to three prizes may be awarded. Step 3 winners will be announced July 31, 2020.

Budget and Resources: A total of 1.5 FTEs conducted activities related to the review, management, and approval of awards. In FY16, the National Institutes of Health/National Institute of Allergy and Infectious Diseases (NIH/NIAID) and ASPR/BARDA each provided $10,000,000 for this Challenge. In FY17, the NIH

Division of Program Coordination, Planning, and Strategic Initiatives within the Office of the Director (NIH/OD/DPCPSI) obligated and disbursed $22,000 for the Step 1 technical evaluation panel meeting. In FY18, NIH/OD/DPCPSI obligated $29,000 for the Step 2 technical evaluation panel meeting.

Partnerships: CDC and FDA provided technical and regulatory expertise to the development of the award evaluation process. They participated with NIH and BARDA scientific staff on the AMR Diagnostic Working Group. CDC scientific staff participated on the technical evaluation panel and FDA scientific staff participated on the programmatic assessment panel. Capital Consulting Corporation served as a support contractor to NIH for the Challenge and developed a website providing information to submitters as well as the mechanism to submit solutions for Steps 1 and 2 of the Challenge.

Advancement of Agency Mission: BARDA's mission is to develop and procure medical countermeasures that address the public health and medical consequences of chemical, biological, radiological, and nuclear accidents, incidents and attacks, pandemic influenza, and emerging infectious diseases. Specifically, BARDA supports the advanced development and procurement of drugs, vaccines and other products that are considered priorities for national health security. BARDA's support ensures continuity of funding at a critical point for medical countermeasures developed by industry or emerging from the basic research and preclinical development activities sponsored by NIH. In procuring medical countermeasures for the Strategic National Stockpile, BARDA enhances the capabilities of CDC to organize an effective response to a public health threat. NIH and BARDA are utilizing the AMR Diagnostic Challenge to identify novel and innovative in vitro diagnostic tests that would 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.

Solution Types: Technology demonstration and hardware; Scientific

Plan for Upcoming 2 FYs: In FY19 and FY20, NIH and ASPR/BARDA will proceed with Steps 2 and 3, respectively, of the AMR Diagnostic Challenge.

A.5.22 The Simple Extensible Sampling Tool Challenge[62]

Lead Sponsoring Agency: Office of Inspector General (OIG)

Status: This competition was completed in FY17.

Competition Goals: The objective of this Challenge was 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 needed a new, modern version of the software that was easier to use and was 508 compliant. In addition, by using a competition, OIG hoped to increase public awareness about the RAT-STATS software.

Goal Types: Solve a specific problem; Inform and educate the public

Justification for Using Prizes and Challenges: The relatively small scale of the programming project made it amendable to work by a single individual knowledgeable about programming. We believed that a prize competition would lower the barrier to access and allow individuals less familiar with the government contracting process to take in the upgrade effort. In addition, the prize competition was designed to allow users to select from several different replacement packages. Finally, the problem was

[62] The website for the The Simple Extensible Sampling Tool Challenge can be viewed at https://www.Challenge.gov/challenge/statistical-software-for-healthcare-oversight/.

well amendable to a competition given that it involved clear metrics for success, but also allowed for a significant amount of creativity by the solvers. In particular, OIG had definitive performance requirements, but were interested in seeing what the public could come up with in terms of the software layout, structure, and new features.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered was $40,000 and the total amount awarded was $34,000. The grand prize winner was listed within the software that was created as a result of the competition. The grand prize winner was also be listed on the agency website and within the instruction manuals for the software. No private sector or philanthropic funds were contributed for the prizes. All funds were obligated and expended from HHS OIG appropriations.

Solicitation of Submissions: OIG announced the competition in the Federal Register, on the HHS/OIG agency website, the Challenge.gov website, and the Challenge.gov Twitter account. OIG also advertised the competition on several industry websites with free job posting areas. Finally, the HHS IDEA Lab included a blog posting describing the competition on its website. OIG was satisfied with the level of response received given the solicitation approach, though larger scale advertising would likely have been needed for a larger competition.

Solicitation Types: Social media (e.g., Twitter, Facebook)

Participation Requirements: The contest was open to the public and anyone who could provide a solution. OIG targeted individuals who were knowledgeable about programming and software design. Rules for participation in the challenge are available at: https://www.Challenge.gov/challenge/statistical-software-for-healthcare-oversight/.

Evaluation of Submissions: A technical expert reviewed each submission to identify whether it was complete, followed the competition rules, and was able to fully replicate RAT-STATS on 60 test datasets. The expert identified three entries that met this requirement. The grand prize was selected by a committee of 12 HHS/OIG employees who represent the types of individuals who would be end users for the new software. Each of the 12 individuals voted on which of the software packages they would prefer to use. The finalist with the most votes was declared the grand prize winner.

Results: Of the eight entries submitted by between September 29, 2016 and May 15, 2017, one participant was awarded the grand prize.

Budget and Resources: The Challenge was run using only internal agency resources. In 2017, these include IT resources and approximately 200 FTE hours, including 180 hours at GS-15 level and 20 hours at GS-13 level. Funds associated with the Challenge were used to pay for cash prizes and the Federal Register Notice posting.

Partnerships: N/A

Advancement of Agency Mission: 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. In addition, sampling is used by the providers in their own efforts to monitor their performance. 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. The competition was designed to advance the agency mission by helping HHS/OIG create a 508 compliant version of the RAT-STATS software that can be expanded as needed to ensure HHS/OIG can meet its audit sampling requirements moving forward.

Solution Types: Software and apps

Plan for Upcoming 2 FYs: N/A

A.5.23 Blockchain in Healthcare Code-a-Thon[63]

Lead Sponsoring Agency: Office of the National Coordinator for Health Information Technology (ONC)

Status: This competition was completed in FY17.

Competition Goals: In September 2016, ONC announced the Use of Blockchain in Health IT and Health-Related Research Challenge. The challenge solicited white papers that investigated the potential relationship between blockchain technology and its use in health IT and health-related research; these were later used to inform the Use of Blockchain in Healthcare and Health-Related Research Workshop. The workshop convened Federal, public, and private stakeholders to receive briefings from Federal and industry leaders utilizing blockchain and/or alternative distributed ledger technologies. Ultimately, participants in the Blockchain in Healthcare Code-A-Thon heard presentations from eight of the Blockchain Challenge winners, shared successes, and generated new ideas around blockchain technology solutions in the healthcare ecosystem. One of the next steps identified during the workshop was to support demonstrations and trial implementations to determine whether blockchain had a place in health IT and, if so, ascertain its role.

Goal Types: Develop technology; Inform and educate the public; Engage new people and communities; Stimulate a market

Justification for Using Prizes and Challenges: Prizes were chosen with the scope to engage a broader stakeholder community including researchers, innovators and start-up or small entities to spur innovation, educate the larger community, spur adoption of metrics, and lay the groundwork for potential future collaboration.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered was $15,000 and the total amount awarded was $13,000. Non-monetary incentives included the opportunity to participate in the Digital Chamber of Commerce's annual Blockchain conference at Georgetown University.

Solicitation of Submissions: Solicitation of submissions included social media outreach (Twitter, LinkedIn), email blasts, and a live webinar.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs)

Participation Requirements: The Challenge was open to the public and targeted technology developers and the health IT community. 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 and to HHS policy guidance.

Evaluation of Submissions: A panel of judges assessed each solution based on the following criteria: (1) technical competence and capabilities (35%); (2) use of data to provide effective outcomes (20%), (3) creativity/innovation (20%); and (4) valuable information and insights regarding data (25%).

Results: A total of 83 participants submitted entries between January 23 and March 7, 2017 and prizes were awarded to ten winners.

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[63] The website for the Blockchain in Healthcare Code-a-Thon can be viewed at https://www.cccinnovationcenter.com/challenges/blockchain-in-healthcare-code-a- thon/.

Budget and Resources: Code-A-Thon development and preparation duties were the responsibility of ONC employees. Contract funds were used to provide event support and logistics and to fund the cash awards. The Challenge utilized 0.4 FTE and $145,000 in funding in FY17.

Partnerships: Digital Chamber of Commerce, a 801c non-profit, provided the venue, food, advertising and an opportunity for the winner to have public exposure through a Blockchain conference. Services provided in this partnership provided a better platform in which to conduct the Challenge without adding additional cost to the taxpayer. The estimated value of this partnership is $50,000.

Advancement of Agency Mission: As the final step in a progression of blockchain-centered events, the Code-A-Thon was an opportunity to ascertain if blockchain could be used to address common problem areas that affect exchange of health data on a national scale.

Solution Types: Software and apps; Creative (design & multimedia); Technology demonstration and hardware

Plan for Upcoming 2 FYs: N/A

A.5.24 CHPL Data Challenge[64]

Lead Sponsoring Agency: ONC

Status: This competition was launched in FY18.

Competition Goals: The ONC Certified Health IT Product List (CHPL) Data Challenge is a call for developers, researchers, and innovators to develop a software application that makes use of the data in the CHPL API in novel ways. The application should provide solutions to challenges for healthcare providers, healthcare consumers, and the health IT community.

Goal Types: Find and highlight innovative ideas; Solve a specific problem; Develop technology; Inform and educate the public

Justification for Using Prizes and Challenges: The opening up of the CHPL with an API and XML files allows the public to use its data in creative ways, including those for which ONC does not have the internal capacity to fulfill or has not even imagined. Compared to a contract or other mechanism, a prize challenge provides the opportunity to reach out to the public for new ideas. Individuals and entities that work daily in the health IT and healthcare field, interacting with patients, can bring new viewpoints to issues that ONC policy specialists may not. The Challenge also provides an opportunity to engage app and software developers who might not be familiar with the health IT world but can bring experience and knowledge from other industries to bear.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered is $40,000 and has not yet been awarded. First and each of two second place runner-ups will receive $20,000 and $10,000, respectively. Non-monetary incentives included public recognition and opportunities to showcase work at ONC-sponsored events.

Solicitation of Submissions: Solicitation of submissions has included social media outreach (Twitter, LinkedIn), email blasts, and a live webinar.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Live video streaming

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[64] The website for the CHPL Data Challenge can be viewed at https://www.cccinnovationcenter.com/challenges/chpl-data-challenge/.

Participation Requirements: The Challenge is open to the public and targets technology developers and the health IT community. The Challenge is being run under the authority of section 105 of the America COMPETES Reauthorization Act and, therefore, has the eligibility criteria pursuant to it and to HHS policy guidance.

Evaluation of Submissions: Submissions were evaluated in November 2018.

Results: Entries were submitted between July 10, 2018 and October 31, 2018, and the Challenge is ongoing.

Budget and Resources: Challenge development and preparation duties were the responsibility of ONC employees. Once ready for launch, the Challenge began utilizing the services of a contractor which has been involved in such duties for ONC since 2010. The current contract is funded at $125,000 and structured to provide support for up to three challenges over a one-year period. These services include hosting of the challenge website, preparation of communications materials, ongoing day-to-day activities of challenge management, and support for reviewing and awarding functions. ONC estimates the Challenge utilized approximately 0.4 FTEs in FY18.

Partnerships: N/A

Advancement of Agency Mission: The Challenge is an opportunity to solve problems using CHPL data for health care providers, health care consumers, and the health IT community. ONC anticipates that participants will create novel solutions using this data, amplified by creative user interfaces that optimize the user's understanding of the proposed issue. These solutions can help provide insight to the public of ONC's certification processes and priorities and demonstrate the program's impact.

Solution Types: Software and apps; Creative (design & multimedia)

Plan for Upcoming 2 FYs: N/A

A.5.25 Consumer Health Data Aggregator Challenge[65]

Lead Sponsoring Agency: ONC

Status: This competition was completed in FY17.

Competition Goals: The Consumer Health Data Aggregator Challenge had 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 Fast Healthcare Interoperability Resources (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.

Goal Types: Find and highlight innovative ideas; Solve a specific problem; Inform and educate the public; Engage new people and communities; Build capacity; Stimulate a market

Justification for Using Prizes and Challenges: Compared to a contract or other mechanism, a prize challenge provides the opportunity to reach out to the public for new ideas. Individuals and entities that work daily in the health IT and health care field, interacting with patients, can bring new viewpoints to issues that ONC policy specialists cannot. The Challenge also provides an opportunity to engage app

[65] The website for the Consumer Health Data Aggregator Challenge can be viewed at https://www.Challenge.gov/challenge/consumer-health-data-aggregator-challenge/.

and software developers who might not be familiar with the health IT world but can bring viewpoints and knowledge from other industries to bear.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered was $175,000 and the total amount awarded was $160,000. In Phase 1, up to five prizes of $5,000 to $15,000 were available; four $10,000 prizes were awarded. In Phase 2, 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 were available; all three were awarded, with one business winning both of the $25,000 awards. The primary non-monetary incentives were the publicity and recognition for winning an ONC challenge. Award funds were disbursed by a contractor acquired through the HHS COMPETES Blanket Purchasing Agreement.

Solicitation of Submissions: Solicitation of submissions included an announcement of the Challenge at a major industry conference, a press release, social media outreach (Twitter, LinkedIn), email blasts, and several webinars. The 25 submissions indicate that the communications vectors worked, especially the main stage conference announcement, although the large prize purse was likely also a factor.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Live video streaming

Participation Requirements: While the Challenge was open to all developers, the need to understand the intersection of electronic health records (EHRs), patient care, and patient data sharing made it most relevant to companies that already had working knowledge of those areas and were 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 and to HHS policy guidance.

Evaluation of Submissions: 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, were steps toward the eventual outcome of the Challenge, not the outcome itself. The final outcomes of Phase 2, consumer apps, were ranked and awarded on the same evaluation criteria. Four evaluation criteria were used to review submissions: (1) the technical feasibility of the plan; (2) the adherence to data privacy and security best practices and applicable law, (3) the strength of the business/sustainability plan; and (4) the provider or health IT developer partnerships. These criteria captured the most important aspects that needed to be identified in the submissions.

Results: A total of 25 entries were submitted in Phase 1 between March 1 and June 1, 2016 and four prizes were awarded. In Phase 2, entries were submitted between June 2 and November 7, 2016 and two prizes were awarded.

Budget and 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.

Partnerships: N/A

Advancement of Agency Mission: The lack of interoperability between EHR systems remains a significant barrier to the modernization of health IT. FHIR 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.

Solution Types: Software and apps; Analytics, visualizations, algorithms

Plan for Upcoming 2 FYs: N/A

A.5.26 Easy EHR Issues Reporting Challenge[66]

Lead Sponsoring Agency: ONC

Status: This competition was launched in FY18.

Competition Goals: Stakeholder feedback indicates there is a need for more efficient and user-friendly mechanisms that allow electronic health record (EHR) end users to report concerns quickly and easily with little or no disruption to their workflow. Mechanisms widely available on the market today normally require the end user to either exit the EHR system entirely or leave the current workflow process in order to report the problem. Some EHRs may include a separate error reporting module, but others require the end user to fill out a report through a totally separate mechanism. This workflow disruption is enough of a burden on users that they avoid reporting. The greater the workflow interruption the more likely they are to delay rather than report immediately while the experience is fresh and most accurately recalled, or to forego reporting entirely. Clinicians need better reporting mechanisms that are designed to address the end user's needs and are complementary with the workflow processes and systems they use.

Goal Types: Solve a specific problem; Develop technology

Justification for Using Prizes and Challenges: Compared to a contract or other mechanism, a prize challenge provides the opportunity to reach out to the public for new ideas. Individuals and entities that work daily in the health IT and health care field, interacting with patients, can bring new viewpoints to issues that ONC policy specialists cannot. The Challenge also provides an opportunity to engage app and software developers who might not be familiar with the health IT world but can bring viewpoints and knowledge from other industries to bear.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered is $80,000 and has not yet been awarded. First, second, and third place winners will receive $45,000, $25,000, and $10,000, respectively. Non-monetary incentives include public recognition and opportunities to showcase work at ONC-sponsored events.

Solicitation of Submissions: Solicitation of submissions has included social media outreach (Twitter, LinkedIn), email blasts, and a live webinar.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Live video streaming

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[66] The website for the Easy EHR Issues Reporting Challenge can be viewed at https://www.cccinnovationcenter.com/challenges/easy-ehr-issue-reporting-challenge/.

Participation Requirements: The Challenge is open to the public and targets technology developers and the health IT community. The Challenge is being run under the authority of section 105 of the America COMPETES Reauthorization Act and, therefore, has the eligibility criteria pursuant to it and to HHS policy guidance.

Evaluation of Submissions: Submissions were evaluated in October 2018.

Results: Entries were submitted between May 22 and October 15, 2018, and the Challenge is ongoing.

Budget and Resources: Challenge development and preparation duties were the responsibility of ONC employees. Once ready for launch, the Challenge began utilizing the services of a contractor that has been involved in such duties for ONC since 2010. The current contract is funded at $125,000 and structured to provide support for up to three challenges over a one-year period. These services include hosting of the challenge website, preparation of communications materials, ongoing day-to-day activities of challenge management, and support for reviewing and awarding functions. The Challenge utilized approximately 0.15 FTE in FY18.

Partnerships: N/A

Advancement of Agency Mission: As of 2015, 96% of hospitals and 78% of office-based physicians have certified EHRs. Clinicians and other members of the health care team routinely work in fast-paced, stressful, and challenging environments. As such, they have come to increasingly rely on EHRs to retrieve patient information, assist in making complex patient care decisions, and ultimately optimize patient safety and health care quality. Despite a growing body of evidence showing the use of advanced health IT being associated with safer care on the whole, it also poses new challenges and risks when deployed into complex clinical environments. Whether through design, development, deployment, operational, or other deficiencies, studies have also shown EHRs can contribute to adverse events and fall short of expectations for safety-related usability, in addition to frustrating end users and posing avoidable risks to patients. These issues are difficult to identify and correct unless the full array of end users' concerns are regularly captured and analyzed for trends and improvement opportunities. The more easily and consistently end users can capture and share their concerns, the better that safety programs and organizations will be able to spot trends and drive improvement.

Solution Types: Software and apps; Analytics, visualizations, algorithms

Plan for Upcoming 2 FYs: N/A

A.5.27 Move Health Data Forward Challenge[67]

Lead Sponsoring Agency: ONC

Status: This competition was completed in FY17.

Competition 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 with the aim of improving 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 was to create API solutions combined with new implementation

[67] The website for the Move Health Data Forward Challenge can be viewed at https://www.Challenge.gov/challenge/move-health-data-forward-challenge/.

specifications, known as Health Relationship Trust (HEART), that have the potential for individuals to securely and electronically authorize the movement of their health data to destinations they choose. This 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.

Goal Types: Find and highlight innovative ideas; Solve a specific problem; Develop technology

Justification for Using Prizes and Challenges: A prize competition was used to challenge the health IT industry to help find new technological ways to put consumers in the driver's seat when it comes to how and when their health information can be shared. This choice helped to promote innovation in the area of consumer-mediated exchange by opening up the challenge audience to include health care providers, social service organizations, developers, entrepreneurs, start-ups, early-stage companies, venture capital firms, health information exchanges, incubators, and accelerators.

Cash Prize Purses and/or Non-Cash Prize Awards: The Challenge had a prize purse of up to $250,000. In Phase 1, up to ten prizes of $5,000 were available. In Phase 2, up to five prizes of $20,000 were available. In Phase 3, up to two prizes of $50,000 were available. The primary non-monetary incentives were the publicity and recognition for winning an ONC challenge, in addition to opportunities to showcase work at ONC-sponsored events. Awards were disbursed by a contractor acquired through the HHS COMPETES Blanket Purchasing Agreement.

Solicitation of Submissions: Five public webinars with over 400 attendees total were hosted throughout the duration of the Challenge, including two webinars launching the Challenge. ONC also identified and pitched top media outlets that covered the Challenge, including ONC Federal partners, the health IT community, local and community-based health care organizations, hospitals, health systems, hospital innovation centers, and consumer groups, and subject-matter related blogs, journals, and magazines. In addition, ONC leveraged HHS and external audiences on social media to publicize the Challenge and reach target stakeholders, fostering early engagement and organic team-building through social conversation.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Day-long event(s) prior to the competition; Live video streaming; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies)

Participation Requirements: The Challenge was open to the public and targeted technology developers and the health IT community. 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 and HHS policy guidance. Phase 1 required participants to describe the technical, operational, financial, and business aspects of their proposed solution, and the main goal was for participants to show feasible and executable plans for innovative solutions and prove its impact potential. Phase 2 required participants to demonstrate, via a live virtual webinar, a viable solution to achieve those goals by allowing for the safe and secure exchange of consumer or provider health records. Phase 3 required participants to implement their solutions through a mobile or web-based application and to conduct a real-time product demo.

Evaluation of Submissions: For all three phases of the Challenge, a combined review panel of Federal and non-Federal subject matter experts reviewed and scored all 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. Based on the quantitative results by the review panel and review of submissions by the Federal challenge managers,

ten winners were selected in Phase 1, five winners were selected in Phase 2, and two winners were selected in Phase 3.

Results: Of the 31 initial entries submitted by 31 participants between May 10 and September 8, 2016, 17 prizes were awarded throughout the three phases.

Budget and Resources: A small team of ONC Federal employees, with one primary challenge manager, developed and executed the Challenge. Sensis was acquired through the HHS COMPETES Blanket Purchasing Agreement. ONC worked with Sensis, a third-party contractor, who provided administrative, challenge development, management and communications assistance. The Challenge utilized approximately 0.35 FTE for challenge oversight and $200,000 over two year to fund contractor challenge management.

Partnerships: N/A

Advancement of Agency Mission: The Challenge emphasized the importance of ONC's mission, which is to improve the health and well-being of individuals and communities through the use of technology and health information that is accessible when and where it matters most. Specifically, the Challenge advanced the agency's mission by focusing on improving consumer-mediated exchange of individuals' health data. The winning solutions were able to demonstrate a consumer-facing solution that incorporated the HEART implementation specifications and used an API that empowers consumers to control the movement of their health data.

Solution Types: Software and apps; Technology demonstration and hardware; Business plans

Plan for Upcoming 2 FYs: N/A

A.5.28 Oh, the Places Data Goes: Health Data Provenance Challenge[68]

Lead Sponsoring Agency: ONC

Status: This competition was launched in FY17 and completed in FY18.

Competition Goals: The goal of Phase 1 of the Data Provenance Challenge was for teams to identify real world provenance problems, understand why they are important to solve, and provide an opportunity for participants to develop practical and executable plans for innovative solutions. The goal of Phase 2 was to demonstrate a viable solution with high technological merit, test the scalability and feasibility of implementation, and assess the impact of the intended outcomes.

Goal Types: Find and highlight innovative ideas; Solve a specific problem; Develop technology; Stimulate a market

Justification for Using Prizes and Challenges: Compared to a contract or other mechanism, a prize challenge provides the opportunity to reach out to the public for new ideas. Individuals and entities that work daily in the health IT and health care field, interacting with patients, can bring new viewpoints to issues that ONC policy specialists cannot. The Challenge also provides an opportunity to engage app and software developers who might not be familiar with the health IT world but can bring experience and knowledge from other industries to bear.

[68] The website for the Oh, the Places Data Goes: Health Data Provenance Challenge can be viewed at https://www.cccinnovationcenter.com/challenges/provenance-challenge/.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered and awarded was $180,000. Non-monetary incentives included public recognition and opportunities to showcase work at ONC-sponsored events.

Solicitation of Submissions: ONC solicited submissions through the Federal Register Notice FRN, Challenge.gov, a contractor website, a HealthIT.gov blog post, the ONC Twitter account, a listserv announcement, email blasts, and an informational webinar. These methods appear to have been effective, having led to 19 Phase 1 submissions.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Day-long event(s) prior to the competition; Other - Informational webinar

Participation Requirements: For Phase 1, teams were required to submit white papers that described their current capabilities and methods used to demonstrate provenance of health data. Teams were required to identify a problem they experienced that inhibited the desired or necessary amount of provenance data to be conveyed during clinical care and propose a solution. Participants were expected to articulate the technical, operational, and business aspects/impacts of their problem and solution, including but not limited to, the value proposition, key partners, implementation plan, timeline, key activities and resources, and metrics for success. Only Phase 1 winners were eligible to participate in the second and final phase, which involved the development and testing of their solution to the problem identified in Phase 1. As a condition of accepting the $20,000 award, Phase 1 winners were required to participate in Phase 2 of the Challenge. Participants submitted a recorded demonstration, solution guide and lessons learned focused on prototyping and testing the effectiveness of the solution.

Evaluation of Submissions: Judges were a combination of ONC employees and outside subject matter experts who had previously worked or were currently working with ONC. Eligible challenge entries were judged by a review panel composed of Federal employees and experts in compliance with the requirements of the America COMPETES Act and the Department of Health and Human Services judging guidelines.[69]

Results: Of the 19 entries submitted in Phase 1 between April 6 and May 22, 2017, six prizes were awarded. Phase 2 entries were submitted between June 14, 2017 and January 22, 2018, and winners announced on February 21, 2018.

Budget and Resources: Challenge development and preparation duties were the responsibility of ONC employees. Once ready for launch, the Challenge began utilizing the services of a contractor which has been involved in such duties for ONC since 2010. This contract was funded to provide challenge support and services include hosting of the challenge website, preparation of communications materials, ongoing day-to-day activities of challenge management, and support for reviewing and awarding functions. The Challenge utilized approximately 0.6 FTEs in FY17 and FY18. Additionally, the Challenge utilized $180,000 in funding in FY18.

Partnerships: N/A

Advancement of Agency Mission: With growing HER adoption comes an increasing availability of digital health tools and growing demand among consumers who want to share their data with their providers. The need for health data provenance, and standard approaches to capture it, is an important priority. Additionally, the Health IT Standards Committee has issued recommendations to ONC in the past on data provenance. Data provenance is a complex issue that plays a role in almost everything related to

[69] http://www.hhs.gov/idealab/wp-content/uploads/2014/04/HHS-COMPETITION-JUDGING- GUIDELINES.pdf

electronic data use and exchange. Thus, finding innovative and standardized solutions to improve and capture data provenance will enable the health care industry to better maximize health data that is already digitized and ready to share.

Solution Types: Ideas; Technology demonstration and hardware

Plan for Upcoming 2 FYs: N/A

A.5.29 Patient Matching Algorithm Challenge[70]

Lead Sponsoring Agency: ONC

Status: This competition was completed in FY17.

Competition Goals: The goal of the Patient Matching Algorithm Challenge was to bring about greater transparency and data on the performance of existing patient matching algorithms, spur the adoption of performance metrics for patient data matching algorithm vendors, and positively impact other aspects of patient matching such as deduplication and linking to clinical data.

Goal Types: Advance scientific research; Inform and educate the public; Engage new people and communities; Stimulate a market

Justification for Using Prizes and Challenges: Prizes were chosen with the scope to engage a broader stakeholder community including researchers, innovators and start-up or small entities to spur innovation, educate the larger community, spur adoption of metrics, and initiate future collaboration.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered and awarded was $75,000. Non-monetary incentives included public recognition and opportunities to showcase work at ONC-sponsored events.

Solicitation of Submissions: Groups specifically targeted for participation in the Challenge included algorithm researchers and vendors, informaticists, researchers, and start-ups.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release

Participation Requirements: The Challenge was open to the public and targeted technology developers and the health IT community. 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 and to HHS policy guidance.

Evaluation of Submissions: Participants were evaluated on their algorithm performance in finding matched pairs in the data set provided. Each individual submission was scored automatically by a scoring server using a key for scoring and received a score for each of the following three metrics: F-Score (which is the harmonic mean between precision and recall), Precision (least mismatched patients), and Recall (least missed matches). The mathematical scoring, rather than the qualitative evaluation performed by human in most ONC challenges, may have been a contributing factor to the extremely high participation.

Results: Of the nearly 7,000 submissions[71] entries submitted by more than 140 teams between June 12 and October 12, 2017, six prizes were awarded to four individual teams (Vynca, PICSURE, Information

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[70] The website for the Patient Matching Algorithm Challenge can be viewed at https://www.patientmatchingchallenge.com/.

[71] https://www.hhs.gov/about/news/2017/11/08/hhs-names- patient-matching-algorithm-challenge-winners.html

Softworks, and Ocuvera). The winners for Best "F-score" were Vynca (first place, $25,000 prize), PICSURE (second place, $20,000), Information Softworks (third place, $15,000). The winner for Best First Run was Information Softworks ($5,000), the winner for Best Recall was PICSURE ($5,000), and the winner for Best Precision was Ocuvera ($5,000). Each winner employed widely different methods. PICSURE used an algorithm based on the Fellegi-Sunter method for probabilistic record matching and performed a significant amount of manual review. Vynca used a stacked model that combined the predictions of eight different models. They reported that they manually reviewed less than 0.001 percent of the records. Although Information Softworks also used a Fellegi-Sunter-based enterprise master patient index (EMPI) system with some additional tuning, they also reported extremely limited manual review.

Budget and Resources: ONC utilized $15,000 for MITRE contract support for Amazon Web Services testing environment, and $140,000 for ongoing challenge contract support. The Challenge utilized approximately 0.8 FTEs in FY17.

Partnerships: ONC partnered with Adam Culbertson, the Healthcare Information and Management Systems Society (HIMSS) Innovator-In-Residence.

Advancement of Agency Mission: In 2014, ONC identified patient matching as central to interoperability, reporting that it "will also address critical issues such as data provenance, data quality and reliability, and patient matching to improve the quality of interoperability, and therefore facilitate an increased quantity of information movement."[72]

Solution Types: Analytics, visualizations, algorithms; Scientific

Plan for Upcoming 2 FYs: N/A

A.5.30 Privacy Policy Snapshot Challenge[73]

Lead Sponsoring Agency: ONC

Status: This competition was completed in FY17.

Competition Goals: The Privacy Policy Snapshot Challenge was a call for designers, developers, and health data privacy experts to create an online Model Privacy Notice (MPN) generator. The MPN is a voluntary, openly available resource designed to help health technology developers who collect digital health data clearly convey information about their privacy and security policies to their users. Similar to a nutrition facts label, the MPN provides a snapshot of a product's existing privacy practices, encouraging transparency and helping consumers make informed choices when selecting products.

Goal Types: Improve government service delivery; Solve a specific problem; Inform and educate the public

Justification for Using Prizes and Challenges: Compared to a contract or other mechanism, a prize challenge provided the opportunity to reach out to the public for new ideas. Individuals and entities that work daily in the health IT and health care field, interacting with patients, can bring new viewpoints to issues that ONC policy specialists cannot. The Challenge also provided an opportunity to engage app

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[72] ONC (2014) A 10-Year Vision to Achieve an Interoperable Health IT Infrastructure, available at https://www.healthit.gov/sites/default/files/ONC10yearInteroperabilityConceptPaper.pdf

[73] The website for the Privacy Policy Snapshot Challenge can be viewed at https://www.Challenge.gov/challenge/privacy-policy-snapshot-challenge/.

and software developers who might not be familiar with the health IT world but can bring viewpoints and knowledge from other industries to bear.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered and awarded was $35,000. First, second, and third place winners were awarded $20,000, $10,000, and $5,000, respectively. Non-monetary incentives included public recognition and opportunities to showcase work at ONC-sponsored events.

Solicitation of Submissions: ONC solicited submissions through social media outreach (Twitter, LinkedIn), email blasts, and a live webinar.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Live video streaming

Participation Requirements: The Challenge was open to the public and targeted technology developers and the health IT community. 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 and to HHS policy guidance.

Evaluation of Submissions: Submissions were evaluated based on the following criteria: (1) accurate use of MPN content, including appropriate modification of flexible language and no deviation from standardized language; (2) use and demonstration of best practices in developing and presenting web content for consumption, including consumer testing, web design, and accessibility; (3) visual appeal of the generated MPN; and (4) ease of use for a developer to implement and use the MPN generator, including ability to customize the MPN. The submission review panel was a combination of Federal and non-Federal subject matter experts.

Results: Of the six entries submitted between December 13, 2016 and April 10, 2017, three prizes were awarded. The number of submissions fell slightly below expectations, although a smaller prize purse and an open source intellectual property policy may have contributed to the small number of submissions.

Budget and Resources: Challenge development and preparation duties were the responsibility of ONC employees. Once ready for launch, the Challenge began utilizing the services of a contractor which has been involved in such duties for ONC since 2010. This contract provided challenge support and services including hosting of the challenge website, preparation of communications materials, ongoing day-to-day activities of challenge management, and support for reviewing and awarding functions. The value of this support was estimated at $15,000. The Challenge utilized 0.4 FTEs.

Partnerships: N/A

Advancement of Agency Mission: In 2011, ONC collaborated with the Federal Trade Commission (FTC) to release a MPN; the project's goals were to increase consumers' awareness of companies' personal health record (PHR) data practices and empower consumers by providing them with an easy way to compare the data practices of two or more PHR companies. In the last five years, the health information technology market has changed significantly and there is now a larger variety of products such as mobile applications and wearable devices that collect digital health data. ONC recognized a need to update the MPN to make it applicable to a broad range of consumer health technologies beyond PHRs. More and more individuals are obtaining access to their electronic health information and using consumer health technology to manage this information. As retail products that collect digital health data directly from consumers are used, such as exercise trackers, it is increasingly important for consumers to be aware of companies' privacy and security policies and information sharing practices. Health technology developers can use the MPN to easily enter their information practices and produce

a notice to allow consumers to quickly learn and understand privacy policies, compare company policies, and make informed decisions.

Solution Types: Software and apps; Analytics, visualizations, algorithms

Plan for Upcoming 2 FYs: N/A

A.5.31 Provider User Experience Challenge[74]

Lead Sponsoring Agency: ONC

Status: This competition was completed in FY17.

Competition Goals: The Provider User Experience Challenge had 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. Despite having a high level of awareness, the Challenge was also intended to raise awareness higher and to incentivize more developers to work with and familiarize themselves with FHIR.

Goal Types: Improve government service delivery; Find and highlight innovative ideas; Solve a specific problem; Inform and educate the public; Engage new people and communities; Build capacity; Stimulate a market

Justification for Using Prizes and Challenges: Compared to a contract or other mechanism, a prize challenge provided the opportunity to reach out to the public for new ideas. Individuals and entities that work daily in the health IT and health care field, interacting with patients, can bring new viewpoints to issues that ONC policy specialists cannot. The Challenge also provided an opportunity to engage app and software developers who might not be familiar with the health IT world but can bring experience and knowledge from other industries to bear.

Cash Prize Purses and/or Non-Cash Prize Awards: The Challenge had 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, 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 were available; all three were awarded, with one business winning both of the $25,000 awards. 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.

Solicitation of Submissions: ONC solicited submissions through an announcement of the challenge at a major industry conference, a press release, social media outreach (Twitter, LinkedIn), email blasts, and several webinars. The 34 submissions indicate that the communications vectors worked, especially the main stage conference announcement, although the large prize purse was likely also a factor.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Live video streaming

Participation Requirements: While the Challenge was open to all 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

[74] The website for the Provider User Experience Challenge can be viewed at https://www.Challenge.gov/challenge/provider-user-experience-challenge/.

the authority of Section 105 of the America COMPETES Reauthorization Act and therefore had the eligibility criteria pursuant to it and to HHS policy guidance.

Evaluation of Submissions: 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, were ranked and awarded on the same evaluation criteria. Five evaluation criteria were used to review submissions: (1) the technical feasibility of the plan; (2) the adherence to data privacy and security best practices and applicable law; (3) the strength of the business/sustainability plan; (4) the impact potential in a clinical setting; and (5) the provider and/or health IT developer partnerships. These criteria captured the most important aspects that needed to be identified in the submissions.

Results: Of the 34 entries submitted in Phase 1 between March 1 and June 1, 2016, four prizes were awarded. Phase 2 entries were submitted between June 2 and November 7, 2016 and two prizes were awarded.

Budget and 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. The Challenge utilized approximately 0.2 FTE in FY17.

Partnerships: N/A

Advancement of Agency Mission: The lack of interoperability between EHR systems remains a significant barrier to the modernization of health IT. FHIR 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, was part of ONC's Connecting and Accelerating a FHIR App Ecosystem initiative. This initiative called 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 Types: Software and apps; Analytics, visualizations, algorithms

Plan for Upcoming 2 FYs: N/A

A.5.32 Proving the Potential: A Health Data and Standards Code-a-Thon[75]

Lead Sponsoring Agency: ONC

[75] The website for the Proving the Potential: a Health Data and Standards Code-a-Thon can be viewed at https://www.cccinnovationcenter.com/challenges/proving-the-potential-a-health-data- and-standards-code-a-thon/.

Status: This competition was completed in FY17.

Competition Goals: Teams were challenged to showcase their skills and vision using APIs, software development kits (SDKs), and other tools made publicly available by leading innovators in healthcare. Projects were intended to be forward-thinking, enhance interoperability, and focus on demonstrating the potential to seamlessly incorporate one or more of the assets into existing health IT systems. Contestants were to address one of the following use cases: (1) electronic quality measures and/or decision support; (2) secure and privacy preserving methods to aggregate patient data; (3) discovery of patients, providers, researchers or services.

Goal Types: Develop technology; Inform and educate the public; Engage new people and communities; Stimulate a market

Justification for Using Prizes and Challenges: Prizes were chosen with the scope to engage a broader stakeholder community, including researchers, innovators, start-ups, and small entities, to spur innovation, educate the larger community, spur adoption of metrics, and lay the groundwork for potential future collaboration.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered was $15,000 and the total amount awarded was $8,000. Non-monetary incentives included public recognition and opportunities to showcase work at ONC-sponsored events.

Solicitation of Submissions: ONC solicited submissions through social media outreach (Twitter, LinkedIn), email blasts, and a live webinar.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs)

Participation Requirements: The Challenge was open to the public and targeted technology developers and the health IT community. 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 and to HHS policy guidance.

Evaluation of Submissions: A panel of judges assessed each solution based on the following criteria: (1) technical competence and capabilities (35%); (2) use of data to provide effective outcomes (20%); (3) creativity/innovation (20%); and (4) valuable information and insights regarding data (25%).

Results: Entries were submitted between April 11 and April 21, 2017. Three monetary awards were issued in addition to four Honorable Mention designations. Participation was lower than anticipated, leading to partial rather than complete award of the full prize purse.

Budget and Resources: Code-A-Thon development and preparation duties were the responsibility of ONC employees. Contract funds were used to provide event support and logistics and to fund the cash awards. The Challenge utilized approximately 0.2 FTE and $145,000 in funding.

Partnerships: N/A

Advancement of Agency Mission: The Challenge intended to link patient data across research, claims and clinical data sets in order to standardize the sharing of patient data across organizations. As part of a Patient Centered Outcomes Research funding opportunity within HHS, a number of open source tools and services have been built to support the use of open APIs as a means to exchange clinical and health related data. This Code-A-Thon aimed to encourage developers to leverage these assets using these underlying services and platforms to build more advanced services on top of them and showcase their innovations.

Solution Types: Software and apps; Creative (design & multimedia); Technology demonstration and hardware

Plan for Upcoming 2 FYs: N/A

A.5.33 Secure API Server Showdown Challenge[76]

Lead Sponsoring Agency: ONC

Status: This competition was launched in FY17 and completed in FY18.

Competition Goals: The main goal of Stage 1 was for participants to implement the Substitutable Medical Applications, Reusable Technologies (SMART) standard on FHIR Authorization specification into an existing open source FHIR code base and to develop a secure FHIR server. The main goal of Stage 2 was to further harden the open source FHIR servers by enabling dedicated testing of the security components by participants. Participants tested the winning FHIR servers from Stage 1 and identified potential security vulnerabilities. This was intended to help improve the security of current and future open source FHIR servers and add to security best practices for use of SMART on FHIR authorization.

Goal Types: Solve a specific problem; Develop technology; Inform and educate the public; Engage new people and communities; Stimulate a market

Justification for Using Prizes and Challenges: Compared to a contract or other mechanism, a prize challenge provided the opportunity to reach out to the public for new ideas. Individuals and entities that work daily in the health IT and health care field, interacting with patients, can bring new viewpoints to issues that ONC policy specialists cannot. The Challenge also provided an opportunity to engage app and software developers who might not be familiar with the health IT world but can bring experience and knowledge from other industries to bear.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered was $50,000 and the total amount awarded was $20,000. Non-monetary incentives included public recognition and opportunities to showcase work at ONC-sponsored events.

Solicitation of Submissions: ONC solicited submissions through Challenge.gov, a contractor website, a HealthIT.gov blog post, the ONC Twitter account, a listserv announcement, email blasts, and university outreach. Despite a strong effort to advertise this Challenge, there was a small number of participants. This result was not unexpected because the Challenge was a very niche topic.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Other - University outreach

Participation Requirements: The Challenge was open to the public and targeted technology developers and the health IT community. 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 and to HHS policy guidance.

Evaluation of Submissions: In Phase 1, submissions were evaluated as to whether they met the FHIR Server requirements as indicated on the Challenge website. A live demonstration of the FHIR server was held with judges evaluating their adherence to the requirements. In Phase 2, submissions were

[76] The website for the Secure API Server Showdown Challenge can be viewed at https://www.cccinnovationcenter.com/challenges/secure-api-server-showdown- challenge/.

evaluated based on the most number of vulnerabilities discovered in FHIR server and two bonus categories.

Results: Of the two entries submitted between October 10, 2017 and January 15, 2018, two prizes were awarded.

Budget and Resources: Challenge development and preparation duties were the responsibility of ONC employees. Once ready for launch, the Challenge began utilizing the services of a contractor which has been involved in such duties for ONC since 2010. The current contract is funded at $125,000 and structured to provide support for up to three challenges over a one-year period. These services include hosting of the challenge website, preparation of communications materials, ongoing day-to-day activities of challenge management, and support for reviewing and awarding functions. The Challenge utilized approximately 3 FTEs in FY17 and FY18 and $20,000 in FY18 funding.

Partnerships: N/A

Advancement of Agency Mission: The Challenge sought to engage the health IT industry to identify FHIR servers that reinforce the value of following technical security best practices on an industry-wide scale. These best practices ensure the most widely-accepted and effective measures are taken, resulting in a high-quality, secure FHIR server, further helping to protect the health information it contains.

Solution Types: Software and apps; Ideas; Technology demonstration and hardware

Plan for Upcoming 2 FYs: N/A

A.5.34 HHS Opioid Code-a-Thon[77]

Lead Sponsoring Agency: Office of the Secretary, Office of the Chief Technology Officer (CTO)

Status: This competition was launched and completed in FY18.

Competition Goals: The purpose of the Code-a-Thon was to develop data-driven solutions to the opioid epidemic using Federal, State, and local (city, county) datasets. CTO's goal was for solutions identified at the Code-a-Thon to be implemented and used to address the opioid crisis.

Goal Types: Find and highlight innovative ideas; Engage new people and communities

Justification for Using Prizes and Challenges: Prizes were used to engage new communities and expertise in answering questions about the opioid epidemic, and to develop data-driven solutions.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered and awarded was $30,000. The $30,000 was in-kind support from co-sponsors: Socrata ($10,000), Tableau ($10,000), Alteryx ($5,000), and the University of Louisiana Lafayette ($5,000). Participants were also offered registration to attend the HHS Opioid Symposium that occurred the morning before the Challenge began.[78]

Solicitation of Submissions: CTO solicited submissions through social media and marketing emails. Non-Federal partners' outreach was critical to reaching communities that might not normally engage in government work.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies)

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[77] The website for the HHS Opioid Code-a-Thon can be viewed at https://www.hhs.gov/challenges/index.html.

[78] Information about the Symposium is available at: https://www.hhs.gov/challenges/symposium/index.html.

Participation Requirements: Interested participants were required to form teams of three to five individuals. Team needed to attest to the following qualifications: (1) team skillsets: team indicates that they possess computer programming, data analytics, and end user design skillsets; (2) team multidisciplinary expertise: team indicates expertise in any two of the following areas relevant to the challenge tracks: health, analytics, social science, design, and/or engineering; and (3) team experience: the team indicates that they collectively have ten years of experience in their respective fields and/or previously participated in a public or private sector sponsored Code-a-Thon.

Evaluation of Submissions: Participants performed a five-minute, in-person demo and provided the following information to be eligible for further review and a prize award on December 7, 2017: (1) team name, participant names, organization(s), and primary point of contact; (2) challenge track; (3) data resources utilized; (4) link to the solution, (5) written summary of the solution. The participants were judged by a group of judges from HHS, state, and private sector representatives. Solutions were judged based on design, potential for impact, technical achievement, and innovation.[79]

Results: Of the 50 team entries submitted by 300 participants on December 7, 2017, three prizes were awarded.

Budget and Resources: The Challenge utilized 2.5 FTEs in challenge planning and execution and $400,000 in FY18 funding for contract services for strategy and execution of the event.

Partnerships: Non-Federal partners sponsored prize money and provided in-kind donations for food, coffee, and snacks. Non-Federal partners also promoted the competition to increase participation. Finally, a non-Federal partner held an event prior to the Challenge. The partner convened a diverse set of stakeholders to develop design principles that helped guide challenge participants' solution development for the Challenge. Federal partners included numerous HHS subagencies (AHRQ, CMS, CDC, SAMHSA, HRSA) and other Federal agencies (Department of Transportation, Department of Justice, Department of Education, Department of Commerce, and Census Bureau). Non-Federal partners included the State of Indiana, the State of Louisiana, the State of North Carolina, the State of Virginia, Denver Health System, Socrata, Tableau, Alteryx, the University of Louisiana LaFayette, IEEE, Appriss Health, Google, Tamr, Stanford MedX. The estimated value of partner contributions is $35,000.

Advancement of Agency Mission: Teams used data from HHS and other Federal agencies, some of it released for the first time, to analyze trends and patterns and propose solutions in three challenge areas. The innovative ideas developed at the Code-a-Thon have led to solutions that are being tested in the field or to new companies being formed. Finally, the NIH NIDA Office of Translational Initiatives and Program Innovations developed a SBIR grant to support new solutions and business models relevant to the opioid epidemic.

Solution Types: Software and apps; Technology demonstration and hardware

Plan for Upcoming 2 FYs: There is a need to continue analysis of data to inform approaches to the opioid epidemic. There are also efforts within HHS to increase data sharing between agencies and analyses conducted using multiple data sources. Future plans will focus on answering questions about the opioid epidemic and other priority area topics through challenge competitions, some of which may specifically engage staff internal to HHS.

[79] More information about the evaluation process is available at: https://www.hhs.gov/challenges/code-a-thon/index.html

A.6 Department of Homeland Security (DHS)

A.6.1 Hidden Signals Challenge-"Can you Identify Biothreats in Real-Time?"[80]

Lead Sponsoring Agency: DHS Science and Technology Directorate

Status: This competition was launched and completed in FY18.

Competition Goals: The Hidden Signals Challenge called upon data innovators from a wide variety of fields—from data science, to civic tech, to epidemiology—to develop concepts (in Stage 1) and system designs (in Stage 2) for novel uses of existing data that will identify signals and achieve timelier alerts for biothreats in cities and communities. DHS intended for this work to be the first step in the design of a local and/or national-level system that could enable city-level operators to make critical and proactive decisions based on the most relevant and actionable insights. The Challenge focused on large metropolitan areas such as New York, Los Angeles, Washington D.C., Chicago, Boston, and Atlanta but was also open to solutions that address all geographic locations.

Goal Types: Improve government service delivery; Find and highlight innovative ideas; Solve a specific problem; Engage new people and communities

Justification for Using Prizes and Challenges: In the context of population health, understanding and utilizing nontraditional data as prognostic indicators provides an opportunity for earlier detection and better situational awareness of potential health threats. Previous and on-going research and development (R&D) efforts have focused on obtaining personal health information; however, this information is difficult to access and not timely enough to enable early intervention. While DHS is aware of certain data sets that could be of value, a prize competition enabled solvers from a broader knowledge base to not only join unique data sets that might otherwise not be considered, but also to apply novel data-driven analytics to provide strategies and algorithms for anticipating and detecting biological threats in a timely manner. Further, surveillance and data integration are topic areas that span a broad range of industries, from commercial business intelligence to law enforcement, and a prize competition would potentially reach such needed expertise that might otherwise be missed. A prize competition enabled novel approaches to the problem.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered and the total amount awarded was $300,000. The prize purse was divided into two stages. In Stage 1, five finalists received $20,000 each and in Stage 2, the first place winner received $150,000 and the second place winner received $50,000. Non-monetary incentives included mentorship for problem solvers in the development and implementation of their solutions during Stage 2. All prize funds were FY17 funds from the Real-Time Biothreat Awareness Apex Program. Cash prizes were paid directly to the winners by the DHS Science and Technology Directorate.

Solicitation of Submissions: During Stage I open submissions, the Challenge sought to drive submissions from innovators and communicate the program's value to the public and stakeholders. During Stage II, the Challenge sought to drive awareness of the program to the public and stakeholders such as city-level employees, healthcare professionals, and data technology influencers across the United States. Promotion included public press announcements and targeted outreach, influencer activation, and sharing messages through the Challenge, DHS Science and Technology (S&T), and Challenge winners' channels. Press coverage included stories in 15 outlets including security (American Security Today),

[80] The website for the Hidden Signals Challenge-"Can you Identify Biothreats in Real-Time?" can be viewed at www.hiddensignalschallenge.com.

government (FedScoop), and healthcare (Fierce Healthcare). For targeted outreach, the vendor directly contacted over 350 validators, experts, and solvers and secured placement for Challenge.gov, NYC Open Data, Open Data Atlanta, Open Data D.C., and Harvard Business School Digital Initiative newsletter. A Challenge-specific newsletter (opened approximately 500 times via forwarding) and blog were also developed. Additionally, social media presence garnered more than one million impressions. Notable tweets included U.S. Chief Data Scientist DJ Patil (@DPatil), In-Q-Tel's B, Next Lab (@HarvardCIL), and data influencer (@KDNuggets). These efforts resulted in nearly 300 visitors to the Challenge website over three days, including tech giants Amazon and Microsoft, city-level employees from NYC Transit Authority and City of Palo Alto, and hospitals such as Longwood Medical and Academic Area, Children's Hospital Colorado, London School of Hygiene and Tropical Medicine, and St. Jude's Children's Hospital.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Day-long event(s) prior to the competition; Live video streaming; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies)

Participation Requirements: The Challenge was open to all individuals over the age of 18 who have not been convicted of a felony. Individuals must be a United States citizen or legal permanent resident at the time of entry. In addition, the Challenge was open to all validly formed legal U.S. entities whose primary place of business was in the U.S. and have not declared or been declared in bankruptcy. Eligibility was subject to verification by the Department of Homeland Security, Science and Technology Directorate before cash prizes were awarded. For full eligibility details, visit: https://www.hiddensignalschallenge.com/rules-terms-conditions/#eligibility

Evaluation of Submissions: Selecting the five Stage I finalists involved the following work streams: (1) preliminary vetting by the vendor, with confirmation by DHS of ineligible submissions; (2) assignment of submissions to a review panel of 17 expert review panelists; (3) review panel scoring against an established rubric (originality, impact, feasibility, sustainability, scalability, team); (4) advancement of the top 20 submissions to judges; (5) judges scoring (same criteria); (6) deliberation call; (7) finalist recommendation; (8) DHS vetted finalists; and (9) clearance by DHS Office of General Counsel (OGC). Selecting the grand prize winner and runner-up for Stage II involved judges scoring against established criteria (empathy, impact, feasibility, sustainability, scalability, and team), a deliberation call, a winner recommendation, and DHS vetting and clearance of winners.

Results: The Challenge consisted of two stages. Stage I submissions opened October 17, 2017 and closed December 4, 2017. Stage I winners were announced February 14, 2018. Of the 37 submissions received in Stage I, five winners (three individuals and two teams) were selected to receive $20,000 each. Stage II was announced February 16, 2018 and submissions closed April 13, 2018. Stage II winners were announced May 30, 2018. Of the 5 submissions received in Stage II, two winners were selected. The first prize winner received $150,000 and the second prize winner received $50,000.

Budget and Resources: Funding for FY17 and FY18 totaled $507,071.48. Of the total funding, $452,772 was allotted to administer the prize through NASA's Center of Excellence for Collaborative Innovation and $36,689.48 was allotted for NASA's overhead. In addition, two full-time equivalent employees (FTEs) supported the planning stage of the Challenge in FY17[81] and 1.5 FTEs supported the execution

[81] Breakdown of FTEs in FY17: 1.5 FTEs by the DHS Science and Technology Directorate, 0.25 FTE by the DHS Prize Office and General Counsel, and 0.25 FTE by DHS Office of Health Affairs National Bio-surveillance Integration Center.

stage of the Challenge in FY18.[82] Funds provided were used to establish an interagency agreement (IA) with NASA and select a third-party prize administrator. Expenses were invoiced by NASA and prize funds were paid directly to winners by the DHS Science and Technology Directorate. Federal personnel supporting the Challenge performed activities such as preparing paperwork/documentation for the prize design, coordinating stakeholders, participating in meetings, providing subject matter expertise and services (e.g., communications and legal), and judging.

Partnerships: For this challenge, the DHS Office of Health Affairs National Biosurveillance Integration Center (NBIC) participated as the primary partner. NBIC offered in-kind support and expertise for the design and development of the Challenge, judging, and participation in the Challenge "virtual accelerator." NBIC provided additional marketing and outreach through their own communication channels, monthly forum, and stakeholder newsletter. For future challenges, clearly defining the roles and responsibilities of all partners will be critical to avoiding conflict and ensuring smooth and successful execution of the challenge. Non-Federal partners included the U.S. Department of Health and Human Services, Insight Data Science, Plymouth University, Enigma Technologies, the City of San Francisco, and Google. Total estimated value of partner contributions was $100,000.

Advancement of Agency Mission: DHS' biodetection and biosurveillance programs have found that the current detection and surveillance methods for biological threats, whether intentional releases of biological agents or infectious diseases, are not timely enough to enable early warning and intervention. Extensive literature reviews and interviews with subject matter experts have resulted in the identification of numerous problems with existing systems and biosurveillance efforts, including barriers to access of relevant situational and health data (e.g., electronic health records); confidence in data sources; uncertainty about existing, evolving, and emerging biological threats; and absence of the infrastructure, technologies, policies, and knowledge needed to effectively collect and derive insights from data. To achieve a timelier bio-surveillance enterprise, local and State entities/operators, as well as DHS operational components, must have access to a system that enables heterogeneous data sets to be captured and analyzed in real-time. These disparate data sets must be analyzed to not only understand relationships among them but also possible correlations with biological threats. By harnessing new streams of nontraditional data and information, an emerging problem may be identified more quickly and confidently, ultimately resolving the problem faster. DHS S&T challenged data innovators from a wide variety of fields to develop concepts for novel uses of existing data that will identify signals and achieve timelier alerts for biothreats in our cities and communities. Successful concepts explored connections between multiple readily accessible data sources to develop real-time insights that can improve public safety responses to emerging biothreats.

Solution Types: Technology demonstration and hardware; Analytics, visualizations, algorithms

Plan for Upcoming 2 FYs: During the upcoming two fiscal years, DHS will focus on a priority cross-cutting and topical area: the opioid epidemic. This topic has many problem spaces that are suitable for a challenge format, including technical approaches for detection/identification as well as big data analytics.

[82] Breakdown of FTEs in FY18: 1 FTE by the DHS Science and Technology Directorate, 0.25 FTE by the DHS Prize Office and General Counsel, and 0.25 FTE by the DHS Office of Health Affairs National Bio-surveillance Integration Center.

A.6.2 Passenger Screening Algorithm Challenge[83]

Lead Sponsoring Agency: DHS Science and Technology Directorate

Status: This competition was launched in FY17 and completed in FY18.

Competition Goals: Original equipment manufacturer (OEM) developers have struggled to decrease the rate of false alarms of Advanced Imaging Technology (AIT) passenger screening systems deployed at airports. False alarms result in secondary screening and pat downs, reducing checkpoint throughput and adversely impacting the traveler experience. Improved image recognition algorithms have the potential to reduce false alarms and are also critical to enabling an effective response to rapidly evolving security threats. DHS Science and Technology Directorate (S&T) and the Transportation Security Administration (TSA) used this Challenge to explore diverse and potentially more comprehensive solutions from many creative sources. Instead of partnering with OEMs on a one-on-one basis, the competition sought image recognition software (i.e., algorithms) that can be adapted into any number of hardware platforms. DHS S&T and TSA are looking to grow the industry around third-party capability providers of threat recognition algorithms. There currently is a very small technical provider base in this field, which limits the number of companies who traditionally propose solutions. DHS S&T and TSA are investigating interface standards that will allow third-party algorithms to be quickly implemented on deployed systems, allowing for rapid adaptation to changing threats in a non-proprietary way. This Challenge sought to identify third-party providers and how their creative approaches can be realized to improve security and provide a better passenger experience.

Goal Types: Improve government service delivery; Find and highlight innovative ideas; Solve a specific problem; Advance scientific research; Develop technology; Engage new people and communities

Justification for Using Prizes and Challenges: Software algorithms are purchased traditionally through OEMs and are highly proprietary to the company. This Challenge aimed to improve the procurement process by engaging skilled algorithm developers. The end results were new approaches and capabilities that were developed faster and more cost-effectively than a traditional research and development contract.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered and the total amount awarded was $1,500,000. Eight awards were made. The first place winner was awarded $500,000; the second place winner was awarded $300,000; the third place winner was awarded $200,000; and the fourth through eight place winners were awarded $100,000 each. DHS S&T dispersed the monetary award payments to the winners after verifying eligibility.

Solicitation of Submissions: Submissions were solicited through the Kaggle platform. The platform included automatic scoring and collaboration tools. Hosts could also view individual submissions for additional analysis. The platform allowed for both solvers and hosts to understand algorithm performance in near real-time, which resulted in strong platform engagement with significant host visibility into the algorithms. Competition marketing was used through the Kaggle platform including their website, blog, and social media. Additional marketing was done through Challenge.gov. Across these websites, there were over 300,000 page views. The Kaggle platform was determined to be the most effective marketing method.

[83] The website for the Passenger Screening Algorithm Challenge can be viewed at http://www.kaggle.com/c/passenger-screening-algorithm-challenge.

Solicitation Types: Social media (e.g., Twitter, Facebook); Press release; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies)

Participation Requirements: All participants were required to agree to non-disclosure rules in order to protect the data used in the competition. Participants were bound by the rules under the America COMPETES Act with regards to prize eligibility. There were no additional restrictions on participation in the competition.

Evaluation of Submissions: Submissions were evaluated using a quantitative log-loss metric. This metric compared the submitted confidence score for each of the 23,596 required predictions to the binary ground-truth (i.e., either an object was present or not). This comparison resulted in a quantitative metric that could then be ranked. Submissions were ultimately approved by evaluators from the DHS S&T Apex Screening at Speed program, DHS S&T Transportation Security Laboratory, and TSA.

Results: Of the 9,339 entries submitted by 586 participants between June 22, 2017 and December 15, 2017, a total of eight awards were made.

Budget and Resources: DHS S&T contributed a total of $1,122,000 through an interagency agreement with NASA's Center of Excellence for Collaboration Innovation to plan and conduct the Challenge. This included $1,030,106.52 for the prize administrator contract to Kaggle, Inc., $81,893.48 for NASA overhead, and $10,000 for a required Client Accounting Advisory Services (CAAS) audit. The $1,500,000 prize purse was dispersed by DHS S&T. The prize purse included a contribution of $1,000,000 from TSA and $500,000 from DHS S&T. In addition, 0.85 full-time equivalent employees (FTEs) supported the Challenge in FY17[84] and in FY18.[85] The source of funding for the $1,122,000 interagency agreement with NASA was from FY16 appropriated funds for Integrated Passenger Screening Systems. The source of funding for the $1,500,000 prize purse is as follows: $500,000 from FY16 appropriated funds for Integrated Passenger Screening Systems and $1,000,000 from TSA through an interagency agreement. All funding was obligated in FY17.

Partnerships: DHS S&T partnered with NASA's Center for Excellence for Collaborative Innovation. NASA provided subject matter expertise and contracting support to help execute the Challenge. In addition to NASA, DHS S&T partnered with TSA's Office of Acquisition Program Management, which provided $1,000,000 to help fund the prize purse and also provided subject matter expertise and judging support to the competition.

Advancement of Agency Mission: Over two million passengers are screened daily at U.S. airports using highly sensitive screening technology to detect potential threats and prevent them from getting through the checkpoint. While passenger security is TSA's number one priority, it is also important to speed up the screening process to ensure an enjoyable travel experience. False alarms, resulting in pat-downs and secondary screening, is a significant contributor to delays at the checkpoint. The DHS Science and Technology Directorate and TSA are striving to reduce false alarm rates, as well as develop the capability to continue to protect against new and evolving threats. A passenger screening system with much lower false alarm rates will have a significant impact to aviation checkpoint operations, improving the passenger experience and overall passenger throughput. TSA will be able to repurpose TSA officers to other critical tasks as opposed to pat-downs. Finally, better algorithms are a critical part

[84] Breakdown of FTEs in FY17: 0.25 FTE by the DHS Prize Office and General Counsel, 0.5 FTE by the DHS S&T Explosives Division, and 0.1 FTE by TSA.

[85] Breakdown of FTEs in FY17: 0.25 FTE by the DHS Prize Office and General Counsel, 0.5 FTE by the DHS S&T Explosives Division, and 0.1 FTE by TSA.

of a flexible and adaptable security posture, allowing TSA to rapidly respond based on real-time requirements.

Solution Types: Software and apps; Analytics, visualizations, algorithms

Plan for Upcoming 2 FYs: For FY19, three competitions are in planning stages and one in early exploration stage for execution by DHS S&T. Crosscutting mission areas include chemical-biological defense, opioid detection in bulk mail, search and rescue, and emergency preparedness. Planned competitions include the development or enhancement of a new technology, opportunities for entrepreneurs to develop and market new technologies, and an educational game to educate and better prepare the public. Additional cross-cutting areas include first responder technologies. For FY20, cross-cutting areas that may be considered by DHS include critical infrastructure technologies, first responder technologies, cyber defense applications, chemical-biological detection technologies, algorithms, sensors, and screening technologies.

A.7 Department of State (State)

A.7.1 AIT FY18 Fishackathon

Lead Sponsoring Agency: American Institute in Taiwan (AIT)

Status: This competition was launched and completed in FY18.

Competition Goals: The goal of the prize competition was to bring together thousands of concerned designers, developers, and subject matter experts to build practical technological solutions to endemic problems faced by the global fishing industry. By attracting problem solvers across the globe and encouraging them to embrace collaborative problem solving efforts, the competition aimed to produce open-source solutions to global challenges on themes such as sustainability, marketplace, and enforcement.

Goal Types: Find and highlight innovative ideas; Solve a specific problem; Advance scientific research; Develop technology; Inform and educate the public; Engage new people and communities; Build capacity

Justification for Using Prizes and Challenges: A prize competition was seen as an effective means for rewarding innovation and technological advances while encouraging young coders to continue their work in this field and collaborate together to solve tough issues. Unlike more traditional methods such as contracts, grants, and cooperative agreements, the prize competition could promote project goals, engage younger audiences, and facilitate the exchange of ideas and networks across the globe.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered and awarded was 180,000 New Taiwan dollars (NTD) in Taipei: and 130,000 NTD in Kaohsiung.

Solicitation of Submissions: In FY18, the AIT utilized social media to gather interest for Fish Hackathon and learned that the competition was effective in attracting young people to showase their creativity and innovative ideas. In the end, there were 140 volunteer coders in teams of three to five in Taipei who spent a weekend developing usable mobile and technological solutions to real-world problems submitted by fisheries experts around the world. In Kaohsiung, approximately 50 participants in 17 teams participated. The AIT was also able to advertise the core programs, increasing awareness of American Innovation Center events.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Day-long event(s) prior to the competition; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies); Other - IT; Other - Home Banner; Other - Youtube

Participation Requirements: N/A

Evaluation of Submissions: Relevant experts from universities, institutions, and research centers were invited to evaluate the submissions for the prize competitions and assess different pitches by the teams. The judges represented a variety of stakeholders, including the Institute of Oceanography in National Taiwan University, Hope Bay Technologies, Inc., National Taiwan Ocean University, Cloudeep, FIH Mobile Limited, and Ocean Says.

Results: N/A

Budget and Resources: AIT did not make monetary donations to the prize competitions for this event. However, AIT Taipei contributed $9,500 USD in grants for venue setup, translations, on-site support, and promotional materials. AIT Kaohsiung contributed $3,000 USD. AIT Taipei utilized eight Information Resource Center staff members, while AIT Kaohsiung partnered with National Sun Yat-sen University American staff to help with the program. All of the American Space staff was utilized for the event and provided grants to partners for venue set up, programming, and translations.

Partnerships: Non-Federal Partners for AIT Taipei included the Council of Agriculture's Fisheries Agency, Taipei City Government, Microsoft Taiwan, and Syntrend Startup Foundation. Non-Federal Partners for AIT Kaohsiung included the Fisheries Agency, Kaohsiung Marine Bureau, and National Sun Yat-sen University. For FY18, the Fisheries Agency contributed 180,000 NTD in Taipei and 130,000 NTD in Kaohsiung. The rest of the special awards were donated by different partners such as Foundation for Women's Rights Promotion and Development and Pixnet.

Advancement of Agency Mission: The prize competition advanced the agency mission by addressing transnational challenges, encouraging innovative problem solving, developing sustainable solutions to economic challenges, and facilitating AIT's engagement with Taiwan's emerging generation of coders and technology innovators.

Solution Types: Software and apps; Creative (design & multimedia); Ideas; Technology demonstration and hardware; Analytics, visualizations, algorithms

Plan for Upcoming 2 FYs: Over the next two FYs, AIT and AIT Kaohsiung will continue to conduct prize competitions to promote the Hackathons and work with Federal and non-Federal partners to provide greater incentives for participation. AIT has received positive feedback from the audiences and participants and gained great publicity for Taiwan. By bringing together coders and participants to develop solutions to unique challenges, the competition will continue to improve the sustainability of both Taiwan and the planet.

A.7.2 FY17 and FY18 NASA Hackathon

Lead Sponsoring Agency: American Institute in Taiwan (AIT)

Status: This competition was completed in both FY17 and FY18.

Competition Goals: The goal of the National Aeronautics and Space Administration (NASA) Hackathon prize competition was to produce open-source solutions to global challenges by attracting problem solvers across the globe and encouraging them to embrace collaborative problem solving efforts.

Goal Types: Find and highlight innovative ideas; Solve a specific problem; Advance scientific research; Develop technology; Inform and educate the public; Engage new people and communities; Build capacity

Justification for Using Prizes and Challenges: A prize competition was seen as an effective means for rewarding innovation and technological advances while encouraging young coders to continue their work in this field and collaborate together to solve tough issues. Unlike more traditional methods such as contracts, grants, and cooperative agreements, the prize competition could promote project goals, engage younger audiences, and facilitate the exchange of ideas and networks across the globe.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered and awarded was 440,000 New Taiwan dollars (NTD) during the FY17 NASA Hackathon and 280,000 NTD during the FY18 NASA Hackathon. FY17 non-monetary incentives included a Discovery Channel film screening for participants, a one-page advertisement in the April issue of Scientific American, and social media publicity through Pixnet. FY18 non-monetary incentives included two internship opportunities and two Xbox consoles.

Solicitation of Submissions: In both FY17 and FY18, social media platforms were utilized to gather interest for the NASA Hackathons. In FY18, Facebook granted advertisement credits to AIT, which allowed AIT to spend approximately $2000 to $3000 in promoting the Hackathon.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Day-long event(s) prior to the competition; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies); Other - IT; Other - Home Banner; Other - Youtube

Participation Requirements: N/A

Evaluation of Submissions: Subject matter experts from universities, institutions, and research centers were invited to serve as judges for the prize competitions. The judges leveraged global criteria provided by NASA to evaluate the pitches by the competing teams.

Results: N/A

Budget and Resources: Funding from AIT for FY17 totaled $7,500 in grants for venue setup, on-site support, translations, and promotional items. AIT also provided three airplane tickets to Orlando, Florida for NASA Hackathon winners. Funding from AIT for FY18 totaled 10,000 NTD in VR Special Awards through the American Innovation Center. AIT also contributed approximately $9,000 in grants for venue setup, on-site support, translations, and promotional items. Seven American Space staff members supported the FY17 Hackathon, and eight American Space staff members supported the FY18 Hackathon.

Partnerships: FY17 non-Federal partners included the Ministry of Science and Technology, Ministry of Economic Affairs, National Taiwan University, and Taipei City Government. FY18 non-Federal partners included the National Space Organization, Chunghwa Telecom, Taipei City Government, National Taiwan Normal University, IBM Taiwan, and Micron. Estimated value of partner contributions totaled 440,000 NTD in FY17 and 280,000 NTD in FY18. In FY17, the Ministry of Science and Technology funded $180,000 NTD of the grand awards, Microsoft donated 60,000 NTD in food and two Xbox consoles, and Intel donated a few monetary awards. In FY18, the National Space Organization funded $180,000 NTD in cash rewards, Microsoft donated 60,000 NTD in food and two Xbox consoles, and IBM offered internship opportunities. The remaining special awards were donated by different partners.

Advancement of Agency Mission: The prize competition advanced the agency mission by addressing transnational challenges, encouraging innovative problem solving, developing sustainable solutions to economic challenges, and facilitating AIT's engagement with Taiwan's emerging generation of coders

and technology innovators. There was an average of 50 groups that signed up in both years, which indirectly helped advertise AIT's core programs and increased the target audiences' awareness of the American Innovation Center events.

Solution Types: Software and apps; Creative (design & multimedia); Ideas; Technology demonstration and hardware; Analytics, visualizations, algorithms

Plan for Upcoming 2 FYs: AIT will continue to conduct prize competitions to promote the Hackathons and work with non-Federal and Federal partners to provide greater incentives for participation.

A.7.3 Boldline P3 Accelerator – Cohort 1[86]

Lead Sponsoring Agency: DOS, Secretary's Office of Global Partnerships (S/GP)

Status: This competition was launched and completed in FY18.

Competition Goals: Boldline is the U.S. Department of State's new partnership accelerator aimed to support and scale innovative public-private partnerships (P3s). One of the first programs of its kind, Boldline supported social good P3s that address pressing global challenges and focused on giving them tools to scale their missions. The main goal of Boldline was to build and deploy strategic connections and collaborations aimed at strengthening the global partnership building ecosystem, promoting and facilitating connectivity between the private sector and governments, and fostering innovative partnership business models. Boldline took the often dotted lines between government, private sector, and civil society and created a bold line between the sectors through partnerships.

Goal Types: Improve government service delivery; Find and highlight innovative ideas; Develop technology; Inform and educate the public; Engage new people and communities; Build capacity; Other - Build public-private partnerships

Justification for Using Prizes and Challenges: The U.S. Department of State, in close collaboration with industry leaders, organized a one-week partnership building accelerator program that brought together public institutions, corporations, innovation companies, entrepreneurship support organizations, and financial institutions to galvanize interest for the participating partnerships and to help build the framework for these partnerships in targeted countries. The program identified timely P3s in the early development stages of their partnerships and P3s ready to scale their operations and activities. Through a one week accelerator and ongoing support, Boldline provided the individuals and institutions behind these partnerships with mentorship, access to resources, government relations, and global networks needed to scale their impact. The accelerator took place in February 2018 in Washington, DC, and participation in the program was highly competitive.

Cash Prize Purses and/or Non-Cash Prize Awards: Non-monetary incentives included mentorship, networking, and training by DOS employees and non-government subject matter experts on public-private partnerships, private sector engagement, and other relevant topics.

Solicitation of Submissions: Submissions for Boldline were obtained from the Federal prize competition website, www.challenges.gov, and the DOS website, www.state.gov/partnerships.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies)

[86] The website for the Boldline P3 Accelerator – Cohort 1 can be viewed at https://www.state.gov/s/partnerships/boldlineaccelerator/index.htm.

Participation Requirements: N/A

Evaluation of Submissions: Submissions were evaluated by a selection committee of leadership in S/GP.

Results: Applications for Boldline opened November 1, 2017 and closed November 21, 2017. The accelerator programming occurred between February 26 and March 2, 2018. Of the 52 entries submitted by nine participants, nine winners were selected.

Budget and Resources: Funding for FY18 totaled $15,991. Funds provided were used for the venue, participant lodging, supplies (printing and audio/video rental), and representative and sponsor funds for catering meals. Five permanent government FTEs and five contractor FTEs supported the challenge in FY18.

Partnerships: The DOS Office of International Religious Freedom within the Bureau of Democracy, Human Rights, and Labor served as a Federal partner during the first cohort.

Advancement of Agency Mission: Boldline advanced the mission of the U.S. Department of State's Office of Global Partnerships by strengthening and deepening U.S. diplomacy and development around the world through partnerships that leverage the creativity, innovation, and core business resources of partners for greater impact. The Office is a center of excellence for collaboration between the U.S. Department of State, the public and private sectors, and civil society. The Department recognizes that it takes more than governments to address many global issues and believes that partnerships with the private sector, civil society, philanthropy, and other non-governmental organizations are necessary for our national security and diplomacy objectives.

Solution Types: Ideas; Other - Partner building; Other - Relationship building; Other - Networking

Plan for Upcoming 2 FYs: The DOS is planning to conduct more Boldline cohorts based on the Secretary's priorities and the DOS' Mission and Goals. Each cohort will focus on a specific topic set and be supported by other State bureaus, offices, and posts (domestic and abroad). The second Boldline P3 Accelerator cohort focused on supporting partnership creation for International Religious Freedom. The third Boldline P3 Accelerator cohort, which is still in progress, will focus on supporting partnership creation for countering propaganda and disinformation abroad.

A.7.4 Boldline P3 Accelerator for Religious Freedom (RF) – Cohort 2[87]

Lead Sponsoring Agency: DOS, Secretary's Office of Global Partnerships (S/GP)

Status: This competition was launched and completed in FY18.

Competition Goals: Boldline Religious Freedom (RF) is the U.S. Department of State's partnership accelerator aimed to support and scale innovative public-private partnerships (P3s) to promote and defend religious freedom around the world. Boldline RF supported stakeholders who are leading social good P3s that align with U.S. foreign policy priorities and focused on giving them tools to scale their missions. The main goal of Boldline RF was to build and deploy strategic collaborations aimed at advancing religious freedom globally by facilitating connectivity between the private sector and governments, fostering innovative partnership models, and providing mentoring and training. Through this accelerator program, Boldline RF took the often dotted lines between government, private sector, and civil society and created a bold line between the sectors through partnerships. The Department defines a partnership as a collaborative working relationship that includes non-governmental partners

[87] The website for the Boldline P3 Accelerator for Religious Freedom (RF) – Cohort 2 can be viewed at https://www.state.gov/s/partnerships/boldlineaccelerator/index.htm.

in which the goals, structure, and governance, as well as roles and responsibilities, are mutually determined and decision-making is shared. Successful partnerships entail shared objectives, transparency, mutual risks and benefits, and accountability.

Goal Types: Improve government service delivery; Find and highlight innovative ideas; Develop technology; Inform and educate the public; Engage new people and communities; Build capacity; Other - Build public-private partnerships

Justification for Using Prizes and Challenges: The U.S. Department of State, in close collaboration with industry leaders, will organized a three-day partnership building accelerator program that brought together civil society organizations, public institutions, corporations, innovation companies, entrepreneurship support organizations, and financial institutions to galvanize interest for the participating partnerships and to help build the framework for these partnerships in their respective countries. The DOS sought the participation of stakeholders representing partnerships in the early development stages or P3s ready to scale their activities and engage additional partners. The Boldline P3 Accelerator provided the individuals and institutions behind these partnerships with the mentorship, skills training, government relations, and global networks needed to scale their impact. The accelerator took place in October 2018 in Washington, D.C., and participation in the program was highly competitive.

Cash Prize Purses and/or Non-Cash Prize Awards: Non-monetary incentives included mentorship, networking, training by DOS employees and non-government subject matter experts on public-private partnerships, private sector engagement, other relevant topics.

Solicitation of Submissions: Submissions for Boldline were obtained from the Federal prize competition website, www.challenges.gov, and the DOS website, www.state.gov/partnerships.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies)

Participation Requirements: N/A

Evaluation of Submissions: Submissions were evaluated by a selection committee of leadership in S/GP.

Results: Applications for Boldline opened June 22, 2018 and closed August 23, 2018. The accelerator programming occurred between October 22 and October 24, 2018. Of the 31 entries submitted by six participants, six winners were selected.

Budget and Resources: Funding for FY18 totaled $38,160. Funds provided were used for the venue, participant lodging, supplies (printing and audio/video rental), third part mentor fees, and representative and sponsor funds for catering meals. Five permanent government FTEs and five contractor FTEs supported the challenge in FY18.

Partnerships: The DOS Office of International Religious Freedom within the Bureau of Democracy, Human Rights, and Labor and the Global Engagement Center served as Federal partners during the first cohort.

Advancement of Agency Mission: The U.S. Department of State's Office of Global Partnerships and Office of International Religious Freedom worked in collaboration to provide the Boldline RF accelerator program. Boldline advanced the missions of both offices by strengthening and deepening U.S. diplomacy and development around the world through partnerships that leverage the creativity, innovation, and core business resources of partners for greater impact while also promoting and defending freedom of religion, conscience, and belief for all people around the world. The U.S. Department of State's Office of Global Partnerships is a center of excellence for collaboration between

the U.S. Department of State, the public and private sectors, and civil society. The Department recognizes that it takes more than governments to address many global issues and believes that partnerships with the private sector, civil society, philanthropy, and other non-governmental organizations are necessary for our national security and diplomacy objectives.

Solution Types: Ideas; Other - Partner building; Other - Relationship building; Other - Networking

Plan for Upcoming 2 FYs: The DOS is planning to conduct more Boldline cohorts based on the Secretary's priorities and the DOS' Mission and Goals. Each cohort will focus on a specific topic set and be supported by other State bureaus, offices, and posts (domestic and abroad). The third Boldline P3 Accelerator cohort, which is still in progress, will focus on supporting partnership creation for countering propaganda and disinformation abroad.

A.7.5 DOS Fishackathon[88]

Lead Sponsoring Agency: DOS, Secretary's Office of Global Partnerships (S/GP)

Status: This competition was completed in both FY17 and FY18.

Competition Goals: The U.S. Department of State launched Fishackathon in 2014 to bring together amateur and professional volunteer coders to develop practical, technological solutions addressing challenges in sustainable fishing worldwide.

Goal Types: Find and highlight innovative ideas; Solve a specific problem; Develop technology; Inform and educate the public; Engage new people and communities

Justification for Using Prizes and Challenges: A hackathon was utilized to engage atypical actors in the development of solutions to challenges facing fisheries worldwide and to promote awareness of sustainable fishing issues among populations unaware of these challenges. The hackathon model typically attracts students and young tech-focused individuals who can apply "outside-the-box" thinking to a sphere they aren't typically involved with.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered and awarded was $200,000 in Amazon Web Service (AWS) credits, provided by AWS. Non-monetary incentives included free .co and .us domain name registrations, provided by Hover.

Solicitation of Submissions: DOS used a global hackathon model to solicit submissions for solutions to the challenges facing fisheries worldwide. Though the solutions proposed by participants have potential for further development and life beyond the competition, the most immediate result of the competition is the awareness of sustainable fishing issues spread to students and tech communities around the globe. The competition was advertised digitally through Hackernest's extensive network and the networks of the regional hosts and sponsors.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies)

Participation Requirements: Target solver audiences included coders, software developers, designers, subject matter experts, and students. Advanced registration for the event(s) was required, but open to all interested in participating.

[88] The website for the Fishackathon can be viewed at www.fishackathon.co.

Evaluation of Submissions: Submissions were judged by a panel of subject matter experts assembled by Hackernest on creativity, feasibility, and impact.

Results: Entries were submitted by more than 3,500 participants globally between February 10 and February 11, 2018. The Grand prize was awarded to one team of five individuals, and there were 35 regional winning teams.

Budget and Resources: The Department of State's only financial commitment to the program was used to purchase promotional materials for the U.S. events. All other costs were covered by Hackernest and regional hosts. This amounted to one FTE in each FY17 and FY18, and funds of $1,289 in FY18.

Partnerships: Non-Federal partners include Hackernest, in both FY17 and FY18, and EachMile in FY18. Hackernest managed all logistics related to the 2018 event, including raising funds, recruiting regional hosts, and all promotion related to the competition. EachMile will take on the role of managing partner for the 2019 event. The total estimated value of partner contributions is $500,000 in kind.

Advancement of Agency Mission: N/A

Solution Types: Software and apps; Ideas

Plan for Upcoming 2 FYs: EachMile plans to revamp the focus of Fishackathon when they run the competition in 2019. They will emphasize developing solutions for capturing data using sensors and the Internet of Things, and sharing data using open platforms and blockchain technology. The global event, which takes place the weekend of October 5th and 6th of 2019, will home in on a select number of cities, rather than the widespread approach favored in past years of the hackathon.

A.7.6 Competition for the President's Day[89]

Lead Sponsoring Agency: U.S. Embassy Astana

Status: This competition was launched and completed in FY18.

Competition Goals: The goal of the competition was to learn more about American culture and holidays.

Goal Types: Inform and educate the public; Engage new people and communities

Justification for Using Prizes and Challenges: Prizes were utilized to encourage participants to continue learning and share their knowledge on social media.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered and awarded was $100. The prize came from the U.S. Consulate General. Non-monetary incentives included T-shirts.

Solicitation of Submissions: The competition was announced on social media and monitored by an Information Assistant.

Solicitation Types: Social media (e.g., Twitter, Facebook)

Participation Requirements: N/A

Evaluation of Submissions: Participant answers were evaluated on the basis of accuracy.

Results: Ten winners were awarded prizes.

[89] The website for the Competition for the President's Day can be viewed at https://www.instagram.com/p/BfXrQIqBPa7/?hl=en&taken-by=uscgalmaty.

Budget and Resources: Over five days, an Information Assistant tracked the answers posted by participants.

Partnerships: N/A

Advancement of Agency Mission: The competition helped advance the agency mission to promote American culture.

Solution Types: Ideas

Plan for Upcoming 2 FYs: The U.S. Consulate tries to engage with online audiences by organizing quizzes or competitions to increase the number of followers, promote global engagement, and spread knowledge of U.S. customs and traditions. Similar competitions will be organized in the upcoming years.

A.7.7 3-2-1 GO![90]

Lead Sponsoring Agency: U.S. Embassy Koror, Public Diplomacy

Status: This competition was completed in FY17.

Competition Goals: The goal of 3-2-1 GO! was to raise awareness for the Olympic Sport Envoy visit. The challenge was to "like" the post highlighting the Olympic Sport Envoy visitor and download a free Olympic poster linked to a State Department promotion of the U.S. Olympic Team.

Goal Types: Inform and educate the public

Justification for Using Prizes and Challenges: A prize competition was utilized to measure the effectiveness of using social media to raise awareness and engage with the community of Palau.

Cash Prize Purses and/or Non-Cash Prize Awards: Non-monetary incentives included a free Olympic poster.

Solicitation of Submissions: The competition leveraged the U.S. Embassy Koror Facebook page.

Solicitation Types: Social media (e.g., Twitter, Facebook)

Participation Requirements: The target audience was the community of Palau.

Evaluation of Submissions: Facebook Analytics was used to measure the number of engagements.

Results: N/A

Budget and Resources: No funds were required for this challenge, and two hours of labor supported the project. A link to a free poster offered by the State Department was provided as an incentive for liking our Facebook post.

Partnerships: The State Department provided the five Olympic posters.

Advancement of Agency Mission: 3-2-1 GO! acted in parallel with the "Plant, Eat and Move" campaign by working to educate Palau's youth on noncommunicable disease (NCD) reduction and active lifestyle choices to combat Palau's growing problem with NCD rates and obesity. Through outreach activities,

[90] The website for the 3-2-1 GO! can be viewed at https://business.facebook.com/usembassykoror/publishing_tools/?section=PUBLISHED_POSTS&sort[0]=published_time_descending&current_page=3, the link has expired but I can provide a picture if necessary.

such as highlighting the visit of U.S. Olympic Sport Envoy, the competition utilized social media to raise awareness and engage with the community of Palau.

Solution Types: Analytics, visualizations, algorithms

Plan for Upcoming 2 FYs: The lessons learned from 3-2-1 GO! will support the design and execution of future prizes and challenges.

A.7.8 E-Farmer Support App

Lead Sponsoring Agency: U.S. Embassy Phnom Penh

Status: This competition was underway in FY18.

Competition Goals: AMK Microfinance Institution Plc. (AMK) proposed a grant to develop an innovative approach to invest in farmer capacity building and technical assistance. The grant was awarded by Feed the Future Harvest II with the goal to improve the farming sector as a whole as well as contribute to AMK's business objectives of increasing farmer productivity and reducing default rates. AMK demonstrated their ownership of this activity by investing in a feasibility study for this platform, seeking support in co-funding application development, content development, and marketing, and requesting expert advice for directly supporting farmers in the United States Government Zone of Influence. AMK anticipates that this initiative will be profitable by 2021, and Harvest II has requested that they provide lessons learned and a sustainability plan by the end of the grant period (June 2019) to analyze the business case for commercial viability, including costs (operation, content updates, and maintenance) and revenue sources.

Goal Types: Solve a specific problem; Develop technology; Build capacity; Stimulate a market

Justification for Using Prizes and Challenges: In order to achieve the goals, Harvest II issued a grant to AMK Microfinance Institution Plc. to implement the E-farmer Support App activity. Through this grant, farmers are expected to increase their productivity by incorporating appropriate improved technologies promoted through the app. Furthermore, this activity supports an innovative idea by a finance institution that is actively pursuing inclusive growth goals. Harvest II expects the project to have several important demonstration effects within the broader market system.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered was $100,000 and the total amount awarded is expected to be $83,420. As of FY18, $13,000 of the cash prize amount was expended.

Solicitation of Submissions: Harvest II published a Grant Program Statement (GPS) in the local newspaper advertising the E-Farmer Support App project. Of the concept papers submitted in response to the GPS, AMK Microfinance Institute Plc. was selected to implement the project. The GPS is considered a competitive grant solicitation method due to its full and open publication and the project's clear and consistent application of identical, clearly stated evaluation criteria across all concepts/applications received.

Solicitation Types: Social media (e.g., Twitter, Facebook); Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies)

Participation Requirements: Through this E-solution, AMK expects to reach 3,000 farmers, 15% of which will be horticulture farmers.

Evaluation of Submissions: AMK's concept note scored high enough to pass to the application phase, which required scoring 70% or more against the grant criteria. The full grant application from AMK was then evaluated by Harvest II's grants evaluation committee and scored in five categories:

implementation plan, sustainability and replicability, measurable impact, budget, and budget contribution.

Results: N/A

Budget and Resources: Funding in FY18 totaled $13,000 and was allocated between six AMK deliverables: (1) $4,000 for the AMK workplan, which outlined the planned activities during the grant period and the person responsible for each activity; (2) $1,000 for the summary of the planned design for database and app architecture, including wireframe; (3) $3,000 for the schedule of original content to be developed and released with Version 1 launch; (4) $1,500 for the list of recruited Agronomist and Community Facilitators in Bakan, Krokor districts, Pursat province, and Moung Russei, Sangke districts in Battambang province; (5) $3,000 for the summary of existing agronomic knowledge contents to be uploaded on mobile app version 1; and (6) $500 for the draft marketing materials, such as leaflets to promote app usage. In addition, one FTE employee supported the project in FY18. The total of non-cash prize amount expenditure, including Harvest II staff time, was $20,000.

Partnerships: The estimated value of partner contributions totaled $147,002.

Advancement of Agency Mission: The E-Farmer Support App is being created to freely share information and agronomic knowledge, as digital solutions can work to close some of the production-technical knowledge gaps of farmers. In addition, the app aims to ultimately expose farmers to business-related services, including finding sellers, buyers, and technical advisors, while helping to reduce default rates among AMK's borrowers. Thus, the E-Farmer Support App contributes to Mission Objective 4.2 (CDCS DO 3): Strengthen sustainable and resilient pathways out of poverty.

Solution Types: Software and apps; Other - Agronomic knowledge transfer

Plan for Upcoming 2 FYs: If AMK deploys the mobile app version 1 successfully, AMK will further develop the app into version 2 and 3 to serve purposes beyond farming, including linking farmers to input supply companies, horticulture buyers, and other private sectors. Mobile app version 2 will be released by April 2019.

A.7.9 Centennial Logo Competition[91,92]

Lead Sponsoring Agency: U.S. Embassy Riga

Status: This competition was launched and completed in FY18.

Competition Goals: The goal of the Centennial Logo Competition was to receive an attractive, eye-catching new logo for the Embassy to use to brand events during the Latvian centennial of independence, to increase our social media following, and to assist with Latvia'seconomic development by providing a professional graphic design tool as a prize.

Goal Types: Improve government service delivery; Find and highlight innovative ideas; Solve a specific problem; Inform and educate the public; Engage new people and communities

Justification for Using Prizes and Challenges: Using the incentive of a prize, and publicizing the contest widely through our social media was an effective and cost-efficient solution to obtain a new embassy

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[91] The website for the Centennial Logo Competition can be viewed at https://www.facebook.com/usembassyriga/photos/a.170854467457/10156215371167458/?type=3&theater.

[92] The Centennial Logo Competition was conducted under the COMPETES Reauthorization Act of 2010, as well as the Smith Mundt Act.

logo. We received 34 submissions in the contest, and were able to choose the best one. The prize offering was a cost-efficient means of stimulating a considerable amount of graphic design work. Furthermore, the publicity that the contest received on social media was a very valuable side benefit of the competition format. The prize that we awarded (an iPad Pro) is a graphic design tool that enabled the winner of the competition to pursue more professional design work, thus stimulating innovation and economic development in Latvia.

Cash Prize Purses and/or Non-Cash Prize Awards: The prize offered for the Competition was an Apple ipad Pro 9.7 (worth $912.74). The prize was procured using the Public Affairs Section's 2018 program budget.

Solicitation of Submissions: We announced the competition via social media posts which we pinned to the top of our social media pages throughout the duration of the Competition, for maximum exposure. The participants submitted their logo designs to the Embassy via email. We then posted all the submitted designs on our embassy social media for the public to vote on the best design. The ultimate selection was based on a jury of embassy staff, with the public vote counting in the case of a tie among jury members.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs)

Participation Requirements: The competition is open to anyone aged 16 and over and who is currently residing in Latvia. Employees of the U.S. Government and their immediate family members were not eligible to participate. There was no limit to the number of entries per person. Group entries were acceptable, but only one prize would have been awarded to the group. No registration or participation fee was required to enter this contest.

Evaluation of Submissions: The ultimate selection was based on a jury of six embassy staff with the public vote counting in the case of a tie among jury members. This format left the ultimate decision on the winner in the embassy's hands, but simultaneously stimulated a lot of interest and traffic on our social media platforms. This format worked very well, in retrospect. With regard to the online voting, it drove lots of interest and traffic on our social media platforms. However, we found that some of the logo designs received many more votes than others, mainly based on the energy with which the submitter of the design tried to share the Embassy posts with their friends online, rather than the quality of the submission. In other words, if we had left the decision on the logo purely up to an online vote, we might not have given the award to the best candidate. The system that we used was effective, in that it left the ultimate decision in the hands of the embassy judges, while also stimulating public interest and participation.

Results: Of the 34 entries submitted by 18 participants between February 13, 2018 and March 4, 2018, 1 prize was awarded to 1 winner.

Budget and Resources: Our locally-employed social media coordinator spent approximately 40 working hours designing the social media post, collecting entries, and responding to participants, procuring the prize, and arranging the prize-giving ceremony at the Embassy. There was also a small amount of time spent by the jury in judging the contest submissions. We allocated $912.74 of PD Program funds toward purchasing the prize.

Partnerships: N/A

Advancement of Agency Mission: Latvia is currently celebrating its 100th year of independence, and the embassy public affairs section is branding its outreach programs this year under the theme Latvia and the U.S.: 100 Years of Friendship. To gain publicity for our programs and also to harness the graphic design skills of the Latvian public, we created this logo competition. We gained maximum exposure for

the competition on social media by posting all of the entries publicly and encouraging online voting for the best logo. This gained the embassy many new social media followers and publicity for our programs. For a relatively small expense, we received many excellent graphic design submissions, the winner of which we are using as an official embassy logo during the Latvian centennial year. The contest prize, an Apple ipad Pro 9.7, served to increase the technological capacity of the Latvian public. Specifically, it provided a professional work tool to a young Latvian whose goal is to work in the graphic design field. The logo competition, therefore, directly contributed to two of our mission objectives: to strengthen the Latvian economy and economic ties to the U.S., and to promote partnership with the U.S. through our shared values.

Solution Types: Creative (design & multimedia); Ideas

Plan for Upcoming 2 FYs: We have no specific plans for other competitions at the moment, but an interesting idea in light of Latvia's centennial would be to use social media to publicize a competition among the Latvian and U.S. public to submit historical photos, documents or artifacts highlighting the U.S.-Latvian relationship over the past century.

A.8 Department of Transportation (DOT)

A.8.1 Solving for Safety Visualization Challenge[93]

Lead Sponsoring Agency: USDOT, Bureau of Transportation Statistics

Status: This competition was launched in FY18, and is underway.

Competition Goals: The Solving for Safety Visualization Challenge is designed to advance the use of data visualizations and visual analytics for answering analytical questions related to roadway and rail system safety. Currently transportation decision makers have a limited number of analytical visualization tools available that reveal insights, and even fewer focused on safety and prevention of serious crashes. Analytical visualization tools can cast new light on the data to reveal insights not seen though tabular analysis. A new opportunity lies in the rapid growth and advancement in technology and analytics markets combined with the volume and variety of transportation and other data now collected by the public and private sectors. Technology has already changed how we get around. USDOT seeks to harness the power of visualization technology to reduce surface transportation crashes.

Goal Types: Find and highlight innovative ideas; Solve a specific problem; Develop technology; Inform and educate the public; Engage new people and communities

Justification for Using Prizes and Challenges: The Solving for Safety Visualization Challenge can act as an engine in driving serious crash reduction. By incentivizing innovation, USDOT is attracting the best Solvers from around the nation to come up with new tools for visualizing the risks of serious crashes. As with other government competitions, the Solving for Safety Visualization Challenge aims to create a vibrant community of thinkers and doers who drive revolutionary innovation. One goal of the Challenge is to empower traditional and non-traditional transportation groups to raise awareness about and take up the quest of improving road and rail user safety - an issue that impacts all lives. The transportation safety community has welcomed innovation, but will benefit futher from the perspective and skills of

[93] The website for the Solving for Safety Visualization Challenge can be viewed at https://www.transportation.gov/solve4safety.

diverse subject areas. To foster new, novel, and innovative analytical visualization tools, USDOT is seeking Solvers and data from a variety of sectors. By hosting a prize competition rather than awarding grants or contracts, USDOT is alleviating traditional burden of entry issues and is inviting Solvers from outside the traditional transportation safety arena to use their innovative methods and techniques to solve for safety. In doing so, USDOT will expand its reach for raising awareness about transportation safety and will continue cultviating a culture of transportation safety.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered is $350,000 and the challenge consists of three stages. Five semi-finalists will compete for a portion of the $100,000 interim prize and two final stage Solvers will compete for a portion of the $250,000 final prize. Non-monetary incentives include national recognition of their work by USDOT.

Solicitation of Submissions: As part of its Safety Data Initiative, on June 14, 2018, the USDOT convened the Safety Data Forum to engage a diverse group of stakeholders in discussion about opportunities to leverage data analytics tools to predict and prevent transportation fatalities and injuries. The forum was attended by representatives of data and technology firms, universities, national safety organizations, and all levels of government. The forum included remarks and presentations from USDOT leaders and staff on Safety Data Initiative pilot projects, the announcement of the Solving for Safety visualization Challenge. On the same day, a Federal Register Notice was published and the Solving for Safety Visualization Challenge webpages went live.

On June 15, 2018, the Bureau of Transportation Statistics began posting Tweets about the Challenge, which were reposted by other USDOT offices and partners. As part of a Safety Data Forum follow-up email, attendees were encouraged to participate in and share the Solving for Saferty Visualization Challenge with their networks. On June 25, 2018, USDOT published a Briefing Room web article describing the competition. Three Stage I webinars were hosted and recorded to connect with potential Solvers and provide additional information about the competition.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Day-long event(s) prior to the competition

Participation Requirements: Eligible Solvers are individuals or teams (United States and U.S. territories) from the business and research communities. This includes organizations such as: technology companies, analytics firms, transportation carriers, industry associations, research institutions, universities, mapping and visualization providers.

Evaluation of Submissions: In Stage I, Ideation, all Solvers participating in the Challenge will develop ideas for an analytical visualization tool. Five Stage I semi-finalists will be invited to Stage II as semi-finalists to develop their ideations into proofs of concept and compete for a cash prize. If a selectee declines to participate in the next stage, an alternate may be selected. The Stage I judging criteria applying to all tools include: *Benefits* (appeal to user), *Data* (novel use), *Technology* (easily maintained), and *Cost to Implement*. *Insights* and *Simulation* criteria apply only to discover insight tools and simulation tools, respectfully. These criteria area weighted equally. The evaluation panels will consider each proposal's alignment with each of these criteria and make recommendations to the selecting official. In Stage II, Concept, the five semi-finalists from Stage I will develop their ideations into proofs of concept (i.e., detilaed system designs and prototypes) for an analytical visualization tool. The five semi-finalists will compete for part of a $100,000 prize purse for their proofs of concept. Stage II judging criteria applying to all tools include: Techincal Approach, Design and Desirability, Analytical Depth, Technology Transfer Readiness Level and Feasibility, Testing and Deployment Approach, and Team. Based on review of the Stage II submissions by the judges, two of the five semi-finalists will also advance to Stage III as finalists. An additional semi-finalist may also recive an honorable mention, but not advance to Stage III. If a selectee declines to participate in the next stage, an alternate may be selected.

In Stage III, Tool, the two finalists from Stage II will further devleop their proofs of concept into full working analytical visualization tools. The two finalists will compete for a $250,000 prize purse, with each receiving a minimum of $50,000. The Stage III prize purse will be awarded to the winners based on the judges' review of the Stage III submissions. Judging criteria for Stage III are preliminary. Final judging criteria for Stage III will be provided to finalists advancing to this stage and posted on the Challenge website.

Results: During Stage I, 54 entries were submitted by participants between June 14, 2018 and July 31, 2018. Stages II and III are currently in development. In October 2018, five Stage I semi-finalists were invited to Stage II as semi-finalists to develop their ideations into proofs of concept and compete for a cash prize. Stage II is in progress and Stage III is currently in development. Prizes have not yet been awarded.

Budget and Resources: In FY18 the Bureau of Transportation Statistics (BTS) allocated $476,000 of the Agency's funds authorized in the FAST Act, sec. 6002 (a)(6). $350,000 was obligated for competition prizes as described in section 6. $63,000 was obligated for a BTS Fellow from the Department of Energy's Oak Ridge Institute for Science and Education Program. The BTS Fellow serves as the Challenge developer and coordinator. Approximately $44,000 of the $63,000 was expended in FY18 fo the Fellow. $63,000 was obligated for the DOT Volpe Center, a cost reimbursable unit of DOT that provides support for the evaluation of ideations submitted to the competition. All funds obligated to Volpe were expended. The .25 FTE represents the program management and oversight from the BTS Director of Spatial Analysis and Visualization, review of documents by counsel and the DOT staff who evaluated the ideations.

Partnerships: Challenge Innovation Agents are companies and organizations interested in providing real-world knowledge, guidance, insight, issues, and data to Solvers, especially those new to the transportation safety space. These groups do not enter into a partnership agreements with USDOT. Rather, Innovation Agents support the Challenge by providing Solvers with resources. Solvers are encouraged to seek support from Innovation Agents to strengthen their individual/team expertise. USDOT provides a public listing of two types of Challenge Innovation Agents: Technical Assistance and Data. Technical Assistance (T.A.) Innovation Agents can provide interested Solvers with knowledge, guidance, insight and issues related to transportation safety. T.A. Innovation Agents may be able to provide technial assistance related to key safety issues impacting their members or employees, transportation safety techniques, transportation system characteristics, users and operations, approaches from other industries and sectors. Data Innovation Agents can provide interested Solvers with access to data or analytic techniques that can be used in the analytical visualization tools. Use of a wide variety of disparate data is encouraged to gain insights into reduced fatalities and serious injuries on the U.S. road and rail systems.

Advancement of Agency Mission: Safety has consistently been USDOT's top strategic and organizational goal. USDOT is pursuing data-informed decision-making to help strategically prioritize and address transportation safety risks. One pillar of this approach is data visualization. USDOT is seeking clear, compelling data visualization tools that make data analysis and insights accessible to policy-makers, transportation providers and the public who make safety choices every day. The USDOT created the Safety Data Initiative (SDI) to support its high priority goal of reducing highway fatalities and serious injuries. The SDI seeks to strategically prioritize and address transportation safety risks through data-informed decision-making. The Solving for Safety Visualization Challenge is an SDI project that challenges innovators from across the nation to develop analytical visualization tools that can help reduce serious crashes on the US road and rail system. USDOT's vision for the Safety Data Initiative is to integrate data sources with each other and with new 'big data' sources that are becoming available

to enhance our understanding of crash risk and our ability to mitigate it. The initiative seeks to build USDOT's capacity to translate the successes of predictive data analytics tools used by private industry and universities to identify systemic factors contributing to serious crashes. It comprises three core components: data visualization, data integaration, and predictive insights.

Solution Types: Technology demonstration and hardware; Analytics, visualizations, algorithms

Plan for Upcoming 2 FYs: N/A

A.9 Environmental Protection Agency (EPA)

A.9.1 Advanced Septic System Nitrogen Sensor Challenge[94,95]

Lead Sponsoring Agency: EPA

Status: This competition was launched in FY17 and is underway in FY18.

Competition Goals: Conventional septic systems are not designed to remove nitrogen, which can lead to problems like excess nitrogen loading to waterways. This Challenge encourages the development and commercialization of an inexpensive nitrogen sensor designed to monitor the performance of innovative and alternative nitrogen removal onsite wastewater treatment systems (OWTS). Adding nitrogen sensors to advanced septic systems will help stakeholders know that their systems are performing as intended and protect valuable coastal resources. Ultimately, such a sensor will give regulators, communities and homeowners long-term assurance of onsite system performance.

Goal Types: Find and highlight innovative ideas; Solve a specific problem; Advance scientific research; Develop technology; Stimulate a market

Justification for Using Prizes and Challenges: Running this Challenge as a prize competition rather than a contract, grant, or cooperative agreement allows EPA to meet the goal of the Challenge in the most efficient manner. Rewarding only the teams who present the best sensor creates a level of competition that raises the expectations of each participating team. It was made clear at the beginning of the Challenge that only the top teams would win monetary prizes for Phase I, the Ideation Challenge, and an International Standards Organization Standard 14034 Environmental Technology Verification for Phase II, if their sensor successful performs during the six month field test in 2019.

Cash Prize Purses and/or Non-Cash Prize Awards: For Phase I of the Challenge, the total prize purse offered was $55,000, and the total amount awarded was $52,500. The prizes allocated were $20,000 for first place, $15,000 for second place, $10,000 for third place, and $2,500 for three honorable mention awards.[96] Non-monetary incentives included recognition on Challenge.gov and the Challenge support contractor page. For Phase II, selected sensors which successfully will receive International Standards Organization (ISO) Environmental Technology Verification (ETV) Standard 14034 verification

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[94] The website for the Advanced Septic System Nitrogen Sensor Challenge can be viewed at http://www.verifiglobal.com/en; https://challenge.gov/a/buzz/challenge/filter?challenge-name=Advanced+Septic+System+Nitrogen+sensor+challenge&agency=18&prize-start=&prize-end=&sort-option=1.

[95] Phase II of the Advanced Septic System Nitrogen Sensor Challenge was conducted under the authority of Sections 104(a) and (b) of the Clean Water Act.

[96] One honorable mention award winner was not eligible under the guidelines of the COMPETES authority.

statements and reports. These reports are internationally accepted as the highest level of testing for environmental technologies.

Solicitation of Submissions: The methods used for solicitation of Phase I included tweets from the EPA Twitter account, emails to EPA listserves, one official EPA press release, posting and outreach through the challenge support contractor via www.innocentive.com. Outside organizations promoted the challenge in the same manner. For Phase II, the solicitation was limited to EPA tweets and social media, one EPA press release, EPA emails to Phase I proposal submitters, EPA Nutrient Challenge companies/teams and EPA listserves, outreach to water sensor technology list serves and posting on www.Verifiglobal.com.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies); Other - InnoCentive (for Phase I)

Participation Requirements: Phase I was open to companies, teams and universities, but prizes could only be awarded to U.S. entities or citizens. The submissions were written proposals with references to research conducted. Phase II is open to any team, company or university that has a wastewater sensor prototype for nitrate and ammonium or total nitrogen.

Evaluation of Submissions: For Phase I, EPA selected a committee of 12 external judges drawn from non profits, USGS, academia, Suffolk County NY and state regulators, the Massachusetts Alternative Septic System Test Center and the septic system manufacturers' organization. EPA met with the judges before the Challenge was launched, and they all gave input on the challenge goals and the judging criteria. The judges made recommendations, which were shared with EPA senior management for final decisions. For Phase II, the sensor prototypes will be evaluated based on their performance during the 6 month ISO EVT 14034 field verification test in 2019. The testing will be conducted according to the test quality assurance plan, which was developed by EPA; the Challenge contractor, Battelle; and a Technical panel, which includes several of the Phase I judges.

Results: For Phase I, the Ideation challenge, 18 entries were submitted by participants between January 17, 2017, and April 17, 2017, and prizes were awarded to six winners. Two entries have been submitted to date for Phase II, the prototype testing program, which opened on December 18, 2017 and has submission due dates of January 31, 2018, August 31, 2019, and December 7, 2018. Phase II will conclude on February 21, 2020.

Budget and Resources: This Challenge used 1 FTE over each FY17 and FY18. FTE activities for Phase I and II included problem formulation; coordinating partners, input from 8 states, Suffolk County, NY and other stakeholders on the sensor performance goals, challenge design, launch, management, and judging; and organizing the Sensor Showcase Day awards ceremony on June 29, 2017. In addition, Phase II has included the development of the ISO ETV 14034 test quality assurance plan. Funding for contract support amounted to $20,000 in FY17, and $157,000 in FY18. For Phase I, contractor support was engaged for reviewing the challenge, posting it online, and managing the submissions. For Phase II, contractor support is being used for the ISO ETV 14034 testing process and also for research on water sensor data management best practices and standards.

Partnerships: For Phase I, the U.S. Geological Survey and the Nature Conservancy contributed their expertise on water sensors and onsite wastewater treatment systems and provided input on problem definition, design, and judging. These organizations have continued their involvement for Phase II through participation on the Technical Panel.

Advancement of Agency Mission: This Challenge advances the EPA's mission by addressing nitrogen pollution in salt water from septic systems. Conventional on-site wastewater treatment systems, or

OWTS (also referred to as septic systems) are not designed to remove nitrogen to the extent required for avoiding harmful algal blooms and for protecting and restoring many productive and valuable marine and coastal waters. While EPA does not directly regulate OWTS, the Agency works closely with States and coastal communities dealing with the difficult technical and economic issues posed by nitrogen pollution.

Solution Types: Ideas; Technology demonstration and hardware; Analytics, visualizations, algorithms; Scientific

Plan for Upcoming 2 FYs: This challenge will continue into FY20 and concludes on February 21, 2020.

A.9.2 Campus RainWorks Challenge[97]

Lead Sponsoring Agency: EPA

Status: This competition was completed in FY17, and the FY18 competition is underway.

Competition Goals: The Campus RainWorks Challenge is a green infrastructure design competition for American colleges and universities that seeks to engage with the next generation of environmental professionals, foster a dialogue about effective stormwater management, and showcase the environmental, economic, and social benefits of green infrastructure practices.

Goal Types: Solve a specific problem; Advance scientific research; Develop technology; Inform and educate the public; Engage new people and communities

Justification for Using Prizes and Challenges: Prizes incentivize participation in the challenge.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered is $16,000, to be awarded to the first and second place winners in the demonstration project and master plan categories. First place teams in each category will receive a student prize of $2,000 and a faculty prize of $3,000 to support green infrastructure training and/or research. Second place teams in each category will receive a student prize of $1,000 and a faculty prize of $2,000. Non-monetary incentives included feedback on student green infrastructure designs from industry experts at EPA, the Water Environment Federation (WEF), the American Society of Landscape Architects (ASLA), and the American Society of Civil Engineers (ASCE).

Solicitation of Submissions: Submissions are solicited through EPA's green infrastructure webpage. Outreach is conducted through email, social media, press releases, and through cooperating organizations, including WEF, ASLA, and ASCE.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies)

Participation Requirements: Student teams must be affiliated with an academic institution that meets the following description: A degree-granting, public or private institution of higher education located in the U.S., State and local governments, federally recognized Indian Tribal Governments, and U.S. territories or possessions.

Evaluation of Submissions: Qualifying submissions will be judged by two rounds of reviewers that include EPA staff, industry professionals, and academics from noncompeting colleges or universities. First round judges will score submissions on a scale of zero to 100 using pre-identified criteria. Based

[97] The website for the Campus RainWorks Challenge can be viewed at www.epa.gov/campusrainworks.

on the average of all scores for each submission, the top submissions will be recommended to a Final Panel of judges. The Final Panel will then rank the top submissions and recommend finalists in each category to a lead judge in EPA's Office of Water. The lead judge will assess the recommendations based on the criteria identified and select the first and second place winners in each category.

Results: Registration for the Challenge takes place September 1 through September 30, 2018. Entries are due December 14, 2018. Judging occurs January through March 2019, and the four winners will be announced in April 2019.

Budget and Resources: EPA used one FTE in each FY17 and FY18 for this Challenge.

Partnerships: EPA has a memorandum of understanding with WEF, ASLA, and ASCE. These organizations volunteer time to publicize the Campus RainWorks Challenge in advance of registration. Members of these organizations also volunteer their time as judges to help evaluate entries.

Advancement of Agency Mission: The Campus RainWorks Challenge is a green infrastructure design competition for American colleges and universities that seeks to engage with the next generation of environmental professionals, foster a dialogue about effective stormwater management, and showcase the environmental, economic, and social benefits of green infrastructure practices. Stormwater runoff is a significant source of water pollution in communities across the United States. The Campus RainWorks Challenge invites students to create green infrastructure designs can protect public health and water quality today and in the future.

Solution Types: Creative (design & multimedia); Ideas; Technology demonstration and hardware; Scientific

Plan for Upcoming 2 FYs: The Campus RainWorks Challenge is an annual challenge that follows the same facilitation process and requires the same amount of funding and FTEs from one year to the next.

A.9.3 Nutrient Sensor Action Challenge - Stage I[98]

Lead Sponsoring Agency: EPA

Status: This competition was launched in FY17 and completed in FY18.

Competition Goals: Many organizations and communities are interested in utilizing automated sensors to provide improved spatial and temporal data that can help inform decisions and actions to protect and restore our Nation's water resources. The goal of this Challenge was for teams to develop plans that demonstrate their ability to deploy and effectively use low-cost continuous nutrient sensors to collect and manage data according to specified standards, and describe how collected information from the sensors may be used in decision-making pertaining to nutrient pollution.

Goal Types: Find and highlight innovative ideas; Solve a specific problem; Advance scientific research; Develop technology; Engage new people and communities; Stimulate a market

Justification for Using Prizes and Challenges: Running this Challenge as a prize competition rather than a contract, grant, or cooperative agreement encouraged multiple teams to compete to develop the best project plans. Since this was a challenge, the agency is only obligated to pay a prize if a solution is submitted that met the challenge criteria. The notion of a competition created enthusiasm and brought attention to the issue of nutrient pollution.

[98] The website for the Nutrient Sensor Action Challenge - Stage I can be viewed at https://www.challenge.gov/challenge/nutrient-sensor-action-challenge/.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered was $50,000, which allowed five $10,000 prizes to be awarded. Non-monetary incentives included recognition, informational webinars, monthly newsletters, and the opportunity for peer networking.

Solicitation of Submissions: Strategies to solicit participation included tweets from the EPA Twitter account, emails to listservs, an EPA press release as well as announcements at conferences and conference calls with relevant organizations. Partner organizations promoted the Challenge in similar ways.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies)

Participation Requirements: Phase I of the Challenge was open to communities and organizations in the United States interested in deploying continuous nutrient sensors to address a nutrient pollution problem.

Evaluation of Submissions: A panel of nine judges was convened to review and evaluate the submissions. Judges evaluated submissions based on the challenge criteria including monitoring, analytics and interpretation, communication, and use. The judges were from government and private organizations. The judges made recommendations to EPA senior management who made the final selection.

Results: Of the 29 entries submitted by 29 participants between July 26, 2017 and September 20, 2017, 5 prizes were awarded to 5 winners. This is Stage I of a two stage challenge. Stage II is a separate challenge.

Budget and Resources: FY17 resources used to support the Challenge included $30,000 in funding and less than one FTE. Contract support was used for the development of communication materials.

Partnerships: Federal partners included NIST, USDA, USGS, and NOAA. Non-Federal partners included the Alliance for Coastal Technologies at the University of Maryland. The estimated value of in kind support received from partners was $40,000.

Advancement of Agency Mission: This Challenge advances the agency's mission by addressing the need for better and more timely information pertaining to water quality, specifically nutrient pollution. The Challenge called on teams to create innovative partnerships to design a strategy for the successful deployment of sensors, manage resulting data, and demonstrate how collected information may be used in decision-making pertaining to nutrient pollution.

Solution Types: Creative (design & multimedia); Ideas; Technology demonstration and hardware; Analytics, visualizations, algorithms; Scientific

Plan for Upcoming 2 FYs: Potential expansion into use of artificial intelligence and machine learning to improve decision-making

A.9.4 Nutrient Sensor Action Challenge - Stage II[99]

Lead Sponsoring Agency: EPA

Status: This competition was launched in FY18, and is underway.

[99] The website for the Nutrient Sensor Action Challenge - Stage II can be viewed at https://www.challenge.gov/challenge/nutrient-sensor-action-challenge-stage-ii/.

Competition Goals: This Challenge is Stage II of the Nutrient Sensor Action Challenge calls for teams to demonstrate effective and strategic deployment of nutrient sensors, management and use of the resulting data to inform a decision(s) and action(s) that result in improved nutrient management.

Goal Types: Find and highlight innovative ideas; Solve a specific problem; Advance scientific research; Develop technology; Engage new people and communities; Stimulate a market

Justification for Using Prizes and Challenges: Nutrient pollution is a very costly and complex issue. Traditional strategies and approaches have had limited results. This Challenge continues to build on the success and progress of the interagency Challenging Nutrients Coalition. Challenges and prizes offer new opportunities to generate interest around the problem of nutrient pollution. This Challenge has engaged teams and organizations that would typically not be working with EPA. A challenge also has the advantage of only paying out a prize if a team has met the requirements of the challenge.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered was $100,000. Up to two prizes totaling $100,000 will be made in 2019. Non-monetary incentives include recognition, informational webinars, networking, and feedback from judges.

Solicitation of Submissions: The methods used for solicitation of the Challenge included tweets from the EPA Twitter account, emails to listservs, EPA press releases, and partnerships with outside organizations that promoted the Challenge in the same manner.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies)

Participation Requirements: Stage II is open to communities, tribes, states, and other organizations in the United States interested in deploying nutrient sensors to address an important nutrient-related water quality issue. Participation in Stage I of the Challenge is not a requirement for participation in Stage II.

Evaluation of Submissions: A panel of judges will be convened for evaluating the submissions received; judging will take place in February 2019. Judges will evaluate submissions based on the requirements specified in the Challenge. The panel of judges will make recommendations that will be shared with EPA senior management for final decision.

Results: Of the 7 entries submitted by 7 participants between March 1, 2018 and January 31, 2019, 2 potential prizes will be awarded.

Budget and Resources: Scientists, data specialists, administrative and communication support were provided by EPA and the partner agencies in support of this Challenge. In FY18, funding in the amount of $30,000 and less than one FTE supported this Challenge. Contract support was used to develop and design communication and outreach materials.

Partnerships: Federal partners include NIST, USDA, USGS, and NOAA. The estimated value of in kind support from partners is $40,000.

Advancement of Agency Mission: This Challenge advances the agency's mission by helping to empower and incentivize communities to collect data and information that will enable them to make more effective decisions about water quality and specifically pertaining to nutrient pollution.

Solution Types: Creative (design & multimedia); Ideas; Technology demonstration and hardware; Business plans; Analytics, visualizations, algorithms; Scientific

Plan for Upcoming 2 FYs: Potential follow-on challenges focusing on using data networking, artificial intelligence, and machine learning to inform decisions about nutrient pollution.

A.10 Federal Trade Commission (FTC)

A.10.1 IoT Home Inspector Challenge[100]

Lead Sponsoring Agency: FTC

Status: This competition was completed in FY17.

Competition Goals: Every day, American consumers use internet-connected devices to make their homes "smarter." Consumers can remotely program their smart home devices to turn on their lights, start the oven, and turn on soft music so they return to a comfortable environment when they get home from work. While these smart devices enable enormous convenience and safety benefits, they can also create security risks. Lax internet of things (IoT) device security can threaten not just device owners, but the entire internet, as demonstrated by the Mirai botnet and other highly-publicized Internet attacks. The IoT Home Inspector Challenge encouraged the public to create a tool that consumers could deploy to guard against security vulnerabilities in software on the IoT devices in their homes. The tool sought would, at a minimum, help protect consumers from security vulnerabilities caused by out-of-date software. The primary objectives were to engage the public to think about the security risks and mitigations related to smart devices and to encourage the development of a technical tool to help protect consumers from security vulnerabilities caused by out-of-date software.

Goal Types: Find and highlight innovative ideas; Solve a specific problem; Inform and educate the public; Stimulate a market

Justification for Using Prizes and Challenges: Staff research and discussions with experts led the FTC to understand that out-of-date software presents a security issue. Device manufacturers do not always provide security updates for their products, but even when they do consumers may not know that they have been released, where to get the updates, and how to install them. Updating is a particular challenge for products that are low-cost and where consumers have not typically maintained an ongoing relationship with the manufacturer (for example, lamps). Finally, the IoT ecosystem is still evolving and there is no common standard for the technologies, so it is difficult to find a solution that applies across technologies. In sum, risks from old and unpatched software contained in home IoT devices will only increase. Many experts consulted agreed that this was an area where a challenge would be extremely useful.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered was $34,000, and the total amount awarded was $28,000. The prizes allocated were $25,000 for first place and $3,000 for honorable mention. The original allocation included amounts for up to three honorable mentions, but the judges only awarded one.

Solicitation of Submissions: The agency promoted the challenge to the general public through press releases announcing the contest and the official rules, along with multiple blog posts on the FTC's consumer and business blogs, the use of social media, a special webpage for contest material and posting on the Challenge.gov website.

[100] The website for the IoT Home Inspector Challenge can be viewed at https://www.ftc.gov/iot-home-inspector-challenge.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release

Participation Requirements: N/A

Evaluation of Submissions: An expert panel of judges reviewed submissions using the following criteria, where each overall section was allocated a certain number of points. Section I: How well does it work? The instructions outlined a number of components for this section, including (1) Recognizing what IoT devices are operating in the consumer's home; (2) Determining what software version is already on those IoT devices; (3) Determining the latest versions of the software that should be on those devices (with a feasible plan for finding sources of information about what version should be on the device and explaining the technical means by which that information would be procured); and (4) Assisting in facilitating updates, to the extent possible. Section II: How user-friendly is the tool? How easy is your tool for the average consumer, without technical expertise, to set up and use? Section III: How scalable is the tool?

Results: Of the entries submitted between March 1 and May 22, 2017, two prizes were awarded.

Budget and Resources: In terms of manpower, the time dedicated to the project included the development of the subject for the contest, developing criteria, consulting a variety of subject-matter outside experts and selecting potential judges for the contest. FTC records indicate a total of 0.5 FTE were used in FY17 to execute the prize competition, however, there was likely an additional 0.25 FTE used that were attributed other activity codes.

Partnerships: N/A

Advancement of Agency Mission: As part of its mandate, the FTC has engaged in research, advocacy, education, policy work, and law enforcement activity to protect consumers in the United States. This work includes efforts aimed at protecting consumers in an ever-changing marketplace, and that includes IoT devices in the home. While IoT or "smart" devices may provide enormous benefits, such as convenience and safety benefits, they can also create security risks. One way the agency tackles these challenges has been through targeted law enforcement. The FTC has also worked to raise awareness about risks and possible mitigating measures through public discourse and through educational materials. The FTC's law enforcement, policy, and education efforts alone cannot address the issue for a number of reasons. First, there are an increasing number and variety of IoT devices today and updating each is complex. In addition, ordinary consumers cannot easily take action to secure their devices, or even just to discover if their software is up-to-date, unless they are aware of the risks, are very motivated to address them, and have a considerable amount of detailed technical know-how.

Solution Types: Software and apps; Creative (design & multimedia); Ideas

Plan for Upcoming 2 FYs: The FTC agency has held four challenges in the last four years and has found them to be valuable, but has no immediate plans to conduct another challenge.

A.11 General Services Administration (GSA)

A.11.1 Student Design Competition: New San Francisco Federal Building Plaza[101]

Lead Sponsoring Agency: GSA

[101] The website for the Student Design Competition: New San Francisco Federal Building Plaza can be viewed at https://www.Challenge.gov/challenge/student-design-competition-new-san-francisco-federal-building-plaza/.

Status: This competition was launched in FY17 and completed in FY18.

Competition Goals: This competition sought ideas that would activate the New San Francisco Federal Building plaza for the benefit of building users and the general public. The New San Francisco Federal Building located at 90 7th Street has become a landmark in San Francisco, California. Its layout and functions celebrate the importance of the city and the urban environment, combining amenities and public space that are designed to enhance the immediate area and the adjacent neighborhood. The offices support the energy and spirit of those who work there and those who visit. Its systems are outstanding examples of integrated engineering and sustainable design, reflecting the wise stewardship of limited resources. Together, these attributes make this a project that has stimulated critical interest.

The original vision for the plaza was that it would be a welcome civic space that is flexible and allows for outdoor dining, concerts, and markets. Since the completion of the building's construction 10 years ago, only the cafe uses the plaza for outdoor dining, and no concerts, markets, or any other public functions have used this space.

Goal Types: Improve government service delivery; Find and highlight innovative ideas; Solve a specific problem; Inform and educate the public; Engage new people and communities

Justification for Using Prizes and Challenges: Holding a design competition for architecture, landscape architecture, and urban design students supported and advanced GSA's mission in a number of ways. The local community in the neighborhood surrounding the building were engaged in the entry evaluation process and, therefore, had their own voice heard.Students are not licensed architects and so provisions of the Brooks Act and FAR 36.601 do not apply because the competition limited entrants to students. In contrast, holding a design competition to hire a licensed architect or engineer would have required compliance with Brooks Act, FAR 36, and FAR 15, and so the source selection and evaluation board (SSEB) prohibited community stakeholders from participating directly in the evaluation of entries. The potential ideas generated by the competition included design and construction solutions or programming a new function for the plaza without changing it, or yet some other solution that does not necessarily require expensive renovation. This was unlike a competition to hire an architect or design-build team because the scope was undefined and may not have even involved renovation work to implement. Having a cash prize attracted far greater interest, improved the quality of the most successful entries and increased the opportunity for recognition.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered and awarded was $1,750. Non-monetary incentives included public acknowledgement on the Challenge.gov website. Three individual cash awards were given to the three winners of the Challenge by sending pre-paid charge-cards (American Express) with a letter to the winners. These pre-paid charge-chards were purchased by the GSA in FY17 under the agency's micro-purchase authority. The value of each card was $1000, $500, and $250, corresponding to 1st, 2nd, and 3rd place prizes, respectively. The honorable mention award-winner received a letter and their proposal was featured on the Challenge.gov website along with the prize-winners.

Solicitation of Submissions: The entire solicitation and submission process was handled on the Challenge.gov platform. GSA published an article about the solicitation on the GSA.gov blog website which linked to the Challenge.gov website. GSA shared the links via its social media accounts on Twitter and Facebook. Additionally, GSA contacted several online architecture and design competition blogs that were not affiliated with any government agency to notify them about the Challenge and they chose to publish links to the Challenge.gov solicitation. These included www.archdaily.com, www.competitions.archi, www.aias.org, and www.archinect.com.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs)

Participation Requirements: The targeted solvers included students of architecture, landscape architecture, urban design, or related programs. The following statement was published in the rules, terms, and conditions for the Challenge: "Only individual submissions are allowed, no team submissions. One submission per contestant is allowed. Contestant certifies through entering the submission that they are currently full-time undergraduate or graduate student enrolled in an accredited architecture, landscape architecture, urban design, or related program. Contestant certifies through entering the submission that they are a citizen or permanent resident of the United States of America."

Evaluation of Submissions: The jury convened in person to evaluate the proposals based on the following evaluation criteria: (1) Creativity: The Guiding Principles for Federal Architecture state that the government should produce facilities that reflect the dignity, enterprise, vigor, and stability of the Federal Government, emphasizing designs that embody the finest contemporary architectural thought; that avoid an official style; and that incorporate the work of living American artists. With these Guiding Principles in mind, submissions that demonstrated greater creativity, coherence, and clarity of vision in achieving the goal of activating the plaza were considered more favorably. (2) Context: GSA recognized that good design is responsive to context. Special attention was paid to the general ensemble of streets and public places of which Federal buildings formed a part; and that, where possible, buildings should permit a generous development of landscape. Submissions that addressed and responded to the physical context of climate and the built environment were considered more favorably. (3) Community: GSA strived to leverage its real estate activity to support community goals. Submissions that demonstrated a superior understanding of local issues and community goals, and which addressed those issues and goals in compelling ways, were considered more favorably. (4) Feasibility: Designs should have adhered to sound construction practice and utilized materials, methods and equipment of proven dependability, and should be economical to build, operate and maintain, and should be accessible. Submissions that were technically feasible to implement were considered more favorably. (5) Value: Part of GSA's mission is to deliver the best value in real estate services to the Federal Government and the American people. Submissions that represented a high-value intervention that could be implemented more cost-effectively were considered more favorably.

Results: Of the 63 entries submitted between August 28 and November 22, 2017, three prizes were awarded to three prize winners and one honorable mention award-winner was announced.

Budget and Resources: GSA allocated one project manager who devoted approximately 8-16 hours per week over a period of 4 months to develop the Challenge, coordinate the evaluation of proposals, and administer the close-out process. In addition, GSA allocated one communications officer to develop communications material and manage communications. The communications officer devoted between 8-16 hours per week for 3 months. Personnel resources amounted to 0.125 FTEs across FY17 and FY18. Agency funding provided in FY17 was $1,750 and $599.74 in FY18.

Partnerships: The U.S. Department of Health and Human Services (HHS) and the Central Market Community Benefit District each provided one person for the two-day proposal evaluation process, equal to approximately 16 manhours each.

Advancement of Agency Mission: The mission of GSA is to deliver the best value in real estate, acquisition, and technology services to the Federal Government and the American people. GSA also has an obligation to reach out to communities to discuss how GSA can support community goals. Holding a design competition for architecture, landscape architecture, and urban design students supported and advanced GSA's mission in two ways. First, the local community at the building were engaged in the entry evaluation process and communicated to GSA ideas that supported community goals. Second,

the competition stimulated innovation by rewarding ideas for the scoping of a plaza intervention which GSA might not have thought of otherwise and which resulted in the best value for the Federal Government and taxpayers. These ideas included a broad range of solutions such as design and construction solutions, programming a new function for the plaza without changing it, and others.

Solution Types: Creative (design & multimedia); Ideas

Plan for Upcoming 2 FYs: GSA considered this process a success and is evaluating other design-related opportunities throughout the country that could benefit from a challenge under the America COMPETES authority, but no specific opportunities have been identified that would occur within the next 2 fiscal years.

A.12 National Aeronautics and Space Administration (NASA)

A.12.1 Earth & Space Air Prize

Lead Sponsoring Agency: NASA

Status: This competition was launched in FY17 and underway in FY18.

Competition Goals: NASA's long-term technology roadmap calls for improvements to the technology for monitoring particles in the air to enable future long-term human space missions. This competition serves to catalyze the aerosol community and accelerate development of highly innovative approaches that may otherwise take years to achieve. The NASA Earth & Space Air Prize, with support from the Robert Wood Johnson Foundation (RWJF), focused on identifying solutions that can catalyze the development of easy to maintain, small, and affordable aerosol sensor technology that has the potential to be useful in spaceflight as well as on Earth anywhere outdoors in a community where pedestrians may be exposed to airborne particle matter.

Goal Types: Solve a specific problem; Develop technology

Justification for Using Prizes and Challenges: A concept scan identified numerous communities pushing to build and enhance nascent community air quality sensor capabilities. This prize competition was launched to incentivize the relevant community to submit ideas and prototypes for solutions that would be beneficial to NASA and the Robert Wood Johnson Foundation (RWJF) goals in detecting particulates in the air on Earth and in space applications.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered was $250,000. $150,000 was awarded to three finalists, and the $100,000 grand prize was awarded in November 2018. Non-monetary incentives included a reception and demonstration event at the Glenn Research Center.

Solicitation of Submissions: The prize administrator, The Common Pool LLC, focused efforts on both primary and secondary outreach and communicated directly with potential participants and key influencers and organizations in science and technology. Outreach efforts kicked off on September 19, 2017 with an announcement of the launch of the Earth and Space Air Prize at the Udvar-Hazy facility of the National Air and Space Museum in conjunction with an event sponsored by Future Engineers. Efforts also included recruitment of potential submissions at the yearly meeting of the professional society of aerosol specialists. NASA used the NASA Solve website (www.nasa.gov/solve), which lists NASA's participatory opportunities, to market this challenge. NASA also published a Web feature that was amplified by the RWJF through social media.

Solicitation Types: Social media (e.g., Twitter, Facebook); Press release; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies); Other:

Outreach conducted by commercial prize administrator, and NASA Solve website (www.nasa.gov/solve)

Participation Requirements: Individuals must be U.S. citizens or permanent residents of the United States and be 18 years of age or older. Organizations must be an entity incorporated in and maintaining a primary place of business in the United States. Teams must be comprised of otherwise eligible individuals or organizations, and led by an otherwise eligible individual or organization. U.S. government employees may participate so long as they rely on no facilities, access, personnel, knowledge or other resources that are available to them as a result of their employment except for those resources available to all other participants on an equal basis. U.S. government employees participating as individuals, or who submit applications on behalf of an otherwise eligible organization, will be responsible for ensuring that their participation in the Competition is permitted by the rules and regulations relevant to their position and that they have obtained any authorization that may be required by virtue of their government position. Failure to do so may result in the disqualification of them individually or of the entity which they represent or in which they are involved. Foreign citizens may only participate as (i) employees of an otherwise eligible US entity who reside in the US, (ii) full-time students at an otherwise eligible US university or college who reside in the US, or (iii) owners of less than 50% of the interests in an otherwise eligible US entity who reside in the US.

Evaluation of Submissions: Submissions were evaluated using a set of criteria available at https://www.earthspaceairprize.org/#scoring. Additionally, the prize administrator uses a trait scoring rubric to ensure fairness in the evaluation process that prevents a tie in the scoring. Final testing occurred in the testing lab at the Glenn Research Center in November 2018 where the instruments must meet specified criteria along with final evaluation by the judging team.

Results: Of the 20 entries submitted by 544 participants in Phase I between September 19, 2017 and January 31, 2018, three finalists were awarded $150,000 total. In Phase II, prototypes were developed and tested and the grand prize winner received $100,000. The three solutions named as finalists were AirSpeQ's Gravimetric PM Monitor Employing Thermophoresis; Applied Particle Technology's Optical particle speciation and counter; and the Volckens Group/Colorado State University's Mobile Aerosol Reference Sensor (MARS).

Budget and Resources: The RWJF provided the bulk of the funding for this challenge inclusive of prize administration and the prize purse for the three finalists. NASA provided funding for the final award. NASA FTE/WYE resources along with RWJF personnel supported development of the challenge, selection of the prize administrator, and judging of the submissions. Agency resources in FY17 was estimated at 0.4 FTE and 0.2 WYE, and 0.3 FTE and $100,000 in prize funding in FY18. The prize administrator was selected through the NASA Open Innovation Services Contract. Funding supported RFP development and award.

Partnerships: RWJF provided financial support, estimated at $350,000 for prize purse ($150,000) and prize administration ($200,000). RWJF also supported the prize with 0.2 FTE of their own personnel. This partnership was an incredibly positive relationship setting a framework for how public-private partnerships can be used to accelerate technology development. NASA entered into a formal agreement which clearly specified roles and responsibilities. NASA now has in place a template for future partnerships. Additionally, NASA laid the groundwork for the financial system that will support intake of funding from private partners. This allowed the acquisition of a professional prize administration team that has been a tremendous bonus to effective conduct of this competition.

Advancement of Agency Mission: NASA has identified particulate monitoring as a gap in its technology roadmap to enable future long-term missions. Current technology does not provide the level of sensitivity, the longevity, or the ability to operate in a reduced-gravity environment. In working with

RWJF, NASA has the opportunity to close this gap. The added bonus of the outcome of this technology demonstration competition is the potential benefit to human health on Earth as well.

Solution Types: Technology demonstration and hardware

Plan for Upcoming 2 FYs: N/A

A.13 National Science Foundation (NSF)

A.13.1 2017-2018 Community College Innovation Challenge[102]

Lead Sponsoring Agency: NSF

Status: This competition was launched in FY17 and completed in FY18.

Competition Goals: The primary goal of the Community College Innovation Challenge (CCIC) was to create seats for community college students, often underrepresented in the research community, at the innovation table and cultivate confidence and skills. CCIC provided community college 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 strategic communication techniques.

Goal Types: Find and highlight innovative ideas; Advance scientific research; Inform and educate the public; Engage new people and communities; Build capacity

Justification for Using Prizes and Challenges: NSF's traditional mechanism of crowdsourcing innovation, advancing STEM research, and developing a STEM workforce via solicitations and grants tends to attract a more established research community from four-year institutions and often leaves community colleges untapped. The modest prize money and all-inclusive four-day professional development boot camp helped attract students to participate in the CCIC. Participants gained greater awareness of opportunities in the sciences and developed an array of important scientific and professional skills. CCIC alumni have gone on to secure venture capital funding, launch start-ups, enter graduate school to pursue degrees in STEM, speak on National Science Board panels, land prestigious industry internships and apprenticeships, and launch local innovation competitions at their schools inspired by CCIC.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered and the total amount awarded was $81,700. Non-monetary incentives, including a four-day Innovation Boot Camp experience for the ten finalist teams and a plaque for all finalist schools, came to $219,000.

Solicitation of Submissions: Submission were solicited via social media (Twitter and Facebook posts); direct, targeted outreach (telephone calls); email (listservs); a press release; day-long event(s) prior to the competition; partnerships with outside organizations (including private companies, non-profit organizations, and other Federal agencies); sessions/announcements at appropriate conferences/workshops; promo toolkit on the website; and mailing materials (postcards, posters).

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Day-long event(s) prior to the competition; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies)

Participation Requirements: The target audience for this Challenge was community college students 18 years old and older. Participants were required to be U.S. citizens, nationals, or permanent residents

[102] The website for the 2017-2018 Community College Innovation Challenge can be viewed at www.nsf.gov/communitycollege.

enrolled in and in academic good standing at a two-year, degree-granting institution. Teams were comprised of three to five students, one faculty mentor, and one community/industry partner. Students who previously advanced to finalist status and participated in a past Innovation Boot Camp were not eligible to re-enter.

Evaluation of Submissions: NSF recruited different populations for three rounds of judging. Preliminary judging was conducted online by American Association for the Advancement of Science Policy Fellows and Science Assistants at NSF. Semifinal judging was also conducted online by NSF Program Officers with thematic scientific expertise. Final judging was conducted in person by high-profile academics, industry representatives, and entrepreneurs with broad STEM knowledge. Evaluation was based on three categories: (1) innovation and impact, defined as the proposed solution's use of science to address a problem and its potential to be transformative in the areas of national security, economy, quality of life, education, and environment, among others; (2) feasibility, defined as the likelihood that the solution is technically feasible as well as economic, political, and social constraints; and (3) clarity of communication, defined as the team's adherence to the entry guidelines, grammar, structure, organization of facts and data, and clarity and consistency of message.

Results: Of the 41 entries submitted by 234 participants between October 18, 2017 and February 14, 2018, 53 participants each received $500 for making it to the final round and an all-expense paid trip to the Innovation Boot Camp. Of the 10 finalist entries, five received 1st-place prizes of $1,500 each and five received 2nd-place prizes of $1,200 each.

Budget and Resources: Funds totaling $416,000 were allocated in FY17, and 1.5 full-time equivalents (FTEs) managed and supported aspects of the competition in FY17 and FY18. Third-party vendors (including the American Association of Community Colleges) were funded using FY17 money that came from NSF's Education and Human Resources Directorate (Division of Undergraduate Education). Entry platform company Skild received $139,000 for platform development and customization, client services support, creative design services, strategic consulting/oversight, engineering, QA testing, prize distribution, and direct outreach. The American Association of Community Colleges (AACC) received $219,000 to support the Innovation Boot Camp, including all logistics costs (travel, lodging, food, per diem, etc.) for student finalists and judges as well as providing essential curricula and other outreach material. Ninja Communications received $42,000 for developing curriculum, conducting pre-boot camp webinars, providing four days of on-site instruction for finalists, and managing the judging process, score sheets, and deliberation. Grant Warner, I-Corps Instructor, received $8,000 for developing curriculum, conducting pre-boot camp webinars, and providing four days of on-site instruction for finalists. MDR received $8,000 for listserv distribution.

Partnerships: NSF has partnered with AACC to run the CCIC competition since the program's inception four years ago. AACC provided expertise with the community college population in challenge development and theme identification as well as recruitment of judges, outreach efforts, and in developing materials and curriculum for the Innovation Boot Camp. AACC coordinated logistics and travel for the Innovation Boot Camp, as well as arranged the finalists' reception, which involved interactive displays and was hosted by the White House's Office of Science and Technology Policy and the Office of American Innovation at the Eisenhower Executive Office Building on June 13, 2018.

Advancement of Agency Mission: CCIC advanced NSF's mission by aligning with NSF's strategic plan. Specifically, CCIC helped: (1) build the capacity of the Nation's citizenry for addressing societal challenges through science and engineering; and (2) prepare and engage a diverse STEM workforce motivated to participate at the frontiers. In addition, the competition served NSF's strategic goal for open innovation.

Solution Types: Software and apps; Ideas; Technology demonstration and hardware; Business plans; Scientific

Plan for Upcoming 2 FYs: N/A

A.13.2 Engineering Research Centers (ERC)-Wide Perfect Pitch Competition[103]

Lead Sponsoring Agency: NSF

Status: This competition was launched in FY17 and completed in FY18.

Competition Goals: The objective of the ERC Perfect Pitch Competition was to help engineering students develop the communication skills critical to expressing their ideas in a clear, concise, and compelling manner. This competition was modeled after the elevator pitch competitions popular in business schools; however, in addition to stressing the importance of concise and persuasive communication, the judging criteria emphasized a culture of innovation and entrepreneurship and empowered students to lead.

Goal Types: Engage new people and communities; Build capacity

Justification for Using Prizes and Challenges: A cash prize provided a way to get students' attention while simultaneously sending a message about the importance of good communications skills. It was meant to generate an atmosphere of excited anticipation within the ERC community, both among students and the center leadership teams. It also provided a climactic focal point during regular ERC biennial meetings.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered and the total amount awarded was $8,000 (1st Prize $5,000; 2nd Prize $2,000; 3rd Prize $1,000). Non-monetary incentives included a Perpetual Trophy awarded to the ERC Home of the 1st place winner.

Solicitation of Submissions: Perfect Pitch Guidelines and the Competition scoring templates were posted on a website dedicated to the Perfect Pitch competition on August 16, 2017. On the same date, an email notification was sent to ERC Education and Outreach Directors and ERC Industrial Liaison Officers.

Solicitation Types: Email (e.g., listservs); Day-long event(s) prior to the competition

Participation Requirements: In FY17, the ERC Program mobilized all 15 ERCs that had active student leadership organizations to compete. Four ERCs had just begun in the month prior to the competition and did not participate. The competitions engaged their entire leadership teams, especially the Centers' Education Directors, Industrial Liaison Officers, and the ERC community. All ERC students (both graduate and undergraduate) engaged in research at one of the actively funded NSF ERCs were eligible to compete. A total of 129 students participated in local competitions, of which 78% were graduate students, 5% were undergraduate students, and 5% were post-doctoral students, who were allowed to compete in some local competitions to enlarge the pool of contestants. Since each ERC held its own competition to determine who would represent it in the ERC-wide competition, the quality of the finalists was quite impressive. Fifteen students represented fifteen ERCs from universities located around the country and across a wide spectrum of advanced technology fields. The contestant pool at the national level included seven women and eight men.

[103] The website for the Engineering Research Centers(Erc)-Wide Perfect Pitch Competition can be viewed at http://erc-assoc.org/programs/pitch and http://erc-assoc.org/content/perfect-pitch-guidelines.

Evaluation of Submissions: Each judging team consisted of one academic with entrepreneurship experience, a previous Perfect Pitch judge, two investment bankers, and one venture capitalist. Contestants in the ERC-wide competition were expected to pitch a compelling problem or opportunity connected with the ERC strategic vision in a clear, articulate, compelling manner within a 90-second window. Evaluation criteria considered the proposed solution, its potential impact, the broader impact of technology, call to action, visual design of slide, and poise/style. At the ERC-wide competition, contestants presented their pitch to the judges one by one; a moderator introduced each speaker and kept time. After each presentation, each judge had 1.5 minutes to enter their score and notes on a spreadsheet. Following the presentations, the judges met to complete their notes and scoring, and a video of the entire competition was available for review to allow the judges to refine their scores and provide more detailed feedback. They then discussed and finalized their decisions, which were conveyed to the program organizer. After the awards ceremony, copies of the ballots with the judges' feedback were given to the students.

Results: Of the 15 participants in the ERC-wide competition on November 2, 2017, three prizes were awarded. A total of 129 students competed locally to represent their home ERCs on September 29, 2017.

Budget and Resources: Total expenses were $13,600, which covered judges' expenses ($3,500), prize purse ($8,000), and overhead ($2,100) to the American Society of Engineering Education, which sponsored the meeting where the final competition took place. In FY17 and FY18, 0.1 full-time equivalent (FTE) was allocated to plan and manage the competition. In FY18, three American Association for the Advancement of Science Fellows also supported the competition.

Partnerships: N/A

Advancement of Agency Mission: The goal of the ERC Program is to integrate engineering research and education with technological innovation to transform national prosperity, health, and security. At the National-level, the Perfect Pitch competition generated excitement within the ERC community as well as interest in ERC innovations and their student champions among venture capitalists and angel investors. Stemming in part from the Perfect Pitch competition, some ERCs have begun to invest resources into improving their student's communication skills.

Solution Types: Creative (design & multimedia)

Plan for Upcoming 2 FYs: N/A

A.13.3 Generation Nano: Superheroes Inspired by Science[104]

Lead Sponsoring Agency: NSF

Status: This competition was launched in FY17 and completed in FY18.

Competition Goals: Generation Nano challenged middle school and high school students to research science and technology advancements and then creatively apply those ideas to empower or drive a unique superhero. The competition was an opportunity to generate an early interest in and excitement for STEM topics among students as well as provide reputable resources to guide their research.

Goal Types: Inform and educate the public; Engage new people and communities

Justification for Using Prizes and Challenges: NSF's traditional mechanism of advancing STEM research and developing a STEM workforce is via solicitations and grants. Unfortunately, this method is not a readily available option for K-12 students. NSF uses prizes as a way to attract this younger audience and

[104] The website for the Generation Nano: Superheroes Inspired by Science can be viewed at Nsf.gov/GenNano.

incentivize them to participate. The modest prize money and the trip to DC for the USA Science & Engineering Festival has helped attract students and teachers, raising awareness of NSF and its mission as well as building confidence and skills that will help propel their future.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered and the total amount awarded was $14,880 ($12,000 in cash prizes, $2,880 for final event logistics). Non-monetary incentives included travel to Washington, D.C. to participate in the USA Science & Engineering Festival for the first place high school and middle school winners. First place received $1,500 per team member, second place received $1,000 per team member, and honorable mention received $500 per team member. In addition, $500 was awarded to teacher(s) who mentored the first place teams / individuals.

Solicitation of Submissions: Entries were solicited through email outreach via listserves and MDR (a paid service); press release; social media (facebook/twitter/Instagram/etc.); social media advertisements; postcards distributed at various events; sessions/talks at various events; and a promo toolkit on the website.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies); Other - Sessions/announcements at appropriate conferences, promo toolkit on the website, mailing materials (postcards, posters) to appropriate contacts

Participation Requirements: All entries had to be received during the competition submission window. Each submission had to be made by an individual. All students had to be enrolled in and be in good standing at a middle or high school or be home-schooled in the U.S., including U.S. territories and possessions, at the time of entry. Students had to be U.S. citizens, nationals, or permanent residents. Each entrant certified, through submission to the contest, that the entry was his or her own original creative work and did not violate or infringe the creative work of others, as protected under U.S. copyright law. Each entrant had to submit a Parental/Guardian Permission Form and Photo Consent Form.

Evaluation of Submissions: Preliminary judging was done online by Fellows across agencies. Semifinal judging was also online by science researchers and members of the comic/entertainment community. Final judging was in person by high-profile science researchers and prominent education and entertainment leaders. Evaluation was based on three categories: (1) creativity (25 percent), defined by the originality and quality of both the superhero and the story, as well as the application of science and technology; (2) use of science and technology (50 percent), defined as how accurately the entrant incorporated science and technology into the story to address the chosen societal mission; and (3) artistic and technical quality (25 percent), defined as the visual appeal and refined execution of the comic or video.

Results: Of the 388 entries submitted by 1100 participants between September 18, 2017 and January 10, 2018, nine entries (14 students) and two teacher honoraria received awards.

Budget and Resources: Funding for FY17 and FY18 totaled $58,000. Of the total funds, $53,000 went to Skild for platform development and customization, client services support, creative design services, strategic consulting/oversight, engineering, QA testing, prize distribution, and direct outreach. The remaining $5,000 went to MDR for marketing via listserv distribution. A total of 1.5 full-time equivalents (FTEs) were used to manage and help support aspects of the competition.

Partnerships: NSF partnered with the National Nanotechnology Initiative, benefiting from its technical knowledge base. NSF also reached out to State Science Teacher Associations and posted the competition on numerous websites, including NASA, The Connectory, and Johns Hopkins Center for Talented Youth. Prominent comic creator Stan Lee promoted the competition on social media. His

support, and that of other science and pop-culture celebrities, helped NSF reach new populations and encourage their participation.

Advancement of Agency Mission: The competition advanced NSF's mission by aligning with its strategic plan. Specifically, Generation Nano helped: (1) build the capacity of the Nation's citizenry for addressing societal challenges through science and engineering; and (2) prepare and engage a diverse STEM workforce motivated to participate at the frontiers. In addition, the competition served NSF's strategic goal for open innovation.

Solution Types: Creative (design & multimedia)

Plan for Upcoming 2 FYs: N/A

A.13.4 NSF Wireless Innovation for a Networked Society (WINS)[105]

Lead Sponsoring Agency: NSF

Status: This competition was launched in FY17 and completed in FY18.

Competition Goals: The NSF WINS Challenges sought practical, new wireless solutions to help people connect to the internet in challenging circumstances, either after a disaster or in areas without sufficient connectivity, as wireless technology innovations should make the internet more accessible, resilient, and healthier. Two challenges were at stake: the Off-The-Grid Internet Challenge and the Smart-Community Networks Challenge: The Off-The-Grid Internet Challenge sought wireless solutions for communication that can be rapidly deployed in post-disaster situations where internet access is unavailable or compromised, while the Smart-Community Networks Challenge sought wireless solutions for communication that can be built on top of existing infrastructure to enhance internet connectivity in communities that need greater access.

Goal Types: Find and highlight innovative ideas; Solve a specific problem; Develop technology; Inform and educate the public; Engage new people and communities

Justification for Using Prizes and Challenges: The prize competition was selected to draw from the large community of entrepreneurs and small business developers who could develop the solutions to this challenge but are not generally attracted to NSF's traditional mechanisms (grants, contracts, cooperative agreements, etc.).

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered and the total amount awarded was $2,000,000. For Phase 1 (Design Concept Stage), first place received $60,000, second place received $40,000, third place received $30,000, and seven honorable mentions each received $10,000. For Phase 2 (Working Prototype Stage), first place received $400,000, second place received $250,000, third place received $100,000, and fourth place received $50,000.

Solicitation of Submissions: The NSF WINS Challenges were open to all U.S.-based entrants, including non-profit and for-profit organizations and individuals ages 18 and over. Each participant had to fill out and submit an Intent to Apply form through the NSF WINS website at wirelesschallenge.mozilla.org between June 15, 2017 and October 15, 2017. Entrants then received information via email on how to register for an account at mozilla.fluxx.io. By submitting a full submission, each team's leader accepted the challenge rules and all decisions of the organizer and judges as final and binding.

[105] The website for the NSF Wireless Innovation for a Networked Society can be viewed at https://wirelesschallenge.mozilla.org; https://www.Challenge.gov/challenge/nsf-wins-wireless-challenges/.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Day-long event(s) prior to the competition; Live video streaming; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies)

Participation Requirements: Participation was open to teams of one or more members with no maximum number of participants per team. Individual participants may be a member of more than one team. Participants must be individuals who are U.S. citizens or permanent residents, or organizations (whether nonprofit or for-profit) that are incorporated in and maintain a primary place of business in the U.S. Designated team leaders, responsible for sending and receiving communications on behalf of their team, had to be at least 18 years of age. Participants between the ages of 13 and 17 were permitted as long as they were not team leaders and obtained written permission to participate from their parent or legal guardian. Only teams that were selected to proceed at the end of the Design Concept Stage could participate in the Working Prototype Stage.

Evaluation of Submissions: Each phase of the competition had a set of judges who evaluated each of the entries submitted in that phase.

Results: Of the 20 entries submitted in Phase 1 between June 1, 2017 and November 15, 2017, eight prizes were awarded at the end of Phase 2 on September 26, 2018.

Budget and Resources: The competition budget for FY17 and FY18 totaled $250,000 in each fiscal year. Funds were used to hire a dedicated program staff, and 0.2 full-time equivalents (FTEs) from the Mozilla Foundation helped with community outreach events, website development, recruitment of judges, and arranging the demonstrations. The $2 million in prize money was paid out in FY18, with $400,000 paid out in January 2018 (Phase 1) and the balance paid out at the end of FY18.

Partnerships: Mozilla Foundation was recruited to help plan and run the Challenge, including outreach, recruitment of judges, and building the website to manage the communications and submission process.

Advancement of Agency Mission: The NSF-WINS Challenges helped identify a broad set of wireless technology solutions to increase access to the internet, bringing together the outcomes of many research activities funded by NSF into solutions that immediately impact society. This aligns with the agency's mission to advance scientific understanding to benefit society.

Solution Types: Software and apps; Technology demonstration and hardware; Business plans

Plan for Upcoming 2 FYs: N/A

A.13.5 NSF-Hearables Challenge[106]

Lead Sponsoring Agency: NSF

Status: This competition was completed in FY17.

Competition Goals: This challenge sought to generate ideas for design concepts or technologies (including algorithms) that might be used to allow a person with a hearable technology to have an understandable conversation at normal volume within a noisy setting, such as a busy restaurant. This challenge sought solutions that are the most broadly accessible to the population.

[106] The website for the NSF-Hearables Challenge can be viewed at https://ninesights.ninesigma.com/web/hearables/innovationcontest.

Goal Types: Find and highlight innovative ideas; Solve a specific problem; Develop technology; Inform and educate the public; Engage new people and communities; Build capacity; Stimulate a market

Justification for Using Prizes and Challenges: The prize competition was selected to attract a wide range of non-traditional participants, as the traditional mechanisms (grants, contracts, cooperative agreements, etc.) were not seen as attractive to a large community of students, entrepreneurs, and small business developers capable of developing solutions to this challenge. Since challenges go to the public and are broadly shared on social media and other media outlets, NSF decided to use a challenge to move research in the area of hearables forward.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered was $145,000 and the total amount awarded was $146,000 ($80,000 for first place, $60,000 for second place, and $3,000 for third and fourth places). Non-monetary incentives included a presentation at the IEEE UbiComp Conference.

Solicitation of Submissions: The NSF Hearables Challenge was open to all U.S.-based entrants, including non-profit and for-profit organizations and individuals ages 18 and over. Each participant had to fill out and submit an Intent to Apply form through the NineSigma website between April 25 and June 22, 2017. A sample audio file was provided at the challenge launch to help competitors develop and train their proposed approach. The final test audio was available for download one week before the June 30 deadline, and participants received information via email on how to register for an account at mozilla.fluxx.io. By submitting a full submission, the team leader formally accepted on behalf of the team the challenge rules and all decisions of the organizer and judges as final and binding. It was a very open competition that attracted entries from a diverse range of individuals and organizations as well as heightening awareness in the computing research community of the potential value of hearing technology.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies)

Participation Requirements: Participation was open to individuals or teams whose leader was a U.S. citizens or permanent resident.

Evaluation of Submissions: All submissions were evaluated for accuracy, defined by the number of words correctly identified from the audio sample. The processed samples were also reviewed by a panel of four judges for clarity, latency, and understandability. Proposals with the highest overall ranking were awarded prizes.

Results: Of the seven entries submitted between April 25, 2017 and June 30, 2017, four prizes were awarded.

Budget and Resources: In FY17, 0.2 full-time equivalents (FTEs) were used to provide oversight of the competition process and review submitted entries. In FY16, NSF entered into and funded a memorandum of understanding with the NASA Challenge Center of Excellence to use their contract with NineSigma to manage the competition. This included community outreach events, website development, recruitment of judges, arranging demonstrations, and paying out prizes. NSF paid out slightly more in prizes than originally planned. The additional funds resulted from budget efficiencies.

Partnerships: The NASA Challenges Center of Excellence supplied technical assistance and expertise in addition to managing the NineSigma efforts.

Advancement of Agency Mission: The prize competition was selected to attract a wide range of non-traditional participants, since the traditional mechanisms (grants, contracts, cooperative agreements, etc.) were not seen as attractive to a large community of students, entrepreneurs and small business

developers who were envisioned as capable of developing solutions to this challenge building upon the outcomes of prior NSF-sponsored research.

Solution Types: Software and apps; Analytics, visualizations, algorithms

Plan for Upcoming 2 FYs: N/A

A.14 Small Business Administration (SBA)

A.14.1 InnovateHER 2017 Challenge[107]

Lead Sponsoring Agency: SBA

Status: This competition was completed in FY17.

Competition Goals: InnovateHER provides an opportunity for entrepreneurs to showcase products or services that have a measurable impact on the lives of women and families, have the potential for commercialization, and fill a need in the marketplace. The goal of the InnovateHER competitions is to empower women entrepreneurs to pitch their products, to create local visibility for them, and to make sure that entrepreneurs connect with our resource partners for assistance in starting and growing their businesses.

Goal Types: Find and highlight innovative ideas; Solve a specific problem; Engage new people and communities; Build capacity

Justification for Using Prizes and Challenges: The purpose of the InnovateHER Challenge is to create local visibility for SBA and to make sure that entrepreneurs connect with our resource partners for assistance in starting and growing their businesses. Also, we were aiming at a combined total of at least 100 or more events nationwide during this competition, and the cash prizes were used as incentives for the participants.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered and awarded was $70,000. The first place cash prize was $40,000, second place was $20,000, and third place was $10,000.

Solicitation of Submissions: Building on the success of the inaugural 2015 InnovateHER Business Challenge, SBA and OWBO received the offer from the Sara Blakely Foundation to donate and support the initiative. The initial round of the InnovateHER Challenge took the form of local competitions that ran across the country beginning December 29, 2016 and ended June 3, 2017. The host organizations running the local competitions selected and submitted one winner from each local competition to SBA, along with a Nomination package by June 23, 2017. Winners were announced during the live pitch competition held on October 26, 2017, in Washington, D.C.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies)

Participation Requirements: Partner organizations wanting to host a local competition as part of the initial round of this Challenge sent requests to the SBA at womenbusiness@sba.gov. SBA evaluated all requests to host a local InnovateHER competition under its sole discretion and confirmed a host's participation in writing. Each host organization was responsible for determining the type of local competition, and ensured it was conducted in a manner consistent with the Challenge Rules. At a

[107] The website for the InnovateHER 2017 Challenge can be viewed at sba.gov/InnovateHER.

minimum, however, each application was required to contain a business plan covering the contestant's proposed product or service and must satisfy the Challenge criteria. The local competitions were administered solely by the local host organizations and were judged by individuals selected by each host in their sole discretion. Host organizations selected and submitted only one winner from the local competition along with a Nomination Package to SBA. 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 are incorporated in and maintain 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) were required to meet the eligibility requirements for individual contestants. An individual could belong to more than one team submitting an entry in this Challenge. SBA employees were not eligible, nor were Federal entities or Federal employees acting within the scope of their employment. Individuals or organizations that were at the time suspended or disbarred by the federal government were not eligible for this Challenge.

Evaluation of Submissions: All business plans were reviewed based on the same Scoring Matrix and rated numerically from 1 to 5 with 5 being the highest possible score in any given segment. The evaluation of each package was the same at the local level where the judges were external to the federal government, SBA level where the judges were internal and at the final pitch where the judges were from the private sector. The criteria were scored as follows: The specifics of the product or service having a measurable impact on the lives of women and families (30%). How the product or service will potentially be commercialized (40%). The specifics of the product or service filling a need in the marketplace (30%).Each finalist was offered the opportunity to participate in the InnovateHER Final Challenge where they made a live marketing pitch to a panel of expert judges drawn from the private sector. The panel of judges selected the three finalists whose pitches, in their sole judgment, best satisfy the Challenge criteria and present the greatest potential for success and rank them in descending order. SBA found this evaluation to be effective.

Results: Of the 120 local competitions held nation wide between December 29, 2016 and June 23, 2017, $70,000 in cash prizes (1st Place - $40,000; 2nd Place - $20,000; and 3rd Place - $10,000) prizes were awarded to three winners.

Budget and Resources: The competition was possible through a generous donation from the Sara Blakely Foundation; SBA did not obligate any appropriated funding for this initiative, and limited agency resources were used to conduct the Challenge. Approximately 3 ½ SBA staff members collaborated with Sara Blakely Foundation and an event planner to plan and execute the event. Several other staff members attended and helped execute various portions of the challenge, including the final event.

Partnerships: The final competition was possible through a generous donation from the Sara Blakely Foundation, in the form of cash prizes of $70,000. The foundation also donated $30,000 for the final event, used to pay an event planner.

Advancement of Agency Mission: The InnovateHER Chellenge creates an opportunity for SBA to be more visible and engaged locally with women entrepreneurs. We promoted our resources and leveraged our partners, creating new public and private partnerships that benefit the small business community.

Solution Types: Creative (design & multimedia); Ideas; Business plans

Plan for Upcoming 2 FYs: In FY 2019, SBA is planning another InnovateHER challenge, following the same goals and format.

A.14.2 Growth Accelerator Fund Competition[108]

Lead Sponsoring Agency: SBA

Status: This competition was completed in FY17.

Competition Goals: The Growth Accelerator Fund Competition aims to stimulate markets that are not being served by traditional venture capital and investment hubs. By infusing operational capital into qualified accelerators and incubators, these entities in turn provide resources to boost the startup and entrepreneurship communities around them. For the 2017 competition, SBA strengthened its previously funded accelerators from all over the country including rural areas and areas outside traditional venture capital hubs. Similar to previous years, SBA sought applications from women and other underrepresented groups. In addition to providing funds to underserved groups and geographic areas with less access to capital, the 2017 competition had an emphasis on accelerator models supporting STEM/ Small Business Innovation Research (SBIR), women-owned or minority-owned small businesses, rural communities, and veteran communities.

Goal Types: Engage new people and communities; Build capacity; Stimulate a market

Justification for Using Prizes and Challenges: The utilization of prize competitions was the preferred method over contracts, grants, and cooperative agreements because it allowed SBA to be more nimble. Various options were reviewed but upon consultation with the prize and challenge community of practice, SBA determined prizes as the most appropriate method for implementation. Prize authority held fewer restrictions, which allowed more diverse models of accelerators and incubators to participate (NGOs, Private, individual-led, etc.). This allowed the Agency to test supporting riskier emerging accelerator and incubator ecosystem efforts that might have a valid chance at developing their local driven venture, while lowering risk due to the relatively small prize awards ($50,000 apiece).

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered was $1,000,000 and the total amount awarded was $1,000,000. The FY17 GAFC competition awarded $1,000,000 in FY17 dollars as cash prizes to 20 entities ($50,000 each). GAFC does not offer non-cash prizes. The entire sum originated from SBA's Entrepreneurial Development appropriations.

Solicitation of Submissions: The 2017 Growth Accelerator Fund Competition was limited to previous winners. As such, previous awardees were notified of the new prize competition via email. A press release was also sent out to announce the competition.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release

Participation Requirements: The 2017 prize pool was limited to prior winners of the Growth Accelerator Fund Competition.

Evaluation of Submissions: Judging consisted of three rounds. For the first two rounds, two reviewers were assigned for every one application. The first round consisted of internal SBA cross-agency judges who evaluated 10-slide PowerPoint decks. Of the 63 initial applicants, 54 were chosen to advance to the next round. Applicants were notified of their semi-finalist status on August 15 and were given directions to create a two minute video pitch highlighting their organization, accomplishments to date, and goals they hoped to achieve with the prize money. The second round consisted of external judges with expertise in entrepreneurial ecosystems and promoting innovation who received both the slide deck and then a two minute video pitch. The second round judges recommended 30 finalists to the Office of

[108] The website for the Growth Accelerator Fund Competition can be viewed at https://www.sba.gov/accelerators.

Investment and Innovation's Director of Innovation. The final round consisted of the Director of Innovation and program staff who evaluated the external judge's recommendations to select the 20 prizes of $50,000 that were ultimately awarded.

Results: Of the 63 entries submitted between June 23 and July 21, 2017, 20 prizes were awarded.

Budget and Resources: SBA's Office of Investment and Innovation does not have a full-time FTE designated primarily to the Growth Accelerator Fund Competition. In FY17, two employees each contributed 0.2 FTEs to collaborate on the competition. These employees also managed a preliminary evaluation of the program in partnership with the Library of Congress Federal Research Division.

Partnerships: N/A

Advancement of Agency Mission: The mission of the U.S. Small Business Administration lies within helping Americans start, grow, expand, and recover their businesses. One of its core strategic objectives is to build healthy entrepreneurial ecosystems and create business friendly environments. The Growth Accelerator Fund Competition fits directly into this goal as it stimulates markets in rural and other areas outside of venture capital and investment hotspots.

Solution Types: Other - Solutions to stimulate innovation with tech-based startups, to include SBIR funding and underrepresented groups.

Plan for Upcoming 2 FYs: SBA decided to roll the FY18 funds into the FY19 competition. To ensure GAFC aligns with the needs of entrepreneurs and the innovation ecosystem, SBA is reviewing the results of the competition through its first four years, while also evaluating potential changes.

A.14.3 #SmallBusinessWeek Hackathon[109]

Lead Sponsoring Agency: SBA

Status: This competition was launched and completed in FY18.

Competition Goals: The National Small Business Week Hackathon Challenge sought to develop a Solution that will help small businesses improve their operations by combining Visa or U.S. Government APIs (Federal, State, or Local) with other technology and other open APIs.

Goal Types: Improve government service delivery; Find and highlight innovative ideas; Solve a specific problem; Develop technology; Inform and educate the public

Justification for Using Prizes and Challenges: The purpose of the Hackathon is to promote SBA's services to the public and to foster cooperation between the public and private sectors for the benefit of small business.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered and the total amount awarded was $24,000. Visa provided cash prizes in the follwing amounts: $10,000 first prize, $7,000 second prize, $5,000 third prize, and $2,000 specialty Visa API prize.

Solicitation of Submissions: The Hackathon event was hosted in Washington, DC on April 27-29, 2018.

[109] The website for the #SmallBusinessWeek Hackathon can be viewed at https://smallbizweek.hackathon.com/.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies)

Participation Requirements: The Challenge was open only to citizens or permanent legal residents of the United States who are above the age of majority in their state of legal residence (including the District of Columbia) as of April 27, 2018; and who register to participate in the Hackathon. The maximum team sizes was five people.

Evaluation of Submissions: At the conclusion of the Hackathon, each team had three minutes to demonstrate the Solution that Participants have developed for the panel of judges, followed by two minutes of Q&A. Demonstration time limits could be shortened or lengthened under Visa and SBA's sole discretion depending on the number of teams. Participants chose how to present their Solution, but were encouraged to explain and demonstrate how their Solution meets the judging criteria. Participants acknowledged that the panel of judges could ask them questions regarding their Solution. The order of demonstrations was decided by the judges in their discretion. Visa and SBA awarded prizes to National Small Business Week Hackathon Challenge teams that, in Visa and SBA's sole determination, best meet the following criteria: [1] Innovation - Is this Solution different and unique from what is already on the market? (30 points); [2] Market Potential - Will this Solution have viable reach, and market potential for small business owners and entrepreneurs? (30 points); [3] Technical Execution - How effectively are the available APIs used? Is your Solution viable and easy to navigate? (20 points); [4] Challenge Fit - Does this Solution effectively respond to the National Small Business Week Hackathon Challenge? (20 points).

Results: Of the entries submitted by 75 participants on April 27, 2018, four prizes were awarded to winners.

Budget and Resources: Limited agency resources were used to conduct the Hackathon. Approximately three SBA staff members collaborated with Visa to plan and execute the event. Several other staff members attended various portions of the event to participate.

Partnerships: Pursuant to SBA's Cosponsorship Authority, Visa serves as a cosponsor of National Small Business Week. They provided the cash prize for the Hackathon winners, assisted with promotion of the event and other elements of event planning, and made their APIs available to participants. The estimated value of partner contributions was $24,000.

Advancement of Agency Mission: Small businesses are critical to local economies and communities throughout the United States. Their owners are passionate about their trades, but they often don't have enough time for the day-to-day financial elements of running a small business, such as making payments efficiently, building and accessing, business credit, optimizing, cash flow, payroll & accounting, and processes. The hackathon aims to help business owners focus more on their true passion by reimagining small business financial management by making use of API's from Visa, the U.S. Government, and third parties to build a game changing new tool.

Solution Types: Software and apps

Plan for Upcoming 2 FYs: In FY19, SBA plans to conduct a second Small Business Week Hackathon with the specific theme of disaster recovery and preparedness for small business.

A.15 United States Agency for International Development (USAID)

A.15.1 Sign on For Literacy Prize[110]

Lead Sponsoring Agency: USAID, All Children Reading: A Grand Challenge for Development (ACR GCD)

Status: This competition was launched in FY18 and is underway.

Competition Goals: Of the estimated 32 million deaf children around the world, 80 percent do not have access to education, and only two percent receive education in sign language. Without early access to language, children fail to develop social and cognitive skills at the same rate as their peers, hindering their ability to learn to read and write and isolating them from society over the course of their lives. The Sign On For Literacy Prize, seeks technology-based innovations that will provide greater access to local sign languages, sign language supported early grade reading materials, and/or reading instruction by engaging families, schools, and communities. Through these solutions, the goal is that parents, educators, and communities will be better prepared to support the early childhood language outcomes of deaf children, access to and the usage of local sign languages will increase, and the literacy outcomes of deaf children will improve.

Goal Types: Find and highlight innovative ideas; Solve a specific problem; Develop technology; Engage new people and communities

Justification for Using Prizes and Challenges: We were seeking to attract innovators who likely would not be aware of or respond to other mechanisms. The ACR GCD based the rationale for a prize structure on the Round One experience: despite the numerous proposals received, very few focused on these thematic areas. Smaller prize awards structured around these neglected thematic areas will encourage organizations to innovate and take more risks in implementing new ideas. ACR GCD has used both the grant and prize mechanisms. One of the valuable aspects we've found in prize competitions, is that it provides an easier on-ramp for organizations to partner with ACR GCD for a competition for a shorter-term, one-off activity, and usually for a smaller financial contribution.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered was $500,000 and the total amount awarded was $125,000. Prizes were awarded to five finalists ($25,000 each) to further develop their solution prototypes in alignment with the feedback provided by the judges. The awards were granted as a one-time lump sum. Non-monetary incentives included promotion by ACR GCD and the prize parnters via social media and other digtial platforms, as well as an invitation to present at events.

Solicitation of Submissions: The competition was announced at the 3rd International Conference of World Federation of the Deaf (WFD) during a session streamed live on Facebook. At the same time, a communication package, outlined below, was shared by ACR GCD and all links to the competition site went live. InnoCentive Listed the Sign On For Literacy Prize in five editions of its Challenge Bulletin, which is sent weekly to approximately 150,000 Solvers. It was also promoted through InnoCentive's social media accounts (Facebook >12,000 likes, Twitter >11,000 followers, LinkedIn >6,400 followers). World Vision circulated a communications package at launch and throughout the competition to the prize partners, encouraging them to promote the Sign On For Literacy Prize to their networks, which included: social media content, a prize announcement video, flyer ad, website banner, press release, Sign on For Literacy infographic and promotional videos. All prize partners continued to promote the prize on social media and other communication channels throughout the competition. As a result, large

[110] The website for the Sign on For Literacy Prize can be viewed at https://allchildrenreading.org/challenge/sign-literacy-prize/ ; also see https://www.innocentive.com/ar/challenge/9934006.

geographical reach was achieved, with many registrations from developing countries. Potential applicants registered from all over the world, from six continents and 61 countries. Applications were submitted from 39 countries and six continents.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Live video streaming; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies)

Participation Requirements: The prize targeted global solvers including individuals, teams and organizations with innovative technology-based solutions that demonstrated the ability to increase access to sign languages and literacy interventions for children who are deaf in low-resource contexts. Entrants were required to submit a written description in English of the proposed innovation and project plan explaining the methods, resources, potential technology platform(s), personnel, existing partnerships (if any), evidence of collaboration with the local deaf community in product design and implementation, and preliminary schedule to implement the proposed innovation. It was also noted that entrants must be able to work with ACR GCD partners and other collaborative organizations for prototype development in Phase 2 and implementation of the innovation in Phase 3. Suppliers of goods and services that did not meet the nationality and source definitions as referenced in 22 CFR 228.11 and 12, specifically geographic code 937 were ineligible for award. Geographic code 937 currently excludes Cuba, Iran, Libya, and North Korea.

Evaluation of Submissions: The evaluation was conducted over five stages. The first two stages were prescreening first by InnoCentive and then by ACR GCD to remove entries that did not meet key requirements. Judging was conducted over three rounds. In the first round of judging 53 entries were scored against judging criteria by a panel of 10 expert judges that included a mix of the prize partners and external technical experts. Each entry was reviewed by 3 judges and the 19 top scoring submissions moved to the next round of judging. In the second round of judging, the 19 remaining entries were scored against the judging criteria by a panel of nine expert judges. This resulted in 8 top scoring submissions. These top 8 applicants were asked to provide written response to questions that surfed during the judging process. These submissions and questions were then reviewed by a steering committee consisting of representatives from the prize partners. Based on the scoring throughout the judging rounds, answers to the questions, and the recommendations of the steering committee members, the prize partners selected five entries to receive an award of $25,000 each and were moved to Phase 2 of the competition. Overall, this evaluation method was found to be very comprehensive and effective in identifying innovative solutions. It was however a very lengthy process.

Results: Of the 104 entries submitted by participants between November 8, 2017 and February 16, 2018, five prizes have been awarded to the Phase 1 winners. Final winners have not yet been determined.

Budget and Resources: A prize design and administration firm, InnoCentive, was contracted to develop the prize requirements and administer the prize. A design-thinking consultant was hired to lead the prize parnters and technical experts through a collaborative process to identify the challenge statement and parameters of the prize. The five prize winners of Phase 1 of the competition were awarded $25,000 each. In 2017, the project funding was $88,855 and two ACR staff members comprised approximately 50% FTE status. In 2018, the project funding was $169,965 and three ACR staff members comprised approximately one FTE staff time.

Partnerships: Partnerships with World Federation of the Deaf (WFD), Deaf Child Worldwide (DCW), and Nyle DiMarco Foundation (NDF) have been critical to the success of this prize. Each provided credibility to the competition and enhanced communications with the global deaf community many of which competed in the competition. In the future, ACR GCD will seek to engage such technical partners such as these. WFD provided technical expertise throughout the design of the competition by attending the

design workshop and providing subsequent reviews and feedback on the prize design. They announced the prize live and streamed it on Facebook at the 3rd International Conference of the WFD which has received over 14,000 views. They also promoted the prize through their social media and other communications channels. WFD also nominated judges that supported the review of the prize submissions. DCW contributed 20,000 GBP to the prize purse and provided technical expertise throughout the design of the competition by reviewing and providing feedback on the prize design. They promoted the prize their their social media and other communications channels and nominted judges that supported the review of the prize submissions. NDF provided technical expertise throughout the design of the competition by attending the design workshop and providing subsequent reviews and feedback on the prize design. They announced the prize through their social social media channels and nominated judges to support the review of the prize submissions. ACR GCD is a partnership of the United States Agency for International Development, World Vision, and the Australian Government. The estimated value of partner contributions for this prize was $77,600 from USAID:, $77,600 from World Vision, $77,600 from the Australian Government:, $26,000 from DCW, and an estimated $10,000 in-kind communications and technical support from WFD.

Advancement of Agency Mission: Of the estimated 32 million deaf children around the world, 80 percent do not have access to education, and only two percent receive education in sign language, the most natural and accessible language for a deaf child. Early acquisition of a first language and access to education in sign language has been proven to greatly increase literacy outcomes in children, both hearing and deaf. However, children who are deaf often have limited access to local sign language, learning resources, or adults that are fluent signers. By providing children, parents, educators and communities a resource for learning the local sign language; children will have a greater opportunity to acquire language as a building block for learning to read and a first step in the child's educational journey. True education for all depends upon inclusive education interventions and systems for people with disabilities and by sourcing new and inclusive approaches, this competition advances the ACR GCD partners' goals of inclusive education and the learning outcomes of all children. The Sign On For Literacy prize also provided an opportunity to profile the lack of education and learning opportunities for children with disabilities around the globe.

Solution Types: Software and apps; Technology demonstration and hardware

Plan for Upcoming 2 FYs: All ACR Prize Activities will depend on the new strategy to be developed by the ACR Partners in Q1 FY2019.

B. Prizes and Challenges under Other Authorities

This Appendix provides summaries of select prizes and challenges voluntarily submitted by agencies that were conducted in FY17 and FY18 under authorities other than COMPETES. Agency reporting on prizes and challenges under other authorities was optional, and therefore the activities presented here are representative rather than comprehensive. Please note that agency plans for the upcoming two fiscal years are notional and subject to the availability of funding.

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B.1 Department of Defense (DOD)

B.1.1 DARPA Spectrum Collaboration Challenge (SC2)[1]

Lead Sponsoring Agency: Defense Advanced Research Projects Agency (DARPA)

Authority: 10 USC 2374a

Status: This competition was underway in both FY17 and FY18, but has not concluded.

Competition Goals: The DARPA Spectrum Collaboration Challenge (SC2) is the first of its kind collaborative machine learning competition to overcome scarcity in the radio frequency (RF) spectrum. Today, spectrum is managed by dividing it into rigid, exclusively licensed bands. This human-driven process is not adaptive to the dynamics of supply and demand, and thus cannot exploit the full potential capacity of the spectrum. In SC2, competitors will reimagine a new, more efficient wireless paradigm in which radio networks autonomously collaborate to dynamically determine how the spectrum should be used moment to moment. The team whose radio design most reliably achieves successful communication in the presence of other competing radios could win as much as $3,500,000.

Goal Types: Find and highlight innovative ideas; Solve a specific problem; Advance scientific research; Develop technology; Engage new people and communities; Stimulate a market

Justification for Using Prizes and Challenges: The objectives of the Spectrum Collaboration Challenge warrant a prize competition format for a number of reasons. First and foremost, the "collaboration" aspect of the competition requires a sizeable field of unaffiliated performers creating a heterogeneous solution set. Further, it is unclear which approach will yield the most effective solution to the problem. The allure of prize money incentivizes teams with diverse backgrounds from academia, industry and independent entrepreneurs to develop creative, varied solutions to the problem. The government is then able to evaluate across the solution set and determine the best approach at a low investment threshold. Finally, SC2 seeks to create a community focused on developing autonomous spectrum management solutions. The current advances in artificial intelligence and machine learning as applied to software radio design create what DARPA believes is a critical inflection point in autonomous management of the wireless spectrum.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered was $18.75 million and the total amount awarded was $7.5 million to date. In Phase I, a total of ten $750,000 prizes were awarded to the top ten performing teams at SC2's Preliminary Event #1 in December 2017. In Phase II,

[1] The website for the DARPA Spectrum Collaboration Challenge (SC2) can be viewed at www.SpectrumCollaborationChallenge.com.

a total of six $750,000 prizes were awarded to successful teams at SC2's Preliminary Event #2 in December 2018 and four $375,000 prizes were awarded to successful teams that passed an extended evaluation in January 2019. In Phase III, three awards will be awarded to successful teams at SC2's Championship Event in October 2019 (1st place: $2 million; second place: $1 million; third place: $750,000), a total of $3.75 million.

Solicitation of Submissions: SC2 was advertised through various means. Prior to launching the challenge, the program manager visited various universities and industry locations in the wireless research community soliciting interest and feedback in the competition. The challenge was officially launched through a DARPA press release and publishing of the SC2 website. The proposal track was additionally advertised through a Broad Agency Announcement (BAA) posted to FedBizOpps. A Competitor's Information Day was hosted at DARPA on August 10, 2016. Open track teams are able to enter at the beginning of each of the three phases of the competition by successfully completing technical entrance hurdles. These hurdles evaluate a team's ability to develop software defined radios and demonstrate applicable machine learning techniques.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Day-long event(s) prior to the competition; Other - FedBizOpps.gov

Participation Requirements: The target solver audience is a cross section of wireless researchers from academia, industry, and independent entrepreneurs. Successful teams will have a strong background in both software defined radio design and artificial intelligence/machine learning techniques. The competition is open to any entity that can provide a US Taxpayer ID number to receive prizes. As such, teams from around the world are currently competing, representing major universities, DoD, commercial contractors, and independent inventors.

Evaluation of Submissions: For entrance to the competition, Open track teams are evaluated based on their successful performance in a series of hurdles, which evaluate teams' ability to develop software defined radios and demonstrate applicable machine learning techniques. Proposal track teams were evaluated based on the merits of their technical approach by a selection board consisting of DARPA program managers, AFRL, and NSF subject matter experts. A valuable lesson learned in establishing a capable competitor field was the use of entrance hurdles to deter and deny technically immature teams. This is essential since the competitor field all share access to a limited government-provided Colosseum resource (a RF emulator testbed that forms the backbone of the competition). To evaluate performance in prize award competition events (Preliminary Event #1, #2, and the SC2 Championship Event), teams submit their software defined radio code to DARPA for testing in Colosseum. Each team's radio software is tested in a series of emulated RF scenarios in the presence of multiple other team radio solutions. Teams are judged on their ability to achieve performance thresholds in collaboration with other teams.

Results: Phase I began July 19, 2016. Proposal track submissions were due September 2, 2016 and open track submissions were due December 2, 2016. Phase I winners were announced December 13, 2017. Phase II began January 1, 2018 and submissions were due April 30, 2018. Phase II winners were announced December 13, 2018 and January 24, 2019. Phase III submissions were due January 11, 2019.

Phase I had 152 participants across 26 open track teams and six proposal track teams. A total of ten prizes were awarded in Phase I. Phase II had 134 participants across 15 open track teams (including one new team) and four proposal track teams. Ten prizes were be awarded in Phase II. Phase III had 109 participants across 912 open track teams (no new teams entered) and three proposal track teams. Phase III will have three prizes.

Budget and Resources: One FTE program manager was assigned to SC2 over FY17 and FY18. DARPA utilizes third party support vendors to perform various tasks for conducting SC2, including hardware procurement/maintenance, software development, RF scenario development, scoring, integrity, visualization, production, and logistics. In FY17, third party vendors were obligated $12.6 million, but expended $11.5 million. In FY18, third party vendors were obligated $5.9 million, but expended $4.1 million.

Partnerships: DARPA contracted with MIT Lincoln Labs to provide expertise in RF scenario design and scoring methodologies. Their considerable knowledge base in these two areas provided valuable inputs to the initial architecture of the competition. DARPA has also entered in a Cooperative Research and Development Agreement (CRADA) with Groupe Spécial Mobile Association (GSMA), to host the SC2 Championship Event at their annual Mobile World Congress Los Angeles conference in October 2019. This relationship with GSMA, a non-Federal partner, provides key synergy in capturing an interested, educated audience of the commercial wireless industry, government policy experts, and DoD entities for the culminating the SC2 Championship Event.

Advancement of Agency Mission: DoD operations increasingly rely on unfettered access to the spectrum in order to carry out their primary mission. Managing the spectrum is a tedious, laborious, and error-prone process. A spectrum manager must take into account the needs of their radio systems, the needs of allied and NATO force radio systems, and existing host nation infrastructure. This delicate planning can easily be disrupted by the rapid change in needs for spectrum services (both ours and allies'), changes in RF conditions, and variability of types of radios which need access based on changing mission needs. Due to inefficiencies in this process, currently available planning tools are unable to effectively allocate spectrum. Resulting SC2 radio technology will increase the efficiency and ability of communications networks to perform electromagnetic maneuver by allowing radio networks to autonomously and collaboratively perform tactical spectrum decision-making at the edge, faster than today's human planning cycle.

Solution Types: Software and apps; Technology demonstration and hardware; Scientific

Plan for Upcoming 2 FYs: DARPA has seen immense success with the Grand Challenges hosted by the Agency since the initial Grand Challenge for autonomous ground vehicles in 2004. Currently, DARPA is running three separate prize challenge competitions, cross-cutting various research areas such as responsive small satellite launch, subterranean navigation, and of course SC2's autonomous spectrum management. For SC2, the next two fiscal years cover the final two prize events, Preliminary Event #2 in December 2018 and the SC2 Championship Event in October 2019.

B.1.2 CubeSat Challenge[2]

Lead Sponsoring Agency: United States Special Operations Command (USSOCOM)

Authority: 10 USC 2374a

Status: This competition was launched in FY17 and completed in FY18.

Competition Goals: USSOCOM is pursuing a development effort to determine the operational utility of using CubeSats and SmallSats to directly support special forces in austere and denied areas. The intent is to solicit operationally relevant and technically feasible payload concepts for USSOCOM CubeSats and SmallSats. Example areas that are relevant to USSOCOM missions include: advanced

[2] The website for the CubeSat Challenge can be viewed at https://herox.com/cubesat-challenge.

communications (including full orbit C2 and data exfiltration); electro-optical infrared sensing and imaging; propulsion systems capable of modifying or maintaining orbits; on-orbit data processing; multi-function payloads;. tagging, tracking, and locating capabilities; next-generation CubeSat and sensor technologies.

Goal Types: Find and highlight innovative ideas; Advance scientific research

Justification for Using Prizes and Challenges: Traditional development conducted over the past several years has not resulted in payloads which can provide satisfactory solutions for these problems. USSOCOM was seeking to find solutions by leveraging commercial and academic sources through the prize challenge solver ecosystem.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered and awarded was $35,000. Under the 3U Satellite Category four $5,000 prizes were awarded, and under the 6U Satellite Category.two $5,000 prizes and one $5,000 People's Choice Award were awarded.

Solicitation of Submissions: Through an interagency agreement between USSOCOM and the National Aeronautics and Space Administration (NASA), USSOCOM employed NASA to solicit prize challenge providers to conduct this challenge. HeroX was selected as the best option to conduct this challenge. All parties used social media to advertise the challenge. This information was also provided to Challenge.gov for posting on their site. USSOCOM found that all of these methods were satisfactory in getting the word out to the general public based on the number of responses and registrants.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies)

Participation Requirements: All public submissions were accepted for this challenge.

Evaluation of Submissions: Submissions were evaluated using a panel of subject matter experts selected from USSOCOM and other agencies who have extensive knowledge in the field of satellite communication technologies. NASA and HeroX provided the judging panelists with an automated evaluation product that automatically tabulated the score submissions.

Results: Of the 35 entries submitted by 18 participants between August 15 and October 18, 2017, seven prizes were awarded to six winners.

Budget and Resources: USSOCOM provided $88,303.97 in funding by using FY17 Research Development Test and Evaluation Funds. $35,000 was awarded to six challengers through the HeroX prize challenge platform. Administrative costs of $41,907 were incurred by HeroX for their efforts in administering this challenge; and $11,396.97 was incurred by NASA via their existing prize challenge contract for their administrative costs.

Partnerships: N/A

Advancement of Agency Mission: Current over-the-horizon audio and video data exfiltration capabilities do not provide the consistent access, coverage, throughput, and flexibility required by U.S. forces. Therefore, USSOCOM executed a development and demonstration effort to determine the operational utility of using CubeSats to directly support U.S. forces in austere and denied areas. USSOCOM was seeking unique solutions to developing/delivering operationally relevant and technically feasible cubesat payload for missions such as advanced communications; tagging, tracking, and locating capabilities; and on-orbit data processing. The intent was to determine to what extent low-cost, tactically controlled small satellites can support over the horizon data exfiltration requirements.

Solution Types: Creative (design & multimedia); Ideas; Scientific

Plan for Upcoming 2 FYs: N/A

B.1.3 Technology Challenges and Opportunities to SOF in 2027[3]

Lead Sponsoring Agency: USSOCOM

Authority: 10 USC 2374a

Status: This competition was completed in FY17.

Competition Goals: USSOCOM was interested in understanding what global challenges or opportunities lay ahead for Special Operations Forces ten years into the future.

Goal Types: Find and highlight innovative ideas

Justification for Using Prizes and Challenges: The pace of technology change is arguably not slowing down and the proliferation of emerging technology-based capabilities to the global population is continuing to cause global effects. Previous efforts to understand the future Special Operation Forces (SOF) environment based on technological advances have taken many forms. The one glaring omission has been reaching out to a non-Department of Defense (DoD) community for their thoughts and perceptions. Through this challenge, USSOCOM aimed to look at the future in a non-traditional way.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered was $25,000 and the total amount awarded was $22,000. Non-monetary incentives included a personal letter from the Special Operations Forces, Acquisition, Technology, and Logistics, Science and Technology (SOF AT&L-ST) Director and a USSOCOM Coin.

Solicitation of Submissions: Submissions were solicited on the InnoCentive web site and the challenge was also announced on the "Challenge.gov" website.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release

Participation Requirements: All public submissions were welcome.

Evaluation of Submissions: Submissions were evaluated by four individuals from SOF and reviewed by the Director, SOF AT&L-ST.

Results: Of the 108 entries submitted between July 21 and August 10, 2017, 18 prizes (ten $1,000 prizes, and eight $1,500 prizes) were awarded to ten winners.

Budget and Resources: USSOCOM provided $25,000 for this challenge using FY17 Research Development Test and Evaluation funds. $22,000.00 was awarded in prizes through the InnoCentive platform and $3,000 was returned to USSOCOM.

Partnerships: N/A

Advancement of Agency Mission: USSOCOM is interested in the impacts of technological innovation in civilian society around the globe. The challenge sought perspectives on how people see the world in 2027 and the critical impacts it might pose for Special Operations Forces by asking the following questions: What new or evolved technology will have the greatest impact, either as a challenge or as an opportunity, for Special Operation Forces in 2027? How is daily life for humans around the world going

[3] The website for the Technology Challenges and Opportunities to SOF in 2027 can be viewed at www.innocentive.com.

to differ from today? What innovations will industry invent, which will shape society ten years from now? How will technologies become disruptive by themselves or converged with other technologies? What are the economic, social, and military effects created by this technological evolution?

Solution Types: Ideas

Plan for Upcoming 2 FYs: A challenge will be used to support USSOCOM's Innovation Foundry (IF) #3 in the second quarter of FY19. USSOCOM will be contracting the challenge through the Capital Factory in Austin, Texas, who will also be hosting the event. The Capital Factory already conducts prize challenges within its ecosystem, and USSOCOM wants to focus on its ecosystem for the next IF. The same pattern for prize awards will be followed: $1,000 for a white paper and $1,500 for participation in person at the IF event.

B.1.4 Urban 3D Challenge[4]

Lead Sponsoring Agency: USSOCOM

Authority: 10 USC 2374a

Status: This competition was launched and completed in FY18.

Competition Goals: USSOCOM is seeking an algorithm that provides reliable, automatic detection and delineation of building footprint outlines based solely on USSOCOM-provided 3D Digital Surface Model (DSM) and Red, Green, Blue (RGB) orthorectified imagery products. Specifically, USSOCOM sought concepts that: (1) are relevant to USSOCOM missions; (2) provide positive operational impact, efficacy, and utility; (3) advance the state of the art for automated detection and delineation of building footprint outlines from specified source data; (4) improve the quality of the data products of the SOFPREP workflow pipeline; and (5) can be integrated into the existing data processing workflow pipeline.

Goal Types: Find and highlight innovative ideas; Solve a specific problem; Develop technology

Justification for Using Prizes and Challenges: Extraction of building footprint outlines from satellite imagery is one of the first and most challenging steps in producing realistic textured 3D scene models to support the Special Operations Forces tactical mission set. While automated algorithms continue to improve, significant manual effort is still required to correct mistakes and ensure acceptable quality. Newly available near-global 3D DSM products along with conventional RGB orthorectified image products offer a wealth of information to enable more reliable automated building footprint extraction which, in turn, is expected to further enable an automated pipeline for 3D scene model production to support SOF missions. USSOCOM was seeking to find solutions by leveraging commercial and academic sources through the prize challenge community.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered and awarded was $34,500. Prizes were awarded as follows: first place $10,000, second place, $8,000, third place $6,000, fourth place $5,000, fifth place $4,000, sixth and seventh places $500, and two additional prizes of $250 each.

Solicitation of Submissions: Through an Interagency Agreement between USSOCOM and NASA, USSOCOM employed NASA to solicit prize challenge providers to conduct this challenge. Topcoder was selected as the best option to conduct this challenge. TopCoder created a marketing campaign which included a direct email campaign that ran for 30 days, where they developed a database of 1,564 contacts based on demographics of individuals and organizations who would be likely, and qualified,

[4] The website for the Urban 3D Challenge can be viewed at http://crowdsourcing.topcoder.com/Urban3D.

to participate in the challenge. In addition to the direct target email, they also reached out to their 5,225 subscribers via a monthly newsletter. In addition to the email campaign, a social media campaign ran for 30 days that directed persons to the Topcoder registration page. This challenge was also posted on the Challenge.gov site.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies)

Participation Requirements: All public submissions were welcome.

Evaluation of Submissions: Finalists were selected by USSOCOM based on quantitative scores provided by TopCoder in coordination with USSOCOM technical subject matter experts. Evaluators worked independently to review the submissions and used a standard scoring methodology derived from baseline quantitative metrics. The results were then tallied and reviewed by TopCoder and USSOCOM before making the final award recommendations.

Results: Of the 790 entries submitted by 217 participants between October 9 and December 4, 2017, eight prizes were awarded to nine winners.

Budget and Resources: USSOCOM provided $134,804 in funding using FY17 RDT&E Funds. Of this, $72,936 was incurred by Topcoder for administering the challenge, $35,000 was awarded to nine challengers through the Topcoder prize challenge platform, $11,500 was provided to judging panelists for their participation in evaluating submissions, $10,608.95 was incurred by NASA for their administrative costs, and $5,000 was expended in supplemental advertising.

Partnerships: N/A

Advancement of Agency Mission: USSOCOM was seeking an algorithm that provides reliable, automatic detection and delineation of building footprint outlines based solely on USSOCOM-provided 3D Digital Surface Model and Red, Green, Blue orthorectified imagery products.

Solution Types: Software and apps; Analytics, visualizations, algorithms

Plan for Upcoming 2 FYs: USSOCOM plans to work with other software coders to experiment with the development of promising machine learning algorithms into emerging software capabilities. Experiments show great potential for improving the detection and delineation of building footprint outlines. USSOCOM may conduct another prize challenge, but this is yet to be determined.

B.2 Department of Health and Human Services (HHS)

B.2.1 Domestic Violence Awareness Month YouTube Challenge

Lead Sponsoring Agency: Administration on Children, Youth and Families (ACYF), Family and Youth Services Bureau (FYSB), Division of Family Violence

Authority: 15 U.S.C. § 3719 and 42 U.S.C. § 10401(a)(1)

Status: This competition was completed in FY17.

Competition Goals: FYSB envisions a future in which all of our nation's youth, individuals, and families, no matter what challenges they may face, can live healthy, productive, violence-free lives. The Challenge goal was to learn more about, and bring attention to, new, emerging, and effective methods that go beyond traditional services, programs, and supports that communities are using with this special population. The Challenge was conducted in an effort to stimulate innovation and raise

awareness of the services and supports for children and youth exposed to domestic violence and their abused parents. In this Challenge, FYSB asked the public to submit videos featuring their most innovative means of helping to improve safety, promote healing, and build the resilience of children and youth exposed to domestic violence and their abused parents. The Challenge sought innovative, creative, and inclusive practices, policies, programs, safe spaces, activities, and strategies to meet this end.

Goal Types: Find and highlight innovative ideas; Solve a specific problem; Inform and educate the public; Engage new people and communities; Build capacity

Justification for Using Prizes and Challenges: This YouTube Challenge was the first of its kind at FYSB. The Challenge was a pilot project to see if a challenge is an effective mechanism for reaching FYSB grantees and gathering information on innovation and promise. If competitions or challenges are found to be effective, this project may lead to larger challenges that create life-saving or life-changing benefits for victims of domestic violence and other populations that are served by Family Violence Program in the Family & Youth Services Bureau (ACF) programs. This Challenge also helped FYSB build our knowledge and skills in running competitions, which will be helpful for future and larger scale competitions.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered and awarded was $10,000. First, second, and third place winners were awarded $5,000, $3,000, and $2,000, respectively

Solicitation of Submissions: N/A

Solicitation Types: Email (e.g., listservs); Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies)

Participation Requirements: Submissions were required to be (1) one to three minutes in length; (2) in a compatible YouTube format with the proper codecs: WebM files, MPEG4, 3GPP, MOV, AVI, MPEGPS, WMV, FLV with suggested aspect of 16:9; and (3) aligned with the vision of FYSB. Entrants must (1) post their video submission to their favorite video sharing site and send the link to their video entry on the Domestic Violence YouTube Challenge listed on www.challenge.gov/domestic-violence-video-challenge by the deadline; (2) highlight one or more new, innovative, emerging, and effective approaches, practices, policies, programs, safe spaces, activities, strategies, and any other ways that help to improve safety, promote healing, and build resilience of children exposed to domestic violence and their abused parents; and (3) include a written transcript for the video for closed captioning purposes.

Evaluation of Submissions: Evaluation criteria included weighted ratings of the following elements: (1) the video content highlighted one or more new, innovative, emerging, and effective approaches, practices, policies, programs, safe spaces, activities, strategies, and any other ways that help to improve safety, promote healing, and build the resilience of children exposed to domestic violence and their abused parents; (2) the video aligned with FYSB's vision; (3) the video content increased awareness of domestic violence issues; (4) the video content was educational, imparts knowledge, or deepens understanding of supports for children, youth, and parents; (5) the video content was innovative; (6) the video content was creative.

Results: Of the 26 entries submitted between October 12 and November 2, 2016, three prizes were awarded.

Budget and Resources: Prize money was awarded from the ACF. Administrative support provided by the Budget Office, Division of Grants Policy, ACF leadership at all levels, Office of the General Counsel, Office of Communications, among others, was critical to get the challenge started, published on the Federal

Register, and awarded. The Challenge utilized 0.05 FTE in FY17 and used FY16 funding obligations to finish the Challenge.

Partnerships: N/A

Advancement of Agency Mission: The prize competition advanced our agency's mission in our goals to inform and educate the public; engage new people and communities; learn about and share innovative ways the community is supporting this population.

Solution Types: Ideas

Plan for Upcoming 2 FYs: There are no future plans for this Challenge at the time of reporting.

B.2.2 Challenges in Computational Precision Medicine (CPM) 2018[5]

Lead Sponsoring Agency: National Institutes of Health (NIH), National Cancer Institute (NCI)

Authority: NCI considers the use of challenges and prize competitions within its statutory authority as a means to fulfill the Institute's purpose.

Status: This competition was launched in FY18, and is underway.

Competition Goals: The overall goal of CPM challenges is to promote development of medical image analysis algorithms for clinical decision support in diagnosis and staging of various cancers. In CPM 2018 these include (1) pancreatic cancer survival prediction: predict pancreatic cancer survival from computed tomography (CT) and clinical data from Memorial Sloan Kettering Cancer Center (MSKCC); (2) 18F-FDG PET radiomics risk stratifiers in head and neck cancer: predict local tumor control following radiation treatment of oropharynx cancer using an ensemble of radiomics and clinical data from MD Anderson Cancer Center (MDACC); (3) combined radiology and pathology classification: evaluate performance of automated classification algorithms that use a combination of imaging and digital pathology data from brain tumor collection of the Cancer Genome Atlas; (4) digital pathology segmentation of nuclei in images: evaluate performance of algorithms for segmentation of nuclei in digital pathology images of low- and high-grade glioma (brain tumor).

Goal Types: Find and highlight innovative ideas; Solve a specific problem; Advance scientific research; Develop technology; Inform and educate the public; Engage new people and communities

Justification for Using Prizes and Challenges: The use of incentivized challenge competitions allows agencies to cast a wide net to find innovative solutions through crowd- sourcing and open science. Furthermore, participants in a challenge agree to benchmark performance of their software tools against a common reference dataset. Such approaches are not typically provided through traditional grant mechanisms. NCI determined that the monetary prize is often secondary to the community's interest to participate in an activity where they can find access to high quality data and the opportunity to benchmark their tools compared to other participants.

Cash Prize Purses and/or Non-Cash Prize Awards: CPM offered non-cash prizes only. Three winners received a certificate of merit, the opportunity to give an oral presentation at the International Conference on Medical Image Computing and Computer Assisted Intervention (MICCAI) 2018 annual

[5] The websites for the Challenges in Computational Precision Medicine (CPM) 2018 are accessible at https://wiki.cancerimagingarchive.net/pages/viewpage.action?pageId=37224869 and http://miccai.cloudapp.net/competitions/.

conference, and the opportunity to be a co-author on a scientific manuscript on one of CPM 2018 challenges.

Solicitation of Submissions: CPM challenges were announced through MICCAI 2018 webpage on satellite events and emailed through several professional listservs. MICCAI has been running medical imaging challenges for over ten years and CPM has been offered regularly since 2014. As a result, NCI has had a growing number of international participants in CPM challenges over the years. Furthermore, given the emerging trends in data science, machine learning and artificial intelligence (AI), NCI expects participation in future will only increase. One factor that is of prime importance in offering a challenge in conjunction with the annual meeting of a scientific society is the timing of the opening and closing of the challenge and announcement of the winners who need enough time to plan their travel to the meeting.

Solicitation Types: Email (e.g., listservs); Press release; Day-long event(s) prior to the competition; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies); Other - Special challenge session at MICCAI annual meeting to highlight the challenge and facilitate presentations by the winners

Participation Requirements: N/A

Evaluation of Submissions: Submissions were evaluated against the ground truth and summarized as an index. The ground truth is always provided by clinical experts who are familiar with the disease and the data.

Results: NCI received 217 submissions for pancreatic cancer survival prediction; 65 submissions in 18F-FDG PET radiomics risk stratifiers in head and neck cancer; 223 submissions in combined radiology and pathology classification; and 314 submissions in digital pathology segmentation of nuclei in images. These submissions were received between June 12, 2018 and August 16, 2018, and 12 prizes were offered.

Budget and Resources: The NCI Program Director devoted 10% time to lead the development of the CPM challenges design and implementation, including an associated workshop. Outside collaborators from academia contributed data and managed individual challenges within the CPM offering. Datasets available through The Cancer Imaging Archive (TCIA), MSKCC, and MDACC were used in training and test phases of the CPM 2018 challenge. An existing challenge platform was used for submission of results and ranking of participants based on a set of evaluation metrics. The challenge platform was utilized under a blanket contract between the platform operator and NCI Center for Biomedical Informatics and Information Technology.

Partnerships: As mentioned, NCI partnered with various organizations which provided shared interest and expertise in development, advertisement, and completion of the Challenge. These partners included MICCAI 2018, Harvard University, MSKCC, MDACC, Stony Brook Cancer Center, and the University of Pennsylvania.

Advancement of Agency Mission: The NCI mission includes dissemination of information on cancer detection, diagnosis, and treatment, and support for innovative solutions to the cancer problem. CPM challenges, performed in collaboration with non-profit entities such as scientific societies and universities leverage existing shared datasets to drive algorithmic excellence and incentivize development of innovative analytic software methods in cancer detection, diagnosis, and staging.

Solution Types: Software and apps; Ideas; Analytics, visualizations, algorithms; Scientific

Plan for Upcoming 2 FYs: A great amount of high quality cancer data (imaging, pathology, genomics, proteomics, and clinical) are generated through NCI-funded grants and cooperative agreements. Often these constitute what is referred to as big data. Solvers in the community, who are typically graduate students or research fellows with innovative ideas usually lack access to such data. Challenges provide a great way to develop tasks related to existing data that are aimed to bring innovative approaches, such as AI, to solve long standing problems, or facilitate more accurate solutions toward clinical decision support. NCI plans to utilize new datasets (imaging and other types) to launch new challenges in 2019 and 2020. These include challenges related to pancreatic and brain cancers, two of the deadliest cancers.

B.2.3 ICGC-TCGA DREAM Somatic Mutation Calling - RNAChallenge (SMC-RNA)[6]

Lead Sponsoring Agency: NIH, NCI

Authority: NCI considers the use of challenges & prize competitions within its statutory authority as a means to fulfill the Institute's purpose.

Status: This competition was completed in FY17.

Competition Goals: The International Cancer Genome Consortium-The Cancer Genome Atlas (ICGC-TCGA) Dialogue for Reverse Engineering Assessments and Methods (DREAM) Somatic Mutation Calling - RNA Challenge (SMC-RNA) is an international effort to improve standard methods for identifying cancer-associated rearrangements in RNA sequencing (RNA-seq) data. NCI held the ICGC-TCGA DREAM Somatic Mutation Calling RNA Challenge (SMC-RNA), a community-based collaborative competition of researchers from across the world. The goal was to rigorously assess the accuracy of methods to perform two key tasks in cancer RNA-Seq data analysis: the quantification of known isoforms and detecting novel fusion transcripts. NCI generated synthetic RNA-Seq data and introduced a phase during which teams make predictions on real human-tumors. The SMC-RNA Challenge will analyze a couple of dozen samples created to have known alterations representing different tumor types, allowing confidence that the winning methods will be generalizable across the broad range of human cancers.

Goal Types: Solve a specific problem; Advance scientific research; Develop technology; Engage new people and communities

Justification for Using Prizes and Challenges: This was a unique way to get new participants to not only create new, better algorithms to solve an issue with RNA sequencing, but also utilize the NCI Cloud Pilots off of which the Challenge was run. The NCI Cloud Pilots are designed to explore innovative methods for accessing and computing on large genomic data. They aim to bring data and analysis together on a single platform by creating a set of data repositories with co-located computational capacity and an application programming interface (API) that provides secure data access. In this model, applications are brought to the data, rather than bringing the data to the applications. The goals of Cloud Pilots are to democratize access to NCI-generated genomic and related data and to create a cost-effective way to provide computational support to the cancer research community.

[6] The website for the ICGC-TCGA DREAM Somatic Mutation Calling - RNA Challenge (SMC-RNA) can be viewed at https://www.synapse.org/#!Synapse:syn2813589/wiki/401435.

Cash Prize Purses and/or Non-Cash Prize Awards: There were no cash prizes for this Challenge. All participants were invited as consortium co-authors on challenge marker papers and winners will receive speaking invitations at the next DREAM conference or Sage Congress.

Solicitation of Submissions: The Challenge was advertised through NCI email groups and regularly scheduled meetings to contractors and grantees, specifically those scientists involved in the TCGA project (as this Challenge used TCGA data) were targeted. In addition, the Challenge was advertised on the DREAM Challenge site. The contractors funded to do this work also advertised the Challenge when they gave presentations at scientific meetings.

Solicitation Types: Email (e.g., listservs); Press release; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies)

Participation Requirements: N/A

Evaluation of Submissions: Submissions were ranked based on scoring metrics for each sub-challenge. In the Quantify Known Isoforms sub-challenge, the scoring metric was the Spearman and Pearson correlations calculated on the relative and true quantity of simulated isoforms or isoform spike-ins. In the Discover Gene Fusions Truth sub-challenge, the scoring metric was the sensitivity, precision and F1-score calculated for each simulated or spike-in tumor when applicable.

Results: 11 entries were submitted between June 29, 2016 and May 12, 2017.

Budget and Resources: Two contracts were awarded to Oregon Health Sciences University and Ontario Institute for Cancer Research for approximately $100,000 each to facilitate the Challenge by setting up the Challenge, the website, the rules, the test datasets, and to evaluate the results of the participants entries. A single Federal staff member oversaw the Challenge at about 5% FTE.

Partnerships: The partnership with the two contractors to run the Challenge was successful. The two contractors both had prior experience with running DREAM Challenges and this was critical in making the Challenge a success.

Advancement of Agency Mission: There is limited international efforts aimed at providing an unbiased and long-lived benchmarking of RNA-Seq Analysis Methods. This Challenge will help inform the standard approaches adopted across the cancer-research community due to the involvement of the organizers and participants in ICGC, TCGA and the Global Alliance for Genomics and Health projects.

Solution Types: Software and apps; Scientific

Plan for Upcoming 2 FYs: N/A

B.2.4 NCI-CPTAC DREAM Proteogenomics Challenge[7]

Lead Sponsoring Agency: NIH, NCI

Authority: NCI considers the use of challenges & prize competitions within its statutory authority as a means to fulfill the Institute's purpose.

Status: This competition was launched in FY17 and completed in FY18.

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[7] The websites for the NCI-CPTAC DREAM Proteogenomics Challenge are accessible at https://www.synapse.org/#!Synapse:syn8228304/wiki/413428 and https://proteomics.cancer.gov/news_and_announcements/best-performers-announced- nci-cptac-dream-proteogenomics-computational.

Competition Goals: Characterization and analyses of alterations in the proteome has the promise to shed light on cancer development and may improve development of both biomarkers and therapeutics. Measuring the proteome is very challenging, but recent rapid technology developments in mass spectrometry are enabling deep proteomics analysis. Multiple initiatives have been launched to take advantage of this development to characterize the proteome of tumors, such as the Clinical Proteomic Tumor Analysis Consortium (CPTAC). This challenge used public and novel proteogenomic data generated by the CPTAC to try to answer fundamental questions about how different levels of biological signal relate to one another. In particular, the Challenge focused on understanding: (1) Can one impute missing values in proteomics data given observed proteins?; (2) Can one predict abundance of any given protein from mRNA and genetic data?; and (3) Can one predict the phosphoproteomic data, using proteomic, mRNA and genetic data?

Goal Types: Solve a specific problem; Advance scientific research; Engage new people and communities; Stimulate a market

Justification for Using Prizes and Challenges: The use of incentivized challenge competitions allows agencies to cast a wide net to find innovative solutions through crowd- sourcing and open science. Furthermore, participants in a challenge agree to benchmark performance of their software tools against a common reference dataset. Such approaches are not typically provided through traditional grant mechanisms. NCI determines that the monetary prize is often secondary to the community's interest to participate in an activity where they can find access to high quality data and the opportunity to benchmark their tools compared to other participants.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered was $25,000 and the total amount awarded was $25,000. NVIDIA Foundation provided the cash prize. Additionally, Nature Publishing supported submission of overview paper and insights that emerge from the Challenge.

Solicitation of Submissions: NCI solicited submissions through emails and speaking presentations at scientific meetings.

Solicitation Types: Email (e.g., listservs); Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies)

Participation Requirements: N/A

Evaluation of Submissions: Submissions were evaluated and peer reviewed based on the algorithmic performance comparing training data to test data sets.

Results: 504 participants were involved in submissions between June 26 and November 20, 2017. Three prizes were awarded to researchers from the University of Michigan and Korea University.

Budget and Resources: NCI staff worked closely with our scientific partners and a Challenge contractor to develop the scientific scope and requirements of the Challenge. NCI provided $250,000 in FY18 funding to manage the organization and logistics of the new Challenge.

Partnerships: The Defense Advanced Research Projects Agency (DARPA) contributed its SIMPLEX suite of scientific discovery tools. The NVIDIA Foundation provided the cash prize. NCI also partnered with Google, IBM, DREAM Challenges, and Nature Publishing.

Advancement of Agency Mission: NCI leads, conducts, and supports cancer research across the nation to advance scientific knowledge and help all people live longer, healthier lives. This crowdsourced Challenge highlighted the use of computational tools in cancer research to extract new information from the cancer proteome and to understand the association between the genome, transcriptome, and

proteome in tumors to better efforts that improve cancer prevention, detection, diagnosis, and survivorship.

Solution Types: Software and apps; Analytics, visualizations, algorithms; Scientific

Plan for Upcoming 2 FYs: N/A

B.2.5 PROSTATEx Challenge[8]

Lead Sponsoring Agency: NIH, NCI

Authority: NCI considers the use of challenges and prize competitions within its statutory authority as a means to fulfill the Institute's purpose.

Status: This competition was completed in FY17.

Competition Goals: The overall goal of the two PROSTATEx challenges (termed PROSTATEx I and II) was to promote development of medical image analysis algorithms for clinical decision support in diagnosis and staging of prostate cancer. The goal of PROSTATEx I was to determine the presence of cancer in each subject based in quantitative image analysis of multi-parametric magnetic resonance imaging (MRI) data. The goal of PROSTATEx II was to use multi-parametric MRI data to determine Gleason Grade Group in prostate cancer.

Goal Types: Find and highlight innovative ideas; Solve a specific problem; Advance scientific research; Develop technology; Inform and educate the public; Engage new people and communities

Justification for Using Prizes and Challenges: The use of incentivized challenge competitions allows agencies to cast a wide net to find innovative solutions through crowd- sourcing and open science. Furthermore, participants in a challenge agree to benchmark performance of their software tools against a common reference dataset. Such approaches are not typically provided through traditional grant mechanisms. NCI determined that the monetary prize is often secondary to the community's interest to participate in an activity where they can find access to high quality data and the opportunity to benchmark their tools compared to other participants.

Cash Prize Purses and/or Non-Cash Prize Awards: PROSTATEx challenges offered non-cash prizes only. The top two teams received waived registration fees to attend SPIE 2017 or American Association of Physicists in Medicine (AAPM) 2017 annual conferences to present results. Both registration fee waivers were provided by the SPIE and AAPM.

Solicitation of Submissions: NCI collaborated with SPIE and AAPM to announce the challenges through their communication channels, including their respective websites, press release, and listserv emails to society members. These methods were effective to get a critical mass of participants involved with each challenge. However, this was only the second time offering prize competitions for SPIE, and the first time for AAPM. Both societies are planning to offer challenges in the coming years. Given the general emerging interest in data science, machine learning, and artificial intelligence (AI), we expect that participation in the future will increase. One factor that is of prime importance in offering a challenge, in conjunction with the annual meeting of a scientific society, is the timing of the opening and closing

[8] The websites for the PROSTATEx Challenge are accessible at https://www.aapm.org/GrandChallenge/PROSTATEx-2/default.asp and http://spiechallenges.cloudapp.net/competitions/7.

of the challenge and announcement of the winners, who need enough time to plan their travel to the meeting.

Solicitation Types: Email (e.g., listservs); Press release; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies); Other - Special sessions at scientific meetings (SPIE Medical Imaging and AAPM) to highlight the challenge and facilitate presentations by the winners

Participation Requirements: N/A

Evaluation of Submissions: Submissions were evaluated through against the ground truth and summarized as an index. The ground truth was provided by clinical experts who are familiar with the disease and the data.

Results: Entries for PROSTATEx I were submitted between November 21, 2016 and January 15, 2017. Entries for PROSTATEx II were submitted between May 15 and June 23, 2017.

Budget and Resources: The NCI Program Director devoted 5% time to guide the development of the Challenge design and implementation. Outside collaborators from academia contributed similar services. Datasets available through the Cancer Imaging Archive (CIA) were used in training and test phases of the Challenge. An existing challenge platform was used for submission of results and ranking of participants based on a set of evaluation metrics. The challenge platform was utilized under a blanket contract between the platform operator and NCI Center for Biomedical Informatics and Information Technology.

Partnerships: NCI partnered with the Food and Drug Administration, SPIE, AAPM, Harvard University, University of Michigan, and Radboud University to develop, advertise, and complete the Challenge. The estimated values of the waived registration fees provided by AAPM and SPIE is estimated at $300-1,000 per person.

Advancement of Agency Mission: The NCI mission includes dissemination of information on cancer detection, diagnosis, and treatment, and support for innovative solutions to the cancer problem. PROSTATEx challenges, performed in collaboration with non-profit entities (scientific societies and universities) leverages existing shared datasets to drive algorithmic excellence and incentivize development of innovative analytic software methods in cancer detection, diagnosis, and staging, using such datasets.

Solution Types: Software and apps; Ideas; Analytics, visualizations, algorithms; Scientific

Plan for Upcoming 2 FYs: A great amount of high quality cancer data (imaging, pathology, genomics, proteomics, and clinical) are generated through NCI-funded grants and cooperative agreements. Often these constitute what is referred to as big data. Solvers in the community, who are typically graduate students or research fellows with innovative ideas usually lack access to such data. Challenges provide a great way to develop tasks related to existing data that are aimed to bring innovative approaches, such as AI, to solve long standing problems, or facilitate more accurate solutions toward clinical decision support. NCI plans to utilize new datasets (imaging and other types) to launch new challenges in 2019 and 2020. These include challenges related to pancreatic and brain cancers, two of the deadliest cancers.

B.3 Department of Homeland Security (DHS)

B.3.1 The U.S. Coast Guard Ready for Rescue Challenge[9]

Lead Sponsoring Agency: United States Coast Guard, Research and Development Center

Authority: Procurement Authority

Status: This competition was launched in FY18.

Competition Goals: The United States Coast Guard's Research and Development Center (USCG RDC) in conjunction with the DHS Science and Technology Directorate (DHS S&T) is seeking new solution based concepts that help make it easier to find and rescue people lost in the water. The best concepts will be effective, affordable, and hold the potential for wide adoption by recreational mariners. The competition will involve four phases: (I) Identify possible solutions; (II) Incentivize the development of working prototypes; (III) Assess the efficacy of the working prototypes to enable USCG search and rescue operations; (IV) Provide additional non-monetary support to encourage commercialization of the solutions.

Goal Types: Improve government service delivery; Find and highlight innovative ideas; Solve a specific problem; Advance scientific research; Develop technology; Inform and educate the public

Justification for Using Prizes and Challenges: The USCG is seeking a wide breadth of potential solutions and prototypes for testing in FY19. A wide variety of potential technologies and approaches will provide the best opportunity for success and eventual adoption of an improved inherent person-in-the-water (PIW) detectability standard. Using other authorities will result in a limited pool of solutions and likely be more expensive to produce and acquire by public boaters and mariners. Prizes and challenges also affords the opportunity for an innovator to have access to government and private sector mentors, limited user evaluation of their prototype, and assistance in commercializing their concept.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse available for offer is $255,000, to be awarded across three phases. The purse for Phase I is $25,000 (five awards at $5000 each), the purse for Phase II is $120,000 (up to seven awards), and the Purse for Phase III is $110,000 (up to five awards). Non-monetary incentives include the ability to work with USCG RDC maritime subject matter experts and boating industry mentors in the development of ideas into products. The DHS Science & Technology Directorate is helping to develop a path for Phase III winners to work with an accelerator or business to further develop and commercialize their prototype. Funding for Phase I is provided by DHS S&T R&D funds while funding for Phases II and III is provided by USCG RDC R&D funds.

Solicitation of Submissions: Phase I solicited the submission of ideas that have a high expectation for commercialization, affordability, and adoption by the boating and maritime community. Phase II will require selected Phase I winners and honorable mentions to present their concept and pathway for prototype development to a review panel. Successful participants will be provided incremental prize award milestones to assist in the development of their prototype. Phase II participants will be invited to participate in a Phase III challenge that evaluates their prototype with USCG search and rescue assets. Phase III participants will compete for a bonus prize purse of $110,000.

[9] The website for The U.S. Coast Guard Ready for Rescue Challenge can be viewed at www.ReadyforRescuechallenge.com.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Live video streaming; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies); Other - Conference promotional activities, outreach with accelerator networks

Participation Requirements: The contest seeks the following skill sets: Public Safety, Maritime Safety, Recreational Sports, Consumer Goods and Materials, Wearables, Textiles, Smart Technologies, and Internet of Things.

Evaluation of Submissions: Submissions will be assessed by a diverse panel of judges from the government and the private sector against five criteria: (1) Effectiveness. The extent to which the solution demonstrates potential to improve detectability of PIW by search and rescue teams using existing Coast Guard search methods. Improved detectability is measured by the degree to which a reduced search time and/or success rate of search and rescue missions may be increased by the proposed solution. (2) Accessibility. The potential to be purchased and/or utilized by a broad set of recreational mariners (boaters, kayakers, Jet Ski, paddle craft, etc.). There are minimal companion purchases and is cost-effective from the consumer perspective (potential to be sold at a low, mass-market price point in the range of $25 to $35 if manufactured at scale). (3) User experience. The likelihood that the proposed solution would be utilized by recreational mariners on the water (boaters, kayakers, jet ski, paddle craft, etc.). The extent to which the solution addresses common barriers to use that limit existing solutions, such as comfort, convenience, or awareness. (4) Feasibility. The extent to which the proposed solution is viable and can be reasonably developed into a prototype within a nine-month period, with the potential to be manufactured at scale. (5) Team. The extent to which the entrant's team demonstrates the appropriate level of experience, commitment, and ability to move from concept to prototype. If entrant is an individual, the level of experience, commitment, and ability to prototype to include access to non-team member assets and capabilities.

Results: The competition is ongoing with entries for Phase I submitted by participants between September 5 and October 15, 2018.

Budget and Resources: In FY17, agency personnel supporting challenge included .25 FTEs. In FY18, agency personnel supporting the program included 0.6 FTE (DHS Prize Office and General Counsel: 0.1 FTE; USCG RDC: 0.5 FTEs). Greater clarity is needed to distinguish whether this amount includes the prize money total from Phase I or not.

Partnerships: In addition to partnering with the DHS Science and Technology Directorate, the competition sought judges and mentors from the private sector to include marine safety equipment manufacturers, distributors, designers, etc. The estimated value of partner contributions is $175,000.

Advancement of Agency Mission: One of the most challenging aspects of maritime search and rescue is finding a person in the water (PIW) because a PIW is often indistinguishable from the surrounding environment. In order to find people in the water more effectively and save more lives, a PIW's inherent detectability must be increased. Examples include color/light for conspicuity, electronic/heat signatures, form factors, and personal floatation devices. Effective PIW detectability enhancements must be suitable for use with USCG sensors and methods. There have been incremental improvements to UCSG rescue methods over time as technology advanced. Recently the USCG has upgraded sensors on aviation and surface assets; however, PIW detectability standards have lagged. The desired outcome of this challenge is effective concepts that increase conspicuity of a PIW and will likely be used by the public. A successful design, prototype and execution will make possible transition to market that will be low cost and easily adapted by the boating public. Results of this challenge may become part of an improved inherent PIW detectability standard.

Solution Types: Ideas; Technology demonstration and hardware; Analytics, visualizations, algorithms

Plan for Upcoming 2 FYs: In FY19, three competitions are in planning and one in early stage exploration for execution in 2019. Crosscutting mission areas include: chemical-biological defense, opioid detection in bulk mail, search and rescue, and emergency preparedness. Planned competitions include the development or enhancement of a new technology, opportunities for entrepreneurs to develop and market new technologies, and an educational game to better prepare the public. Additional cross-cutting areas include first responder technologies. In FY20, cross-cutting areas that may be considered by DHS include: critical infrastructure technologies, first responder technologies, cyber defense applications, chemical-biological detection technologies, algorithms, sensors, and screening technologies.

B.4 Department of State (State)

B.4.1 Diplomacy Lab[10]

Lead Sponsoring Agency: State, Secretary's Office of Global Partnerships (S/GP)

Authority: State Department Basic Authorities Act of 1956

Status: This competition was underway in both FY17 and FY18, but has not concluded.

Competition Goals: Students participating in Diplomacy Lab explore real-world challenges identified by DOS and work under the guidance of faculty members who are authorities in their fields. This initiative allows students to contribute directly to the policymaking process while helping State tap into an underutilized reservoir of intellectual capital. Teams that develop exceptional results and ideas are recognized for their work and may be invited to brief senior State officials on their findings.

Goal Types: Improve government service delivery; Engage new people and communities

Justification for Using Prizes and Challenges: N/A

Cash Prize Purses and/or Non-Cash Prize Awards: This Challenge provided university partners with real-world experience and State with free research and recruiting opportunities.

Solicitation of Submissions: State provided participating universities with a list of proposed projects. Partner universities then identify faculty members to lead teams of students in Diplomacy Lab projects. Over the course of a semester, professors guide students in developing a final work product that accomplishes the goals outlined by State. Students have opportunities throughout the semester to discuss their research with State officials. Diplomacy Lab member institutions may bid on project proposals developed by State six months prior to each semester during the bidding window. Each university is encouraged to submit bids for its top four priority projects. It is also highly recommended that each university choose four alternate projects with an individual proposal in the event a particular project is over-subscribed

Solicitation Types: Email (e.g., listservs); Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies)

Participation Requirements: Diplomacy Lab is open to students and faculty at vetted and approved partner universities in the United States.

Evaluation of Submissions: N/A

[10] The website for the Diplomacy Lab can be viewed at www.diplomacylab.org.

Results: N/A

Budget and Resources: This Challenge utilized one FTE in both FY17 and FY18.

Partnerships: Partner universities are vetted and approved according to 2 FAM 970. Partner universities provide research to projects proposed by State offices and embassies worldwide. Non-Federal partners have included College of William and Mary, Florida International University, Georgetown University, Georgia Institute of Technology, Gettysburg College, Hunter College, Indiana University Bloomington, Indiana University – Purdue University Indianapolis, John Jay College of Criminal Justice, Miami University, Missouri University of Science and Technology, Montana State University, Stevens Institute of Technology, Stockton University, Syracuse University, Tufts University, University of California San Diego, University of Oklahoma, University of Kansas, University of New Mexico, University of Notre Dame, University of Pittsburgh, University of Tennessee, University of Virginia, University of Washington, Virginia Tech, Wilbur Wright College, Yale University, Oberlin College, and Columbia University.

Advancement of Agency Mission: Diplomacy Lab is designed to address two priorities: (1) State's determination to engage the American people in the work of diplomacy; and (2) the imperative to broaden State's research base in response to a proliferation of complex global challenges.

Solution Types: Ideas; Other - Research

Plan for Upcoming 2 FYs: Diplomacy Lab will continue to operate as it has during the past two fiscal years, with an aim to grow its partner network to expand the geographic and academic diversity of research provided.

B.4.2 Almaty Mini Maker Faire—Pitching Challenge[11]

Lead Sponsoring Agency: U.S. Embassy Astana

Authority: The United States Information and Education and Exchange Act of 1948, as amended (P.L. 80-402; 22 U.S.C. § 1431 et seq.), a.k.a. the Smith-Mundt Act

Status: This competition was launched and completed in FY18.

Competition Goals: The goal of the competition was to identify ideas and projects with the potential to change social life related to science, technology, engineering and mathematics (STEM) education and ecological problems.

Goal Types: Find and highlight innovative ideas; Solve a specific problem; Develop technology; Engage new people and communities

Justification for Using Prizes and Challenges: Prizes were awarded to allow the winners to continue to work on the projects following the conclusion of the competition.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered and awarded was $6,000. The prize came from the grant that was given to the local non-governmental organization.

Solicitation of Submissions: The competition was announced on social media and monitored by an Information Assistant who collected all of the submitted applications. The judges selected the

[11] The website for the Almaty Mini Maker Faire – Pitching Challenge can be viewed at https://www.facebook.com/AlmatyMiniMakerFaire/photos/a.337478493324638/352379608501193/?type=3&theater.

participants who would present their works during the Maker Faire, and those selected gave a presentation at the end of the event.

Solicitation Types: Social media (e.g., Twitter, Facebook); Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies)

Participation Requirements: Teams were required to pre-register for the competition by submitting a proposal, plan, and one minute video explaining the project.

Evaluation of Submissions: On the day of the event, selected participants presented their projects in front of a panel of five judges and answered any follow-up questions.

Results: Of the 12 participants who presented their solutions, three participants were each awarded a $2,000 prize.

Budget and Resources: Over five days, several people from the Public Affairs team worked to ensure the execution of the competition.

Partnerships: N/A

Advancement of Agency Mission: Almaty Mini Maker Faire promotes do-it-yourself activities, technology, innovation, science, and STEM education, specifically focusing on how individuals can use technology to solve social problems.

Solution Types: Software and apps; Creative (design & multimedia); Ideas; Technology demonstration and hardware; Scientific

Plan for Upcoming 2 FYs: The Almaty Mini Maker faire was well attended by both participants and the media. The competition proved to be an effective means to incite discussion around novel solutions by relating social issues to STEM topics and encouraging physical solutions to real problems. This type of event will be repeated during the next 2 fiscal years.

B.4.3 Spelling Bee[12]

Lead Sponsoring Agency: U.S. Embassy Astana

Authority: The United States Information and Education and Exchange Act of 1948, as amended (P.L. 80-402; 22 U.S.C. § 1431 et seq.), a.k.a. the Smith-Mundt Act

Status: This competition was launched and completed in FY18.

Competition Goals: The purpose of this Challenge is to invite students to come to the Spelling Bee competition and support each country. Active fans would have been awarded.

Goal Types: Engage new people and communities; Build capacity

Justification for Using Prizes and Challenges: Because the event was organized on a Saturday and before that it was a public holiday, therefore we wanted to attract more people to come and support and learn more about AmericanSpace's services.

Cash Prize Purses and/or Non-Cash Prize Awards: Winners were awarded T-shirts.

[12] The website for the Spelling Bee can be viewed at https://www.facebook.com/almaty.usconsulate/photos/a.316951578330291/2337570952935000/?type=3&theater.

Solicitation of Submissions: N/A

Solicitation Types: Social media (e.g., Twitter, Facebook)

Participation Requirements: N/A

Evaluation of Submissions: Evaluation was through observation of participants who came to support the Spelling Bee competition and how active they were.

Results: Of the 20 participants, five prizes were awarded to five winners.

Budget and Resources: This Challenge utilized three to four hours of time of one FTE and $15 in funding.

Partnerships: N/A

Advancement of Agency Mission: This Challenge intended to advance State's mission through promotion of the English language.

Solution Types: Creative (design & multimedia); Ideas

Plan for Upcoming 2 FYs: The event was very successful and well-attended by students and was covered by media. This project will be continued in the future as it also covers other Central Asian countries.

B.4.4 World Tourism Day Quiz[13]

Lead Sponsoring Agency: U.S. Embassy Astana

Authority: The United States Information and Education and Exchange Act of 1948, as amended (P.L. 80-402; 22 U.S.C. § 1431 et seq.), a.k.a. the Smith-Mundt Act

Status: This competition was launched and completed in FY18.

Competition Goals: The prize competition was launched on World Tourism Day to promote and inspire tourism in the United States. Through Facebook, the participants were asked to identify which city or state a person would need to travel to in order to enjoy something special (e.g., "the best beef bbq" or "the highest mountain peak in America"). The competition also sought to promote and applaud the use of English language; the competition was administered in English and required some light research to find the answers to the quiz questions.

Goal Types: Inform and educate the public; Engage new people and communities; Stimulate a market; Other - Promote tourism in the United States of America

Justification for Using Prizes and Challenges: N/A

Cash Prize Purses and/or Non-Cash Prize Awards: Non-monetary incentives included a United States Consulate General (USCG) Almaty branded notebook, bookmark, and pen. Three sets of prizes were awarded.

Solicitation of Submissions: The quiz was announced on the USCG Almaty Facebook Page.

Solicitation Types: Social media (e.g., Twitter, Facebook)

Participation Requirements: Participants needed to access and read the USCG Almaty Facebook page.

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[13] The website for the World Tourism Day Quiz can be viewed at https://www.facebook.com/almaty.usconsulate/photos/a.316951578330291/2704438682914890/?type=3&theater.

Evaluation of Submissions: The first five people to answer all four quiz questions correctly were identified as the winners. The winners were notified to pick up their prizes the next day at the American Space.

Results: Of the seven entries submitted between September 27 and September 28, 2018, five winners were selected.

Budget and Resources: Funding for FY18 totaled $15 to supply the prize package. In addition, 0.5 FTE employees, one American Eligible Family Member employee and one Locally Employed staff member, supported the planning and launching stages of the competition.

Partnerships: N/A

Advancement of Agency Mission: Promoting and advancing the English language is a priority for both the U.S. Embassy Astana and the government of Kazakhstan. Through tourism, the competition provides an opportunity to expose our young, social media audience to American values and perspectives.

Solution Types: N/A

Plan for Upcoming 2 FYs: Over the next two fiscal years, the U.S. Embassy Astana will continue to promote the English language, Western ideas and values, and tourism between the United States and Almaty.

B.4.5 Impact Video Competition

Lead Sponsoring Agency: U.S. Embassy Lilongwe

Authority: Foreign Assistance Act

Status: This competition was launched in FY17 and completed in FY18.

Competition Goals: USAID aims to clearly and effectively demonstrate the impact of its development programs. Through this contest, contestants submitted one to two-page pitches attempting to show how their programs had a positive impact on Malawi. Entries were judged largely upon their ability to show quantitative evidence of their impact. For the winners, USAID hired a professional video production team to make a short film about their project and its impact. USAID and the partners will both retain copies of these videos for communications/marketing purposes respectively.

Goal Types: Find and highlight innovative ideas; Inform and educate the public

Justification for Using Prizes and Challenges: While partners submit regular reports to USAID, sometimes these only include standard, required indicators which do not adequately capture impact. Through this competition, partners were incentivized to take a deeper look at their programs and show evidence of substantial impact at a broad level based on quantitative evidence. This way, partners did the investigation on their own. By doing so, USAID saved the costs of awarding a new contract to determine this information.

Cash Prize Purses and/or Non-Cash Prize Awards: A video was produced for each of the three winning entries. The videos described their USAID and President's Emergency Plan for AIDS Relief (PEPFAR) funded projects in Malawi. USAID uses the videos to communicate the effectiveness of its programming and to convey ideas and information to the American and global public around issues related to foreign policy, such as HIV, deforestation, and economic growth).[14]

[14] The costs for the videos were: GH-C/2012/201 $32,417 – disbursed, DV/2015/2016 $32,417 – in requisition

Solicitation of Submissions: Announcement at a partners meeting; subsequent email to partners

Solicitation Types: Email (e.g., listservs); Day-long event(s) prior to the competition

Participation Requirements: Organizations had to be current USAID/Malawi partners implementing development projects to participate in this Challenge. To win, organizations had to show that their program made a positive impact on U.S. Government foreign policy goals.

Evaluation of Submissions: Evaluators were internal to USAID. Evaluation criteria included evidence of quantitative impact, sustainability, and the degree to which the story was compelling based on making a difference in the lives of Malawians and achieving the goals of the U.S. Government in Malawi. It worked well because USAID applied the same criteria across all submissions.

Results: Of the 30 entries submitted by 30 organizations between October 30, 2017 and December 8, 2017, three prizes were awarded.

Budget and Resources: Staff time was utilized to organize, judge, and communicate regarding the contest. This Challenge had travel costs for USAID staff to ground truth claims of impact and accompany the film company during filming. Staff time was used to work with the video production company to develop films in advance of filming (storyboarding etc.), and to review production company editing and final film production. This Challenge utilized approximately 1 FTE throughout FY17 and FY18 and about $63,000 in FY18 funding.

Partnerships: Partners, on a voluntary basis, submitted a one to two-page pitch for their story. Once USAID selected the winners, those partners used staff time to work with USAID staff to hone the story. Partners worked with USAID and film production company staff to produce the video. Non-Federal partners included Pact, Inc.; Tetra Tech; Baylor University; and Johns Hopkins University. Partner contributions are estimated at $2,000 and travel costs.

Advancement of Agency Mission: This Challenge advances agency mission by showing how USAID programs are fulfilling U.S. foreign policy goals.

Solution Types: Creative (design & multimedia)

Plan for Upcoming 2 FYs: The mission may hold another contest in subsequent years, with similar anticipated costs, but those plans are not confirmed at the time of reporting.

B.4.6 "150 Years of Cooperation and Friendship" Logo Contest[15]

Lead Sponsoring Agency: U.S. Embassy Montevideo, Public Affairs

Authority: Fulbright-Hays Act

Status: This competition was completed in FY17.

Competition Goals: This Challenge intended to obtain an official logo to be used in all official communications during 2017 for the 150th anniversary of diplomatic relations between the U.S. and Uruguay, and encourage the community to engage with the celebrations and gain new followers as well.

Goal Types: Solve a specific problem; Engage new people and communities

[15] The website for the "150 Years of Cooperation and Friendship" Logo Contest can be viewed at https://uy.usembassy.gov/es/logo150.

Justification for Using Prizes and Challenges: The Prize was offered to engage with a wider audience and to have as many logos as possible and professionally done, as the selected logo was going to be used in all official Embassy communications.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered and awarded was a Nikon Coolpix AW130 and Sandisk 16GB memory card, valued at $271. Non-monetary incentives included having the winning logo be used in all official communications during 2017, a certificate signed by the Ambassador, and getting mentioned and participating in the 150th anniversary celebrations.

Solicitation of Submissions: Participants were asked to send their designs to the Embassy Webmaster email account.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs)

Participation Requirements: Challenge requirements included: (1) the Challenge was only open to Uruguayan citizens; (2) there was no age limit; (3) more than one design by participant was accepted; (4) logos must be done by participants and no property rights could be violated during the creative process; (5) participants agree to give the U.S. Embassy in Montevideo full authorization to use the context, platform, and product.

Evaluation of Submissions: After the closing date, all logos were printed and displayed in a conference room where Embassy staff was invited to vote for their preferred submission. The voting process ended with five finalists that were presented to the front office. The final decision was made considering not only the logo itself, but the different applications for which it was needed, including size, proportions, and use in both full-color and black-and-white applications.

Results: Of the 182 entries submitted by 134 participants between February 27, 2017 and March 16, 2017, one prize was awarded to one winner.

Budget and Resources: Budget and resources were utilized to create contest regulations and graphics, promotion on social media, posting on the website and procurement of the waterproof digital camera. Additionally, budget and resources included collecting all submitted logos, presenting them to the jury, carrying out the selection, and announcing the winning logo and designer. Costs included three hours of time on behalf of the webmaster $59.47; three hours for the audiovisual tech assistant $35.56; camera supplier (i.e., vendor) $271.00; Facebook promotion $100.00. The Challenge also utilized $371 in FY17 funding and six FTEs.

Partnerships: N/A

Advancement of Agency Mission: DOS celebrated the long history of friendship and cooperation between the United States and Uruguay by inviting the members of the Uruguayan public to design a logo to recognize the 150-year anniversary of bilateral relations between both countries. This initiative was intended to improve the Mission's image and popularity within the local community. Within the Mission, all employees, both American and local staff, were encouraged to work together to pick the winning logo as an activity which contributes to the development of a better working environment.

Solution Types: Creative (design & multimedia); Ideas

Plan for Upcoming 2 FYs: N/A

B.4.7 #MEthroughUSeyes[16]

Lead Sponsoring Agency: U.S. Embassy Podgorica

Authority: The United States Information and Education and Exchange Act of 1948, as amended (P.L. 80-402; 22 U.S.C. § 1431 et seq.), a.k.a. the Smith-Mundt Act

Status: This competition was launched and completed in FY18.

Competition Goals: The contest objective was to show how American citizens spend their time in Montenegro and what are the most beautiful places in Montenegro according to people from the USA, thus showcasing that appreciating nature is a shared value.

Goal Types: Inform and educate the public; Engage new people and communities

Justification for Using Prizes and Challenges: N/A

Cash Prize Purses and/or Non-Cash Prize Awards: Non-monetary incentives included 10 branded bags containing U.S. Embassy's branded materials.

Solicitation of Submissions: Participants were asked to post their own picture of Montenegro landmarks on the Embassy's social media properties.

Solicitation Types: Social media (e.g., Twitter, Facebook)

Participation Requirements: Contestants must have been at least 13 years old on the date of entry into the contest. Contestants must have been U.S. citizens or lawful permanent residents.

Evaluation of Submissions: At the end of the submission period, the Public Affairs team evaluated the photos and selected favorites.

Results: Of the 120 entries submitted by 50 participants between May 5, 2017 and May 25, 2017, 10 prizes were awarded to 10 winners.

Budget and Resources: The prize was a branded bag containing U.S. Embassy branded materials, including a t-shirt, an umbrella, a notebook, a pen, a pin, and a mug with American symbols. Best photos were exhibited at the American Corner - Podgorica. One staff member worked on the contest organization, execution and promotion for a total of five work days in FY18.

Partnerships: N/A

Advancement of Agency Mission: The contest served to advance U.S.-Montenegro partnership and highlighted the Montenegrin public support of the United States and its values and policies.

Solution Types: Other - Sharing a photo

Plan for Upcoming 2 FYs: N/A

[16] The website for the #MEthroughUSeyes (U.S. Embassy Podgorica) can be viewed at https://www.facebook.com/notes/us-embassy-podgorica/methroughuseyes/10154665107302705/?__tn__=HH-R.

B.4.8 #OscarsME2018[17]

Lead Sponsoring Agency: U.S. Embassy Podgorica

Authority: The United States Information and Education and Exchange Act of 1948, as amended (P.L. 80-402; 22 U.S.C. § 1431 et seq.), a.k.a. the Smith-Mundt Act

Status: This competition was launched and completed in FY18.

Competition Goals: Embassy Podgorica used the Academy Awards to engage and expand its social media following with the goal of increasing support for U.S. values.

Goal Types: Inform and educate the public; Engage new people and communities

Justification for Using Prizes and Challenges: N/A

Cash Prize Purses and/or Non-Cash Prize Awards: Winners received an invitation to the U.S. Embassy reception celebrating American film and the Academy Awards with Ambassador Uyehara.

Solicitation of Submissions: Participants were asked to fill in a Google form by following a link from Embassy social media properties.

Solicitation Types: Social media (e.g., Twitter, Facebook)

Participation Requirements: Contestants must have been at least 18 years old on the date of entry into the contest. Contestants must have been residents of Montenegro and not U.S. citizens or lawful permanent residents.

Evaluation of Submissions: Winners were randomly selected at the end of the polling period.

Results: Of the 400 entries submitted by 250 participants between February 5, 2018 and February 26, 2018, five prizes were awarded to five winners.

Budget and Resources: One staff member worked on the contest organization, execution and promotion for a total of five work days in FY18. This Challenge required no additional financial resources.

Partnerships: N/A

Advancement of Agency Mission: The contest served to advance the Montenegrin public's support of the United States and its values and policies. This program focused on educating the Montenegrin public about cultural events in the United States and related American values.

Solution Types: Other - Participating in a quiz

Plan for Upcoming 2 FYs: N/A

[17] The website for the #OscarsME2018 (U.S. Embassy Podgorica) can be viewed at https://www.facebook.com/notes/us-embassy-podgorica/oscarsme2018-official-game-rules/10155456275822705/?__tn__=HH-R.

B.4.9 #USElections2016 - Official Trivia Contest Rules[18]

Lead Sponsoring Agency: U.S. Embassy Podgorica

Authority: The United States Information and Education and Exchange Act of 1948, as amended (P.L. 80-402; 22 U.S.C. § 1431 et seq.), a.k.a. the Smith-Mundt Act

Status: This competition was completed in FY17.

Competition Goals: As U.S. Presidential Elections were getting closer, DOS wanted to engage with social media followers and share knowledge about election rules, procedures, and trivia. DOS aimed to promote good democratic practices and explain to followers the historic developments that led to these practices. Sharing U.S. election stories and experiences would not only familiarize the audience with the U.S. electoral system, but let them think about what is similar in their country and what could be improved. The overall objective was not only to raise awareness about the 2016 elections, but to promote the value and the power of young people's participation in process of choosing state representatives and decision makers.

Goal Types: Inform and educate the public

Justification for Using Prizes and Challenges: N/A

Cash Prize Purses and/or Non-Cash Prize Awards: Winners received invitations to the Election Breakfast event and met with the Ambassador.

Solicitation of Submissions: Participants were asked to fill in a Google form, and link answers to the Embassy social media properties.

Solicitation Types: Social media (e.g., Twitter, Facebook)

Participation Requirements: Contestants must have been at least 16 years old on the date of entry into the contest. Contestants must have been residents of Montenegro and not U.S. citizens or lawful permanent residents.

Evaluation of Submissions: One winner was selected at random every day during the contest.

Results: Of the 450 entries submitted by 450 participants between October 21, 2016 and October 31, 2016, 10 prizes were awarded to 10 winners.

Budget and Resources: One staff member worked on the contest organization, execution and promotion for total of 5 work days in FY17. This Challenge required no additional financial resources.

Partnerships: N/A

Advancement of Agency Mission: The contest served to advance the Montenegrin public's support of the United States and its values and policies. This program focused on educating the Montenegrin public about the electoral process in the United States.

Solution Types: N/A

Plan for Upcoming 2 FYs: N/A

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[18] The website for the #USElections2016 - Official Trivia Contest Rules (U.S. Embassy Podgorica) can be viewed at https://www.facebook.com/notes/us-embassy-podgorica/selections2016-official-trivia-contest-rules/10154069651817705/.

B.4.10 GIFT O'CLOCK 2016 - #MEholidaysWithUS[19]

Lead Sponsoring Agency: U.S. Embassy Podgorica

Authority: The United States Information and Education and Exchange Act of 1948, as amended (P.L. 80-402; 22 U.S.C. § 1431 et seq.), a.k.a. the Smith-Mundt Act

Status: This competition was completed in FY17.

Competition Goals: The goal of this contest was to expand the reach of the Embassy's social media following by showcasing American holiday traditions.

Goal Types: Inform and educate the public; Engage new people and communities

Justification for Using Prizes and Challenges: Prizes were used as an incentive to encourage participation and contribute to the goal of expanding social media following.

Cash Prize Purses and/or Non-Cash Prize Awards: Each winner was awarded a branded bag containing U.S. Embassy's branded materials, including a t-shirt, umbrella, notebook, pen, pin, and mug with American symbols.

Solicitation of Submissions: Participants were asked to post a picture of their holiday decorations on the Embassy's social media properties.

Solicitation Types: Social media (e.g., Twitter, Facebook)

Participation Requirements: Contestants must have been at least 13 years old on the date of entry into the contest. Contestants must have been residents of Montenegro and not U.S. citizens or lawful permanent residents.

Evaluation of Submissions: One winner was selected randomly every day during the contest.

Results: Of the 30 entries submitted by 50 participants between December 12 and December 22, 2016, 10 prizes were awarded to 10 winners.

Budget and Resources: One staff member worked on the contest organization, execution and promotion for a total of five work days in FY17.

Partnerships: N/A

Advancement of Agency Mission: The contest served to advance the Montenegrin public's support of the United States and its values and policies.

Solution Types: Other - Sharing a photo

Plan for Upcoming 2 FYs: N/A

[19] The website for the GIFT O'CLOCK 2016 - #MEholidaysWithUS (U.S. Embassy Podgorica) can be viewed at https://www.facebook.com/notes/us-embassy-podgorica/gift-oclock-2016-meholidayswithus/10154214370007705/?__tn__=HH-R.

B.4.11 Montenegrin Summer in the States #USalumniMNE[20]

Lead Sponsoring Agency: U.S. Embassy Podgorica

Authority: The United States Information and Education and Exchange Act of 1948, as amended (P.L. 80-402; 22 U.S.C. § 1431 et seq.), a.k.a. the Smith-Mundt Act

Status: This competition was underway in FY18.

Competition Goals: This contest aims to strengthen people-to-people ties between the United States and Montenegro and provide a forum for current and past Montenegrin participants in the Summer Work Travel program to share their experiences through photographs.

Goal Types: Inform and educate the public; Engage new people and communities

Justification for Using Prizes and Challenges: N/A

Cash Prize Purses and/or Non-Cash Prize Awards: Each winner will be awarded with a branded bag containing U.S. Embassy's branded materials, including a t-shirt, umbrella, notebook, pen, pin, and mug with American symbols, and an invitation to an Embassy reception. Thirteen branded bags containing U.S. Embassy branded materials and 13 invitations were awarded.

Solicitation of Submissions: Participants were asked to post a picture of their experiences in the United States on the Embassy's social media pages.

Solicitation Types: Social media (e.g., Twitter, Facebook)

Participation Requirements: Contestants must have been at least 18 years old on the date of entry into the contest. Contestants must have been Montenegrin citizens or lawful permanent residents.

Evaluation of Submissions: At the end of the submission period, the Public Affairs team selected the best photos. Authors of the winning photos were contacted via direct message.

Results: Of the 231 entries submitted by 70 participants between August 1 and September 10, 2018, 13 prizes were awarded to 13 winners.

Budget and Resources: Beyond the prizes, this Challenge required no additional financial resources. One staff member worked on the contest organization, execution, and promotion for a total of five work days

Partnerships: N/A

Advancement of Agency Mission: The contest served to advance the Montenegrin public's support of the United States, and its values, and policies.

Solution Types: Other - Sharing a photo

Plan for Upcoming 2 FYs: N/A

[20] The website for the Montenegrin Summer in the States #USalumniMNE (U.S. Embassy Podgorica) can be viewed at https://www.facebook.com/notes/us-embassy-podgorica/montenegrin-summer-in-the-states-usalumnimne/10155898786427705/?__tn__=HH-R.

B.4.12 Tis the season 2017 - #MEholidaysWithUS[21]

Lead Sponsoring Agency: U.S. Embassy Podgorica

Authority: The United States Information and Education and Exchange Act of 1948, as amended (P.L. 80-402; 22 U.S.C. § 1431 et seq.), a.k.a. the Smith-Mundt Act

Status: This competition was launched and completed in FY18.

Competition Goals: The goal of this contest was to expand the reach of the Embassy's social media and showcase American holiday traditions.

Goal Types: Inform and educate the public; Engage new people and communities

Justification for Using Prizes and Challenges: Prizes were used as an incentive to encourage participation and contribute to the goal of expanding social media following.

Cash Prize Purses and/or Non-Cash Prize Awards: Each winner was awarded a branded bag containing U.S. Embassy's branded materials, including a t-shirt, umbrella, notebook, pen, pin, and mug with American symbols. Five branded bags containing U.S. Embassy's branded materials were awarded.

Solicitation of Submissions: Participants were asked to post a picture of their holiday decorations on the Embassy's social media properties.

Solicitation Types: Social media (e.g., Twitter, Facebook)

Participation Requirements: Contestants must have been at least 13 years old on the date of entry into the contest. Contestants must have been residents of Montenegro and not U.S. citizens or lawful permanent residents.

Evaluation of Submissions: Public Affairs evaluated the submissions internally and selected winners.

Results: Of the 45 entries submitted by 50 participants between December 13 and December 26, 2017, five prizes were awarded to five winners.

Budget and Resources: Beyond the prizes, this Challenge required no additional financial resources. One staff member worked on the contest organization, execution, and promotion for a total of five work days in FY18.

Partnerships: N/A

Advancement of Agency Mission: The contest served to advance the Montenegrin public's support of the United States, and its values and policies.

Solution Types: Other - Sharing a photo

Plan for Upcoming 2 FYs: N/A

[21] The website for the Tis the season 2017 - #MEholidaysWithUS (U.S. Embassy Podgorica) can be viewed at https://www.facebook.com/montenegro.usembassy/posts/10155979179929712.

B.4.13 U.S. Embassy Podgorica: Give Away #1[22]

Lead Sponsoring Agency: U.S. Embassy Podgorica

Authority: The United States Information and Education and Exchange Act of 1948, as amended (P.L. 80-402; 22 U.S.C. § 1431 et seq.), a.k.a. the Smith-Mundt Act

Status: This competition was launched and completed in FY18.

Competition Goals: The contest objective was to share symbols of the United States across social networks and increase the number of followers of the Embassy's Instagram account.

Goal Types: Inform and educate the public; Engage new people and communities

Justification for Using Prizes and Challenges: Prizes were used as an incentive to encourage participation and contribute to the goal of expanding social media following.

Cash Prize Purses and/or Non-Cash Prize Awards: The winner was awarded a branded bag containing U.S. Embassy's branded materials including a t-shirt, notebook, pen, pin, and mug with American symbols.

Solicitation of Submissions: Participants were invited to tag a friend.

Solicitation Types: Social media (e.g., Twitter, Facebook)

Participation Requirements: Participation was open to citizens of Montenegro of all ages, who reside in Montenegro. Each user could enter only one comment to qualify.

Evaluation of Submissions: The winner was selected by a raffle.

Results: Of the 68 entries submitted by 120 participants between July 30 and August 1, 2018, one prize were awarded to one winner.

Budget and Resources: Beyond the prize, this Challenge required no additional financial resources. One staff member worked on the contest organization, execution, and promotion for a total of two work days in FY18.

Partnerships: N/A

Advancement of Agency Mission: The contest served to advance the Montenegrin public's support of the United States, and its values and policies.

Solution Types: Other - Tagging a friend

Plan for Upcoming 2 FYs: N/A

B.4.14 U.S. Embassy Podgorica: Give Away #2[23]

Lead Sponsoring Agency: U.S. Embassy Podgorica

Authority: The United States Information and Education and Exchange Act of 1948, as amended (P.L. 80-402; 22 U.S.C. § 1431 et seq.), a.k.a. the Smith-Mundt Act

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[22] The website for the U.S. Embassy Podgorica: Give Away #1 can be viewed at https://www.instagram.com/p/Bl2YWNThMbA/?utm_source=ig_web_copy_link.

[23] The website for the U.S. Embassy Podgorica: Give Away #2 can be viewed at https://www.instagram.com/p/Bm0p_6XhX5P/?utm_source=ig_web_copy_link.

Status: This competition was launched and completed in FY18.

Competition Goals: The objective of the contest was to increase the Embassy's social media following, particular on its new Instagram account.

Goal Types: Inform and educate the public; Engage new people and communities

Justification for Using Prizes and Challenges: Prizes were used as an incentive to encourage participation and contribute to the goal of expanding social media following.

Cash Prize Purses and/or Non-Cash Prize Awards: The winner was awarded a branded bag containing U.S. Embassy's branded materials.

Solicitation of Submissions: Participants were invited to tag a friend.

Solicitation Types: Social media (e.g., Twitter, Facebook)

Participation Requirements: Participation was open to citizens of Montenegro of all ages, who reside in Montenegro. Each user might have entered only one comment to qualify.

Evaluation of Submissions: The winner was selected by a raffle.

Results: Of the 64 entries submitted by 89 participants between August 23 and August 25, 2018, one prize were awarded to one winner.

Budget and Resources: Beyond the prize, this Challenge required no additional financial resources. One staff member worked on the contest organization, execution, and promotion for a total of two work days in FY18.

Partnerships: N/A

Advancement of Agency Mission: The contest served to advance the Montenegrin public's support of the United States, and its values and policies.

Solution Types: Other - Tagging a friend

Plan for Upcoming 2 FYs: N/A

B.4.15 U.S. Embassy Podgorica: Give Away #3[24]

Lead Sponsoring Agency: U.S. Embassy Podgorica

Authority: The United States Information and Education and Exchange Act of 1948, as amended (P.L. 80-402; 22 U.S.C. § 1431 et seq.), a.k.a. the Smith-Mundt Act

Status: This competition was launched and completed in FY18.

Competition Goals: The contest objective was to share symbols of the United States across the social networks and increase the number of followers of the Embassy's Instagram account.

Goal Types: Inform and educate the public; Engage new people and communities

Justification for Using Prizes and Challenges: Prizes were used as an incentive to encourage participation and contribute to the goal of expanding social media following.

[24] The website for the U.S. Embassy Podgorica: Give Away #3 can be viewed at https://www.instagram.com/p/Bo1il9HBB_V/?utm_source=ig_web_copy_link.

Cash Prize Purses and/or Non-Cash Prize Awards: A winner was awarded with a branded bag and a pair of U.S. Embassy's branded headphones.

Solicitation of Submissions: Participants were invited to tag a friend.

Solicitation Types: Social media (e.g., Twitter, Facebook)

Participation Requirements: The Challenge was open to citizens of Montenegro of all ages, who reside in Montenegro. Each user was restricted to one entry.

Evaluation of Submissions: The winner was selected by a raffle.

Results: Of the 36 entries submitted by 50 participants between October 12 and October 17, 2018, one prize were awarded to one winner.

Budget and Resources: Beyond the prize, this Challenge required no additional financial resources. One staff member worked on the contest organization, execution, and promotion for a total of two work days in FY18.

Partnerships: N/A

Advancement of Agency Mission: The contest served to advance the Montenegrin public's support of the United States, and its values and policies.

Solution Types: Other - Tagging a friend

Plan for Upcoming 2 FYs: N/A

B.5 Department of Veterans Affairs (VA)

B.5.1 PseudoVet[25]

Lead Sponsoring Agency: VA

Authority: Space Act/Procurement Authority

Status: This competition was launched in FY17 and FY18, and was completed in FY18.

Competition Goals: Through this challenge, the VA sought the development of PseudoVet 1.0, a publically available, automated patient data fabrication engine that provides a set of active synthetic patients for healthcare software development and application testing. The target was to generate and perform continuous updates of mock provider, clinic, and scheduling entries to a subset of as many as 10,000 fabricated patients representing various clinical diagnoses based on template data.

Goal Types: Solve a specific problem; Develop technology

Justification for Using Prizes and Challenges: The VA was interested in crowd-sourcing the development of PseudoVet for a variety of reasons including the desire to broaden participation by Veterans in the gig economy to solve pressing problems for the VA. In this way we ensured development of a product for Veterans by Veterans. Few mechanisms aside from Prize competitions allow for this type of sourcing from citizens with talent and great ideas.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered was $95,000 and the total amount awarded was $167,000. Non-monetary incentives included recognition via TopCoder and VA.

[25] The website for the PseudoVet can be viewed at https://www.topcoder.com/PseudoVet.

Solicitation of Submissions: Solicitation was conducted by TopCoder on their platform. This solicitation specifically targeted the TopCoder community of solvers. Although VA pushed other solvers to the TopCoder platform, the agency relied heavily on this vendor's existing community. A more aggressive communications push by VA would have likely led to a greater diversity of solvers beyond just the TopCoder community.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release

Participation Requirements: The target solver base for this challenge was those possessing deep development expertise. This challenge was highly complex and narrow in the type of solver skillset that would be required. Because of this, the VA did not limit eligibility exclusively to United States citizens.

Evaluation of Submissions: The overall project was split into several individual challenges. Submissions were evaluated on a number of factors including: code quality, performance, requirements met, and documentation.

Results: Of the 542 entries submitted between August 8, 2017 and February 1, 2018, 75 prizes were awarded.

Budget and Resources: The VA contracted with TopCoder to administer this prize competition and to disburse funds to winners. The total budget was $500,000. The National Aeronautics and Space Administration (NASA) received an approximate 8% servicing fee through the interagency agreement. The remaining $442,152 was budgeted as follows over both fiscal years: $167,000 for prizes and $277,152 for administration costs to TopCoder. In FY17, the funding total was $177,152, and 0.25 FTEs were used. In FY18, the funding total was $267,000, and 0.25 FTEs were used.

Partnerships: N/A

Advancement of Agency Mission: Electronic health record systems sometimes require realistic patient data in order to facilitate development, testing, and training. While it is possible to obfuscate patient data from production systems, this is risky and involves a large effort to ensure no real patient data are accidently exposed. The alternative is to secure the environments as production, but this often needlessly complicates development, testing, and training. Pseudovet was developed to create realistic, but fake patient data. This data can be used in non-production environments to facilitate development, testing, and training. If one of these systems were to be exploited or improperly accessed, the data contained would have no impact on real individuals.

Solution Types: Software and apps

Plan for Upcoming 2 FYs: N/A

B.5.2 VA Gun Safety Matters Challenge[26]

Lead Sponsoring Agency: VA

Authority: Space Act/Procurement Authority

Status: This competition was launched in FY17 and completed in FY18.

Competition Goals: NineSigma, representing the U.S. Department of Veterans Affairs, sought novel and effective approaches that offer enhanced gun safety mechanisms to prevent suicide, injury, and

[26] The website for the VA Gun Safety Matters Challenge can be viewed at https://ninesights.ninesigma.com/web/gunsafety-Matters.

accidents. Specifically, the VA sought cost-effective options for a tangible device or system to be used voluntarily by a veteran or trusted friend or family member. The device or system was required to allow for 100% voluntary control (implementation, suspension, decommissioning) by the veteran. The goal was to provide safe firearm storage within or outside the home. Approaches were sought that addressed emotional distress or crisis, especially for those individuals who may not have a secondary support system such as family members or friends nearby, or who do not have the means for storing their guns safely.

Goal Types: Find and highlight innovative ideas; Solve a specific problem; Inform and educate the public; Engage new people and communities

Justification for Using Prizes and Challenges: Suicide prevention has been a top priority for years. Resources have been allocated to research, clinical intervention, and innovation. Much is known now about suicide decedents and the fact that the majority of veterans dying by suicide use a gun/firearm to do so needed to be addressed. The VA was interested in trying a new approach of crowd-sourcing to addressing some of the challenges facing the agency.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered and awarded was $60,000. The first place award was $30,000, the second place award was $20,000, and the third place award was $10,000. Non-monetary incentives included access to VA resources, such as subject matter experts, for any potential follow-on design and development; recognition across VA media streams to highlight the winning concepts/design; and a communications push via NineSigma media streams.

Solicitation of Submissions: Largely, the internet and social media were used to solicit submissions. The company contracted to administer the challenge, Ninesigma, Inc., also used email to solicit submissions. Overall, the judges anticipated more than the 40 submissions received, so one lesson learned is to request a more robust marketing plan in the future.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Webinar

Participation Requirements: Companies of all sizes, consultants, venture capitalists, entrepreneurs, or inventors were invited to respond to this request. Citizens or permanent residents of the US and its territories were eligible to participate. Responses were solicited via the online response form and included the following: (1) A description of the proposed approach, including a discussion of any technical aspects that enable an effective prevention mechanism for the use of a gun in a suicide attempt; (2) Any data or evidence to show or support the effectiveness of the approach in its current capability; (3) Availability of samples, prototypes, or demonstration of proposed technology; (4) Supporting data to show fit to stated criteria for the approach; and (5) Experience of the submitter or submission team in the proposed technology field.

Evaluation of Submissions: A team of subject matter experts across the Department of Veterans Affairs was compiled. Among the panel of judges, who reviewed the submissions and rated each based on a series of questions directly from the challenge criteria, were both civilian and veteran employees. In the future, one lesson learned is to provide a timeline to the judges so that they know what to expect. Winners were selected after compiling the scores of all judges.

Results: Of the 40 entries submitted between September 19, 2017 and January 8, 2018, three prizes were awarded.

Budget and Resources: A total of $135,000 was spent on this open innovation prize challenge. Three Department of Veterans Affairs subject matter experts worked together along with NASA staff in the entire process. There was no specific FTE allocated to this project, but in both FY17 and FY18 0.1 FTEs were used.

Partnerships: N/A

Advancement of Agency Mission: Suicide prevention has been among the top priorities for the Department of Veterans Affairs for several years. An average of twenty veterans die by suicide each day. In 2014, roughly 67% of all Veteran deaths by suicide were the result of firearm injuries. Statistics for that year also show that about 65% of all veterans who die by suicide are age 50 or older. Compared to their age-matched civilian peers, both male and female veterans have an increased risk for suicide. Research suggests that most suicidal crises pass within minutes to hours, and that building in time and space between a suicidal impulse and access to a gun reduces suicide deaths. In response, the VA Challenge Team was given the authority to seek solutions through an Innovation Challenge. The Gun Safety Challenge invited proposals for solutions that offer new options for enhanced safe gun storage to prevent suicide, injury, and accidents.

Solution Types: Software and apps; Creative (design & multimedia); Ideas; Technology demonstration and hardware

Plan for Upcoming 2 FYs: The VA Office of Mental Health and Suicide Prevention may pursue prize competition(s) again although there is no specific plan to at this time.

B.5.3 Veterans Online Memorial Challenge

Lead Sponsoring Agency: VA

Authority: Space Act/Procurement Authority

Status: This competition was launched in FY17 and completed in FY18.

Competition Goals: The online memorial will enable remembering, celebrating, and commemorating those buried at VA national cemeteries. This capability will allow remote participation in the grieving process, and extended celebration of veterans' lives, and can also serve a social memorialization function for students, researchers, and genealogists.

Goal Types: Improve government service delivery; Solve a specific problem; Develop technology

Justification for Using Prizes and Challenges: The purpose of this website is to provide an enhanced memorialization experience using user/public-driven content. Tapping the public to develop a tool that is both used and curated by the public seemed like a logical approach. Additionally, several of the micro-competition rounds of this challenge specifically engaged veteran solvers. As a result, this form of crowd-sourcing created an incentive structure that enabled meaningful contribution by veterans to develop a solution for veterans and their loved ones.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered was $197,373 and the total amount awarded was $169,043. Non-monetary incentives included recognition in the TopCoder newsletter.

Solicitation of Submissions: The VA relied primarily on HeroX and TopCoder to generate communications out to their robust solver communities. VA also released a blog post about the challenge and pushed information via the agency's innovation social media streams.

Solicitation Types: Social media (e.g., Twitter, Facebook); Press release

Participation Requirements: For the HeroX ideation challenge, the VA was seeking ideas to help frame the ideal online memorialization platform and experience. Participation and eligibility was according to HeroX platform rules and guidance. For the TopCoder-assisted challenges, the VA also relied on the existing eligibility, rules, and requirements.

Evaluation of Submissions: The VA team performed incremental reviews of wireframes, user interfaces, and final prototypes. VA reviewers conducted reviews and selections of winners across the stages of the challenge.

Results: Of the 76 entries submitted by 563 participants between September 27, 2017 and June 30, 2018, prizes were awarded to 22 winners.

Budget and Resources: The overall budget was $500,000. Of this, the NASA Center of Excellence for Collaborative Innovation received a service fee of approximately 8% ($40,000). The amount awarded as prizes to winners was $169,043. The administration cost for this challenge was $290,000 to the prize vendor, TopCoder. This prize competition lasted approximately nine months from beginning (planning) to close-out and required approximately 1.25 FTEs over the life-cycle of the challenge.

Partnerships: N/A

Advancement of Agency Mission: Currently, 77 of VA National Cemetery Administration's (NCA) national cemeteries are closed to burial, and that number will increase over time. NCA, in its commitment to memorialize Veterans in perpetuity, seeks to make available the stories of service and sacrifice of Veterans of all periods.

Solution Types: Software and apps

Plan for Upcoming 2 FYs: N/A

B.6 Environmental Protection Agency (EPA)

B.6.1 Smart City Air Challenge

Lead Sponsoring Agency: EPA

Authority: Clean Air Act Amendments, Section 103

Status: This competition was launched in FY17 and is underway in FY18.

Competition Goals: EPA needs to be ready to deal with the tremendous amount of data that will be produced from inexpensive air quality sensors. The main purpose of the Challenge is to learn how communities will manage large volumes of environmental data, yield a set of best practices for doing so, and encourage communities to share their practices with each other. A secondary purpose is to help people be more aware of air quality levels in their community.

Goal Types: Find and highlight innovative ideas; Engage new people and communities; Stimulate a market

Justification for Using Prizes and Challenges: Inexpensive sensors are not ready for regulatory use, but they are developing rapidly. EPA needs to be ready to deal with the tremendous amount of data they will provide. EPA can learn how communities manage the data from collecting it, to storing it, to making it available to the public. The Challenge provided EPA with real-world lessons about data management that could not have been learned using other approaches.

Cash Prize Purses and/or Non-Cash Prize Awards: Of a total prize purse of $100,000, $80,000 has been awarded.

Solicitation of Submissions: EPA used a website to describe the Challenge and posted frequent updates there. EPA reached out to potential applicants using social media, email, and webinars. Social media were particularly effective, especially EPA's social media accounts, which were picked up by influential

parties. Email and listservs were effective at engaging existing communities of interest. Webinars were useful in providing details and answering questions in real time about the challenge itself and about communities that had implemented similar projects. Finally, EPA reached out to journals and encouraged them to describe the Challenge to their readers.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Other - Webinars

Participation Requirements: The target audience was communities that could deploy hundreds of air quality sensors. Any group could enter as long as it included a U.S. local governmental party as a partner and all members of the team were over 15 years old. EPA defined community as anything from neighborhoods to counties to tribes. Applicants were not allowed to be a Federal entity or Federal employee acting within the scope of their employment. Employees of EPA, and/or any other individual or entity associated with the development, evaluation, or administration of the Challenge as well as members of such persons' immediate families (spouses, children, siblings, parents), and persons living in the same household as such persons, whether or not related, were not eligible to participate in the Challenge. Constraints included (1) the ability to deploy 250 to 500 sensors in a community; (2) community involvement in purchasing and using the sensors; (3) identification of partners and project sustainability; and (4) transparency in terms of making the data open and describing the data management plans.

Evaluation of Submissions: EPA evaluated the submissions based on four criteria: data management, data use, sensor procurement and deployment, and project sustainability. The Challenge used judges who were knowledgeable in the fields of data management and air quality measurement. Judges included subject matter experts from the Office of Air and Radiation, the Office of Environmental Information, and the Office of Research and Development. Submissions were screened to determine if they met the constraints. If so, judges evaluated them based on the four criteria. Judges were trained so they could evaluate the submissions in a similar fashion on a scale of 1 to 10 for each criterion. The fifteen judges were divided into three groups of five judges that had a similar mix of types of expertise. Each group of judges evaluated five submissions. Then all of the judges reviewed the highest rated submissions. Finally the judges conferred and agreed about the best two submissions and the four honorable mentions.

Results: Of the 22 entries submitted by over 100 participants between August 30 and October 28, 2016, two winners plus four honorable mentions were awarded.

Budget and Resources: Third-party vendors provided assistance with communications materials and planning the judging process. EPA staff tracked their activities and coordinated with the EPA project officer. In FY17, the competition was allocated $15,000 and 0.2 FTE; in FY18, no additional funding and only 0.05 FTE was used. Cash prize funds were provided in FY16 using a Miscellaneous Obligation Document (MOD). The funds were contributed by EPA's Office of Air and Radiation and EPA's Office of Environmental Information in the amount of $50,000 each. Such funds can be distributed once the MOD has been approved and do not have restrictions for distribution during a specific fiscal year.

Partnerships: N/A

Advancement of Agency Mission: The mission of EPA is to protect human health and the environment. The prize competition advanced the mission by learning how communities collect and use air quality data to understand local environmental conditions. This information will be used by individuals or agencies to protect themselves or the environment.

Solution Types: Other - Project plans

Plan for Upcoming 2 FYs: EPA plans to use what is learned how to help manage data that is collected and used at the local level.

B.6.2 Tox Test Challenge Stage II[27]

Lead Sponsoring Agency: EPA

Authority: Toxic Substances Control Act (TSCA)

Status: This competition was completed in FY17.

Competition Goals: Scientists from EPA, the National Center for Advancing Translational Sciences (NCATS), and the National Institute of Environmental Health Sciences' (NIEHS) National Toxicology Program (NTP) are using high speed, automated screening technologies called high-throughput screening (HTS) assays to rapidly test whether thousands of commonly used chemicals may affect human health. However, since current HTS assays do not fully incorporate chemical metabolism, they can miss chemicals that are metabolized to a more toxic form. In January 2016, EPA launched stage I of the Transform Toxicity Testing Challenge along with their partners, NCATS and the NIEHS NTP. The Transform Toxicity Challenge asked teams to develop prototypes that retrofit existing HTS assays to incorporate processes that reflect how chemicals are broken down and metabolized by the body. After selecting semi-finalists in May 2017, the EPA and its partners selected the Transform Toxicity Challenge Stage II winners.

Goal Types: Find and highlight innovative ideas; Solve a specific problem; Advance scientific research; Develop technology; Engage new people and communities; Build capacity; Stimulate a market

Justification for Using Prizes and Challenges: The prize/challenge approach enabled the agency to reach scientists from multiple disciplines that may offer new and creative strategies to address the problem. The prize approach provided the agency with the opportunity to review multiple solutions and only make the award if one of the solutions met the criteria.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered was $500,000, distributed in $100,000 awards to five winners. Non-monetary incentives included rigorous prototype testing, evaluation, and feedback on technology performance. Participants also received recognition and publicity and took part in peer networking.

Solicitation of Submissions: Solicitation strategies for the Challenge included tweets from the EPA twitter account, emails to relevant listservs, and official EPA press releases. Partner organizations also promoted the Challenge using similar strategies.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies)

Participation Requirements: N/A

Evaluation of Submissions: A panel of five judges was convened to evaluated the prototypes against the requirements identified in the challenge. Rigorous testing was conducted. The judging panel made recommendations to EPA management who made the final selection.

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[27] The website for the Tox Test Challenge Stage II can be viewed at https://www.challenge.gov/challenge/transform-tox-testing-challenge-stage-2/.

Results: Of the nine entries submitted by nine participants between January 30 and August 31, 2017 for phase two of this Challenge, five prizes were awarded to five winners.

Budget and Resources: Resources from EPA and partner organizations included scientists and technical staff as well as communication and administrative support. Contractor support was used to develop and host a website and provide communication support. In FY17, the challenge budget was $500,000 and required less than one FTE.

Partnerships: Federal partners included the NIH NCATS, and NIH's NTP within the NIEHS.

Advancement of Agency Mission: EPA's mission is to protect human health and to safeguard the natural environment. This Challenge helps to advance the agency's mission by accelerating the market and incentivizing the development of technology and algorithms that will help to more accurately and effectively screen chemicals for toxicity.

Solution Types: Technology demonstration and hardware; Scientific

Plan for Upcoming 2 FYs: Plans for next steps are in discussion.

B.6.3 Wildland Fire Sensors Challenge[28]

Lead Sponsoring Agency: EPA

Authority: Clean Air Act, Section 103, 42 USC 7403

Status: This competition was launched in FY17 and completed in FY18.

Competition Goals: This Challenge addresses the need to advance air measurement technology used in wildland fire situations to provide more accurate information about smoke levels to state and local organizations so that citizens and first responders can minimize their exposure. The technical goal was to make air measurement technology in wildland fire situations easier to deploy, suitable for use in high concentration events, durable to withstand difficult field conditions, and able to report data continuously and wirelessly. Desired measurements were to include fine particles (PM2.5), ozone, carbon monoxide, and carbon dioxide.

Goal Types: Improve government service delivery; Find and highlight innovative ideas; Solve a specific problem; Advance scientific research; Develop technology; Inform and educate the public; Engage new people and communities; Stimulate a market

Justification for Using Prizes and Challenges: A challenge/prize approach enabled us to reach technology developers from around the world and from disciplines who normally would not be focused on EPA research opportunities but could bring creative new approaches to the problem. In addition, the prize approach would create more excitement and visibility and be less bureaucratic than traditional contracting or grant mechanisms. Involvement of six Federal agencies also signaled that this is a priority for technology development. Using technologies that are already in development, a challenge had the potential to provide a wide range of solutions more cost effectively than was likely in-house or through a contract. A prize approach also provided an easy way to collaborate with multiple Federal agencies, now and in the future. Lastly, a competition provided a reasonably low-risk process because the agency only had to award prize funds if the challenge succeeded.

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[28] The website for the Wildland Fire Sensors Challenge can be viewed at https://www.challenge.gov/challenge/wildland-fire-sensors-challenge/ & https://www.epa.gov/air-research/winners-wildland-fire-sensors-challenge-develop-air-monitoring-system-prototypes.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered was $60,000, with $35,000 awarded to the first prize winner and $25,000 awarded to the second prize winner. Non-monetary incentives included rigorous testing, evaluation and feedback on technology performance. Winners were announced at a conference where they could receive recognition from peers, the public, and media.

Solicitation of Submissions: A contractor was retained to share the Challenge with the international solver community. The Challenge announcement was posted on Challenge.gov. Federal partners amplified the announcement through social media, webinars, newsletters, list serves, flyers, announcements at professional meetings, etc.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies); Other - Informational webinars

Participation Requirements: The target solver audience included engineers, technology developers, sensor developers, environmental scientists, computer scientists, telemetry experts, etc.

Evaluation of Submissions: For the first stage, EPA technical staff reviewed the written submissions and identified those that addressed the challenge criteria. These were asked to submit prototypes. Not all did so. To evaluate the submissions that were received, EPA technical staff worked with technical colleagues in other agencies to agree on testing procedures. Rigorous technology testing was carried out at EPA and U.S. Forest Service laboratories. Using the agreed-upon criteria, an interagency judging panel, with participation from a non-Federal partner, Tall Timbers Research Station, reviewed the results of the testing, met by conference call, received a briefing on the results and evaluated the data based on the requirements in the Challenge. They made recommendations for challenge winners and an honorable mention. Finally, senior managers within EPA's Office of Research and Development reviewed the recommendations and made the final decisions.

Results: Twenty-seven preliminary submissions were received by November 22, 2017, and ten prototypes by January 5, 2018. Two prizes and one honorable mention prizes were awarded.

Budget and Resources: In FY17, $16,000 was provided for contractor support for communication and outreach and $25,000 was allocated for the award. In FY18, $35,000 was spent for the award. Less than one FTE was used in FY17, but 1.5 FTE was needed in FY18. Communications and administrative support involved preparing the communications plan, written materials, FAQs, press release, and social media for both the launch and announcement of the winners as well as development of a video to describe the challenge and the winners. Federal partners collaborated on the challenge design, technical review, testing, and judging involved review of written submissions, conducting laboratory testing of prototypes, and a multi-agency panel that met to review all of the results and develop recommendations for awards.

Partnerships: Federal Partners included the U.S. Forest Service, National Aeronautics and Space Administration, National Oceanic and Atmospheric Administration, Centers for Disease Control and Prevention, and National Park Service. The non-Federal partner was Tall Timbers Research Station. Partners provided technical expertise in challenge development and judging and monetary support for laboratory testing. In-kind support was provided for use of testing facilities and staff time for testing, marketing, outreach, and communications. The estimated value of partner contributions amounted to $30,000 in direct contributions and $30,000 in in-kind support.

Advancement of Agency Mission: EPA's mission is to protect human health and to safeguard the natural environment. Wildland fires are increasing in intensity and duration. Communities are exposed to

dangerous levels of air pollutants from smoke for weeks at a time. The very young, the elderly, those with respiratory or cardiovascular health conditions are particularly at risk. To enable communities to reduce dangerous smoke exposures, they need near real-time information about smoke conditions. With information about where smoke and pollutant concentrations are highest, people can plan their daily activities to avoid the worst exposures and protect their health as much as possible. This Challenge helped advance EPA's mission to protect public health by developing the technologies needed to address this new, longer lasting environmental health threat.

Solution Types: Technology demonstration and hardware

Plan for Upcoming 2 FYs: N/A

B.7 National Aeronautics and Space Administration (NASA)

B.7.1 3D-Printed Habitat Challenge (Phases 2&3)[29]

Lead Sponsoring Agency: NASA

Authority: 51 USC § 20144

Status: This competition was launched in FY17 and is currently underway in FY18.

Competition Goals: The 3D-Printed Habitat Challenge seeks to develop housing solutions for extended duration missions on planetary surfaces (particularly on Mars) using advanced additive construction technology. This technology will use indigenous materials, mission recyclables, and the capabilities of 3D-printing to achieve efficient and sustainable building materials and construction. These developments will be applicable both to the fulfillment of the Mars mission and to the creation of cheaper and more sustainable housing solutions on Earth.

Goal Types: Find and highlight innovative ideas; Solve a specific problem; Advance scientific research; Develop technology; Inform and educate the public; Engage new people and communities; Stimulate a market

Justification for Using Prizes and Challenges: 3D-printing technology is maturing quickly, and there are inventors and entrepreneurs who are investing money to develop systems that can construct large structures the size of a house for potential profit or service in an emergency situation. The purpose of this competition is to see how NASA can push the technology and harness it for space exploration. A prize competition brings in experts from outside the space industry and ideas that are outside-the-box to engage the public in space exploration activities.

Cash Prize Purses and/or Non-Cash Prize Awards: In FY17, the total prize purse offered was $1,100,000 and the total amount awarded was $701,000. For Phase 2 level 1, $100,000 was available, and a total of $100,000 was awarded to two teams; for Phase 2 level 2, $500,000 was available, and a total of $201,000 was awarded to four teams; and for Phase 2 level 3, $500,000 was available, and a total of $400,000 was awarded to two teams. In FY18, $100,000 was available for Phase 3 level 1 and a total of $100,000 was awarded to five teams. For Phase 3 level 2, $400,000 is available, and a total of $120,000 was awarded to three teams. Phase 3 continues into FY19 with additional prize purse available.

[29] The website for the 3D-Printed Habitat Challenge (Phases 2&3) can be viewed at https://www.bradley.edu/challenge/.

Solicitation of Submissions: Public announcement of the Challenge was made on the FedBizOps website. For Phase 2, the Challenge was announced at Maker Faire in New York. Phase 3 was opened at the Building Information Modeling (BIM) Forum Conference in Dallas, Texas, in November 2017. Centennial Challenges has exhibited the Challenge at the American Concrete Institute (ACI) Conventions in Detroit and Los Angeles and also at the World of Concrete in Dallas. A website that is produced by Bradley University specifically for administering the Challenge is promoted in many correspondences and public press releases. The NASA Centennial Challenges Program and NASA Solve social media accounts (Facebook, Twitter, and Instagram) are used to bring attention to activities or videos to attract competitors and for general awareness.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Day-long event(s) prior to the competition; Live video streaming; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies)

Participation Requirements: The target solver audience is inventors, entrepreneurs, designers, architects, makers, and the construction industry. All U.S. citizens and foreign nationals are welcome to participate in the Challenge except for four countries currently on the designated country list that support terrorism. Only U.S. citizens are eligible to win prize money.

Evaluation of Submissions: A lead judge was selected from one of the sponsors to bring expertise from the construction industry. In selecting judges, experts with a good mix of experience with both space and terrestrial projects were sought. The submissions were evaluated strictly according to rules and rubrics established prior to the competition's start. Wherever possible, objective guidelines were established to help judges make evaluations.

Results: For Phase 2, entries from seven teams were received for level 1, seven for level 2, and three for level 3 by October 06, 2017; total participation for Phase 2 was ~100 people. Two prizes were awarded for level 1 on March 31, 2017; six prizes were awarded for level 2 on May 31, 2017; and two prizes were awarded for level 3 on August 25, 2017. For Phase 3, which will conclude in May 2019, entries from 18 teams were received for level 1 and three for level 2 by November 07, 2017; total participation was 178 people. Five prizes were awarded for level 1 on May 16, 2018 and three prizes were awarded for level 2 on July 11, 2018.

Budget and Resources: Funding for the 3D-Printed Habitat Challenge in both FY17 and FY18 was $319,000. In FY17 and FY18, 1.4 FTEs[30] were needed for the competition to provide subject matter experts from NASA who participated in the development of the rules, judging, and guidance of the allied organization (Bradley University) to direct the competition toward the correct technology that can make an impact for space exploration. Procurement and travel funds were utilized to help promote the competition to the communities that were most capable of advancing the technology and to conduct workshops to plan for the Challenge and invigorate challenge teams.

Partnerships: Bradley University is the allied organization conducting the 3D-Printed Habitat Challenge with support from sponsors Caterpillar, Bechtel, and Brick & Mortar Ventures. Bradley University executes the competition and ensures that the outcomes meet the overall goals of NASA and the Centennial Challenges Program. Caterpillar, as a major sponsor of the Challenge, facilitates all coordination activities of the Challenge and provides facilities for the major head-to-head competition at the Edwards Facility near Peoria, Illinois. Construction Engineering Research Lab (CERL) of the U.S. Army Corps of Engineers has provided expert guidance under a Memorandum of Agreement for rules

[30] 1.2 FTEs were from the Marshall Space Flight Center and 0.2 FTEs were from the Kennedy Space Center.

development and judging. The total value of Bradley University & sponsors (Caterpillar, Bechtel, and Brick & Mortar Ventures) contribution for 2017 was $747,000 and approximately $1,000,000 for 2018.

Advancement of Agency Mission: Advancements in 3D-Printing (i.e., additive manufacturing) will provide benefits to future NASA missions and may enable new mission scenarios. Using indigenous and recyclable material on a lunar or Mars mission will reduce overall payload requirements and reduce the risk for astronauts, making space exploration missions possible.

Solution Types: Creative (design & multimedia); Ideas; Technology demonstration and hardware; Scientific; Other - Space Exploration

Plan for Upcoming 2 FYs: The 3D-Printed Habitat Challenge Phase 3 is planned to run thru May 2019. The final level of the competition will be the autonomous 1:3 Sub-Scale Habitat at the Caterpillar Edwards Facility where eight teams will be invited to compete. NASA will evaluate whether to open a Phase 4 that would involve construction of the full-scale habitat.

B.7.2 Breakthrough, Innovative, and Game-Changing (BIG) Idea Challenge[31]

Lead Sponsoring Agency: NASA

Authority: 31 USC § 6301, et seq.

Status: This competition was completed in both FY17 and FY18.

Competition Goals: The BIG Idea Challenge provides for the free flow of information, ideas, and concepts between NASA's Game Changing Development (GCD) program and the university research, education, and industry communities, and achieves the following secondary objectives: (1) opportunities to inexpensively tap university talent on important challenges facing GCD with potential to more quickly advance technology readiness levels; (2) potentially introduce concepts into future NASA research and program planning; (3) provide opportunity for NASA GCD engineers to interact with faculty and students as well as explore workforce pipeline opportunities; (4) provide a real-world challenge for the aerospace industry and other stakeholders that results in the development of a highly talented future workforce pool; (5) demonstrate and leverage university-NASA GCD-industry cooperation; and, (6) provide students with the opportunity to develop highly transferable skills in collaboration, communication, and critical thinking, as well as the opportunity to engage in teamwork activities, which are relevant and highly desired skills for future NASA GCDP employees.

Goal Types: Find and highlight innovative ideas; Solve a specific problem; Develop technology; Engage new people and communities; Build capacity; Other - Educational outreach and engagement

Justification for Using Prizes and Challenges: This initiative uses a challenge/competition format but does not award monetary prizes. For a STEM education outreach effort, this format is useful because this initiative is designed to align with academic studies in multi-disciplines related to NASA's mission and to foster exciting innovation and sharing of ideas from the best and the brightest students in the United States. By design, this program ties in with academic calendars and lends itself to become focal projects in senior capstone courses, student clubs, and graduate student studies within university environments.

[31] The website for the Breakthrough, Innovative, and Game-Changing (BIG) Idea Challenge can be viewed at http://bigidea.nianet.org.

Cash Prize Purses and/or Non-Cash Prize Awards: No prize money is offered as part of this Challenge. Non-monetary incentives include opportunity to work on real-world, NASA-based research; expert feedback from judges; public recognition; tour of a NASA facility; opportunity to present in front of subject-matter expert judges; NASA internship opportunities offered to winning team to further advance promising designs.

Solicitation of Submissions: The FY17 and FY18 BIG Idea Challenges were promoted using a robust email campaign targeting ~3,000 faculty with specified interest in aerospace engineering. Emails targeted directly to university professors have proven to be very effective, and we see a significant correlation between website visits and email distributions. The Challenge was also announced through NASA's Education Express and Science Wow! to ~31,000 subscribers and ~90,000 NASA Education Twitter Followers. The Challenge was posted on the NASA Solve website and on the Institute for Broadening Participation's Pathways to Science page. Additionally, an informational flyer was created and distributed to the National Institute of Aerospace's (NIA) network of previous participants in other challenges to explain the challenge details and constraints. Press releases were issued by NASA for both the FY17 and FY18 Challenges. A website for the challenge is maintained and updated for each year's challenge.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release

Participation Requirements: The BIG Idea Challenge is open to teams of three to five undergraduate and graduate students studying in fields applicable to human space exploration (i.e., aerospace, electrical, and mechanical engineering; and life, physical, and computer sciences). Eligibility is limited to students from accredited universities in the United States. Foreign universities are not eligible to participate in the BIG Idea Challenge.

Evaluation of Submissions: Participating teams for the FY17 and FY18 BIG Idea Challenges were selected as finalists by a panel of judges using an evaluation rubric. Judges for the FY17 challenge were all from NASA while the FY18 challenge was a hybrid of government and external (industry) reviewers. In FY17, the criteria were: (1) feasibility of proposed concept or idea, including low system mass, design simplicity, and ground testability (40 percent); (2) innovative, unique and/or synergistic advanced concepts, modularity, and concept of operations for robotic assembly, module deployment and replacement, and extensibility (30 percent); (3) systems analysis of requirements, including identification of challenges and issues including Technical Readiness Level of mission-enabling technologies (20 percent); (4) evidence of credible and implementable project plan (5 percent); and (5) concept is supported by original engineering and analysis (5 percent). In FY18, the criteria were: (1) feasibility of proposed design, including low system mass, design simplicity, Mars environmental resiliency, and Earth ground testability (40 percent); (2) innovation of proposed ConOps for unattended installation/deployment and sustained, long-term power generation in the Martian environment (30 percent); (3) adequacy of proposed engineering analysis to support structural design and power output predictions (20 percent); (4) ability to fabricate an affordable proof-of-concept experimental prototype that addresses the key design and operational challenges (10 percent)

Results: In FY17, 29 submissions were received from five teams. In FY18, 16 submissions were received from five teams. Winners were announced on November 30, 2016 and November 30, 2017, respectively.

Budget and Resources: The administrative cost for the BIG Idea Challenge activity was $110,980 in FY17 and $125,316 in FY18. These costs were for NIA program management and other direct costs including but not limited to university stipends provided to participating universities through their respective Office of Sponsored Programs to enable the teams to participate in the culminating NASA Forum/Design Review. Additional costs for FY17 included $80,000 for NASA internships awarded through the Challenge

($70,000 for internships and $10,000 for materials to build BIG Idea prototypes). Additional costs for FY18 included $70,000 for NASA internships ($60,000 for internships and $10,000 for materials to build BIG idea prototypes).

Partnerships: Through a cooperative agreement with NASA Langley Research Center, the NIA provides day-to-day administration of the BIG Idea Challenge for NASA. Their certified program managers, program coordinators, and meeting planners provided a robust marketing plan, extensive contact lists, in-kind challenge website hosting, graphics support, submission management, and event planning for the culminating Forum. Involving industry (Space Systems Loral) on the judging panel added value to the competition and opened additional avenues for future internships/jobs for the students.

Advancement of Agency Mission: The BIG Idea Challenge engages the university community with NASA's GCD program efforts to rapidly mature innovative/high impact capabilities and technologies for infusion in a broad array of future NASA missions. It links academic institutes with the NASA Space Technology Mission Directorate, in which the GCD program resides, and multidisciplinary university teams are asked to provide innovative solutions to current GCD projects. Each year, the program theme is developed by one of GCD's Principal Technologists (PT) and is fashioned in a way that allows the academic community to be an active, productive, and contributing part of the PT's work at NASA.

Solution Types: Ideas; Analytics, visualizations, algorithms; Scientific

Plan for Upcoming 2 FYs: The FY19 BIG Idea theme currently seeks ideas from the academic community for the design and operation of a Mars Greenhouse that will complement the Mars Ice Home. Supplying reliable and effective food production systems on Mars will reduce the need to transport food from Earth and also promote crew health on long surface missions. A design review of the top five finalist teams will be conducted during the BIG Idea Forum in April 2019 at NASA Langley Research Center and features a robust panel of judges from NASA and industry.

B.7.3 CineSpace Film Competition[32]

Lead Sponsoring Agency: NASA

Authority: 31 USC § 6301, et seq.

Status: This FY17 competition is complete, and the FY18 competition is underway.

Competition Goals: The International Space Station (ISS) External Integration Office created a unique film competition inspired by the past, current, and future efforts of the United States and its global partners to expand human knowledge through the exploration of space. NASA and the Houston Cinema Arts Society (HCAS) offered filmmakers around the world a chance to share their works inspired by and using actual NASA imagery. The films of the finalists and winners were screened at the Houston Cinema Arts Festival in November of 2017 and 2018.

Goal Types: Inform and educate the public

Justification for Using Prizes and Challenges: Crowd-based challenges using a prize have been proven extremely effective for film development for use by NASA.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered and awarded was $26,000. Non-monetary incentives included showing of the winning films during the HCAS Film Festival in Houston.

[32] The website for the CineSpace Film Competition can be viewed at https://tongal.com/l/55fz9wra0awp.

Solicitation of Submissions: Tongal, the NASA Tournament Lab (NTL) vendor managing the Challenge, solicited submissions from its existing member community and the public through blog features, emails, and social media campaigns. Tongal promoted the Challenge heavily at the start and during the final month while maintaining consistent awareness throughout the campaign. Tongal reached out to its community and other film communities by posting to relevant websites and newsletter blasts.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies); Other - Outreach by the vendor to existing platform members

Participation Requirements: Submissions from any restricted country list were not eligible to receive the award.

Evaluation of Submissions: Judging was completed by the NASA/HCAS team.

Results: In FY17, 689 entries were submitted by 646 participants. Five winners were announced November 11, 2017. In FY18, 242 entries were submitted by 222 participants. Five winners were announced November 13, 2018.

Budget and Resources: The full challenge budget ($56,000 in FY17 and $50,000 in FY18) was funded by the NASA ISS External Integration Office. The funds were disbursed to the vendor via the NASA Open Innovation Services contract. The vendor conducted the Challenge and awarded the prize money. Funds included prizes, vendor project management resources, and platform fees. NASA FTE/work year equivalent (WYE) resources (0.01 FTE and 0.02 WYE in both FY17 and FY18) supported challenge coordination activities including development of the Task Order Request for Proposal and award processes as well as oversight of challenge execution .

Partnerships: The HCAS participated in the evaluation of the submissions for selection as winners and provided the venue for showcasing the winning films.

Advancement of Agency Mission: This film competition supports NASA's mission to expand human knowledge through the exploration of space as well as highlighting the significant amount of imagery available to the public from NASA's repository.

Solution Types: Creative (design & multimedia)

Plan for Upcoming 2 FYs: There is a plan to conduct this challenge for the next fiscal year.

B.7.4 Cube Quest Challenge[33]

Lead Sponsoring Agency: NASA

Authority: 51 USC § 20144

Status: This competition was underway in both FY17 and FY18, but has not concluded.

Competition Goals: NASA's Space Technology Mission Directorate (STMD)/Centennial Challenges program administers the Cube Quest Challenge to incentivize the advancement of CubeSat and nanosatellite capabilities to stimulate the small spacecraft market needed for conducting unique and more affordable science and explorations missions in deep space. The goal of the Challenge is to develop CubeSat technologies and missions with advanced capabilities needed for deep space

[33] The website for the Cube Quest Challenge can be viewed at https://www.nasa.gov/cubequest/details.

operations and then to demonstrate their performance at the Moon ("Lunar Derby") or beyond ("Deep Space Derby").

Goal Types: Find and highlight innovative ideas; Solve a specific problem; Advance scientific research; Develop technology; Inform and educate the public; Engage new people and communities; Stimulate a market

Justification for Using Prizes and Challenges: The objective of the Challenge is to reward citizen inventors who successfully advance the CubeSat technologies needed for operations at the Moon and beyond, particularly long-distance communications, navigation beyond earth, and long-term survival. Our goal is to advance technologies and private industry for spacecraft whose small size and light weight will help NASA to explore and conduct science in deep space in novel, more affordable ways.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered was $5,000,000. A set of eight challenge goals were set for the in-space competition that takes place after a competitor achieves lunar orbit ("Lunar Derby") or a range of four million kilometers from Earth ("Deep Space Derby"). The total of all eight challenge goals comprises a prize purse of $4.5M. During a series of Ground Tournaments (GTs), $460,000 was awarded (GT-1: five prizes of $20,000 each were awarded in September 2015; GT-2: five prizes of $30,000 each were awarded in March 2016; GT-3: five prizes of $30,000 each were awarded in October 2016; and GT-4: three prizes of $20,000 each were awarded in June 2017). As a non-monetary incentive, each of the three winners of GT-4 were offered the opportunity to launch a 6U CubeSat via the Space Launch System as a secondary payload on NASA's EM-1 mission.

Solicitation of Submissions: Public announcement of the Challenge was announced in FedBizOps and to a small satellite mailing list maintained by the STMD Small Spacecraft Technology Program. An organizing summit, open public event was conducted with the purpose of announcing the Challenge and disseminating rules and answering questions. It was attended by more than 120 members of the interested public.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Day-long event(s) prior to the competition; Live video streaming

Participation Requirements: The team leader had to be (i) a citizen or permanent resident of the United States, or (ii) an entity that is incorporated in and maintains a primary place of business in the United States. A competitor team was comprised of one or more team members. A team member could be an individual or an entity. If a team member was an individual, the individual had to be a citizen or permanent resident of the United States. If the team member was an entity, the entity must be a U.S. entity (i.e., incorporated in and maintains a primary place of business in the United States). Foreign nationals could only participate as either owners, employees, or students of an otherwise eligible U.S. entity. No team member could be a citizen of a country on the NASA Export Control Program list of designated countries. A Federal entity or Federal employee could not participate in the Challenge if acting within the scope of their employment. An entity employee, or entity, contracted by the US. Government and physically located at a federally owned facility could not participate if acting within the scope of the contract.

Evaluation of Submissions: A panel of five judges was convened for each of the GT events. The judging panel comprised of three NASA subject matter experts, one expert from academia, and one expert retired from small spacecraft industry. Prior to each GT, judging instructions were updated and re-published. The goals and standards were raised as expectations for CubeSat design maturity increased at each successive milestone. Judges used a written set of detailed instructions for evaluating and scoring submittals according to a scaling system specified in the instructions. The scoring instructions

were publicly available to competitors before each judged event. Judges also provided written, post-judging feedback summaries to teams after each judged event, for use by the teams to consider improvements before the next event.

Results: Thirteen teams submitted 13 entries for GT-1, ten entries for GT-2, seven entries for GT-3, and five entries for GT-4.

Budget and Resources: The Challenge is part of NASA's Centennial Challenges Program, which is part of NASA's STMD. Challenge development, oversight, and prize purse were funded by NASA's STMD. The FY17 FTE and procurement budget ($942,000 and three FTEs) was used for administration of the Challenge, enforcement of rules, and execution of GT-3 and GT-4. It included a prize award event at Ames Research Center including rental of facility for GT-4. The FY18 FTE and procurement budget ($761,000 and three FTEs) was used for administration of the Challenge, enforcement and updates of the rules, and preparations for the upcoming in-space competition scheduled for FY20-FY21.

Partnerships: N/A

Advancement of Agency Mission: Advancements in small spacecraft capabilities will provide benefits to future missions and may enable new mission scenarios, including future investigations of the Moon and near-Earth asteroids. If capabilities associated with larger spacecraft can be achieved in the smaller platform of CubeSats, a dramatic improvement in the affordability of space missions will result, greatly increasing science and research possibilities.

Solution Types: Technology demonstration and hardware

Plan for Upcoming 2 FYs: The Challenge continues in FY19 and FY20 with the in-space competition phase. In FY20, the top three CubeSat designs are scheduled to launch on NASA's EM-1 mission. From the Moon or beyond, the CubeSat operating teams will compete for prizes by accomplishing any of a set of eight in-space competition goals. Other teams may choose to compete by obtaining their own launch to reach the Moon or beyond to compete in the in-space competition. The competition will end exactly 365 days after EM-1 launch (regardless of whether or when a team may have obtained their own launch), and prizes will be awarded after all accomplishments are judged at that time.

B.7.5 Future Engineers 3D Design Challenges[34]

Lead Sponsoring Agency: NASA

Authority: 51 USC § 20113(e)

Status: This competition was completed in both FY17 and FY18.

Competition Goals: Through a series of Future Engineers 3D Space Challenges, students focused on solving real-world space exploration problems and submitted model designs for 3D printable objects for use by astronauts in space. In the Mars Medical Challenge, students were challenged to design an object that could be used by an astronaut to maintain physical health on a 3-year mission to Mars. Students submitted a digital 3D model intended to be 3D printed and used for a wide range of medical needs including diagnostic, preventative, first-aid, emergency, surgical, and/or dental purposes. In the Two for the Crew Challenge, students were challenged to create a tool that comingles the functions of two objects currently used by crew aboard the International Space Station. Students invented multi-

[34] The website for the Future Engineers 3D Design Challenges can be viewed at https://www.futureengineers.org/.

use tools and customized equipment, including solutions used for maintenance, medical, trash management, and securing and storing items in microgravity.

Goal Types: Find and highlight innovative ideas; Solve a specific problem; Inform and educate the public

Justification for Using Prizes and Challenges: A challenge run through an agreement made with the American Society of Mechanical Engineers under the National Aeronautics and Space Act (a Space Act Agreement) provided NASA the opportunity to engage in a no-cost partnership arrangement to obtain solutions and to engage a broad range of student ideas from ages 5-19, thereby gaining out-of-discipline perspectives and a broad spectrum of possible solutions to NASA problems.

Cash Prize Purses and/or Non-Cash Prize Awards: No cash prizes were offered. For the Two for the Crew Challenge, the teen winner had their design printed on the Made In Space 3D printer on the International Space Station (ISS) and got a trip to Washington D.C. for a VIP space experience, including participating in an ISS Downlink at the Smithsonian Air and Space Museum. The junior winner was awarded a trip to Washington D.C. for a VIP space experience, including participating in an ISS Downlink at the Smithsonian Air and Space Museum. Four finalists in each age group were awarded a Makerbot Replicator Mini+ donated to their school, library, or education organization. Sixteen semi-finalists in each age group were awarded a 3D printing-in-space prize pack. For the Mars Medical Challenge, the winner in each age group was awarded a trip to Houston, Texas and a tour of the NASA Johnson Space Center to learn about human exploration, space medicine, and the Journey to Mars. Four finalists in each age group were awarded a MakerBot Replicator Mini+ printer donated to their school, library or education organizations and a set of Giant Microbes plush cells. Sixteen semi-finalists in each age group were awarded a Mars-themed prize pack

Solicitation of Submissions: The challenges were launched on the Future Engineers platform, an online education platform that hosts national innovation challenge for K-12 students. They have been extremely successful in engaging students and, as a result of the collaboration, received a Small Business Innovation Research award from the Department of Education to expand the platform to the in-school setting.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies)

Participation Requirements: The 3D Space Challenge was open to eligible persons between the ages of 5-19 residing in the United States.

Evaluation of Submissions: The competition is comprised of an open entry submission phase with two categories: junior engineers (ages 5-12) and teen engineers (ages 13-19). Submissions were initially judged to determine ten semifinalists and then culminated in a second round of judging to select four finalists followed by an interview round to select one winner in each age group. Submissions were judged using the following criteria: innovation and creativity of the solution (40%); quality of the 3D modeled geometry, and compliance with design guidelines (20%); usefulness of the design in a space environment (20%); ability to communicate the design through the text description, and finalist interview (20%).

Results: The Mars Medical Challenge received 745 entries. A total of thirty prizes including semi-finalists, finalists, and winners were awarded. The Two for the Crew Challenge received 565 entries. A total of thirty-one prizes including semi-finalists, finalists, and winners were awarded.

Budget and Resources: NASA resources in both FY17 and FY18 were 0.25 FTE each.

Partnerships: The Challenge was conducted through a nonreimbursable agreement under the National Aeronautics and Space Act (the Space Act Agreement) with the American Society of Mechanical Engineers Foundation, which implemented the Challenge through the Future Engineers platform. The value of partner contributions was $400,000 in each fiscal year.

Advancement of Agency Mission: These challenges provide an opportunity for students to focus on real-world space exploration challenges and prepare our next generation of space explorers who will take the first step on Mars. The challenges also provide NASA with an opportunity to tap into the creativity and innovation of a new pool of solvers to obtain potential new designs for future space missions.

Solution Types: Creative (design & multimedia); Technology demonstration and hardware

Plan for Upcoming 2 FYs: Continuation of challenges through a no-cost contract.

B.7.6 High Performance Fast Computing Architecture Challenge

Lead Sponsoring Agency: NASA

Authority: 31 USC § 6301, et seq.

Status: This competition was cancelled in FY17.

Competition Goals: NASA's Aeronautics Research Mission Directorate (ARMD) sought an architectural analysis of the current processing configuration for the FUN3D software with recommendations on improving performance.

Goal Types: Solve a specific problem; Develop technology

Justification for Using Prizes and Challenges: The agency firmly supports the use of prize challenges to solve difficult problems and engage a broader community in agency activities.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered was $35,000. The total amount awarded was $0 because the Challenge was cancelled.

Solicitation of Submissions: As with all NASA Tournament Lab challenges, NASA worked with its vendor, Topcoder, to mobilize an international community specific to the Challenge, based on the curated community already existing for the particular vendor platform. For this Challenge, NASA chose to release its own web feature on the nasa.gov public website. Cancellation of the Challenge was also posted as a web feature.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Other - NASA web feature

Participation Requirements: Participation was limited to U.S. citizens only.

Evaluation of Submissions: N/A

Results: More than 1,800 people applied to receive a copy of the code base from both the ideation and architecture challenges. A total of 335 entries were submitted between May 03, 2017 and September 30, 2017, when the Challenge was cancelled.

Budget and Resources: The full challenge budget was funded by NASA's ARMD. The funds were awarded to the crowdsourcing vendor TopCoder via the NASA Open Innovation Services (NOIS) contract. The awarded vendor received $107,000 of the originally awarded $141,500 for their effort in challenge design and launch prior to cancellation. NASA FTE/WYE resources (0.8 FTE and 0.1 WYE) supported the Challenge coordination activities needed prior to and up to the release of a NOIS task order as well as significant efforts involved in cancelling the Challenge.

Partnerships: N/A

Advancement of Agency Mission: This challenge was intended to support NASA's aims to improve the performance and efficiency of aeronautical systems. NASA was seeking ideas for innovative architecture enhancements for the NASA FUN3D software while providing readily achievable benefits to the current ARMD program with minimal additional capital investment. However, the extremely high number of applicants, more than 1,800, coupled with the difficulty in satisfying the extensive vetting requirements to control the public distribution of the software made it unlikely the Challenge owner would achieve the Challenge's original objectives in a timely manner. NASA looked at several alternatives to keep the challenge design intact like significantly extending the challenge performance period, and offering a much smaller portion of the code. None were considered viable options.

Solution Types: Software and apps; Ideas

Plan for Upcoming 2 FYs: N/A

B.7.7 High Performance Fast Computing Ideation Challenge

Lead Sponsoring Agency: NASA

Authority: 31 USC § 6301, et seq.

Status: This competition was cancelled in FY17.

Competition Goals: NASA's Aeronautics Research Mission Directorate (ARMD) sought ideas to improve the performance of its existing FUN3D Computational Fluid Dynamics software to maximize innovation and decrease software execution time while providing readily achievable benefits to the current ARMD program.

Goal Types: Solve a specific problem; Develop technology

Justification for Using Prizes and Challenges: The agency firmly supports the use of prize challenges to solve difficult problems and engage a broader community in agency activities.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered was $20,000. The total amount awarded was $0 because the Challenge was cancelled.

Solicitation of Submissions: As with all NASA Tournament Lab challenges, NASA worked with its vendor, HeroX, to mobilize an international community specific to the Challenge, based on the curated community already existing for the particular vendor platform. For this Challenge, NASA chose to release its own web feature about the Challenge on the nasa.gov public website. Cancellation of the Challenge was also posted as a web feature.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Other - NASA web feature

Participation Requirements: Participation was limited to U.S. citizens only.

Evaluation of Submissions: N/A

Results: More than 1,800 people applied to receive a copy of the code base from both the ideation and architecture challenges. A total of 4,808 entries were submitted between May 03, 2017 and June 16, 2017, when the Challenge was canceled.

Budget and Resources: The full challenge budget was funded by NASA's ARMD. The funds were awarded to the crowdsourcing vendor HeroX via the NASA Open Innovation Services (NOIS) contract. The vendor received $26,600 of the originally awarded $49,500 for their effort in challenge design and launch prior

to cancelation. NASA FTE/WYE resources (0.8 FTE and 0.1 WYE) supported the challenge coordination activities needed prior to and up to the release of a NOIS task order as well as significant efforts involved in cancelling the Challenge.

Partnerships: N/A

Advancement of Agency Mission: This Challenge was intended to support NASA's aims to improve the performance and efficiency of aeronautical systems. However, the extremely high number of applicants, more than 1,800, coupled with the difficulty in satisfying the extensive vetting requirements to control the public distribution of the software made it unlikely the challenge owner would achieve the challenge's original objectives in a timely manner. NASA looked at several alternatives to keep the challenge design intact like significantly extending the challenge performance period, and offering a much smaller portion of the code. None were considered viable options.

Solution Types: Software and apps; Ideas

Plan for Upcoming 2 FYs: N/A

B.7.8 REALM User Interface Challenge[35]

Lead Sponsoring Agency: NASA

Authority: 31 USC § 6301, et seq.

Status: This competition was completed in FY17.

Competition Goals: Radio-Frequency Identification (RFID)-Enabled Autonomous Logistics Management (REALM) is a system onboard the International Space Station (ISS) that uses RFID tags to locate and track various tools and inventory. The goal of this Challenge was to develop a software user interface for a complex event processing system using REALM to locate, track, and manage ISS inventory and tools as they are moved around the ISS. The solution for this Challenge was required to address all system user scenarios for the REALM system and the user application requirements.

Goal Types: Solve a specific problem

Justification for Using Prizes and Challenges: NASA's Advanced Exploration Systems Logistics Reduction/RFID Auto Logistics Management Project needed a novel and cost-effective approach to harvest user interface designs that ensure a positive user experience for the ISS astronauts and mission controllers. The prize approach provided access to myriad solutions and met cost and schedule constraints.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered and awarded was $11,025. Topcoder, the vendor, also offered participants the chance to gain Topcoder points toward attendance at its annual TopCoder Open event. The Open is Topcoder's annual online and onsite tournament to celebrate and reward their community.

Solicitation of Submissions: As with all NASA Tournament Lab challenges, NASA works with its vendor to mobilize an international community specific to the Challenge, often based on the curated community already existing for the vendor platform. NASA used the NASA Solve website (www.nasa.gov/solve), which lists NASA's participatory opportunities, to market this Challenge.

[35] The website for the REALM User Interface Challenge can be viewed at https://www.topcoder.com/challenge-details/30055215/?type=design.

Solicitation Types: Social media (e.g., Twitter, Facebook); Other - Outreach to vendor platform members; Other - NASA Solve website (www.nasa.gov/solve)

Participation Requirements: Winners were vetted to ensure they were not on any restricted country list and are, therefore, eligible to receive the award.

Evaluation of Submissions: The user interface application submissions were evaluated against a number of technical and functional requirements including the ability to enable an on-demand search of the complex event processing (CEP) system to determine an item's location; ability to edit CEP scenarios of interest; ability to interface to a Unity 3D representation of the instrumented ISS modules to display location and location trajectories of item(s) queried; and enables on-demand searches for either a single or multiple items.

Results: Of the 51 entries submitted by 129 participants between September 16, 2016 and December 02, 2016, nine prizes were awarded to nine winners.

Budget and Resources: The full challenge budget was funded by NASA's Human Exploration and Operations Mission Directorate (Advanced Exploration Systems division). A total of $32,900 was awarded to the crowdsourcing vendor Topcoder via the NASA Open Innovation Services (NOIS) contract to execute the Challenge and fund the challenge purse. The awarded vendor conducted the Challenge and awarded the prize money per the task order. Fund allocations included prizes, vendor project management resources, and platform fees. NASA FTE/WYE resources (0.03 FTE and 0.1 WYE) supported the challenge coordination activities including the task order request for proposal development and award processes as well as oversight of challenge execution per the task order.

Partnerships: N/A

Advancement of Agency Mission: This Challenge supports NASA's mission to work with industry to improve America's aerospace technologies through the application of crowdsourcing as an innovative and cost-effective acquisition tool for solutions to specific operational needs. In this case, the solution contributed to the system that helps locate and manage the thousands of items and tools located on the ISS and helps to save the crew's time locating critical items and resulting in valuable cost savings for the agency. The Topcoder community successfully designed a set of application wireframes (i.e., user interface prototypes) that met the technical and functional requirements defined in the task order. The user interface code was completed and delivered to NASA's GitHub software repository at: https://github.com/NASA-Tournament-Lab/NTL-REALM-User-Interface.

Solution Types: Software and apps

Plan for Upcoming 2 FYs: N/A

B.7.9 Human Exploration Rover Challenge[36]

Lead Sponsoring Agency: NASA

Authority: 51 USC § 20113(e)

Status: This competition was completed in both FY17 and FY18.

Competition Goals: The Human Exploration Rover Challenge sought to (1) solicit ideas that stimulate innovation in a manner that has potential to advance NASA's mission through collaboration with educational institutions and students; (2) contribute to solving tough problems related to NASA's

[36] The website for the Human Exploration Rover Challenge can be viewed at NASA.gov/roverchallenge.

mission using challenges and prize competitions; (3) present high school and college students with a hands-on engineering design challenge that meets the foundation principles of NASA human exploration missions; (4) provide a team-based engineering project that emphasizes problem solving and the use of engineering systems and design processes; (5) meet the grades 9-12 national education standards and the college fields of study standards of science, technology, engineering, and mathematics (STEM).

Goal Types: Find and highlight innovative ideas; Inform and educate the public; Engage new people and communities

Justification for Using Prizes and Challenges: The nature of the activity and the age and experience level of this audience is not well suited to contracts, grants, and cooperative agreements. The teams engage in the Challenge to compete for corporate-sponsored prizes and bragging rights.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered was $12,400 in 2017 and $12,900 in 2018. The total amount awarded was $12,400 in 2017 and $12,900 in 2018. Non-monetary incentives included participation and winner plaques and certificates. Cash prizes were provided by corporate sponsors through the U.S. Space & Rocket Center Education Foundation. Non-cash prizes (i.e., plaques, trophies, banners, certificates) were provided by sponsors as well.

Solicitation of Submissions: The Marshall Space Flight Center Public and Employee Communications media team produced and assisted with media advisories, news releases, web features, interviews, and stories for the center's Marshall Star newsletter. In 2018, they focused on Facebook and Periscope. In only one day of competition, they received 192,212 views, just shy of 2017's two day total of 204,190. In 2017, the Ustream broadcast was viewed 29,390 times.

Coverage by 686 news stories received 59,596,488 views. The broadcast on Facebook Live was viewed 157,597 times with 4,953 engagements. The broadcast on Periscope (Twitter) was viewed 34,615 times with 72 engagements. Fifteen posts on the Rover Facebook page reached 376,004 and received 1,498 engagements. Twenty-three tweets on the Rover Twitter account reached 2,818,614 and received 547 engagements.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Live video streaming; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies)

Participation Requirements: The competition targeted high school and college/university students. Each rover had to be the work of a student team from a high school or accredited institution of higher learning. The school or institution could enter up to two teams. A group of high schools could also collaborate in building a rover entry. An entity that promotes education, such as a museum, science center, planetarium, or youth-serving organization, could also enter up to two rover teams in each division. Teams could consist of up to six students.

Evaluation of Submissions: In 2017, winning teams were determined based on run time and accumulated penalties. In 2018, teams had six minutes of 'oxygen' to complete as many obstacles and tasks as possible. One minute of 'reserve oxygen' was added, if necessary, for teams to journey back to home base. However, no additional points could be earned after six minutes or during the use of 'reserve oxygen.' Teams returning to the home base within six minutes received bonus points. Teams arriving after seven minutes were not eligible for competition prizes. Participants could bypass many of the obstacles and tasks, but after six minutes they had to bypass all of them. Obstacles and tasks were assigned points based on difficulty. Teams were encouraged to implement a strategy based on

the time remaining and the choices of obstacles or tasks to undertake. Additionally, points were given for meeting pre- and post-challenge requirements.

Results: There were six hundred participants and 31 awarded prizes in both FY17 and FY18. In 2018, over 500 students comprising 88 teams from 22 states and Puerto Rico, along with nine international teams from Bangladesh, Bolivia, Brazil, Colombia, Germany, India, Lithuania, Mexico and Peru participated in the Challenge. Some prizes were awarded to both the winning high school and college teams. Other prizes were for a single category winner (i.e., either high school or college team).

Budget and Resources: NASA's Human Exploration and Operations Mission Directorate provided funding for FTEs and WYEs ($196,000 and 0.4 FTE in both FY17 and FY18), web services, and logistics. Sponsor funding supported prizes.

Partnerships: The Challenge has evolved into a large community event. Partnerships have been formed with the Chamber of Commerce, the Huntsville/Madison County Convention and Visitor's Bureau, and the U. S. Space & Rocket Center. Corporate sponsors mainly provide monetary contributions. These include the Boeing Company, Lockheed Martin, Jacobs, Polaris, the American Institute of Aeronautics and Astronautics, Orbital ATK, Aerojet Rocketdyne, Davidson Technologies, Science Applications International Corporation, Teledyne Brown Engineering, Corporate Office Properties Trust, and the Tennessee Valley Chapter of the Systems Safety Society, Inc. Other corporate sponsors, such as Northrop Grumman Corporation and the National Space Club, contribute through in-kind support of trophies/plaques, tents, banners, and volunteers. The estimated value of partner contributions was $91,000 in 2017 and $94,700 in 2018.

Advancement of Agency Mission: This Challenge met multiple NASA Office of Education 2017 performance goals. The Challenge (1) assured that students participating in NASA higher education investments were representative of the diversity of the Nation. Of the more than 600 students who participated in the Human Exploration Rover Challenge, 197 were Hispanic, 71 were Black or African America, 10 were American Indian/Alaska Native, and 130 were Asian. Nine teams were from minority-serving institutions. The Challenge (2) continued to provide opportunities for learners to engage in STEM education through NASA-unique content provided to informal education institutions designed to inspire and educate the public. The Challenge, which was open to the public and was widely promoted in the media, was held at the U. S. Space & Rocket Center, an Alabama state flagship museum and Smithsonian affiliate. And lastly, the Challenge (3) continued to provide opportunities for learners to participate in STEM education engagement activities that capitalize on NASA-unique assets and content.

Solution Types: Creative (design & multimedia); Ideas; Technology demonstration and hardware

Plan for Upcoming 2 FYs: In 2018, in an effort to better align with NASA's mission, the competition moved away from being a timed race format to one driven by accomplishing mission objective tasks limited by a six-minute supply of 'oxygen' with a one-minute reserve. The new format forced teams to make real-time decisions about which tasks to attempt and which to leave behind. Because the new requirements were substantially different from the past 24 years of the competition, no additional changes are planned for the next two years.

B.7.10 International Space Apps Challenge[37]

Lead Sponsoring Agency: NASA

Authority: 51 USC § 20113(e)

Status: This FY17 competition is complete, and the FY18 competition is underway.

Competition Goals: The goal of the International Space Apps Challenge is to inspire communities of talented volunteers to use NASA data to solve some of the most exciting problems in space science and technology, to foster engagement in STEM topics with emphasis on Earth and space science and exploration, and to help improve the quality of life on Earth.

Goal Types: Find and highlight innovative ideas; Advance scientific research; Develop technology; Inform and educate the public; Engage new people and communities; Build capacity

Justification for Using Prizes and Challenges: Space Apps is a free and open hackathon, and in the hackathon ecosystem, prizes are the prevailing award for participation.

Cash Prize Purses and/or Non-Cash Prize Awards: There was no cash award prize offered for this Challenge. Non-monetary incentives included recognition of winning solutions and an invitation for winners to attend a launch event or tour of Kennedy Space Center at their own expense.

Solicitation of Submissions: Space Apps is advertised through the spaceappschallenge.org website, and through social media, using #SpaceApps and @SpaceApps. Submissions occur at the end of hackathon weekend, via the spaceappschallenge.org website.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Day-long event(s) prior to the competition; Live video streaming; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies)

Participation Requirements: Anyone is welcome to register and participate in the Challenge. Participation is fully voluntary. Children under the age of 13 should be registered and accompanied at all times by a parent or legal guardian.

Evaluation of Submissions: Submissions were evaluated by NASA civil servants and NASA contractors only.

Results: More than 2000 entries were submitted by more than 25,000 participants.

Budget and Resources: Funding ($850,000 and 3.25 FTEs in FY17; $975,000 and 5.25 FTEs in FY18) supports contract staff who manage the event and website, create materials for use at local events, and serve as the interface with participants worldwide.

Partnerships: Local host organizations and their sponsors in several dozen locations around the world provided facilities and publicity for Space Apps in their respective locations.

Advancement of Agency Mission: Space Apps advances the Agency's mission to drive advances in science, technology, aeronautics, and space exploration to enhance knowledge, education, innovation, economic vitality, and stewardship of Earth.

Solution Types: Software and apps; Creative (design & multimedia); Ideas; Technology demonstration and hardware; Analytics, visualizations, algorithms; Scientific

[37] The website for the International Space Apps Challenge can be viewed at Spaceappschallenge.org.

Plan for Upcoming 2 FYs: Space Apps in FY19 and FY20 will be closely aligned with and similar to Space Apps in FY17 and FY18. Based on past experience, the number of participants is expected to grow.

B.7.11 RASC-AL Special Edition: Mars Ice Challenge[38]

Lead Sponsoring Agency: NASA

Authority: 31 USC § 6301, et seq.

Status: This competition was completed in both FY17 and FY18.

Competition Goals: To provide students with the opportunity to design and build prototypes that can extract water from simulated Martian subsurface ice testing environments. Currently the NASA in situ resource utilization (ISRU) community has focused on extracting water from hydrated Mars regolith, but recent discoveries of what are thought to be large ice deposits just under the surface on Mars have mission planners re-thinking how a sustained human presence on Mars could be enabled by a water rich environment. This Challenge is intended to cultivate innovative thinking from university students on a task that NASA has spent very little resources on, yet may be the true enabler of Earth independence on Mars.

Goal Types: Find and highlight innovative ideas; Solve a specific problem; Advance scientific research; Develop technology; Engage new people and communities; Build capacity

Justification for Using Prizes and Challenges: This initiative does not use monetary prizes but does use a challenge/competition format. This format is useful because this initiative is intended to align with academic studies in multi-disciplines related to NASA's mission for undergraduate and graduate students, and to foster exciting innovation and sharing of ideas from the best and the brightest students in the United States with NASA, the university community, and the space exploration industry. NASA technical and research programs directly benefit by tapping new approaches to space exploration, and students benefit by applying their academic knowledge to real-world problems and active engagement with NASA, industry experts and their peers.

Cash Prize Purses and/or Non-Cash Prize Awards: There was no cash award prize offered for this Challenge. Non-monetary incentives included the opportunity to work on real-world, ISRU research for NASA that is among the first of its kind; expert feedback from subject matter experts; public recognition; tour of a NASA facility; opportunity to demonstrate technology in front of NASA and industry experts; developing capabilities, skills and hands-on experience. The most promising designs may result in invitations to present research at a technical conference. Subject to the availability of funds, such invitations may include an accompanying stipend to further advance development of the concept and to offset the cost of traveling to the event.

Solicitation of Submissions: The 2018 RASC-AL Special Edition: Mars Ice Challenge Competition was announced and promoted through both NASA and the National Institute of Aerospace's (NIA) Communications Teams (including NASA's Education Express and Science Wow!) and through direct email to over 3,000 engineering faculty throughout the country. Additionally, emails and phone calls were made to engineering professors and robotics clubs at universities across the country to promote the Mars Ice Challenge. A Facebook group and Twitter account were also utilized to draw interest from

[38] The website for the RASC-AL Special Edition: Mars Ice Challenge can be viewed at http://specialedition.rascal.nianet.org.

students. Feature stories on the nasa.gov website also called for project plan proposals each year. A website for the challenge is maintained and updated by the NIA.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Live video streaming; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies)

Participation Requirements: The RASC-AL Special Edition: Mars Ice Challenge is open to full-time undergraduate and graduate student teams and faculty advisors at accredited U.S. universities. Teams may include senior capstone courses, robotics clubs, multi-university teams, multi-disciplinary teams, etc. Multi-disciplinary teams are encouraged.

Evaluation of Submissions: The Mars Ice Challenge steering (and judging) committee is comprised of NASA and industry experts who evaluate all submission deliverables using rubrics for project plan proposals, mid-project reviews, and on-site technology demonstrations. Mars Ice Challenge projects are evaluated and judged based on adherence to the system prototype design constraints and requirements and the following criteria. For the onsite competition, 50% of the team's score was related to water extraction, and the remaining 50% was related to the technical paper and poster presentation, with points deducted from the total score for exceeding the volume, mass, current, or Newton limits, failure to provide a weight-on-bit data logger, misalignment of system with the technical paper, or excessive dirt thrown outside of their designated area. Paramount to the Challenge is how well the teams can describe their water extraction system's path-to-flight (i.e., what modifications their system would need to operate on Mars). The path-to-flight portions of the technical papers and poster presentations received the bulk of the points available in the scoring matrix.

Results: Twenty-eight entries were submitted in FY17 by 8 teams consisting of 109 individuals. Eighteen entries were submitted in FY18 by 10 teams consisting of 154 individuals.

Budget and Resources: Funding for the FY17 Challenge was $284,999 and 0.1 FTE. Funding for the FY18 Challenge was $285,500 and 0.15 FTE. These costs were for NIA program management and other direct costs including but not limited to testing materials and technology development participation stipends provided to participating universities through their respective Offices of Sponsored Programs.

Partnerships: NASA partners with the NIA, who provides day-to-day administration of the Challenge. They have extensive expertise in managing successful higher education STEM competitions for NASA and are well equipped with certified program managers that provide a well-rounded experience for participants. They provide a robust marketing plan, extensive contact lists, in-kind challenge website hosting, graphics support, submission management, simulated test bed creation, and event planning for the culminating technology demonstrations/Forum at NASA's Langley Research Center. Industry partners also brought their unique expertise to this Challenge and incorporating industry involvement on the steering committee added value to the overall competition and enabled students to interact with the foremost experts in this field. In FY17 and FY18, an expert from Honeybee Robotics served an integral member of the Challenge steering committee (with estimated value of $2500 in both FY17 and FY18). In FY17, an expert from SpaceX also participated in the Challenge and collected participant resumes for consideration of internships and jobs at SpaceX.

Advancement of Agency Mission: The Challenge provides university undergraduate and graduate engineering students the opportunity to assist NASA achieve its strategic goal of extending humanity's reach into space. The Challenge fuels innovation for aerospace systems, analogs, and technology prototyping at the nation's best collegiate institutions. The Challenge enlists teams of students to focus on ISRU technology demonstrations for harvesting water from subsurface ice, a focus for NASA over the next few decades. The Challenge also leverages interaction to explore workforce pipeline opportunities

and attract a highly skilled, competent, and diverse workforce. MIC contributes to NASA's goals to enhance STEM experience of undergraduate students and provide graduate-trained STEM professionals with basic and applied research expertise.

Solution Types: Ideas; Technology demonstration and hardware; Analytics, visualizations, algorithms

Plan for Upcoming 2 FYs: Maintaining its relevance to the agency's shifted focus to return Americans to the Moon, the FY19 challenge has evolved into the Moon to Mars Ice & Prospecting Challenge, which will provide university-level engineering students with the opportunity to design and build prototype hardware that can not only extract water, but can also assess subsurface density profiles relevant to both lunar and Martian ISRU. The purpose of updating the challenge in FY19 is to explore and demonstrate methods to identify different layers using system telemetry, and ultimately extract water from ice deposits that could be found in lunar or Martian ice deposits. In FY20, NASA and NIA plan to continue adding evolutionary, incremental elements to the challenge so that university-based student teams/participants can continue making significant, relevant contributions to advancing ISRU research and technology.

B.7.12 NASA Tournament Lab Micro-Purchase Challenges

Lead Sponsoring Agency: NASA

Authority: 31 USC § 6301, et seq.

Status: This competition was completed in both FY17 and FY18.

Competition Goals: This was a collection of challenges with small purses executed through the NASA Tournament Lab that sought to achieve goals such as developing graphics, videos, or animations to communicate a space project's utility or function; developing portions of a course or curriculum for training software developers on how to use a particular computer code needed for a space project; and developing models, solutions, or designs to solve a variety of problems involving radiation shielding, spacecraft thermal protection systems, robotic cameras, and lunar and Martian sample return.

Goal Types: Find and highlight innovative ideas; Solve a specific problem; Advance scientific research; Develop technology; Inform and educate the public; Engage new people and communities

Justification for Using Prizes and Challenges: These challenges utilized prizes as a way to incentivize members of large crowdsourcing communities to deliver their most creative ideas and designs. This method has been consistently shown to be successful in finding novel, high-quality concepts, designs, and creative products in a cost effective and schedule efficient way. These 25 challenges cost just over $50,000 total (averaging only $2000 per challenge) and yet resulted in savings of an estimated $100,000.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered was $44,800 (over multiple challenges) and the total amount awarded was $44,000 (over multiple challenges).

Solicitation of Submissions: These challenges were executed under the government's micro-purchase program, which allows for the direct purchase of a product up to $3,500 in FY17 and $10,000 in FY18. The solicitation of submissions was executed by the vendor as part of the transaction. Some of the challenges were advertised on the NASA Solve website (www.nasa.gov/solve).

Solicitation Types: Other - Communications provided by the vendor; Other - NASA Solve website

Participation Requirements: NASA did not levy any specialized participation requirements. Each vendor maintains participation requirements in their user terms and conditions that ensured participation aligned with applicable laws such as banned country participants.

Evaluation of Submissions: For completed challenges, the end products were reviewed and approved by each of the NASA technical teams to ensure all requirements were met.

Results: Of the 1,514 (across all 25 challenges) entries submitted by 809 participants, 35 prizes were awarded.

Budget and Resources: All challenge budgets were fully funded by NASA's Human Exploration and Operations Mission Directorate. The funds were paid to the crowdsourcing vendor via the government micro-purchase program and vendors conducted the challenges and awarded the prize money. In FY17, $5,290 and 0.1 FTEs were spent; in FY18, $46,707 and 0.2 FTEs were spent. Freelancer.com and GrabCAD.com were paid for a variety of delivered media ranging from training materials to videos. Budgets for individual challenges were (1) Delay/Distruption Tolerant Networking (DTN) Interplanetary Overlay Network (ION) Training course sample challenge: $574; (2) DTN imagery or animation challenge: $574; (3) Origami/Folding Radiation Shielding Concepts Challenge: $1,060; (4) Origami/Folding Radiation Shielding Models Challenge: $1,060; (5) Astrobee Robotic Arm Design Architecture Study Challenge Series (14 challenges): $25,000; (6) REALM Project Overview Animated Video Storyboard Challenge: $573; (7) REALM Project Overview Animated Video Challenge: $3,030; (8) 3D Model Development for Human Rated Spacecraft Thermal Protection System (TPS) 3D Printing Process Challenge: $3,500; (9) Model Animation for Human Rated Spacecraft Thermal Protection System (TPS) 3D Printing Process Animation Challenge: $6,000; (10) Sample Return Regolith Sorter Design Challenge: $10,000; (11) Autonomous Systems Operations-ISS-TEA Project Graphic: $317; and (12) In-Space Manufacturing Refabricator Mission Patch/Graphic Challenge: $310.

Partnerships: N/A

Advancement of Agency Mission: These challenges contributed to key projects at NASA: (1) developing the communications protocols required for deep space exploration at distances that incur significant light-time delays in communications; (2) enhancing mission operations for current ISS missions and future missions by building an automated inventory tracking system; (3) developing radiation shielding concepts and designs to protect humans in deep space exploration (one of the current key unsolved risks for deep space exploration); (4) developing autonomous systems necessary for human management of complex systems in deep space where time delayed communications constrain ground interactions; (5) developing new production processes for thermal protection systems required for human exploration due to high speed entries required upon return; (6) developing sample return sorting mechanisms so that robotic surface exploration and scientific return can be enhanced; and (7) developing recycling and in space manufacturing methods that enable more efficient and resilient human space exploration in deep space.

Solution Types: Software and apps; Creative (design & multimedia); Ideas

Plan for Upcoming 2 FYs: The NASA Tournament Lab Micro-Purchase Challenges are a mechanism that most NASA projects can afford without special funding requests and therefore it is anticipated that their use will grow in the future.

B.7.13 Open MCT Notebook Challenge[39]

Lead Sponsoring Agency: NASA

Authority: 31 USC § 6301, et seq.

Status: This competition was launched in FY17 and completed in FY18.

Competition Goals: This Challenge was launched to add a new user-creatable Notebook plugin component for the Mission Control Technology (MCT) software framework. A Notebook is a container for multiple Notebook entries, which are comprised of a timestamp, text, and optionally one or more embedded links to other objects in Open MCT. Embedded links themselves can optionally include a snapshot image capture of their linked object's view state at a given point in time. For example, a user might be viewing a plot of a telemetry element that tracks temperature for a system in a rocket. They might see an anomalous temperature spike in the plot, and would be able to immediately create a new Notebook entry describing what they saw that also includes a visual image capture of the plot.

Goal Types: Solve a specific problem; Develop technology

Justification for Using Prizes and Challenges: Competitive crowd-based software development methods have proven effective for efficient generation of quality software especially when Government resources are limited.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered and awarded was $12,900. Non-monetary incentives included points from the vendor, TopCoder, toward attendance at the yearly prestigious TopCoder Open, an annual online and onsite tournament to celebrate and reward the TopCoder community.

Solicitation of Submissions: As with all NASA Tournament Lab challenges, NASA worked with its vendor to mobilize an international community specific to the Challenge, based on the curated community already existing for the vendor platform. NASA used the NASA Solve website (www.nasa.gov/solve), which lists NASA's participatory opportunities, to market this Challenge. This Challenge was broken up into six distinct competitions and marketed directly to Topcoder members via challenge listing and Topcoder's development newsletter.

Solicitation Types: Social media (e.g., Twitter, Facebook); Other - Outreach by TopCoder to its platform members; Other - NASA Solve website (www.nasa.gov/solve)

Participation Requirements: Winners are vetted to ensure they are not on any restricted country list and are, therefore, eligible to receive the award.

Evaluation of Submissions: The NASA MCT team evaluated the products developed and selected by the TopCoder community to ensure a quality implementation of the requirements as provided in the NOIS contract task order statement of work.

Results: Of the 35 entries submitted by 87 participants between September 28, 2017 and November 13, 2017, 3 prizes were awarded to 3 winners.

Budget and Resources: The full challenge budget was funded by NASA's Human Exploration and Operations Mission Directorate. The funds ($34,952 in FY17) were awarded to the crowdsourcing vendor TopCoder via the NOIS contract. The awarded vendor conducted the Challenge and awarded the

[39] The website for the Open MCT Notebook Challenge can be viewed at https://www.topcoder.com/challenges/#&query=MCT&tracks=datasci&tracks=design&tracks=develop.

challenge purse per the task order. NASA FTE/WYE resources (0.01 FTE in FY17 and FY18; 0.014 WYE in FY17 and 0.01 WYE in FY18) supported the challenge coordination activities including the task order request for proposal development and award processes as well as oversight of challenge execution per the task order.

Partnerships: N/A

Advancement of Agency Mission: This challenge supports NASA's mission to work with industry to improve America's aerospace technologies through the application of crowdsourcing as an innovative and cost-effective acquisition tool for solutions to specific operational needs.

Solution Types: Software and apps

Plan for Upcoming 2 FYs: N/A

B.7.14 Partnership Agreement Maker (PAM) Graphical User Interface (GUI) Updates[40]

Lead Sponsoring Agency: NASA

Authority: 31 USC § 6301, et seq.

Status: This competition was completed in FY17.

Competition Goals: Develop a new user interface for NASA's Partnership Agreement Maker (PAM) that is intuitive, user-friendly, and will render well on mobile devices. PAM is NASA's online tool for the development, execution, and storage of all agreement types, whether with other domestic or foreign government agencies, non-governmental organizations, or commercial entities. The design should have reused existing functionality, not changed existing code, and improved the user experience for completing a workflow.

Goal Types: Improve government service delivery; Solve a specific problem

Justification for Using Prizes and Challenges: The NASA Partnerships Office is extending its approaches to acquisition.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered and awarded was $15,684. Non-monetary incentives included points from the vendor, TopCoder, toward attendance at the prestigious TopCoder Open, an annual online and onsite tournament to celebrate and reward the TopCoder community.

Solicitation of Submissions: The limited marketing approach for this challenge consisted of alerts to TopCoder members through weekly newsletters and RSS feeds/social media.

Solicitation Types: Other - TopCoder development newsletters; Other - RSS feeds/social media

Participation Requirements: As with all NASA Tournament Lab challenges, NASA worked with the vendor to mobilize an international community specific to the Challenge, based on the curated community already existing for the vendor platform. Winners were vetted to ensure they were not on any restricted country list and were, therefore, eligible to receive the award.

Evaluation of Submissions: Three representatives (two technical and one managerial) from the NASA Partnerships Office evaluated submissions throughout the design and build phases and made award

[40] The website for the Partnership Agreement Maker (PAM) Graphical User Interface (GUI) Updates can be viewed at https://www.topcoder.com/challenge-details/30055736/?type=design.

determinations based on aesthetic and functional capabilities that would support the defined system requirements. Success criteria include adherence to defined technical requirements for system integration and interoperability with the existing system code base and architecture, as well as select design enhancements to the graphic interface to improve the overall user experience.

Results: Of the 60 entries submitted by 194 participants between November 21, 2016 and April 03, 2017, 12 prizes were awarded to 12 winners.

Budget and Resources: The full challenge budget was funded by NASA's Mission Support Directorate. The funds were awarded to the crowdsourcing vendor via the NOIS contract. The awarded vendor conducted the Challenge and awarded the prize money per the task order. Fund allocations included prizes, vendor project management resources, and platform fees. NASA FTE/WYE resources used in FY17 ($34,990, 0.14 FTE, and 0.01 WYE) supported the challenge coordination activities including the task order request for proposal development and award processes as well as oversight of challenge execution per the task order.

Partnerships: N/A

Advancement of Agency Mission: The Challenge introduced a new approach for service acquisition to the NASA Partnerships Office and provided a refreshed user interface for a critical Agency-wide routing system, thereby supporting NASA's mission to improve America's aerospace technologies.

Solution Types: Software and apps

Plan for Upcoming 2 FYs: N/A

B.7.15 REALM Location Tracking Algorithm Challenge[41]

Lead Sponsoring Agency: NASA

Authority: 31 USC § 6301, et seq.

Status: This competition was launched in FY18, and is underway.

Competition Goals: The Radio-Frequency Identification (RFID) Enabled Autonomous Logistics Management (REALM) project seeks to build a machine learning based algorithm to help find, identify, and track cargo on the International Space Station (ISS). Tracking items in space habitats can be more challenging than it might at first seem. The environment is predominantly closed, with the exception of the jettisoning of trash or the delivery of new cargo or return of some items by visiting vehicles. However, there are a number of factors that complicate tracking, including crews that change out in six-month intervals, laboratory space that doubles as living space, cargo transfer bags that are nearly identical in appearance, and limited stowage space.

Goal Types: Solve a specific problem; Develop technology

Justification for Using Prizes and Challenges: Expert communities such as those found on TopCoder have been shown repeatedly to respond to prize-based challenges to complete tasks such as developing high-performing algorithms based on machine-learning data science.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered is $26,500. TopCoder provides gamified incentives such as point scores and badges to its members who participate.

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[41] The website for the REALM Location Tracking Algorithm Challenge can be viewed at http://www.topcoder.com.

Solicitation of Submissions: This project was executed under the NOIS multi-vendor indefinite delivery, indefinite quantity (IDIQ) contract. TopCoder was selected as the NOIS contract vendor for this task order based on a NOIS solicitation within the NOIS contract. TopCoder executed the task order to develop and execute the Challenge, which included outreach to its members and the wider public about participation in the Challenge. Additionally, this Challenge was posted on Challenge.gov and on the NASA Solve (www.nasa.gov/solve) website.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs)

Participation Requirements: NASA did not levy any specialized participation requirements. TopCoder maintains participation requirements in their user terms and conditions that ensured participation aligned with applicable laws such as banned country participants.

Evaluation of Submissions: This Challenge is in its early stages, and the evaluation plan is still in development.

Results: No prizes have been awarded at this stage of the Challenge.

Budget and Resources: The funding for this project was provided by the NASA Human Explorations Operations Missions Directorate (HEOMD)/Advance Exploration Systems (AES) division's Logistics Reduction (LR)/REALM Project. The total budget for the NOIS task order to TopCoder under the fixed price contract was $89,700. Of those funds, $26,500 was budgeted for the prize pool. This Challenge is still in progress.

Partnerships: N/A

Advancement of Agency Mission: This Challenge contributes to NASA's mission for human space exploration. Specifically, an improved cargo location tracking algorithm would save significant crew time and effort operating in a zero-gravity environment with rotating crews.

Solution Types: Analytics, visualizations, algorithms

Plan for Upcoming 2 FYs: N/A

B.7.16 Rice Business Plan Competition[42]

Lead Sponsoring Agency: NASA

Authority: 31 USC § 6301, et seq.

Status: This competition was completed in both FY17 and FY18.

Competition Goals: The Rice Business Plan Competition is an event that matches startup companies with potential funding sponsors. NASA/Johnson Space Center provides a small amount of prize funding which allows participation in the process and access to the proposals from the best teams. The support NASA provided for this competition was intended to encourage the development of commercial technologies that can address physical challenges of spaceflight, which also have benefits on Earth. It aimed to engage faculty and students in addressing key space flight challenges in the areas of life sciences, engineering, and commercial space. It also sought to identify technology innovations which may assist NASA in achieving its mission and objectives.

[42] The website for the Rice Business Plan Competition can be viewed at https://rbpc.rice.edu.

Goal Types: Find and highlight innovative ideas; Advance scientific research; Inform and educate the public; Engage new people and communities; Stimulate a market

Justification for Using Prizes and Challenges: This competition enabled NASA to learn about emerging technologies that the agency may not otherwise have known existed.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered and awarded was $20,000 in FY17 and $50,000 in FY18. Non-monetary incentives included recognition by NASA Johnson Space Center.

Solicitation of Submissions: Rice University solicited globally for applications to their overall Business Plan Competition.

Solicitation Types: Other - Rice University outreach

Participation Requirements: Only U.S. teams are eligible for the NASA award.

Evaluation of Submissions: NASA established a scoring method and then evaluated the business plan teams and their technologies to select a winner.

Results: Of the more than 400 submissions (1 per team) received in FY17 between November 1, 2016 and March 15, 2017, 42 teams were selected to compete. One prize was awarded to one winner. Of the more than 750 submissions (1 per team) received in FY18 between November 1, 2017 and March 15, 2018, 42 teams were selected to compete. One prize was awarded to one winner.

Budget and Resources: In FY17, the grant budget was funded by NASA Johnson Space Center's Human Health and Performance Directorate. In FY18, the Chief Technologist in the Exploration Integration and Science Directorate put in place a new three-year grant and collected funding from different organizations within the Johnson Space Center. In FY17, $20,000 was allocated for the prize and $7,500 was provided to Rice University through a grant for management and administration of the competition; in FY18, $50,000 was allocated for the prize and $7,500 went to Rice University. NASA FTE (0.03 in both FY17 and FY18) supported competition activities including preparing the grant agreement with Rice University, managing logistics of the competition, and ensuring a multi-disciplinary team was available to judge the competition for the NASA Earth/Space Human Health and Performance Innovation Prize.

Partnerships: N/A

Advancement of Agency Mission: The Rice Business Plan Competition is an event that matches startup companies with potential funding sponsors. The support NASA provided for this competition was intended to encourage the development of commercial technologies that can address physical challenges of spaceflight, which also have benefits on Earth. It aimed to engage faculty and students in addressing key space flight challenges in the area of life sciences, engineering, and commercial space. It also sought to identify technology innovations which may assist NASA in achieving its mission and objectives. Even when the proposals did not align with NASA's needs, they can provide a rare opportunity to see fresh ideas from startup companies at a point when NASA might still have the opportunity to influence their direction.

Solution Types: Ideas; Technology demonstration and hardware; Business plans

Plan for Upcoming 2 FYs: The final year for the Human Health and Performance grant was 2017. NASA has established a three-year grant with Rice University to continue participating in the Rice Business Plan Competition through 2020.

B.7.17 Robonaut 2 Tool Localization Challenge[43]

Lead Sponsoring Agency: NASA

Authority: 31 USC § 6301, et seq.

Status: This competition was completed in FY17.

Competition Goals: The Challenge was launched to develop a general vision algorithm for Robonaut 2 (R2), NASA's dexterous humanoid robot, to improve the robot's ability to manipulate objects. The R2 team was looking to find vision algorithms that would be effective with noisy stereo vision data for localizing a specific point on a variety of tools. The Challenge was comprised of three separate algorithm contests run on the vendor, TopCoder, platform.

Goal Types: Solve a specific problem; Develop technology

Justification for Using Prizes and Challenges: Crowd-based challenges incentivized with a monetary purse have proven extremely effective for algorithm development, particularly when a team is resource limited.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered and awarded was $19,250. For the first contest, the following prizes were awarded: $5,000 for first place, $2,500 for second place, $1,500 for third place, and $750 for fourth place. For the second contest the following prizes were awarded: $4,000 for first place, $2,750 for second place, $1,750 for third place, and $1,000 for fourth place. The winner of the optimization round won a NASA swag bag and a one-hour talk and coffee with the Harvard Crowd Innovation Lab team. The winners also received points from TopCoder toward attendance at the yearly TopCoder Open, an annual online and onsite tournament to celebrate and reward the TopCoder community.

Solicitation of Submissions: As with all NASA Tournament Lab challenges, NASA worked with its vendor to mobilize an international community specific to the Challenge, based on the curated community already existing for the particular vendor platform. In addition to soliciting submissions from its existing member community, TopCoder ran a blog feature, newsletter promotion, and forum promotion, as well as direct email campaigns and support for a NASA press release.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Other - Outreach by vendor Topcoder to its platform's members

Participation Requirements: Winners were vetted to ensure they were not on any restricted country list and were, therefore, eligible to receive the award.

Evaluation of Submissions: NASA and Harvard worked with TopCoder to establish scoring methods and then worked to verify the resulting algorithms to determine their relative performance and select winners. In order to win a prize, the submitter had to achieve a score in the top five, according to system test results. Within seven days from the announcement of the challenge winners, winning candidates had to submit a complete report at least two pages long outlining their final algorithm, explaining the logic behind and steps to its approach, and describing how to install any required libraries to run it.

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[43] The website for the Robonaut 2 Tool Localization Challenge can be viewed at https://community.topcoder.com/longcontest/?module=ViewProblemStatement&rd=16672&compid=51137 .

Results: Of the 222 entries submitted by 1,912 participants between February 23, 2016 and March 08, 2016 for Algorithm Contest 1 and October 05, 2017 and October 19, 2017 for Algorithm Contest 2, nine prizes were awarded to nine winners in the Optimization Algorithm Final Contest on October 26, 2017.

Budget and Resources: The full challenge budget ($59,500 for challenge execution and prize purse) was funded by NASA's Human Exploration and Operations Mission Directorate. In addition, 0.014 FTEs were allocated to support the Challenge. The funds were awarded to the crowdsourcing vendor TopCoder via the NOIS contract. The awarded vendor conducted the Challenge and awarded the prize money per the task order.

Partnerships: N/A

Advancement of Agency Mission: This Challenge supports NASA's mission to work with industry to improve America's aerospace technologies. It provided the R2 team with several algorithmic approaches to this difficult problem of detecting points on a three-dimensional tool and recognizing that tool. Given the low cost of this challenge and the serial contests involved, the team was able to gain insight into some very effective approaches to building this algorithm.

Solution Types: Analytics, visualizations, algorithms

Plan for Upcoming 2 FYs: N/A

B.7.18 Robotic Mining Competition[44]

Lead Sponsoring Agency: NASA

Authority: 51 USC § 20113(e)

Status: This competition was completed in both FY17 and FY18.

Competition Goals: This competition is for university-level students to design and build a mining robot that can traverse simulated chaotic lunar/Martian terrain, excavate the regolith and ice simulant (gravel), and deposit it into a collector bin to simulate an off-world mining mission. The complexities of the challenge include the abrasive characteristics of the regolith, weight and size limitations of the mining robot, and the ability to tele-operate it from a remote Mission Control Center. Teams also submit a systems engineering paper explaining their design philosophy, engage in K-12 Outreach in their communities, and give a project presentation to judges at Kennedy Space Center.

Goal Types: Solve a specific problem; Develop technology; Inform and educate the public; Engage new people and communities

Justification for Using Prizes and Challenges: Teams provide their best students, faculty advisors, robots, equipment, supplies, transportation, etc. to come to the competition at the Kennedy Space Center. Prizes inspire and motivate students to compete.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered in both FY17 and FY18 was $17,000 and the total amount awarded in both FY17 and FY18 was $17,000. Three trophies were awarded in FY18 for the Judges' Innovation Award, the Solar System Exploration Research Virtual Institute (SSERVI) Regolith Mechanics Award, and Efficient Use of Communications Power Award. Non-monetary incentives included NASA bragging rights: schools and students got to say "We ran our robot at NASA's Robotic Mining Competition" or "We successfully wrote a NASA peer-reviewed Systems

[44] The website for the Robotic Mining Competition can be viewed at https://www.nasa.gov/offices/education/centers/kennedy/technology/nasarmc.html.

Engineering Paper" or "We took home the Robotic Mining Competition's 'Joe Kosmo Award for Excellence'."

Solicitation of Submissions: The competition registration date was announced on the NASA RMC website, on social media (Facebook and Twitter), and in announcements sent to all the teams that competed the previous year.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs)

Participation Requirements: Teams from post-high school vocational/technical schools, colleges, and universities located in the United States, its Commonwealths, territories, and possessions were eligible to register for the competition (no more than one team per university campus was allowed). A team consisted of current faculty/staff members of the college or university and at least two undergraduate students. Students had to be enrolled during the current or previous school semester and submit transcripts demonstrating good academic standing. The number of team members was at the discretion of the school but had to be sufficient to successfully design, build, and operate their mining robot.

Evaluation of Submissions: Both the first and second round of systems engineering papers judging was done by engineers from across NASA. Presentations and demonstrations during the week of the mining competition were judged by engineers from across NASA. Both the first and second rounds of the outreach report was judged by communications and education personnel from across NASA. Points during the on-site mining competition were awarded based on numerous factors including but not limited to the amount of regolith returned. This event was judged by engineers from across NASA. Points from all categories were tallied for the grand prize, The Joe Kosmo Award for Excellence.

Results: Of the 48 entries (740 individuals) submitted for the FY17 competition, 22 prizes were awarded to 12 different teams. Of the 46 entries (810 individuals) submitted for the FY18 competition, 23 prizes were awarded to 11 different teams.

Budget and Resources: NASA's Human Exploration and Operations Mission Directorate provided 1.0 FTE and $361,750 in FY17, and 1.0 FTE and $362,325 in FY18. This funding supported contractor labor as well as preparations, materials, supplies, and the NASA-funded awards for the competition.

Partnerships: Non-Federal partners in FY17 (Honeybee, Harris, Caterpillar, Moon Express, Igus, and Lockheed Martin) contributed $38,540. Non-Federal partners in FY18 (Honeybee, Harris, Caterpillar, Moon Express, and Boeing) contributed $41,500.

Advancement of Agency Mission: NASA directly benefits from the competition by encouraging the development of innovative robotic excavation concepts. These concepts may result in unique solutions applicable to an actual excavation device and/or payload on an in-situ resource utilization (ISRU) mission. Advances in off-world mining have the potential to significantly contribute to our nation's space vision and NASA space exploration operations.

Solution Types: Software and apps; Technology demonstration and hardware; Scientific

Plan for Upcoming 2 FYs: In FY19, the objectives of the competition will remain the same; however, the playing field will have significant changes. Teams will be required to submit 60 mechanical data points about the robots. In FY20, the competition will incorporate a gravity offloading device to better simulate lunar and Martian gravity. In FY21, the competition will incorporate a 3-D printing component to keep the competition current and on task with new technology research needs.

B.7.19 Space Poop Challenge[45]

Lead Sponsoring Agency: NASA

Authority: 31 USC § 6301, et seq.

Status: This competition was completed in FY17.

Competition Goals: The goal was to find viable concepts and designs for a urine and fecal management system for use in landing and entry space suits over a continuous duration of 144 hours in the event of a cabin depressurization or alternate contingency scenario. Currently space suits are worn for launch and entry activities and in-space activities to protect the crew from any unforeseen circumstances that the space environment can cause. An astronaut might find himself or herself in this suit for up to 10 hours at a time nominally for launch or landing, or up to 6 days if something catastrophic happens while in space. The current fecal-management solution is equipping the astronauts with diapers. However, the diaper is a low-tech and very temporary solution. Most significantly, it does not provide a healthy or protective option longer than one day.

Goal Types: Solve a specific problem; Develop technology

Justification for Using Prizes and Challenges: A crowdsourced competition provided the greatest possibility of identifying innovative solutions with the limited available budget.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered and awarded was $30,000. Non-monetary incentives included official letters of recognition being sent to the top 25 submissions along with a Crew Survival Systems patch and NASA Tournament Lab stickers.

Solicitation of Submissions: As is the case for all NASA Tournament Lab challenges, NASA worked with a vendor to mobilize an international community specific to the Challenge based on the curated community already existing for the vendor's platform. The vendor solicited submissions from its existing member community and the public through blog features, emails, social media campaigns.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Other - Outreach by challenge vendor

Participation Requirements: Winners are vetted to ensure they are not on any restricted country list and are, therefore, eligible to receive the award.

Evaluation of Submissions: Initial screening evaluation of the more than 5,000 submissions was done by HeroX based on the stated evaluation criteria. Eighty-four submissions were provided to a NASA evaluation panel. This panel recommended a list of finalists that included the top 25 submissions along with the list of recommended first, second, and third place submissions.

Results: Of the 5,170 entries submitted by 20,129 participants between October 11, 2016 and December 20, 2016, 3 prizes were awarded to 3 winners.

Budget and Resources: The full challenge budget ($58,000) was funded by NASA's Human Exploration Operations Mission Directorate. The funds were awarded to the crowdsourcing vendor HeroX via the NOIS contract. The awarded vendor conducted the Challenge and awarded the challenge purse per the task order. NASA FTE/WYE resources (0.025 FTE and 0.002 WYE) supported the Challenge coordination activities including the task order request for proposal development and award processes as well as oversight of Challenge execution per the Task Order.

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[45] The website for the Space Poop Challenge can be viewed at https://herox.com/SpacePoop.

Partnerships: N/A

Advancement of Agency Mission: This Challenge supports NASA's mission to work with industry to improve America's aerospace technologies through the application of crowdsourcing as an innovative and cost-effective acquisition tool for solutions to specific operational needs. This Challenge resulted in the submission of many novel and interesting ideas for dealing with human waste in a space suit environment over an extended time period. The three winners provided some unique solutions including an airlock and internal suit manipulation tool that was based on laparoscopic surgical techniques and tools. This approach allows for the removal of waste material, entry of wipes and underwear, and manipulation required for cleaning in the space suit. Another concept included a design for self-inflating air pumps to help dry the skin that used emergency air bagging technology to save power and complexity while providing high rate airflow. The winning submission also included a compact wiping mechanism that provided a novel approach to skin cleaning and infection prevention.

Solution Types: Other - Design

Plan for Upcoming 2 FYs: N/A

B.7.20 Space Robotics Challenge[46]

Lead Sponsoring Agency: NASA

Authority: 51 USC § 20144

Status: This competition was completed in FY17.

Competition Goals: The goal of the Space Robotics Challenge (SRC) was to foster innovations in technology to advance robotic autonomy in manipulation and perception in humanoid robots to help astronauts on the journey to Mars and other deep-space destinations. Autonomy is critical for space flight missions to Mars and beyond due to the time it takes to send and receive commands from Earth. As missions grow longer and more complex, robots could be used as precursor explorers, helpers in space, and caretakers of assets left behind. There are also potential Earth applications for autonomous capabilities, including disaster relief and clean-up and/or maintenance of areas with conditions hazardous to humans.

Goal Types: Find and highlight innovative ideas; Solve a specific problem; Develop technology; Inform and educate the public; Engage new people and communities; Stimulate a market

Justification for Using Prizes and Challenges: The competition gave access to the complex NASA R5 robot, providing multiple entities with access to advance the technology for both space and Earth applications. Also, partnering on the competition with Space Center Houston gave NASA the opportunity to engage and inspire the broader public, including K-12 and educators.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered was $900,000 and the total amount awarded was $570,000. As non-monetary incentives, the top four teams were awarded a code implementation partnership with an R5 Host Team for at least two weeks.

Solicitation of Submissions: Soliciting competitors was conducted mainly by NineSigma from their database of solvers. Potential competitors were engaged via direct email and a customized newsletter. Social media efforts were coordinated between NASA, Space Center Houston, and NineSigma. Postings

[46] The websites for the Space Robotics Challenge are accessible at NASA.gov/spacebot and www.spaceroboticschallenge.com.

were made on LinkedIn, Twitter, and Facebook. Feedback from competitors was that social media was the main attractor. Two webinars were executed in order to engage the public. Four videos were made to promote the Challenge on social media, the first of which was used to tease the release of the Challenge, and the remaining three to further explain the goals of the Challenge and the current state of technology.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies)

Participation Requirements: Anyone could participate in the SRC as long as they were not a citizen of a country on the NASA Export Control Program List. Only U.S. citizens or permanent residents were eligible to win a cash prize; non-U.S. citizens were allowed to participate and be recognized as winners. Teams with foreign participation were only eligible to receive cash awards from NASA if the overall composition of the team was at least 51% U.S. citizens and entity team members were incorporated in and maintained a primary place of business in the U.S. or were full-time students at an accredited U.S. institution, had a valid student visa, and submitted a signed foreign participation acknowledgement form.

Evaluation of Submissions: Since the competition was completed in a simulation environment, a large portion of the scoring was based on an established algorithm. For the qualification round, the scoring from the algorithm was reviewed by the Open Source Robotics Foundation (OSRF) and validated by the NASA Centennial Challenges program team. For the Virtual Competition Round, once the teams completed their runs, their log files were generated and uploaded. OSRF then executed a double-blind peer review process for each team and each round (i.e., each team was only known to the reviewers by a randomly designated number) and created a summary of how each team performed. Two additional people at OSRF then approved these summaries or offered refinement. The outcome of this verification process was the metric score and time. The videos of the simulations were then passed to the judging panel for subjective scoring. The expert judges did not see the teams' computed scores in order to remove any bias.

Results: A total of 405 teams (754 people) registered to participate, 92 teams (290 people) were selected to compete in the qualifying round, and 20 teams (100 people) reached the final round. Each of the 20 teams in the final round received $15,000; the first place team received $125,000, the second place team received $100,000, the third place team received $50,000, and the fourth place team received $25,000.

Budget and Resources: One FTE and funding in the amount of $306,000 in FY17 provided by the NASA Space Technology Mission Directorate/Centennial Challenges Program were used to support the vendor, OSRF, to develop and execute the simulation environment for the challenge tasks; workforce to develop and execute the Challenge; travel to the challenge meetings and events; and for the subject matter expert and NASA project team at Johnson Space Center.

Partnerships: Non-Federal partners included Space Center Houston (allied organization), NineSigma Inc. (challenge sponsor), Florida Institute of Human and Machine Cognition – R5 Software, Open Source Robotics Foundation Inc., and Gazebo Design and Support. Space Center Houston contributed $985,202, and NineSigma Inc. contributed $362,627.

Advancement of Agency Mission: The SRC aligns the needs of NASA's Space Technology Mission Directorate and Human Exploration and Operations Mission Directorate.

Solution Types: Software and apps; Analytics, visualizations, algorithms

Plan for Upcoming 2 FYs: Phase 2 of the SRC is currently in development. The goal of phase 2 will be to advance autonomous surface mobility for NASA exploration robotic systems. This new phase will push the technology even further by striving for fully autonomous operations.

B.7.21 Student Launch Initiative[47]

Lead Sponsoring Agency: NASA

Authority: 51 USC § 20113€

Status: This competition was completed in both FY17 and FY18.

Competition Goals: The NASA Student Launch Initiative (SLI) is a research-based, competitive, experiential exploration activity intended to provide relevant, cost-effective research and development of rocket propulsion and ground support systems. SLI connects learners, educators, and communities in NASA-unique opportunities that align with STEM Challenges under the NASA Office of Education's STEM Engagement. The activity reaches a broad audience of middle schools, high schools, colleges and universities across the nation through an eight-month commitment to design, construct, and fly payloads and vehicle components. Teams launch the experiments on high-power rockets and share the research results, which could be used in future design and development of NASA projects.

Goal Types: Solve a specific problem; Advance scientific research; Develop technology; Inform and educate the public; Engage new people and communities

Justification for Using Prizes and Challenges: Student Launch has been conducted for more than 15 years. The challenge/competition allows NASA to reach a different demographic than usually reached with grants and contracts. It also allows participants to propose more easily because there is no grant or contract paperwork.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered was $9,500 in both FY17 and FY18 and was contributed by partners. The total amount awarded was $9,500 in both FY17 and FY18. Non-monetary incentives included trophies.

Solicitation of Submissions: The request for proposal was announced on the Student Launch website. Former teams and any interested teams were emailed. NASA posted a press release and announced the opportunity on social media.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Live video streaming; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies)

Participation Requirements: For universities and colleges, the opportunity to propose was open to all. For middle schools and high schools, proposal opportunity was open to the top 25 performing teams from the Team America Rocketry Challenge and the top three teams from Rockets4Schools.

Evaluation of Submissions: Submitted proposals were scored by a panel of NASA Marshall Space Flight Center (MSFC) subject matter experts using a rubric.

[47] The website for the Student Launch Initiative can be viewed at https://www.nasa.gov/audience/forstudents/studentlaunch/home/index.html.

Results: For 2017, 68 entries (810 participants) were submitted between August 15, 2016 and April 24, 2017. For 2018, 75 entries (879 participants) were submitted between August 21, 2017 and April 27, 2018. In both 2017 and 2018, 19 prizes (3 cash awards; 16 trophies) were awarded.

Budget and Resources: In both FY17 and FY18, $377,000 went to personnel (FTE and contract support) for challenge design, proposal review, four design reviews throughout the eight-month process, launch week activities, safety review and monitoring, website development, social media and press releases, and interaction with teams and appropriate NASA entities (Office of Education, Human Exploration and Operations Mission Directorate, Center management). A total of $102,000 went to contracts for launch services (National Association of Rocketry), launch week services (meeting rooms, emergency vehicle support, port-o-lets and other necessities), transportation for teams to NASA's Marshall Space Flight Center, and to launch field. $15,000 was budgeted for materials and $55,000 was used for stipends for team mentors. Mentors were required to have level 2 high powered rocketry certification and to travel to launch and were responsible for rocket for safety purposes.

Partnerships: Partners provided prize money, trophies, and items that the Federal Government does not provide, including an awards banquet and stipends to the team. In both years, Orbital ATK provided $5,000 sent directly to the first place winner and $4,669 in trophies (i.e., prize trophies for winners and a participation trophy for each team). The Huntsville Chapter of the National Space Club provided $2,500 to the second place overall winner; $2,000 to the high school/middle school winner (delivered through NASA MSFC contractor, Aetos); $183.71 for trophies; and $16.29 in contractor overhead fees.

Advancement of Agency Mission: SLI provides relevant, cost-effective research and development of rocket propulsion and ground support systems. Additionally, SLI connects learners, educators, and communities in NASA-unique opportunities that align with STEM Challenges under the NASA Office of Education's STEM Engagement.

Solution Types: Technology demonstration and hardware

Plan for Upcoming 2 FYs: Plan to continue the Challenge for FY19 and FY20, using NASA's Space Launch System as the research emphasis.

B.7.22 Swarmathon[48]

Lead Sponsoring Agency: NASA

Authority: FAR

Status: This competition was completed in both FY17 and FY18.

Competition Goals: The 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 is designed to improve students' skills in robotics and computer science, and further advance technology for future NASA space exploration missions. The NASA Swarmathon project used small, robotic vehicles called Swarmies to challenge programming skills of students at select minority-serving institutions. Swarmies were equipped with a Wi-Fi antenna, GPS, webcam, and sensors developed to search for resources. There was a physical competition (with sets of three robots) and a virtual competition. Virtual teams had their code run in a simulation environment. Physical teams had their code installed on Swarmie

[48] The website for the Swarmathon can be viewed at http://nasaswarmathon.com/.

robots which were run at the physical competition at NASA Kennedy Space Center in April. The physical layout and format were reproduced in a simulated environment for the virtual competition.

Goal Types: Solve a specific problem; Advance scientific research; Develop technology; Inform and educate the public; Engage new people and communities; Build capacity

Justification for Using Prizes and Challenges: Prize competitions reach far more students and institutions than could be reached through direct pay mechanisms. Instead of one funded school and their results, over 30 provided proof of concept algorithms for search methods. Competitions allow students and faculty to engage with NASA research and training in a way that gives them flexibility for the amount of time they spend on the project. Prize awards provide an incentive for students to expand their learning, gain valuable hands-on experience, and utilize their skills to solve a real-world problem.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered and awarded in FY17 was $15,000 and $17,000 in FY18. Non-monetary incentives included trophies.

Solicitation of Submissions: One of the goals of the NASA Swarmathon was to recruit a sizeable and diverse pool of applicants from MSIs across the United States and its territories. The project sought diversity in the form of MSI types, geographic distribution, and school sizes. To support the goal of making every computer science department at every MSI aware of this opportunity, the following marketing efforts were undertaken: constant updates of the nasaswamathon.com website; postcard mailers to computer science faculty at MSIs; publication in NASA Education Express electronic newsletter; dissemination through Penn Center for MSIs; recruitment webinar; and promotion through social media.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Live video streaming; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies)

Participation Requirements: Reviewers evaluated each application using a rubric based on seven different criteria and awarded a score ranging from one to four for each criterion. The criteria were as follows: (1) faculty technical qualifications; (2) faculty teaching experience; (3) goals and objectives to accomplish project; (4) description of student engagement; (5) description of plan to deadlines and milestones; (6) number of students engaged; (7) other strengths. All the faculty team mentors established various methods to convene students and provide them with the instruction necessary to prepare for the NASA Swarmathon. These methods included offering advanced topics courses for credit, offering special topic courses for credit, working with campus clubs and societies, and hosting weekly or monthly meetings.

Evaluation of Submissions: Student teams were challenged to develop search algorithms for robotic swarms. These algorithms were written in Robot Operating System (ROS) with Java and C++ and submitted about four weeks before the actual competition. These search algorithms were run on 'house' Swarmies on the week of competition. The objective was to find resources in the form of cubes with software tags on them. Judges monitored the software and the robots during their runs, which were 20-40 minutes long. Winning teams were those that obtained and returned the most resources to the home collection nest. Each team was also required to submit a five page technical report that described the algorithms and approaches they developed using pseudo-code, equations, flow charts, figures, or descriptions. These reports were judged for most innovative and functional solutions.

Results: In FY17, 34 university teams (400 students) and 30 high school teams (300 students) participated. In FY18, 30 university teams (360 students) and 20 high school (200 students) participated. In FY17, 27 prizes were awarded to 19 different teams; in FY18, 28 prizes went to 19 different teams.

Budget and Resources: Funding was provided through a grant from the NASA Minority University Research Program within the NASA Office of Education (now Office of STEM Engagement) to the University of New Mexico (UNM), as a cooperative agreement. Expenses were paid by UNM through the grant. In both FY17 and FY18, 1.0 FTE and $824,000 were used to support the competition

Partnerships: The NASA Swarmathon was funded from NASA Office of Education, through a cooperative agreement grant. This project was overseen by a management team consisting of the grant principle investigator at the UNM computer science department and NASA Kennedy Space Center. The estimated value of partner contributions was $25,000 in both FY17 and FY18.

Advancement of Agency Mission: In situ resource utilization of water or ice to provide hydrogen and oxygen for fuel, breathing, and drinking and other resources in support of human missions to the Moon and Mars is a stated goal of NASA. Being able to send robots to gather these resources rather than sending tons of fuel, oxygen, and water required to support extended missions makes them not just cheaper but, in many cases, feasible. To make robots a realistic option for supporting human missions we have to understand how to organize teams of lightweight robots so they can find and collect resources efficiently. This competition has set hundreds of students, who would not normally have access to a robotics environment, on career paths as roboticists, computer programmers, and engineers.

Solution Types: Software and apps; Creative (design & multimedia); Technology demonstration and hardware

Plan for Upcoming 2 FYs: For FY19, Swarmathon will utilize the current Swarmies. For FY20, Swarmathon plans to utilize for its new robots a ground version of the Pop-Up Flat Folding Explorer Robot (PUFFER), a robot concept being developed by the Jet Propulsion Laboratory (JPL) through NASA funding. A letter of interest has been provided to Swarmathon from the JPL PUFFER development leads. The JPL PUFFER team is interested in making the hardware and autonomy available to more institutions through potentially open-sourcing its design, firmware, and software. NASA Swarmathon provides a framework for JPL's objective by utilizing the PUFFER design in the Swarmathon autonomous competition. JPL would benefit by getting the PUFFER into the academic community to help JPL solve technology challenges. The goals for Swarmathon will be to evolve the competition search arenas over the years to increase the challenge level and thereby provide usable software for JPL testing.

B.7.23 Vascular Tissue Challenge[49]

Lead Sponsoring Agency: NASA

Authority: 51 USC § 20144

Status: This competition was launched in FY17 and is underway in FY18.

Competition Goals: The goal of the Vascular Tissue Challenge (VTC) is to break through one of the critical obstacles in developing medically useful 3D-engineered heart, lung, kidney, liver, and pancreas tissues for pharmaceutical research, organ bandages, and ultimately organ transplants on Earth or in space. Specifically, the VTC goal is to inspire the successful creation of thick (1 cm x 1 cm) human vascularized organ tissue in an engineered environment while maintaining the function of the tissues similar to those

[49] The websites for the Vascular Tissue Challenge are accessible at https://www.nasa.gov/directorates/spacetech/centennial_challenges/vascular_tissue.html and https://neworgan.org/vtc-prize.php.

within the human body through a 30-day survival period. Teams must demonstrate three successful trials with at least a 75% trial success rate to win an award. Current state of the art is 2 mm for tissue size with no vascular system or a vascular system where tissues do not behave as they do in the body. No one has achieved the combination of increase in size with a vascular system that functions as organ tissues do in the body. Because there are data indicating that engineered tissues can grow larger and more medically relevant in space, the Center for the Advancement of Science in Space (CASIS) also offers the opportunity to fly winning strategies on the ISS.

Goal Types: Find and highlight innovative ideas; Solve a specific problem; Advance scientific research; Develop technology; Inform and educate the public; Stimulate a market; Other - Provide lifesaving medical advances

Justification for Using Prizes and Challenges: In the context of the VTC, prizes are accelerants that inspire focus, new innovators, and non-traditional collaborations to solve a problem of exceptional difficulty that has escaped resolution with conventional practices. Prizes enable new and highly innovative approaches, including those that conservative organizations consider to be too risky.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered is $500,000. Non-monetary incentives included the opportunity to fly the winning entry to the ISS.

Solicitation of Submissions: Solicitation mechanisms included a White House kickoff event; website announcements from multiple organizations (NASA Centennial Challenges, NASA Solve, the Methuselah Foundation, and the New Organ Alliance); presence at professional conferences, workshops, and symposia; advertisement through NASA and Methuselah Foundation webinars, videos, and other public outreach mechanisms; and word of mouth recruiting through the growing VTC scientific network. In addition, because of its profound importance to medicine, both the National Science Foundation and Veterans Administration contributed resources and personnel, and the National Institutes of Health participated in the workshops. These agencies' networks have also been used to solicit submissions.

Solicitation Types: Social media (e.g., Twitter, Facebook); Day-long event(s) prior to the competition; Live video streaming; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies); Other - White House kickoff event; Other - NIH and NSF networks

Participation Requirements: Participation is open to teams from organizations incorporated in the United States. Team leads must be U.S. citizens or permanent residents.

Evaluation of Submissions: An expert judging panel was recruited, and criteria and decisions are informed by a large group of subject matter experts and oversight committee members who can provide additional support for judging the adequacy of a submission.

Results: Twelve teams have indicated intention to participate since June 13, 2016. Closing date is September 30, 2019.

Budget and Resources: The VTC is part of NASA's Centennial Challenges Program, which is part of NASA's Space Technology Mission Directorate. The challenge development and oversight and prize purse are funded by NASA's Space Technology Mission Directorate. The VTC budgets ($270,000 in FY17 and $400,000 in FY18, not including prize purse) and civil servant resources (1.2 FTE in both FY17 and FY18) are used primarily for workshops where experts from multiple disciplines are assembled to work with the competitors to identify key obstacles and how to overcome them. A secondary investment is in the preparation of workshop reports and its development into publications, which began in FY18 and will be completed in FY19.

Partnerships: Non-Federal partners include the Methuselah Foundation, the New Organ Alliance, and CASIS. The Methuselah Foundation is the implementing partner in the VTC and has been outstanding in raising companion funds for judges and teams to travel to workshops, symposia, and conferences as well as to advertise the competition and recruit judges and other subject matter experts. The Methuselah Foundation also recruited National Science Foundation and Veterans Administration support. In addition, CASIS is offering to fly prize winners' investigations on the ISS.[50] CASIS was selected by NASA in 2011 to be the sole manager of the ISS National Laboratory. The estimated value of partner contributions in FY18 is $102,000, which includes $60,000 for management and implementation and $26,000 for workshops and other events.

Advancement of Agency Mission: NASA's objective for this Challenge is to produce technologies capable of creating viable, thick (>1 cm) metabolic tissues that can be used to advance research on human physiology, fundamental space biology, and medicine on both the Earth and the ISS. VTC is responsive to a mandate in the 1958 Space Act (as amended), the foundational legal document governing NASA: "Congress declares that the general welfare of the United States requires that the unique competence of the <National Aeronautics and Space> Administration in science and engineering systems be directed to assisting in bioengineering research, development, and demonstration programs designed to alleviate and minimize the effects of disability."

Solution Types: Technology demonstration and hardware; Analytics, visualizations, algorithms; Scientific; Other - Science and Technology Breakthrough in medically important 3D tissue engineering

Plan for Upcoming 2 FYs: The VTC ends September 30, 2019. Over the next year, because of the humanitarian potential and the unique insights obtained via the workshops, the VTC team, both paid and volunteer, plan to write articles that capture the state of the art of 3D tissue engineering, describe critical research issues and recommendations, and articulate the role of spaceflight in potentially overcoming the significant gravitational issues constraining successful development of tissues large enough to be medically useful. Two more workshops are planned, one in January 2019 and another as a closeout workshop in September 2019. A closeout report will be prepared.

B.8 National Science Foundation (NSF)

B.8.1 The NSF 2026 Idea Machine[51]

Lead Sponsoring Agency: NSF

Authority: NSF Act of 1950, as amended

Status: This competition was launched in FY18, and is underway.

Competition Goals: The goal of the NSF 2026 Idea Machine is to engage a broad swath of stakeholders in the science, technology, engineering, and mathematics (STEM) and STEM education research

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[50] Prior space research has shown that growing certain tissues in microgravity yields larger and often superior tissues to those grown under the best conditions on Earth. However, the vascularization of those tissues has still not been satisfactorily achieved, and without it, the tissues are of limited utility for developing solutions to medical problems on Earth or in space. Once vascularized tissues are successfully developed, space flight might offer an important tool for further breakthroughs.

[51] The website for The NSF 2026 Idea Machine can be viewed at https://www.nsf.gov/news/special_reports/nsf2026ideamachine/index.jsp.

enterprise to identify grand challenges for future, long-term investment by NSF (i.e., to identify the next set of big ideas). The competition will help set the U.S. agenda for fundamental research in science and engineering by asking entrants to suggest the pressing research questions that need to be answered in the coming decade, the next set of big ideas for future investment by NSF in anticipation of the Nation's 250th anniversary in 2026 and beyond. It is an opportunity for researchers, the public, and other interested stakeholders to contribute to NSF's mission to support basic research and enable new discoveries that drive the U.S. economy, enhance national security, and advance knowledge to sustain the country's global leadership in science and engineering.

Goal Types: Find and highlight innovative ideas; Advance scientific research; Engage new people and communities

Justification for Using Prizes and Challenges: A prize competition was chosen in order to maximize excitement, engage the public, and incentivize participation by a wide range of potential contestants, including thinkers inside and outside the academic and industrial research communities. The NSF 2026 Idea Machine prize competition is based on the premise that scientific creativity and innovation have no bounds. Its premise is that everyone in the science and engineering community, from high school students to emeritus professors, as well as anyone who loves science in the general public have ideas about the future and what might be possible. NSF wants to harness those rich imaginations through an ideation prize competition that extends the agency's tradition of reaching out to the community to find fresh, new ideas that have the potential to benefit science and society.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered is $164,000 (to be awarded summer 2019). Non-monetary incentives included public recognition (posting entries on website), thank-you letters from NSF leadership, and acknowledgment of honorable mentions at winner recognition event. Grand prize winners (up to four indivduals or teams comprised of up to five individuals) will receive travel support to attend the recognition event in summer of 2019 in the Washington, D.C. area.

Solicitation of Submissions: The NSF 2026 Idea Machine was announced at meetings of the National Science Board, other NSF events (e.g., NSF Days), and scientific disciplinary organization meetings attended by NSF staff. A toolkit of materials for outreach available to NSF staff members included postcards, posters, sample social media posts, sample emails, and slide presentations. The NSF 2026 website went live prior to launch of the competition, and announcements went out over all NSF social media platforms. The competition was announced via email to current and former principal investigators, representatives of scientific organizations, NSF directorate advisory committees, non-profit organizations, industry groups, independent research institutes and centers, heads of science and engineering research departments at universities, and STEM high-school teachers. The launch of the competition was also announced by press release, the NSF Director's Newsletter, and on social media platforms.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Other - Paid advertising

Participation Requirements: All contestants (including individual entrants and all team members) must be at least 14 years of age by September 1, 2018, and be U.S. citizens or permanent residents, or residing legally in the U.S. on September 1, 2018. Only one entry per individual or team is permitted. A contestant may submit an entry as an individual or as a member of a team, but not both. A contestant may only be on at most one team. Entries may be submitted by individuals or by teams comprised of up to five individuals, one of whom must be designated as the team leader. Restrictions apply to people working at NSF, Idea Machine judges, and Federal contractors.

Evaluation of Submissions: Entries will be screened by NSF staff for responsiveness to the competition call and consistency with the competition rules. Entries that meet the initial screening criteria will be judged by NSF staff who will select approximately 30 for the next phase of the competition. Those entrants continuing to the second phase will be invited to make video submissions. The second phase entries will be judged by a Blue-Ribbon panel of external experts in two stages. The Blue-Ribbon panel will make recommendations to NSF. The final selection of winning entries will be at the discretion of NSF and will include consideration of additional factors such as the Foundation's current and planned investments, the unique suitability of NSF to lead research activities on the proposed big idea, risk/reward balance of investing in the idea, readiness of the relevant research communities to take on the idea, and the scope and scale of the idea.

Results: The competition is still active and results have not yet been determined. The competition opened for submission on August 31, 2018 and closes on September 30, 2019. The competition has received 801 entries.

Budget and Resources: The NSF 2026 Idea Machine is led by the Office of Integrative Activities (OIA) and is managed by a working group representing all the directorates and four offices within NSF. For FY18, one FTE and $311,000 have been allocated. The Office of Legislative and Public Affairs supports inreach and outreach (creating graphics and materials, developing and maintaining the Idea Machine website, and announcing the competition via social media platforms, email updates, press releases, leadership blogs and speeches, etc.). Post Modern Company (subcontract to SKILD) was contracted to build, operate, and maintain an online platform that facilitates the submission of entries (text and video), collection of public comments, and judging of competition entries. The contractor is also providing technical support to contestants and marketing the competition, and will distribute cash prizes for winning entries. The contract price was valued at $303,000 (including funds for cash prizes) in FY18. The NSF 2026 Idea Machine is being advertised throughout the entry submission window via on-line leaderboard ads in Science, Science New, and Science Advances (all products of the American Association for the Advancement of Science). The cost for advertisement was $8,000 in FY18. In FY19, OIA will support a one-day virtual meeting and a three-day in-person meeting of the Blue-Ribbon panel at NSF. The estimated cost for this is $33,000.

Partnerships: N/A

Advancement of Agency Mission: Thematic initiatives informed by the NSF 2026 Idea Machine will advance NSF's mission to "promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense." The NSF 2026 Idea Machine exemplifies a new way of eliciting the most forward-looking ideas and enabling a broad consensus with respect to major initiatives that require and deserve support over the next decade to sustain America's global leadership in science and engineering.

Solution Types: Ideas; Scientific

Plan for Upcoming 2 FYs: This is the pilot year for the NSF 2026 Idea Machine, and depending on the response and quality of entries, it will continue in FY19 and FY20 as an annual competition. Several NSF programs that ran challenge competitions during FY17-FY18 are considering hosting new competitions to build on prior successes.

B.8.2 The Vizzies Challenge[52]

Lead Sponsoring Agency: NSF

Authority: NSF Act of 1950, as amended

Status: This FY17 competition is complete, and the FY18 competition is underway.

Competition Goals: In the Vizzies Challenge, NSF asks participants to submit creative, science visualizations that promote understanding of scientific and engineering research. As the need to increase science literacy grows more urgent, visualizations can provide immediate and influential connections between scientists and other citizens. Utilizing these visualizations may be the best hope for nurturing popular interest, as well as helping scientists explain complex problems, while also demonstrating to the public the illustrative aspects of science and engineering. This national contest intends to recognize outstanding achievement by academic scientists, engineers, and the public in the use of visual media to promote understanding of research results.

Goal Types: Inform and educate the public; Engage new people and communities

Justification for Using Prizes and Challenges: Traditional methods such as the grants-approval process would be ill-suited to recognizing the outstanding performance and creation of participants' visual media. Running the Vizzies as a prize competition allows NSF to engage the general public in an interactive manner, and it allows us to partner with outside organizations to more fully realize the reach and potential of the Challenge.

Cash Prize Purses and/or Non-Cash Prize Awards: In FY17, the total prize purse offered and awarded was $11,250. Experts' Choice winners were awarded $2,000 for each category and People's Choice winners were awarded $250 in each category. In FY18, the total prize purse was $11,500. Up to five Experts' Choice will receive $2,000 and up to three People's Choice will receive $500. Non-monetary incentives include featuring winning entries on PopSci.com and on NSF.gov.

Solicitation of Submissions: Entries were solicited via email listservs, social media (facebook/twitter/Instagram/etc.) and social media advertisements, postcards distributed at various events, sessions/talks at various events.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies)

Participation Requirements: Eligibility requirements stipulated that team leads must be U.S. citizens, nationals or permanent residents; all entrants must be 18 years or older; entries must convey science, technology, engineering, and/or mathematics principles; and entries must not advertise or promote a commercial product visually or orally.

Evaluation of Submissions: Vizzies judging is completed in three phases. In each phase, judges evaluated visual impact (50%), effective communication (30%), and freshness and originality (20%). For the first and second rounds, judges were primarily program officers, science assistants, and American Association fo the Advancement of Science Fellows at NSF. For the third round of judging, experts in scientific visualization, art, publishing, and media evaluated entries. As part of the third round, members of the public were also invited to vote on their favorite entry.

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[52] The website for The Vizzies Challenge can be viewed at NSF.gov/vizzies.

Results: A total of 372 entries were submitted between January 15, 2018 and April 18, 2018. Ten prizes were awarded in 2017 and eight prizes will be awarded in 2018, one prize was later retracted.

Budget and Resources: One FTE (in both FY17 and FY18) was responsible for managing the Vizzies competition. This included answering inquiries, working with contractors on setup, editing and working with other office members to update the website, as well as managing the application, submission, and evaluation processes. In FY17, $35,000 for the competition was disbursed through a contract with PostModern to entry platform company WizeHive. In FY18, $40,000 was disbursed through PostModern to entry platform company Skild. An additional $3,000 left over from a previous competition NSF had run with Skild was transferred to the Vizzies account.

Partnerships: Popular Science magazine provided social media support and advertising for the competition. Additionally, the magazine has published the winners in its online edition, and will do so again for the 2018 winners. The value of this contribution is estimated at $10,000-$30,000.

Advancement of Agency Mission: The mission of the National Science Foundation is to fund fundamental and basic research in science and engineering across all fields of study. The Vizzies Challenge helps us to advance that mission by increasing awareness of the agency and our work. The Vizzies Challenge has historically been a valuable asset for interacting with non-traditional audiences, since the competition is open to all US citizens, nationals, and permanent residents, not just academic researchers. By combining an expert panel and a popular choice aspect to the Challenge, the public can engage with NSF in a new and novel way.

Solution Types: Software and apps; Creative (design & multimedia); Technology demonstration and hardware; Analytics, visualizations, algorithms; Scientific

Plan for Upcoming 2 FYs: N/A

B.9 Office of the Director of National Intelligence (ODNI)

B.9.1 3D Multi-View Stereo Challenge[53]

Lead Sponsoring Agency: Intelligence Advanced Research Projects Activity (IARPA)

Authority: National Security Act, 50 USC 3024(n)

Status: This competition was completed in FY17 and prizes were distributed in FY18.

Competition Goals: There were several goals for the Multi-View Stereo Challenge. The main goal was to encourage the development of an algorithm better than the current state of the art. The winning algorithm would then be provided as an open source baseline for generating 3D point clouds for others to use and try to improve, and the top algorithm, along with the competition data, would be hosted online indefinitely to encourage further algorithm development. Thus, this challenge will allow individuals outside the IC in the computer vision community to develop algorithms for satellite imagery.

Goal Types: Find and highlight innovative ideas; Advance scientific research; Develop technology; Inform and educate the public; Engage new people and communities

Justification for Using Prizes and Challenges: IARPA uses prize challenges to reach a broad audience of scientific thinkers, including those in other parts of the world, and have them participate in research

[53] The website for the 3D Multi-View Stereo Challenge can be viewed at https://www.iarpa.gov/index.php/working-with-iarpa/prize-challenges/785-multi-view-stereo-3d-challenge

problems of interest to the Intelligence Community (IC). The prize challenges are a way to quickly identify new research methods, ways of thinking, and perspectives that can be applied to IC problems and IARPA programs. Prizes can be awarded in a more agile way than a traditional grant or procurement contract, and challenge problems are posed so that participants can deliver results and prototypes on shorter timelines.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered and awarded was $100,000. $84,000 of the prize purse was paid out in FY17 and the remainder was distributed in FY18. Prize awards in the Explorer Challenge break down as follows: First Place - $5,000, Second Place - $4,000, Third Place - $3,000, Fourth Place - $2,000, Fifth Place - $1,000, Best Feedback - $1,000. Prize awards in the Master Challenge break down as follows: First Place - $20,000, Second Place - $16,000, Third Place - $11,000, Fourth Place - $7,000, Fifth Place - $5,000, Bonus Opportunities - $12,000, Open Source Award (x3) $5,000. Non-monetary incentives included the opportunity for winners to present their solutions at a government and industry workshop on the challenge.

Solicitation of Submissions: A presentation was made at the Conference on Computer Vision and Pattern Recognition to solicit feedback and participation. Additionally, members from academia, the computer vision field, and other computer vision entities were targeted for participation. The challenge attracted a wide audience of competitors from various fields, as well as participation from within the Topcoder community.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Day-long event(s) prior to the competition

Participation Requirements: The target audience for this challenge was data scientists, computer vision programmers, and others interested in the realm of data satellite imagery. Solvers 18 and over were eligible, including those from around the globe, with the exception of those who reside in Iran, Cuba, North Korea, Crimea Region of Ukraine, Sudan, or Syria. In addition, those who are on the Specially Designated Nationals list promulgated and amended, from time to time, by the United States Department of the Treasury were ineligible.

Evaluation of Submissions: For this data science competition, there was a data set released with training data and test data for solvers to work with. They created their algorithms and submitted results to a holdback data set that calculated a provisional leaderboard that alerted people to progress over the duration of the challenge. At the end of the challenge, the algorithms were run against a final data set the solvers had not seen or interacted with. This final score and review of their code resulted in the winning solution being selected. Solvers were also asked to document their algorithms and code for final evaluation to ensure that the code was understandable and doing what was intended in the challenge. There was in introductory Explorer Challenge Phase and an advanced Master Challenge Phase to the competition.

Results: Between July and October 2016, the Explorer Challenge drew 686 registrants with 16 active competitors and the Master Challenge drew 369 participants with 24 active competitors. Thirteen prizes were awarded to 10 winners.

Budget and Resources: N/A

Partnerships: N/A

Advancement of Agency Mission: This IARPA public prize challenge has resulted in immediate major outcomes of benefit to the intelligence community and also the public community of remote sensing researchers. Three Open Source solutions were made public via the challenge and posted on the challenge website. Results of the prize challenge indicate the best performing research solutions are

based on the Satellite Stereo Pipeline (S2P), the RPC Stereo Processor, and the NASA Ames Stereo Pipeline (ASP). As a result of prize incentives from the challenge, multi-view stereo solutions based on S2P and ASP are being open sourced. All source imagery, ground truth LIDAR, and metric analysis software for the prize challenge has been publicly released as a commercial satellite benchmark to support the research community. This data is made available at http://www.jhuapl.edu/satellite-benchmark.html. The best research solutions from the challenge are based on variations of the Semi-Global Matching dynamic programming algorithm first published by Hirschmuller in 2008. This establishes a baseline for further research.

Solution Types: Analytics, visualizations, algorithms

Plan for Upcoming 2 FYs: N/A

B.9.2 Disguised Faces in the Wild Competition

Lead Sponsoring Agency: IARPA

Authority: National Security Act, 50 USC 3024(n)

Status: This competition was launched and completed in FY18.

Competition Goals: The goal of the Disguised Faces in the Wild Competition was to advance the performance of face recognition on disguised or obfuscated faces. With recent advancements in deep learning, the capabilities of automatic face recognition have been significantly increased. However, face recognition in an unconstrained environment with non-cooperative users is still a research challenge, pertinent for users such as law enforcement agencies. While several covariates such as pose, expression, illumination, aging, and low resolution have received significant attention, "disguise" is still considered an arduous covariate of face recognition.

Goal Types: Solve a specific problem; Advance scientific research; Develop technology; Other - Benchmark state of the art

Justification for Using Prizes and Challenges: IARPA uses prize challenges to reach a broad audience of scientific thinkers, including those in other parts of the world, and have them participate in research problems of interest to the intelligence community (IC). The prize challenges are a way to quickly identify new research methods, ways of thinking, and perspectives that can be applied to IC problems and IARPA programs. Prizes can be awarded in a more agile way than a traditional grant or procurement contract, and challenge problems are posed so that participants can deliver results and prototypes on shorter timelines.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered and awarded was $25,500. Six prizes were awarded: first ($6,000) and second ($2,500) place in Overall Recognition Accuracy, Impersonation Recognition, and Obfuscation Recognition. Non-monetary incentives included the opportunity to present at the 2018 Institute of Electrical and Electronics Engineers (IEEE) Computer Vision and Pattern Recognition Conference.

Solicitation of Submissions: The prize challenge was advertised through challenge.gov and http://iab-rubric.org/DFW/dfw.html with all rules and participation instructions. Organizations signed a participation agreement with Indraprastha Institute of Information Technology (IIIT)-Delhi and submitted executable software to them for evaluation. The target audience for this challenge were academic and industry researchers in face recognition.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies)

Participation Requirements: N/A

Evaluation of Submissions: IIIT-Delhi evaluated the performance of submitted algorithms by conducting standardized biometric tests involving a sequestered test and evaluation dataset. Metrics and evaluation conditions were published in the prize challenge rules ahead of time.

Results: Of the 12 entries submitted between January 20 and May 1, 2018, six prizes were awarded to two winners.

Budget and Resources: N/A

Partnerships: Non-Federal partners included the University of Maryland, IBM, and IIIT-Delhi.

Advancement of Agency Mission: Face recognition is used in many U.S. Government missions, including counter terrorism, criminal justice, and national security. This prize challenge allowed IARPA to engage the wider academic and commercial research communities developing face recognition software to stimulate advances in unconstrained face recognition as well as to benchmark the state of the art of existing solutions.

Solution Types: Software and apps

Plan for Upcoming 2 FYs: N/A

B.9.3 Functional Map of the World (FMOW) Challenge[54]

Lead Sponsoring Agency: IARPA

Authority: National Security Act, 50 USC 3024(n)

Status: This competition was launched in FY17 and completed in FY18.

Competition Goals: Recent advances in computing capabilities have led to deep learning algorithms and great advances in computer vision and machine learning. The goal of the Functional Map of the World Challenge was to encourage researchers to apply such techniques to provide an understanding of satellite images and develop machine learning algorithms that would successfully predict the functional use of buildings and land use. To satisfy the desired data driven techniques, one million annotated images were generated and placed online.

Goal Types: Find and highlight innovative ideas; Advance scientific research; Develop technology; Inform and educate the public; Engage new people and communities

Justification for Using Prizes and Challenges: IARPA uses prize challenges to reach a broad audience of scientific thinkers, including those in other parts of the world, and have them participate in research problems of interest to the Intelligence Community (IC). The prize challenges are a way to quickly identify new research methods, ways of thinking, and perspectives that can be applied to IC problems and IARPA programs. Prizes can be awarded in a more agile way than a traditional grant or procurement contract, and challenge problems are posed so that participants can deliver results and prototypes on shorter timelines.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered was $112,500 and the total amount awarded was $107,500. Prize awards in the FMOW Challenge break down as follows: First Place - $25,00, Second Place - $16,000, Third Place - $12,000, Fourth Place - $8,000, Fifth Place - $5,000,

[54] The website for the Functional Map of the World (FMOW) Challenge can be viewed at https://www.iarpa.gov/challenges/fmow.html.

Undergrad - $5,000, Open Source (x3) - $5,000, Best POI - $5,000, Progress Prizes (x3) - $3,000, Workshop Presenter (x5) $2,500. The Prizes covered participation in the challenge, with a set aside of travel money awarded for those selected to travel to the final workshop held by IARPA in conjunction with SpaceNet. At the final workshop, the winners were able to present their solution to a government group interested in Geospatial Imagery.

Solicitation of Submissions: Participants in the previous Multi-View Stereo 3D Challenge were solicited along with members from academia, the computer vision field, and other computer vision entities. The challenge attracted a wide audience of competitors from various fields, as well as participation from within the Topcoder community.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Day-long event(s) prior to the competition

Participation Requirements: The target audience for this challenge was data scientists, computer vision programmers, and others interested in the realm of satellite imagery data. Solvers 18 and over were eligible, including those from around the globe, with the exception of those who reside in Iran, Cuba, North Korea, Crimea Region of Ukraine, Sudan, or Syria. In addition, those who are on the Specially Designated Nationals list promulgated and amended, from time to time, by the United States Department of the Treasury were ineligible.

Evaluation of Submissions: For this data science competition, there was a data set released with training data and test data for solvers to work with. They created their algorithms and submitted results to a holdback data set that calculated a provisional leaderboard that alerted people to progress over the duration of the challenge. At the end of the challenge, the algorithms were run against a final data set the solvers had not seen or interacted with previously. This final score and review of their code identified the winning solution. Solvers were also asked to document their algorithms and code for final evaluation to ensure that the code was understandable and doing what was intended in the challenge.

Results: A total of 858 registered participants generated 1408 entries (submitted by 69 participants) between September and December 2017. Ten prizes were awarded to 11 winners.

Budget and Resources: N/A

Partnerships: N/A

Advancement of Agency Mission: IARPA released the full data set, including the sequestered data, on SpaceNetTM after the challenge in order to further scientific research on the data. See https://spacenetchallenge.github.io/datasets/fmow_summary.html for more information. Data is now available for free to download, removing the cost burden to efficiently accessing the data. Three open source solutions released to the public to allow the computer vision community to keep working on improved solutions.

Solution Types: Analytics, visualizations, algorithms

Plan for Upcoming 2 FYs: N/A

B.9.4 Fusion of Face Recognition Algorithms (FOFRA)[55]

Lead Sponsoring Agency: IARPA

Authority: National Security Act, 50 USC 3024(n)

Status: This competition was launched and completed in FY18.

Competition Goals: How can the data outputs of multiple face recognition algorithms be leveraged to improve overall accuracy? There is a large literature on biometric fusion intended to improve accuracy via fusion of multiple modalities (e.g., face + fingerprint), multiple algorithms, or multiple samples. However, most of the research has only addressed one-to-one (1:1) verification at the score level. This prize challenge is aimed at stimulating research into methods to improve one-to-many (1:N) identification accuracy via template-level fusion. Further accuracy gains could be realized by fusing feature-level templates or through more innovative score-level fusion methods informed by modern data science.

Goal Types: Solve a specific problem; Advance scientific research; Develop technology

Justification for Using Prizes and Challenges: IARPA uses prize challenges to reach a broad audience of scientific thinkers, including those in other parts of the world, and have them participate in research problems of interest to the intelligence community (IC). The prize challenges are a way to quickly identify new research methods, ways of thinking, and perspectives that can be applied to IC problems and IARPA programs. Prizes can be awarded in a more agile way than a traditional grant or procurement contract, and challenge problems are posed so that participants can deliver results and prototypes on shorter timelines.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered was $70,000, but no working submissions were received. There were five prizes available, though none were awarded: Verification Score-level Fusion ($8,000), Verification Template-level Fusion ($16,000), Identification Score-level Fusion ($11,000), Identification Template-level Fusion (Two-way) ($18,000), and Identification Template-level Fusion (Three-way) ($17,000).

Solicitation of Submissions: The prize challenge was advertised through iarpa.gov, challenge.gov, and nist.gov with all rules and participation instructions. Organizations signed a participation agreement with the National Institute of Standards and Technology (NIST) and submitted executable software to NIST for evaluation. IARPA is in the process of evaluating the prize challenge to determine lessons learned so as to inform how or if to proceed with re-launching the challenge. The challenge received 16 requests for the training/validation data, which is low for a biometrics challenge but still significant enough that more submissions were expected.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies)

Participation Requirements: N/A

Evaluation of Submissions: No evaluation was performed due to a lack of functioning software submissions. NIST was to evaluate the performance of submitted algorithms by conducting

[55] The website for the Fusion of Face Recognition Algorithms (FOFRA) can be viewed at https://www.iarpa.gov/index.php/working-with-iarpa/prize-challenges/1110-fusion-of-face-recognition-algorithms-fofra-prize-challenge.

standardized biometric tests involving a sequestered testing and evaluation dataset. Metrics and evaluation conditions were published in the prize challenge rules ahead of time. Results were to be presented to a panel of U.S. Government employee judges who then would select winners based on technical performance.

Results: One entry was submitted between May 23 and August 6, 2018. No prizes were awarded.

Budget and Resources: N/A

Partnerships: IARPA partnered with NIST for this challenge.

Advancement of Agency Mission: Face recognition is used in many U.S. Government missions, including counter terrorism, criminal justice, and national security. Face recognition error rates, particularly on uncontrolled face imagery, are well above zero. While algorithm development has seen considerable investment, other mechanisms for improving accuracy are known. Among them, there is a large academic literature on biometric fusion, covering multimodal and multi-algorithmic fusion. It shows that substantial accuracy gains can be made over using a single mode, or a single algorithm alone, and this can be achieved, in large part, using quite simple methods. The gains decrease when the fused inputs are correlated. The vast majority of the literature addresses biometric verification, rather than identification. Moreover, the literature covers score-level fusion rather than feature (i.e. template) level fusion. The latter, on information theoretic grounds, offers greater accuracy gains at the expense of some complexity.

Solution Types: Software and apps

Plan for Upcoming 2 FYs: N/A

B.9.5 Geopolitical Forecasting Challenge[56]

Lead Sponsoring Agency: IARPA

Authority: National Security Act, 50 USC 3024(n)

Status: This competition was launched in FY18 and is underway.

Competition Goals: Decision makers rely on the Intelligence Community (IC) to provide accurate and relevant geopolitical forecasts, and IARPA is working to identify methods to maximize the quality of these forecasts. The Geopolitical Forecasting (GF) Challenge sought to crowdsource innovative algorithms for integrating crowdsourced forecasts and other data into accurate, timely forecasts on worldwide issues. The effort was run in parallel to IARPA's geopolitical forecasting research program Hybrid Forecasting Competition (HFC). Challenge Solvers competed on a largely overlapping set of Individual Forecasting Problems (IFPs) as HFC research teams and were given access to the same human forecaster data stream. In addition to the provided data stream, solvers were free to use other data streams and existing/developed models for the challenge.

Goal Types: Find and highlight innovative ideas; Solve a specific problem; Advance scientific research

Justification for Using Prizes and Challenges: IARPA uses prize challenges to reach a broader audience of scientific thinkers, including those in other parts of the world, and have them participate in research problems of interest to the IC. The prize challenges are a way to quickly identify new research methods, ways of thinking, and perspectives that can be applied to IC problems and IARPA programs. Prizes can

[56] The website for the Geopolitical Forecasting Challenge can be viewed at https://www.iarpa.gov/challenges/gfchallenge.html.

be awarded in a more agile way than a traditional grant or procurement contract, and challenge problems are posed so that participants can deliver results and prototypes in shorter timelines.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered amounts to $200,000. The first place overall prize is $20,000, and the second through fifth place overall prizes are $12,000, $10,000, $7,000, and $4,000, respectively. A bonus "Ultimate Forecaster" award with a total value of $40,000 was available to the solver who finished in first place. Additional bonus awards included the Star Forecaster awards, which provides for $30,000 split amongst all eligible solvers/teams. Additional incentives and milestone prizes include a Best in Domain/Region Pair prize purse of $25,000 (five awards of $5,000 each), a Best Undergraduate award of $4,000, a Milestone 1 award of $7,500 (ten awards of $750 each), a Milestone 2 award of $10,000 (ten awards of $1,000 each), a Milestone 3 award of $12,500 (ten awards of $1,250 each), an Election Forecaster Award of $10,000, a Spring Forecaster award of $2,400 (three awards of $800 each), an Interim Prize of $2,600, and a Workship Presenter Prize of $2,500. Non-monetary incentives included an opportunity to interact with IARPA Program Manager Dr. Seth Goldstein, and attendance at the IARPA Hybrid Forecasting Competition Principal Investigator meeting/GFChallenge workshop.

Solicitation of Submissions: GF Challenge Solvers submitted their forecasts via a platform built by Cultivate Labs. They were able to access the IFPs, submit their forecasts, view a leaderboard, and view their scores on the various IFPs through this platform. Solvers were also required to submit a Final Solver Document, where they provided greater context and explanation for their solutions in a narrative format.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies)

Participation Requirements: To be eligible to win a prize under this competition, an individual or entity: (1) Must have completed and submitted a registration form at HeroX GF Challenge; (2) Must be an individual or team each member of which is 18 years of age or over, or an incorporated entity; and (3) May not be a Federal entity or Federal employee acting within the scope of their employment. 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. Some participating individuals or organizations were not eligible for prizes. However, these solvers did have the opportunity, upon IARPA approval, to participate in the challenge and be eligible for ranking on the leaderboard.

Evaluation of Submissions: For most of the prize categories, the score was the sum of solvers' Net Brier Points (NBPs) over all germane IFPs for that category. NBPs measure solver performance versus a baseline based on current state-of-the-art human forecast collection and aggregation methods derived from the IARPA ACE program. To be eligible for overall prizes, solvers needed to have attempted at least 70% of all IFPs and have positive NBPs (i.e., beat the state-of-the-art baseline) on more than 50% of IFPs attempted. For overall performance prize bonuses, solvers needed to meet qualifying criteria listed above and additionally beat the GF Challenge Baseline and HFC Top score. To be eligible for milestone or domain/region prizes a solver must have submitted forecasts for at least 80% of the IFPs considered for that prize. For Milestone Prizes, only the IFPs that were resolved during that time period counted for that Milestone's prizes. IFPs that were opened, but not resolved, during a Milestone did not count. Those IFPs were counted towards the Milestone period in which the IFP resolves. Net Brier Points were calculated using a metric, based on the Brier score, which incorporates forecast accuracy, timeliness,

and confidence in contrast to the state-of-the-art baseline. This baseline was available to solvers via the Cultivate Labs platform. HFC Top Score was the top scoring method, coming out of the parallel HFC research program; it was visible on the leaderboard during the challenge.

Results: There were 17 participants in this challenge. A total of 46 prizes were awarded to 10 participants, totaling $125,150. One challenge participant, a University Affiliated Research Center, relinquished prizes in order to be eligible for the competition. Eight participants had forecast methods that outperformed the benchmark, which was the prior state of the art in forecast aggregation from the IARPA ACE program. These methods also outperformed the best HFC methods, albeit with relaxed participation rules as compared with the HFC Performers.

Budget and Resources: N/A

Partnerships: N/A

Advancement of Agency Mission: IARPA's mission is to envision and lead high-risk, high-payoff research that delivers innovative technology for future overwhelming intelligence advantage. The GF Challenge invited Solvers from around the world to develop solutions that produced probabilistic forecasts in response to numerous closed-ended forecasting questions that concerned specific, objectively verifiable geopolitical events containing timeframes with deadlines and locations. Questions like: Who will win the upcoming presidential election in Egypt? What will the spot price of Brent Crude oil be on [date]? This challenge directly advanced IARPA's mission to engage the public by challenging them to develop solutions that are capable of processing data and making forecasts. Methods that outperformed the state-of-the-art or HFC Performer methods overall, or on specific subsets of forecasting questions (e.g., for particular regions or topics) have the potential to inform geopolitical forecasting within the intelligence community.

Solution Types: Analytics, visualizations, algorithms

Plan for Upcoming 2 FYs: N/A

B.9.6 Mercury Challenge[57]

Lead Sponsoring Agency: IARPA

Authority: National Security Act, 50 USC 3024(n)

Status: This competition was launched in FY18, and is underway.

Competition Goals: In an effort to provide early warning capabilities, the Department of Defense's Integrated Crisis Early Warning System and IARPA's Open Source Indicators programs want to leverage novel statistical and machine learning techniques using publicly available data sources to forecast societal such as civil unrest and disease outbreaks with a high degree of accuracy. Participants are encouraged to develop and test innovative forecasting methods that ingest and process publicly available data sources to predict military activity, non-violent civil unrest, and infectious disease in specific places of interest.

Goal Types: Find and highlight innovative ideas; Solve a specific problem; Advance scientific research; Engage new people and communities

Justification for Using Prizes and Challenges: IARPA uses prize challenges to reach a broad audience of scientific thinkers, including those in other parts of the world, and have them participate in research

[57] The website for the Mercury Challenge can be viewed at https://www.iarpa.gov/challenges/mercury.html.

problems of interest to the intelligence community (IC). The prize challenges are a way to quickly identify new research methods, ways of thinking, and perspectives that can be applied to IC problems and IARPA programs. Prizes can be awarded in a more agile way than a traditional grant or procurement contract, and challenge problems are posed so that participants can deliver results and prototypes on shorter timelines.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered is $100,000. During the first scoring period, $21,000 will be given out to six total winners. During the second scoring period, $79,000 will be given out to nineteen total winners.

Solicitation of Submissions: The challenge was marketed through press release, media hits, social media, email outreach, two early Q&A sessions, and a community day. The challenge was also marketed to the Topcoder community.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Day-long event(s) prior to the competition; Other - WeWork; Other - Topcoder

Participation Requirements: To be eligible to win a prize under this competition, an individual or entity: must be an individual or team each of whose members are 18 years of age and over, or an incorporated entity; may not be a Federal entity or Federal employee acting within the scope of their employment. 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. Federal grantees may not use Federal funds to develop challenge solutions 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.

Evaluation of Submissions: For military activity forecasts, the effectiveness of each participant's methods will be judged using the following metrics: (1) Lead Time, the number of days between the date the forecast was produced and the date the actual event was reported; (2) F-Score, the harmonic mean of Precision; and (3) Recall Quality Score (QS), the similarity of warning details to event details in terms of the distance between the warning location and the event location, the number of days between the warning Event Date and the actual Event Date, and agreement between warning and event actor and event subtype. QS is measured on a scale of 0.0 to 4.0. For count forecasts, which include civil unrest (CU) events and disease, the effectiveness of each participant's methods will be judged using the following metrics: (1) Lead Time, the average number of days between the date the forecasted count was submitted and the effective Event Date; (2) Weekly Counts, where the week is defined as the International Organization for Standardization week, which starts on Monday and ends on Sunday; (3) Monthly Counts, where the effective Event Date is the 15th of the month; and (4) Quality Score, the average quality score of each valid forecast (ranges from 0 to 1), which is based on the difference between the forecast count and the actual count. Ranking of participants who achieve these two thresholds will be done using Quality Score carried to three significant digits. In the event of a tie additional significant digits will be used to determine the final winners. The Mercury Challenge will compare participant submissions against a "base rate" model. Base Rate models are models that only use information included in the history of observed events. It is expected that Participant models will score better than the base rate models. The top scorers who beat the baseline will be awarded the Best Overall prize(s).

Results: At the time of this report, no prizes have been awarded. The challenge is broken up into two separate scoring periods: (1) August 7 to October 31, 2018, and (2) November 1, 2018 to January 31.

Budget and Resources: N/A

Partnerships: N/A

Advancement of Agency Mission: IARPA's mission is to lead high-risk, high-payoff research that delivers innovative technology for future overwhelming intelligence advantage. The Mercury Challenge invited technologists, data scientists, and machine learning engineers who are skilled at breaking down complex data to participate. Surprise events such as the fall of the Berlin Wall, Iraq's invasion of Kuwait, the civil unrest that gave rise to the Arab Spring, and Russian incursions into Ukraine, forced rapid responses in the absence of data related to the underlying causes of these events. IARPA aims to connect the dots that lead up to events such as these. This challenge directly advances IARPA's mission to engage the public by challenging them to develop solutions by making forecasts.

Solution Types: Ideas; Analytics, visualizations, algorithms

Plan for Upcoming 2 FYs: N/A

B.9.7 MORGOTH'S CROWN (Modeling of Reflectance Given Only Transmission of High-Concentration Spectra for Chemical Recognition over Widely-Varying Environments)[58]

Lead Sponsoring Agency: IARPA

Authority: National Security Act, 50 USC 3024(n)

Status: This competition was launched in FY17 and completed in FY18.

Competition Goals: The aim of MORGOTH'S CROWN challenge was to crowdsource breakthroughs in infrared (IR) spectral modeling that could enable predictions of trace chemical spectra on a surface from bulk reflectance or absorption spectra. A major hurdle for active/passive-standoff detection in real-world settings is compensating for spectral changes due to chemical or physical interactions of chemicals with a substrate and/or from physical characteristics of the chemical (e.g., particle size and shape, deposition, thickness, etc.). An improved or breakthrough IR spectral model would enable easier construction of more comprehensive and robust chemical detection libraries that would enhance passive or active infrared chemical detection probabilities in complex environments. Participants were asked to generate an algorithm that would predict the spectra of combinations of chemicals and substrates that were not used in the training data. For example, if the training set involved caffeine layered on aluminum, participants could have been asked to predict the spectra of caffeine on glass or acetaminophen on aluminum.

Goal Types: Find and highlight innovative ideas; Solve a specific problem; Advance scientific research; Develop technology; Inform and educate the public; Engage new people and communities; Build capacity

Justification for Using Prizes and Challenges: IARPA uses prize challenges to reach a broad audience of scientific thinkers, including those in other parts of the world, and have them participate in research problems of interest to the intelligence community (IC). The prize challenges are a way to quickly identify new research methods, ways of thinking, and perspectives that can be applied to IC problems and IARPA programs. Prizes can be awarded in a more agile way than a traditional grant or procurement contract, and challenge problems are posed so that participants can deliver results and prototypes in shorter timelines.

[58] The website for MORGOTH'S CROWN can be viewed at www.iarpa.gov/challenges/morgothscrown.html.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered was $50,000 and the total amount awarded was $49,500. The top five awards were distributed as follows: First Place: $20,000, Second Place: $15,000, Third Place: $10,000, Fourth Place: $2,000, and Fifth Place: $1,000. Three bonus prizes were offered, to include: Progress Prize 1: $1,000, Progress Prize 2: $500, Progress Prize 3: $500 (not awarded). Non-monetary incentives included the opportunity to present solutions at a government workshop.

Solicitation of Submissions: The target audience were members of academia, small businesses, and experts across the globe who deal with spectroscopy, chemistry, physics, etc. We reached out via email and social media and marketed through the Topcoder platform in addition to listing on Challenge.gov. Outreach hit over 2,000 email contacts.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Other - Topcoder solvers pool

Participation Requirements: The challenge targeted chemists, computer scientists, the machine learning community, and anyone else who may want to participate in a data analysis challenge. U.S. and foreign participants were solicited. The only limitation on participation was that anyone affiliated with either a SILMARILS (Standoff ILluminator for Measuring Absorbance and Reflectance Infrared Light Signatures) program performer or test and evaluation team member had to recuse themselves from winning prizes, but could participate and be scored.

Evaluation of Submissions: An automated scoring function based on a non-linear combination of Spectral Information Divergence and Spectral Angle Mapper metrics was used to provide an overall "closeness of fit" score between the predicted spectra and the measured ground truth data (test data set), with higher scores indicating better fits. Challenge participants were provided with their composite score, and allowed to submit multiple predictions of the test data set over the course of the challenge in order to iteratively improve their algorithms. At the conclusion of the challenge the ten highest scoring participants submitted their algorithm code to the MORGOTH'S CROWN challenge team, where the algorithms were run to provide predictions of an additional 18 different substrate and chemical morphology combinations which the participants had never seen or been able to score their algorithm against during development (validation data set). Scores against this validation set were used to determine the final challenge rankings and prizes.

Results: Of the 664 entries submitted by 37 participants between July 26 and September 20, 2017, seven prizes were awarded to five winners.

Budget and Resources: N/A

Partnerships: N/A

Advancement of Agency Mission: IARPA'S MORGOTH'S CROWN prize challenge was a crowdsourced effort to encourage new approaches in infrared spectral modeling to quantitatively predict trace spectra on surfaces from bulk reflectance spectra. All algorithm development methods and algorithm types were allowed, ranging from traditional first-principle physics based models to pure machine learning approaches. After developing and training their algorithm using the training data set, which was provided with full characterization and metadata, performers were asked to submit spectral predictions for 18 different substrate and chemical morphology combinations. The results of the MORGOTH'S CROWN challenge showed that machine-learning based approaches were better able to quantitatively predict new spectra than physics-based models. This indicates that new approaches to chemical spectral prediction, which is important for detecting traces of explosives, narcotics, and other chemical hazards on surfaces are needed.

Solution Types: Software and apps

Plan for Upcoming 2 FYs: N/A

B.9.8 Nail-to-Nail (N2N) Fingerprint Challenge[59]

Lead Sponsoring Agency: IARPA

Authority: National Security Act, 50 USC 3024(n)

Status: This competition was launched in FY17 and completed in FY18.

Competition Goals: The goal of the N2N Challenge was to improve biometric fingerprint collection and recognition systems by eliminating plain fingerprint captures. IARPA was looking for new and innovative approaches to developing an N2N fingerprint capture device that: (1) Does not require a human operator (though verbal instructions can be provided); (2) Is capable of collecting full nail-to-nail friction ridge surfaces that lead to biometric recognition that is as good or better than existing standard human operator assisted methods; (3) Is able to capture the information in the same or less time as existing approaches; (4) Enables fully- or semi-cooperative subject interaction; (5) Uses contact or contactless capture methods; and (6) Uses novel or conventional fingerprint sensor hardware.

Goal Types: Solve a specific problem; Advance scientific research; Develop technology; Engage new people and communities; Stimulate a market

Justification for Using Prizes and Challenges: IARPA uses prize challenges to reach a broad audience of scientific thinkers, including those in other parts of the world, and have them participate in research problems of interest to the intelligence community (IC). The prize challenges are a way to quickly identify new research methods, ways of thinking, and perspectives that can be applied to IC problems and IARPA programs. Prizes can be awarded in a more agile way than using a traditional grant or procurement contract, and challenge problems are posed so that participants can deliver results and prototypes in shorter timelines.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered was $290,000 and the total amount awarded was $255,000. Prizes were awarded in the following manner: Print Provider (x8) - $8,000, Master Builder (x8) - $2,000, Workshop Presenter (x5) - $5,000, Best Latent Accuracy - $25,000, Fastest Scan - $25,000, Best Gallery Accuracy - $25,000, Grand Prize - $100,000. In the event that no one met the metrics for the Grand Prize, a Second Place of $15,000 and Third Place of $10,000 were to be awarded in the following categories: Best Latent Accuracy, Fastest Scan, and Best Gallery Accuracy. Non-monetary incentives included the opportunity to present findings at the N2N Workshop held at the Biometrics Congress Conference in Washington, DC.

Solicitation of Submissions: The challenge was promoted on challenge.gov and iarpa.gov along with press releases, an email campaign and a social media campaign. As this was a three-stage downselect challenge, marketing was only done at the start of the challenge as new solvers could not join the challenge after the first downselect period.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies)

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[59] The website for the Nail-to-Nail (N2N) Fingerprint Challenge can be viewed at https://www.iarpa.gov/challenges/n2n/n2n.html.

Participation Requirements: The challenge was open to all U.S. and foreign citizens, companies, teams, and any organization or single participant. Solvers were required to submit a write up, as well as safety review documents in order to participate in the Live test and undergo a safety evaluation as well as Human Subjects Training.

Evaluation of Submissions: The first round of submissions were evaluated and feedback provided to participants on considerations and pros and cons of their devices in preparation for Stage 2. During Stage 2, Solvers submitted a device documentation review as well as a video demonstrating their device in action. Solvers were then judged by a government panel and those whose devices were feasible were invited to the Live Test event. During the Live Test event, Solvers captured fingerprints from human test subjects. The same human test subject prints were also captured by the baseline station run by professional hands-on print collectors as well as a set of latent prints collected by forensic examiners. At the end of the challenge, the prints were sent through a government matching system and compared against the baseline rolls for each human test subject. The matching results were used to calculate the final results of the challenge.

Results: Of the 15 entries submitted by nine participants between February 2 and September 22, 2017, seven prizes were awarded to eight winners.

Budget and Resources: N/A

Partnerships: N/A

Advancement of Agency Mission: The challenge produced a new public fingerprint dataset containing 41,177 fingerprint images and 13,644 latent images, a subset of which will be released for scientific research. New methods were discovered for fingerprint scanning from academic research and prototype design using new materials and ways of thinking. The challenge compared the efficacy of current state-of-the-art COTS (commercial off the shelf) products to understand their strengths in three areas: live matching, latent matching, and speed. Areas of improvement in large-scale latent print processing and capture were identified. Finally, the challenge shed new light on the comparison of current gold-standard methods of fingerprint collection.

Solution Types: Software and apps

Plan for Upcoming 2 FYs: N/A

B.9.9 OpenCLIR (Open Crosslingual Information Retrieval)[60]

Lead Sponsoring Agency: IARPA

Authority: National Security Act, 50 USC 3024(n)

Status: This competition was launched in FY17 and is underway in FY18.

Competition Goals: The goal of the OpenCLIR (Open Cross Language Information Retrieval) evaluation is to develop methods to locate text and speech content in documents (speech or text) in low-resource languages using English queries. This capability is one of several expected to ultimately support effective triage and analysis of large volumes of data in a variety of less studied languages. Successful systems will be able to adapt to new languages and new genres.

Goal Types: Advance scientific research; Develop technology

[60] The website for OpenCLIR can be viewed at https://openclir.nist.gov/.

Justification for Using Prizes and Challenges: IARPA uses prize challenges to reach a broad audience of scientific thinkers, including those in other parts of the world, and have them participate in research problems of interest to the intelligence community (IC). The prize challenges are a way to quickly identify new research methods, ways of thinking, and perspectives that can be applied to IC problems and IARPA programs. Prizes can be awarded in a more agile way than using a traditional grant or procurement contract, and challenge problems are posed so that participants can deliver results and prototypes on shorter timelines.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered is $30,000, which includes $10,000 for the Text Award and $20,000 for the Auditory Award.

Solicitation of Submissions: Email lists of natural language processing practitioners, IARPA Twitter (hashtag #OpenCLIR), and a Keynote Address at a machine translation conference were used to advertise the challenge. Participants did not specify how they learned of the challenge so we have no data on which approach was most effective.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Other - Announcement in conference keynote address

Participation Requirements: Participants should have a background in natural language processing technology.

Evaluation of Submissions: Participants were judged on two criteria: (1) performance on the CLIR detection metric, Actual Query Weighted Value (AQWV), weighted 80%, and (2) comprehensiveness of system description, weighted 20%.

Results: The challenge is not yet complete. The challenge evaluation period is from March 11, 2019 to March 15, 2019 with system descriptions due March 29, 2019.

Budget and Resources: N/A

Partnerships: The Federal Bureau of Investigation's National Virtual Translation Center provided annotated data for the evaluation. The National Institute of Standards and Technology provided visiting foreign researchers to run the challenge at their cost, approximately $40,000.

Advancement of Agency Mission: When the challenge is complete, it should advance the state of the art in low resource machine translation, cross-lingual information retrieval and automatic speech recognition.

Solution Types: Software and apps; Ideas; Scientific

Plan for Upcoming 2 FYs: N/A

B.9.10 The ODNI-OUSD(I) Xamine Challenge: Machine Verification of Collected Information[61]

Lead Sponsoring Agency: ODNI

Authority: N/A

Status: This competition was launched in FY18 and is underway.

[61] The website for The Odni-Ousd(i) Xamine Challenge: Machine Verification of Collected Information can be viewed at www.innocentive.com/ar/challenge/9934079.

Competition Goals: Machine-based approaches to generating and evaluating analytic products from disparate structured and unstructured data types are emerging areas of research for the U.S. Intelligence Community (IC). As these approaches mature beyond demonstration systems with controlled data sources, such IC systems will require a means for inspecting and ensuring the integrity of the data that are ingested by these systems. These considerations will become particularly critical as the information available to the IC's analytic community continues to exceed the ability for traditional, human vetting. Accordingly, the ODNI and the Office of the Under Secretary of Defense for Intelligence [OUSD(I)] are seeking ideas and descriptions of a viable technical approach for enabling the automated validation of information prior to the dissemination of machine-generated intelligence products.

Goal Types: Find and highlight innovative ideas; Advance scientific research; Develop technology; Inform and educate the public; Engage new people and communities

Justification for Using Prizes and Challenges: ODNI decided to use prize competitions for this topic in order to leverage funding and reach as large an audience as possible. Competitions allow more individuals and companies to be engaged and involved than traditional contracts or grants. The Xamine Challenge attracted 119 registrants.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered is $75,000. This prize pool reflects an initial phase, with a $25,000 prize purse, and a second phase, with a $50,000 prize purse. Awards for the first phase are under evaluation, and the second phase has not yet launched. The competition is solely funded by the government and no other private sector or philanthropic funds contribute to the competition prize.

Solicitation of Submissions: On 4 May 2018, the competition went live on the InnoCentive prize competition website and was posted on Challenge.gov. ODNI issued a press release and publicized the Challenge on social media. InnoCentive promoted the prize competition through their social media platforms (LinkedIn, Twitter, Facebook, and Google+) and weekly email blasts to over 140,000 solvers during the competition posting period. As a result of this outreach, 119 teams from 32 countries registered for the competition.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release

Participation Requirements: N/A

Evaluation of Submissions: This competition has received 15 submissions that at the time of this report are being evaluated by ODNI and OUSD(I) representatives.

Results: 15 entries were submitted between May 4 and July 2, 2018, and at the time of this report prizes have not been awarded.

Budget and Resources: OUSD(I) representatives were involved in evaluating Xamine submissions. The Air Force Research Laboratory (AFRL) and Ball Aerospace managed the contracts and sub-contracts for this prize competition. InnoCentive, Inc. was utilized as a third party vendor to help plan and conduct the prize competition.

Partnerships: For this prize competition, ODNI partnered with OUSD(I), AFRL, and Ball Aerospace. ODNI used the Economy Act to ensure economical and efficient services.

Advancement of Agency Mission: As previously stated, as machine-driven approaches to generating and evaluating analytic products mature beyond demonstration systems, IC systems will require a means for inspecting and ensuring data integrity. Through this competition, ODNI and OUSD(I) are seeking a viable technical approach to rapidly and objectively determine the trustworthiness of input information prior to the dissemination of machine-generated intelligence products that support IC missions.

Solution Types: Software and apps; Ideas; Analytics, visualizations, algorithms

Plan for Upcoming 2 FYs: In FY19, the office of the Director of Science and Technology (DS&T) within ODNI in partnership with OUSD(I) will sponsor two public prize competitions—"Xplore" and "Xpect"—to explore opportunities, using artificial intelligence techniques, to revolutionize the IC's finished intelligence production processes. These challenges are part of a series of efforts exploring technical approaches to accelerate and automate the production of intelligence, and build on the "Xpress", "Xtend", and "Xamine" challenges launched in Fiscal Years 2017 and 2018. Through the Xplore Challenge, solvers will be asked to describe artificial intelligence-based approaches for enabling the automated and predictive discovery of information. The Xpect Challenge will ask solvers to describe artificial intelligence-based approaches for automating model-based indications of change.

B.9.11 The ODNI-OUSD(I) Xpress Challenge: Machine Generation of Analytic Products[62]

Lead Sponsoring Agency: ODNI

Authority: N/A

Status: This competition was launched in FY17 and completed in FY18.

Competition Goals: The primary objective of this prize competition was to determine the state-of-the-art in natural language processing (NLP). ODNI wanted to examine the feasibility of using NLP and related artificial intelligence technologies to craft analytic products with national security implications.

Goal Types: Find and highlight innovative ideas; Advance scientific research; Develop technology; Inform and educate the public; Engage new people and communities

Justification for Using Prizes and Challenges: ODNI decided to use prize competitions for this topic in order to leverage funding and reach as large an audience as possible. Competitions allow more individuals and companies to be engaged and involved than traditional contracts or grants. The Xpress Challenge engaged over 8,000 people with 387 registrants.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered was $500,000, which included a top award of $100,000 for the best overall submission and $30,000 in Early STEM Education awards for high school student team submissions. The total amount awarded was $200,000, with $150,000 awarded to the first place submission, and $50,000 awarded to the second place submission. The competition was solely funded by the government and there were no other private sector or philanthropic funds contributed to the competition prize.

Solicitation of Submissions: On April 6, 2017, the competition went live on the InnoCentive prize competition page and was posted on Challenge.gov. ODNI issued a press release and publicized the Challenge on social media. The Armed Forces Communications and Electronics Association interviewed ODNI and published an article promoting the Challenge on May 10, 2017. InnoCentive promoted the prize competition through their social media platforms (LinkedIn, Twitter, Facebook, and Google+) and weekly email blasts to over 140,000 solvers during the competition posting period. As a result of this outreach, over 8,000 people expressed interested in the competition and viewed the prize competition page, and 387 people from 42 countries registered for the competition.

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[62] The website for The Odni-Ousd(i) Xpress Challenge: Machine Generation of Analytic Products can be viewed at www.innocentive.com/ar/challenge/9933982.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies)

Participation Requirements: N/A

Evaluation of Submissions: This competition received 15 submissions that were evaluated using ODNI's Rating Scale for Evaluating Analytic Tradecraft Standards (RSEATS). RSEATS was created and finalized before the competition launched and solvers were given access to the evaluation methodology and award schedule. The rating scale was based on how solvers demonstrated the success of their proposal, used clear and logical argumentation, and provided the source code for validation. Of the 15 submissions, 11 were asked to provide their source code and documentation in order to reproduce the submitted analytical product. InnoCentive ran validation tests on the provided source codes. The results of these tests were sent to ODNI for final review and award decision. Literal, Inferential, and Evaluative awards were based on the top Automated Indicator Sharing (AIS) scores in each category using the RSEATS evaluation criteria. An Overall Best Solution award was to be given to the solver who produced the best cumulative scores from AIS evaluation. The final category was a Creativity award. Two submissions were selected for the awards.

Results: Of the 15 entries submitted between April 6 and July 5, 2017, prizes were awarded to 2 winners.

Budget and Resources: OUSD(I) representatives were involved in code validation in September. AFRL and Ball Aerospace managed the contracts and sub-contracts for this prize competition. ODNI's AIS completed a blind review of the submissions and scored them based on RSEATS evaluation criteria. InnoCentive, Inc. was utilized as a third party vendor to help plan and conduct the prize competition. AFCEA International provided SIGNAL Magazine content for use by the solvers participating in the competition.

Partnerships: For this prize competition, ODNI partnered with OUSD(I), AFRL, and Ball Aerospace. ODNI used the Economy Act to ensure economical and efficient services.

Advancement of Agency Mission: ODNI and OUSD(I) issued this challenge in order to understand the state of scientific advancement towards machine-generated intelligence, as advances in this area promise to reduce the amount of time devoted to thinking, understanding, and acting on the intelligence rather than just generating it. To do this, the challenge posed a representative question and asked respondents to use a completely automated system to sift through text reports and generate a finished intelligence product. ODNI and OUSD(I) did not seek any rights in the systems used to generate the product, as the focus is on assessing the state of the art in the area of machine-generated intelligence. Systems capable of winning this Challenge would be of use not just within the intelligence community, but across government agencies and the business worldwide.

Solution Types: Software and apps; Technology demonstration and hardware; Analytics, visualizations, algorithms

Plan for Upcoming 2 FYs: In FY19, the office of the Director of Science and Technology (DS&T) within ODNI in partnership with OUSD(I) will sponsor two public prize competitions—"Xplore" and "Xpect"—to explore opportunities, using artificial intelligence techniques, to revolutionize the IC's finished intelligence production processes. These challenges are part of a series of efforts exploring technical approaches to accelerate and automate the production of intelligence, and build on the "Xpress", "Xtend", and "Xamine" challenges launched in Fiscal Years 2017 and 2018. Through the Xplore Challenge, solvers will be asked to describe artificial intelligence-based approaches for enabling the

automated and predictive discovery of information. The Xpect Challenge will ask solvers to describe artificial intelligence-based approaches for automating model-based indications of change.

B.9.12 The ODNI-OUSD(I) Xtend Challenge: Machine Evaluation of Analytic Products[63]

Lead Sponsoring Agency: ODNI

Authority: N/A

Status: This competition was launched in FY18 and is underway.

Competition Goals: The evaluation of analytic products is an area ripe for exploring new technological capabilities and approaches. Currently, intelligence products are reviewed—prior to publication—by numerous levels of management and edited against an IC agency's signature style using essentially the same methods as publishers have used for generations. The ODNI and OUSD(I) sought ideas and descriptions of a viable technical approach for enabling the automated evaluation of finished intelligence products.

Goal Types: Find and highlight innovative ideas; Advance scientific research; Develop technology; Inform and educate the public; Engage new people and communities

Justification for Using Prizes and Challenges: ODNI decided to use prize competitions for this topic in order to leverage funding and reach as large an audience as possible. Competitions allow more individuals and companies to be engaged and involved than traditional contracts or grants. The Xtend Challenge attracted 186 registrants.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered was $75,000. This prize pool reflects an initial phase, with a $25,000 prize purse and a second phase, with a $50,000 prize purse. Awards for the first phase have been completed, and the second phase is underway. The competition was solely funded by the government and there were no other private sector or philanthropic funds contributed to the competition prize.

Solicitation of Submissions: On November 16, 2017, the competition went live on the InnoCentive prize competition page and was posted on Challenge.gov. ODNI issued a press release and publicized the Challenge on social media. InnoCentive promoted the prize competition through their social media platforms (LinkedIn, Twitter, Facebook, and Google+) and weekly email blasts to over 140,000 solvers during the competition posting period. As a result of this outreach, 186 teams from 32 countries registered for the competition. The prize competition press release was issued on November 16, 2017.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release

Participation Requirements: N/A

Evaluation of Submissions: This competition received 18 submissions that were evaluated by ODNI and OUSD(I) representatives. Of the 18 submissions, 3 were selected for initial awards from the $25,000 prize pool and asked to provide additional information regarding their solution. Final determination of awards from the remaining $50,000 prize pool is still pending.

[63] The website The Odni-Ousd(i) Xtend Challenge: Machine Evaluation of Analytic Products can be viewed at www.innocentive.com/ar/challenge/9934078.

Results: Of the 18 entries submitted between November 16, 2017 and January 15, 2018, three prizes were awarded in the first phase. At the time of this report, prizes for the second phase have not been awarded.

Budget and Resources: OUSD(I) representatives were involved in evaluating Xtend submissions. AFRL and Ball Aerospace managed the contracts and sub-contracts for this prize competition. InnoCentive, Inc. was utilized as a third party vendor to help plan and conduct the prize competition.

Partnerships: For this prize competition, ODNI partnered with OUSD(I), AFRL, and Ball Aerospace. ODNI used the Economy Act to ensure economical and efficient services.

Advancement of Agency Mission: The ODNI and OUSD(I) issued this challenge to determine a viable technical approach for enabling the automated evaluation of finished intelligence products. The evaluation of analytic products is an area ripe for exploring new technological capabilities and approaches. Currently, intelligence products are reviewed—prior to publication—by numerous levels of management and edited against an IC agency's signature style using essentially the same methods as publishers have used for generations. This human-based approach is highly subjective and introduces latency that constrains the IC's ability to produce effective and timely intelligence products, and may inhibit potential gains offered by advanced analytics and computational methods. For this Ideation Challenge, Solvers are asked to submit their ideas along with a well-supported, technology-based justification for how the proposed approach could evaluate analytic intelligence products. An additional award pool was available for solvers who were able to provide more detailed information such as a pseudo-code implementation of their proposed solution.

Solution Types: Software and apps; Ideas; Analytics, visualizations, algorithms

Plan for Upcoming 2 FYs: In FY19, the office of the Director of Science and Technology (DS&T) within ODNI in partnership with OUSD(I) will sponsor two public prize competitions—"Xplore" and "Xpect"—to explore opportunities, using artificial intelligence techniques, to revolutionize the Intelligence Community's (IC) finished intelligence production processes. These challenges are part of a series of efforts exploring technical approaches to accelerate and automate the production of intelligence, and build on the "Xpress", "Xtend", and "Xamine" challenges launched in Fiscal Years 2017 and 2018. Through the Xplore Challenge, solvers will be asked to describe artificial intelligence-based approaches for enabling the automated and predictive discovery of information. The Xpect Challenge will ask solvers to describe artificial intelligence-based approaches for automating model-based indications of change.

B.9.13 UG2 Prize Challenge[64]

Lead Sponsoring Agency: IARPA

Authority: National Security Act, 50 USC 3024(n)

Status: This competition was launched and completed in FY18.

Competition Goals: This challenge sought to answer important questions for general applications related to computational photography and scene understanding, such as: What is the current state-of-the art for image restoration and enhancement applied to images acquired under less than ideal circumstances? Or, can the application of enhancement algorithms as a pre-processing step improve image interpretability for manual analysis or automatic visual recognition to classify scene content? As

[64] The website for the UG2 Prize Challenge can be viewed at http://www.ug2challenge.org/.

a well-defined case study, the challenge aimed to advance the analysis of images collected by small unmanned aerial vehicles (UAVs) by improving image restoration and enhancement algorithm performance using the UAVs, Glider and Ground data (UG2) Dataset.

Goal Types: Solve a specific problem; Advance scientific research; Develop technology; Other - Benchmark state of the art

Justification for Using Prizes and Challenges: IARPA uses prize challenges to reach a broad audience of scientific thinkers, including those in other parts of the world, and have them participate in research problems of interest to the intelligence community (IC). The prize challenges are a way to quickly identify new research methods, ways of thinking, and perspectives that can be applied to IC problems and IARPA programs. Prizes can be awarded in a more agile way than a traditional grant or procurement contract, and challenge problems are posed so that participants can deliver results and prototypes on shorter timelines.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered and awarded was $75,000. This includes two award categories, Image Enhancement to Facilitate Manual Inspection and Image Enhancement to Improve Automatic Object Recognition, each with first and second place prizes of $25,000 and $12,500, respectively. Non-monetary incentives included an opportunity to present at the 2018 IEEE Computer Vision and Pattern Recognition Conference.

Solicitation of Submissions: The prize challenge was advertised through iarpa.gov, challenge.gov, and http://www.ug2challenge.org/ with all rules and participation instructions. Organizations signed a participation agreement with the University of Notre Dame and submitted executable software to them for evaluation.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies)

Participation Requirements: N/A

Evaluation of Submissions: The University of Notre Dame evaluated the performance of submitted algorithms by conducting standardized tests involving a sequestered test and evaluation dataset. Metrics and evaluation conditions were published in the prize challenge rules ahead of time. Results were presented to a panel of subject matter expert judges who then selected winners based on technical performance.

Results: Of the 12 entries submitted by six participants between January 31 and April 15, 2018, four prizes were awarded to three winners.

Budget and Resources: N/A

Partnerships: The University of Notre Dame was the non-Federal partner for this challenge.

Advancement of Agency Mission: The advantages of conducting visual surveillance from a platform like a small UAV are clear. Man-portable systems can be launched from safe positions to penetrate difficult or dangerous terrain, acquiring hours of video without putting human lives at risk. What is unclear is how to automate the interpretation of these images, a necessary measure in the face of millions of frames from individual flights. Human analysts cannot manually sift through data of this scale for actionable intelligence information. Ideally, a computer vision system would be able to identify objects, events, and human identities of interest to analysts, surfacing valuable data out of a massive pool of largely uninteresting or irrelevant images. To build such a system, one could turn to recent machine learning breakthroughs in visual recognition, which have been enabled by access to millions of training

images from the Internet. However, such approaches cannot be used as off-the-shelf components to assemble the system IARPA desires, because they do not take into account artifacts unique to the operation of the sensor and optics platform on a small UAV.

Solution Types: Software and apps

Plan for Upcoming 2 FYs: N/A

B.10 United States Agency for International Development (USAID)

B.10.1 EduApp4Syria Prize Competition[65]

Lead Sponsoring Agency: Norwegian Agency for Development Cooperation (Norad)

Authority: Implementing partner ran the challenge

Status: This competition was completed in FY17.

Competition Goals: The Syrian conflict caused disruption to the education of millions of children, in addition to threatening their physical safety and psychosocial well-being. At the time the prize was launched, almost three million Syrian children were out of school. Achieving reading and writing fluency (i.e., literacy) is foundational for lifelong learning. As such, it is important to provide opportunities to develop this skill for children who may be transient. Smartphones have been a survival tool used by many refugees, and reports and findings from field trips indicate high availability 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. The EduApp4Syria competition catalyzed the development of a smartphone application that can be used to increase literacy levels in Arabic and improve psychosocial well-being for children (ages 5–10). The app is primarily meant to supplement the formal and non-formal educational programs that exist, even though it could also be used within these programs. The two winning apps, Antura and the Letters and Feed the Monster, are now available for free on the App Store and Google Play.

Goal Types: Find and highlight innovative ideas; Solve a specific problem; Develop technology; Engage new people and communities

Justification for Using Prizes and Challenges: USAID was seeking to attract innovators who likely would not be aware of or respond to other mechanisms. Additionally, this competition was conducted in partnership with Norad, who chose the mechanism. The All Children Reading Grand Challenge for Development (ACR GCD) has used both grant and prize mechanisms. One of the valuable aspects of prize competitions is that it provides an easier on-ramp for organizations to partner with ACR GCD for a competition for a shorter-term, one-off activity, and usually require a smaller financial contribution.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered and total amount awarded was 15 million Norwegian Kroner (NOK) (approximately U.S. $1,700,000). For Phase 1, Norad paid up to the sum of 2.5 million NOK (approximately U.S. $300,000), distributed evenly among up to five suppliers. Upon entering into contract, the selected suppliers received 150,000 NOK of these funds

[65] The websites for the EduApp4Syria Prize Competition are accessible at https://allchildrenreading.org/challenge/grant-prizes/ and https://www.norad.no/en/front/thematic-areas/education/innovation/eduapp4syria/.

to work towards the initial deliverables. For Phase 2, Norad paid up to the sum of 7.5 million NOK (approximately U.S. $900,000), distributed evenly among up to three suppliers. For Phase 3, Norad paid up to the sum of 5 million NOK (approximately U.S. $600,000), distributed evenly among up to two suppliers. All awards were funded directly by the Norwegian government under a tender process by Norad. Non-monetary incentives included gaming technical expertise provide by Zynga; alpha testing conducted in Norway and beta field testing conducted in Amman, Jordan in December 2016; funding and technical advise for field testing of select applications by the United Nations International Children's Emergency Fund (UNICEF) Ventures' Office of Innovation; technical and impact evaluation of the two winning games by ACR GCD; promotion by ACR GCD and Norad via social media and other digital platforms; and invitations to present at events.

Solicitation of Submissions: ACR disseminated information about the Challenge through social media (e.g., Twitter and Facebook); the ACR GCD monthly newsletter; press releases; a dialogue conference in Oslo, Norway and Washington D.C. to attain feedback on the prize design; live video streaming that was later shared via social media; partnerships with outside organizations; and the Norad and ACR GCD websites. Competition documents and a short video about the competition were available in English and Arabic. The competition also received media coverage by Voice of America (VOA), The Guardian, ReliefWeb, Devex, and EdSource The Buzz.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Day-long event(s) prior to the competition; Live video streaming; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies); Other - the Norad and ACR GCD websites; Other - competition documents in English and Arabic; Other - videos about the competition in English and Arabic; Other - the winning apps produced in English and Arabic

Participation Requirements: The supplier entering a bid must have been a legally established enterprise. If several suppliers were cooperating, only one, regarded as the main supplier, supplied necessary documentation. Legally established enterprises included (amongst others) sole proprietorships and non-profit organizations.

Evaluation of Submissions: A jury led by a professor in game-based learning at the Norwegian University of Science and Technology (NTNU) selected the solutions to proceed at each stage. The collaboration advisory group sent comments on the proposed solutions to the jury for its consideration, but the jury made an independent decision. The solutions were judged by established criteria at each phase: Phase 0 evaluated the bidder's design of the prototype and plan for project execution; Phase 1 and Phase 2 evaluated the alpha and beta versions of the product, respectively, in relation to the testing specifications, the competence of project management, the project's capacities and resources, and bidder's plan for developing a functioning solution within the signaled timeframe; and Phase 3 evaluated the product's results with comprehensive testing through market release, outreach strategies, and improvements based on market feedback. All phases compared the product to the functional requirements listed in Part 2, "Appendix 1: Specification of Requirements" of the competition reference document.

Results: Of the 78 entries submitted by 78 participants between January 29, 2016 and April 1, 2016, five prizes were awarded to two winners.

Budget and Resources: A total of 1 full-time equivalent (FTE) was used to support the Challenge; 0.5 FTE was used in FY17 and 0.5 FTE was used in FY18. The total funding by ACR GCD in FY18 was $200,000, which was used for the technical and impact evaluation of the two games.

Partnerships: Partners included the Norwegian Government, which funded the competition. Norad coordinated the competition, coordinated and hosted the competition dialogue conference in Norway,

and managed the tender process. The Department of Computer and Information Science at NTNU, contributed research and expertise in game technology, game-based learning, e-learning, m-learning, and software engineering. NTNU's main responsibilities included leading and coordinating the competition and jury process, monitoring app development and maintenance, and leading the research related to the effects of using the chosen app(s). Thee ACR GCD, in a partnership with USAID, provided prize design technical expertise, led the communication strategy and activities, coordinated and hosted a competition dialogue conference (Washington D.C.), hosted the prize runner-up and finalists' profiles on the ACR GCD website, promoted the competition, managed U.S. media relations support, served on the submission review panel, and funded the technical and impact evaluation. Orange assisted in extensive outreach to potential competitors and promoted the winning application(s) through communication campaigns with the help of other divisions like StarAfrica (For more information, please visit http://en.starafrica.com/.). INEE served as an important source of knowledge of education in crises and conflict for the EduApp4Syria-competition. INEE provided input and quality assurance to specifications and selection processes; generated knowledge and awareness about the project among humanitarian organizations and other relevant stakeholders working on education in emergencies; and used its professional and communications network to inform potential users of the application about the learning resource once it was developed. World Vision and the Australian Government were also partners. The estimated value of partner contributions was approximately $1.7 million.

Advancement of Agency Mission: The EduApp4Syria competition sought to catalyze the development of a smartphone application that could significantly increase literacy levels in Arabic and improve psychosocial well-being for children (ages 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. The EduApp4Syria competition also profiled the critical education crisis many Syrian children face. It was a unique competition in that it not only sought to address literacy but also to improve psychosocial well-being for children greatly affected by the conflict. The two winning games, Antura and the Letters and Feed the Monster, can be downloaded for free on Google Play and the App Store. Feed the Monster has also been reversioned into over 20 languages (with more anticipated), and Antura and the Letters is now available in English. The code is also available on GitHub. Advancing USAID's Mission to improve reading scores for students and provide access to reading materials in local languages, the Apps have now been downloaded on more than 125,000 devices. Impact evaluation results showed for each subtest, letter sounds, syllable reading, invented word and oral reading fluency, the treatment group gains were greater than the control group.[66]

Solution Types: Software and apps

Plan for Upcoming 2 FYs: All future prize commitments will be determined by the ACR Round 3 strategy, which currently in development.

[66] Comings, J. (2018). Assessing the impact of literacy learning games for Syrian refugee children: An executive overview of Antura and the Letters and Feed the Monster impact evaluations. Washington, DC: World Vision and Foundation for Information Technology Education and Development.

B.10.2 Book Boost: Access for All Challenge[67]

Lead Sponsoring Agency: USAID

Authority: ADS 302.3.4.13 Grants Under Contracts (GUCs)

Status: This competition was launched in FY18 and is underway.

Competition Goals: Ensuring children have books in the language(s) they use and understand and in formats they can access is critical to building foundational literacy skills and learning to read. The Book Boost: Access for All Challenge, a challenge under All Children Reading: A Grand Challenge for Development, seeks innovative business models that incorporate accessibility components from the onset, reducing the costs of retrofitting an inaccessible book after production and thus creating a more efficient and cost-effective process. This optimization of the title development phase of the book value chain can contribute to an increased number of accessible titles as well as increased quality of accessible titles. Successful applicants will demonstrate strategies to optimize content creation by using innovative, cost-effective strategies that illustrate potential production growth of high-quality, accessible titles.

Goal Types: Find and highlight innovative ideas; Solve a specific problem; Build capacity; Stimulate a market

Justification for Using Prizes and Challenges: ACR GCD based the rationale for the Book Boost prize structure on the Round 1 experience of implementing challenge competitions. Despite the numerous proposals received, very few focused on the thematic areas. Smaller prize awards structured around the neglected thematic areas will encourage organizations to innovate and take more risks in implementing new ideas. ACR GCD sought to attract innovators who likely would not be aware of or respond to other mechanisms. ACR GCD has used both the grant and prize mechanisms. One of the valuable aspects USAID has found in prize competitions is that they provide an easier on-ramp for organizations to partner with ACR GCD for a competition for a shorter-term, one-off activity, and usually require a smaller financial contribution.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered was $360,000 and the total amount awarded was $348,000. The top four submissions were awarded a prize of $12,000 each before advancing to Phase 2 of the competition; the two winners of the competition were awarded a prize of $150,000 each. The funding was equally pooled from ACR and Pearson. Non-monetary incentives included promotion by ACR GCD and the prize partners via social media and other digital platforms and invitations to present at events. Pearson also offered in-kind business planning and brainstorming sessions.

Solicitation of Submissions: Submissions were solicited online (www.allchildrenreading.org) and promoted to over 2,900 subscribers via the ACR social media outlets (Facebook and Twitter) and monthly newsletter. The competition was also announced via USAID, World Vision, DFAT, and Pearson and Project Literacy listserves. Submissions were accepted via Submittable,[68] an online proposal

[67] The website for the Book Boost: Access for All Challenge can be viewed at https://allchildrenreading.org/challenge/book-boost-access-challenge/.

[68] The online proposal submission management site can be accessed at https://bookboost.submittable.com/submit.

submission management site. The solicitation overview was available in Arabic, French, Hindi, Portuguese, Spanish, and International Sign.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Live video streaming; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies)

Participation Requirements: Eligible applicants include, but are not limited to, for-profit and nonprofit organizations, non governmental (NGO) organizations and associations, academic and education research institutions, faith-based organizations, civil society organizations, and foundations. Government entities are ineligible for this opportunity, but partnerships with governments are encouraged. USAID is unable to award cash prizes to suppliers of goods and services that do not meet the nationality and source definitions as referenced in 22 CFR 228.11 and 12, specifically geographic code 937. Geographic code 937 currently excludes Cuba, Iran, Libya, and North Korea.

Evaluation of Submissions: Business plans will be evaluated across the eight key areas outlined in the Business Model Enhancement Plan Requirements.The maximum score for a business plan is 100 points: up to 5 points can be given for summary, concept and team management; 10 points for market analysis; 25 points for strategy; 10 points for collaboration; 15 points for finances; 15 points for timeline and project planning; and 20 points for sustainability.

Results: Of the 15 submissions received, eight met the basic requirements for the Challenge. The top four submissions were awarded a prize of $12,000 each before advancing to Phase 2 of the competition. The two winners of the competition were awarded a prize of $150,000 each. The Challenge is separated into three phases. Phase 1 is the submission of the solver's business model enhancement plan. Phase 2 consists of virtual presentations by the finalists on the viability of their business plans to a panel of judges. Phase 3 is the implementation of the business model enhancement plan.

Budget and Resources: A third party prize vendor, Submittable, was used to accept submissions and manage the judging process for a total cost of $4,250. Technical assistance was provided by a contractor to set-up and manage the platform at a total cost of approximately $3,000. The leading organization in creating accessible content was contracted for technical assistance to support the design and evaluation of the prize for $10,000, and a literacy expert was contracted for $1,000. Approximately $10,000 was allocated for communications support, including the translation of the prize call into multiple languages and the development of promotional and press materials. Five experts in accessible publishing and early grade reading content creation provided 15 hours of time each to evaluate all prize submissions for an estimated total of $3,000 in in-kind support. In FY18, one FTE was used to support the competition design, launch, evaluation and testing. The total funding in FY18 to support the Challenge was $77,301.

Partnerships: Challenge partners included World Vision, USAID, DFAT, and Pearson, who each shared their respective strengths, expertise, technologies, methodologies, and resources (including in-kind services, in-kind goods, and monetary) on specified activities in order to contribute to the shared goal of closing the global literacy gap. Specifically, the Challenge partners increased awareness and mobilized action; advanced best practices; and innovated for new solutions. These partnerships have been critical to the success of the Challenge. Each provided credibility to the competition and enhanced communications with publishers and content developers. The total estimated value of partner contributions is $332,500, of which $130,000 is from ACR and $202,500 is from Pearson. In the future, ACR GCD aims to engage similar technical partners.

Advancement of Agency Mission: Learning to read is transformative and impacts a child's lifelong opportunity to reach their full potential. However, around 250 million children of primary school age

around the world are unable to recognize basic letters and numbers, even though half of them have spent at least four years in school. Despite the importance of books in boosting foundational literacy skills, there is a global shortage of books for children in many mother languages. For the estimated 19 million children globally that are blind or have low vision or the millions of children with other disabilities that impact their use of traditionally printed material, the shortage of quality books in accessible formats is even more severe. Current technologies provide the potential for publishers to produce books that are accessible and designed for reading by everyone, including those with print disabilities, but these are not being leveraged at scale. ACR GCD and Pearson's Project Literacy launched the Book Boost: Access for All Challenge to drive innovation in the publishing space to address these gaps. The Challenge seeks business models that are rooted in optimizing and increasing the number of accessible books in the title development phase of the book value chain. The competition partners believe innovative solutions in title development will improve the overall book value chain, resulting in a more cost-efficient process. An efficient value chain will increase the number of new, high-quality, accessible titles available to stakeholders involved in book distribution. As part of ACR GCD's commitment to ensuring all children learn to read, it also sources solutions that address barriers preventing children with disabilities from learning to read.

Solution Types: Software and apps; Technology demonstration and hardware; Business plans

Plan for Upcoming 2 FYs: Additional grant-funded activities will be determined by the ACR Round 3 strategy in development in FY19.

B.10.3 Data-Driven Farming Prize[69]

Lead Sponsoring Agency: USAID

Authority: USAID Innovation Incentive Award Authority in Section 7034(d)(4) of Division K of the FY16 Department of State, Foreign Operations, and Related Programs Appropriations Act at P.L. 115-131

Status: This competition was completed in FY17.

Competition Goals: Industrial agriculture benefits from digital tools and data that provide information on how much water to use for irrigation, when to harvest crops, and what price to sell crops. Smallholder farmers could benefit from this information too. The Challenge had eight specific goals: (1) attract new approaches and tools to source, organize and translate data into actionable farming insights; (2) improve opportunities for more effective and efficient agricultural decision making in situ; (3) mobilize new talents towards the Nepali agricultural market; (4) build new partnerships in the agricultural value chain in Nepal; (5) build context specificity capacity and responsiveness to local user needs in innovators; (6) support scaling new product/services in the agricultural market in Nepal; (7) leverage investments across stakeholders to support solutions entry into the market; and (8) raise awareness on the potential of data to generate useful information for the agricultural production.

Goal Types: Solve a specific problem; Develop technology; Build capacity; Stimulate a market

Justification for Using Prizes and Challenges: Prize competitions are a tried and tested method for supporting innovation, offering a reward to those who can first or most effectively meet a defined challenge. Rather than being a reward for past achievements, prize competitions act as an incentive for meeting a specific challenge. Prizes are also a means of expanding a challenge beyond the usual participants and thus facilitate the engagement and participation of anyone who can solve the

[69] The website for the Data-Driven Farming Prize can be viewed at https://datadrivenfarming.challenges.org/.

challenge. The Feed the Future initiative sees this open innovation approach as a critical tool in its work to improve agricultural productivity, expand markets and trade, and increase the economic resilience of vulnerable rural communities in all partner countries.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered and the total amount awarded was $300,000. Two $100,000 awards and two $50,000 awards were issued. The four cash prizes were distributed using Digital Development for Feed the Future's FY16 funds. Funds were distributed via a miscellaneous obligation using the USAID Innovation Incentive Award Authority. Non-monetary incentives included enrollment in a ten-week bespoke Microsoft Innovation Center accelerator program, mentorship, and introductions to potential partners. In addition, finalists participated in Microsoft BizSpark, a global program that helps startups succeed by giving them free access to Microsoft Azure cloud services, software, and support. BizSpark startups received five Visual Studio Enterprise with MSDN subscriptions, each with a $150 monthly Azure credit. This totaled $750/month across all five developers to spend on Azure services. These benefits were available for one year. Microsoft BizSpark services were distributed directly to finalists by USAID's prize partner, the Microsoft Innovation Center Nepal.

Solicitation of Submissions: To recruit qualified competitors, USAID relied on extensive research of promising data-driven agriculture innovations. USAID also relied on an active social media campaign; personal outreach (which was very effective, as three finalists stated they applied because a trusted contact encouraged them to do so); a webinar to coach competitors through the application process; several in-person workshops hosted in Nepal to encourage and coach applicants through the application process (which proved to be very effective for Nepali competitors); and attendance at related agriculture conferences.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Live video streaming; Other - Newspaper advertisements; Other - Participation in conferences; Other - Panels during the competition; Other - Direct outreach to promising innovators

Participation Requirements: In order of priority, the target solver audience was innovators working in Nepal's agricultural technology space; innovators from around the world working in agricultural technology; and Nepali innovators working in other data communication endeavors. However, the Challenge was open to all interested individuals, groups, organizations, companies, and sources and sectors, particularly local innovators from South Asia. Though the call was global and solvers could come from all over the world, the solutions were tested and applied to Nepal. All entrants needed to demonstrate a willingness to share their experiences and help establish a body of knowledge that can bring about a sustained change in the use of data to improve agriculture productivity. Applicants needed to ensure they have the capacity to develop a prototype of the solution over the challenge time frame. Some support was provided to help achieve this, but if selected, applicants had to be able to develop and test prototypes during the course of the prize. Any intellectual property in the submission belonged to the applicant. Applicants retained the intellectual property rights to their entry to the prize. Intellectual property had to be clearly marked as proprietary, and it was the applicant's responsibility to ensure they were not infringing on the intellectual property of others. Entries were not assessed if required fields were not complete. Entries must have been submitted in English. USAID conducted a responsibility determination prior to the award to ensure that the award to the organization met applicable U.S. laws, including regulations administered by the Office of Foreign Assets Control (OFAC) of the U.S. Department of Treasury (for more information, see http://www.ustreas.gov/ofac, including the list of Specially Designated Nationals).

Evaluation of Submissions: After applicants submitted their written applications, an internal eligibility screening and assessment was performed by subcontractors. The first round of judging was based on the written applications and performed by a judging panel. Judges from the panel came from USAID Bureau for Food Security, USAID US Global Development Lab, USAID Nepal, International Maize and Wheat Improvement Center (CIMMYT), International Center for Integrated Mountain Development (ICIMOD), Microsoft Innovation Center-Nepal, Global Open Data for Agriculture and Nutrition (GODAN), and DAI. Thirteen finalists submitted their innovations. Innovation field testing was conducted by USAID's partners, International Maize and Wheat Improvement Center (CIMMYT), and International Center for Integrated Mountain Development (ICIMOD). Test results were summarized by the field test partners and assessed by subcontractors. Thirteen finalists submitted their written development plans and pitch videos. During the second round of judging, judges reviewed the field test results, assessments, development plans, and pitch video. Four winners were recommended by the judges. Lessons learned included that judges need to see the solutions to believe that they worked; judging panels were best conducted in person; and judges should be carefully separated from the mentoring and testing process to prevent bias.

Results: Of the 143 applicants who provided submissions between February 9, 2017 and April 6, 2017, two $100,000 awards and two $50,000 awards were given. PEAT and Db2Map won the $100,000 awards and ICT 4 Agri and Spero Analytics won the $50,000 awards.

Budget and Resources: The Challenge had a $1.2 million budget. The $300,000 cash prize was funded through the Innovation Incentive Award Authority in FY17. A total of 0.5 FTE was also used to support the Challenge in FY17. The following items were funded through a USAID implementing partner mechanism and subcontract: seed funding at $30,600; staffing at $658,160; travel for innovators at $76,500; events at $110,000; testing and assessment at $46,600; online platform at $7,650; communications and outreach at $50,490; and Monitoring, Evaluation, Research and Learning (MERL) at $30,000.

Partnerships: Strong partnerships were the core of the Data-Driven Farming Prize. USAID Nepal buy-in for the program was key to the success of the Prize, and its endorsement of the activity ensured that the right networks of stakeholders were involved in the Prize. Similarly, the Prize was built in strong collaboration with local partners such as Feed the Future Initiative; GODAN; the Nepal office of CIMMYT, which provided in-kind support, mentorship, expertise, testing support, and facility use; ICIMOD, which provided in-kind support, mentorship, expertise, testing support, and facility use; and the Microsoft Innovation Center Nepal, which provided in-kind support, marketing and outreach support, Microsoft BizSpark, facilitation support, a bespoke accelerator program, mentorship, expertise, testing support, and partnership brokering. The estimated value of partner contributions is $246,000. Such strong field partners presence, as well as the prize activities ran in the country (including the launch event, co-creation workshop, innovation marketplace to showcase solutions, and the award ceremony), attracted the interest of the Nepali agricultural private sector in witnessing the development of new effective solutions. All finalists confirmed the Prize was a tremendous platform to boost new partnerships, and more than 22 partnerships have been attributed to the Prize. USAID also found that the co-creation approach at the center of the Prize deepened partnerships between partners. For example, one of the prize partners stated "I liked seeing different agricultural stakeholders have a-ha moments about how these innovators, or these partners, or these other convened value chain actors, or these datasets could unlock a new possibility in their ability to deliver more value for smallholder farmers."

Advancement of Agency Mission: USAID is the world's premier international development agency and a catalytic actor driving development results. USAID's work advances U.S. national security and

economic prosperity, demonstrates American generosity, and promotes a path to recipient self-reliance and resilience. This prize sought to catalyze local solutions to the local challenges of food security and secure livelihoods. Feed the Future believes in helping farmers extract maximum value from local agricultural production by increasing their access to the data and information needed to make more effective farming decisions. Democratizing access to data and information can drive the transformation of commercially-driven agriculture in targeted regions. As a result, the Prize aimed to support solutions for farmers and value chain actors to make effective choices to enhance their productivity, on-the-ground decision-making, and market planning.

Solution Types: Software and apps; Technology demonstration and hardware; Business plans

Plan for Upcoming 2 FYs: Following the Prize in FY17, USAID undertook a year long assessment of the Prize's impact and learned that following the Prize, the thirteen finalists and winners were able to develop 22 partnerships and leverage $5 million in additional funding. In addition to the Prize-specific outcomes, the Prize also built a case for the value of prizes within USAID and catalyzed two additional prizes: Feed the Future's Fall Armyworm Tech Prize (FY17) and USAID/Nepal's forthcoming Counter Trafficking in Persons Tech Prize (FY18).

B.10.4 Fall Armyworm Tech Prize[70]

Lead Sponsoring Agency: USAID

Authority: Innovation Incentive Award Authority in Section 7034(d)(4) of Division K of the FY17 Department of State, Foreign Operations, and Related Programs Appropriations Act at P.L. 115-131

Status: This competition was underway in FY18.

Competition Goals: The fall armyworm (FAW) is not a new pest but is new to the African context. Smallholder farmers may misidentify the insect and select an improper treatment method in an effort to save their crops. Farmers urgently need clear and actionable pest identification information and a series of reasonable treatment options that take regional contexts and limitations into account. The FAW Tech Prize is seeking digital tools and approaches that provide timely, context-specific information that enable smallholder farmers and those who support them to identify, treat, and track incidence of FAW in Africa. Primary outcomes include enabling smallholder farmers and those who support them to accurately identify incidence of FAW in their crops; produce timely, context-appropriate, and empowering insights for smallholder farmers to treat the incidence of FAW; reduce productivity losses caused by FAW among those using the tool or approach; and ensure the appropriate and responsible use of pest management assessments, tools, and interventions.

Goal Types: Find and highlight innovative ideas; Solve a specific problem; Develop technology; Inform and educate the public; Engage new people and communities; Build capacity

Justification for Using Prizes and Challenges: Prize competitions are a tried and tested method for supporting innovation, offering a reward to those who can first or most effectively deliver a defined result. Rather than being a reward for past achievements, prize competitions act as an incentive for meeting a specific challenge. Prizes are also a means of expanding a challenge beyond the usual participants and thus facilitate the engagement and participation of anyone who can solve the challenge. The Feed the Future initiative sees this open innovation approach as a critical tool in its work

[70] The website for the Fall Armyworm Tech Prize can be viewed at https://fallarmywormtech.challenges.org/.

to improve agricultural productivity, expand markets and trade, and increase the economic resilience of vulnerable rural communities in all partner countries.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered will be $400,000, $300,000 of which comes from USAID's FY17 DA funds, $50,000 of which comes from the Foundation for Food and Agriculture Research, and $50,000 of which comes from Land O'Lakes International Development. Five prize awards will be given. One grand prize winner will receive $150,000; two most promising solutions will receive $75,000 each; and two up-and-comers will receive $50,000 each. Of USAID's $300,000 prize purse contribution, $100,000 will be contributed to the grand prize winner, and $50,000 will be contributed to each of the remaining four awards. Non-monetary incentives for the 20 prize finalists will include funded travel to Kampala, Uganda for the Co-Creation event; participation in the 4-day Co-Creation event with mentors, subject matter experts, and end-users; ongoing mentorship and support to refine finalists' products/solutions; funded travel to Cape Town, South Africa for the awards event; and participation in a 3-day awards event to showcase products/solutions, network with investors/others, and attend the final awards event.

Solicitation of Submissions: The FAW Tech Prize solicited applications primarily through its associated online platform: https://fallarmywormtech.challenges.org/. The website contained a description of the Prize along with an applicant handbook. USAID also promoted and communicated the application timeline and procedures through the platform's blog and by hosting a webinar with interested individuals/organizations. The webinar was effective at answering questions on the criteria and application process among interested individuals from around the world. The Prize was also promoted through social media, email, and in-person events. On the latter, several events were held in Uganda with groups of entrepreneurs and innovators, among others. These in-person events were very effective in promoting the Prize, sharing information, and engaging new actors in a USAID competition.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies); Other - Webinar

Participation Requirements: The Prize was open to all individuals, groups, organizations, and companies, particularly local innovators from Africa. Though the call was global and solvers can come from all over the world, the solutions will be tested and applied in field contexts in Africa. Applicants need to demonstrate a willingness to share their experiences and help establish a body of knowledge that can bring about a sustained change in smallholder farmer outreach, awareness, and action with respect to digital tools and plant health, pest management, and disease management. Applicants need to ensure they have the capacity to either adapt their existing solution to address FAW or develop a prototype of the solution within the prize time frame. Any intellectual property in the submission entry must belong to the entrant. Entrants will retain the intellectual property, and such intellectual property must be clearly marked as proprietary. It is the entrants' responsibility to ensure that they are not infringing on the intellectual property of others. Entries will not be assessed if all required fields have not been completed. This applies to any stage of submission for the Prize and also relates to missing documentation that may have been requested. Entries need to be submitted in English. USAID will conduct a responsibility determination prior to the announcement of the award to ensure that selected organizations meets applicable U.S. laws, including regulations administered by the Office of Foreign Assets Control (OFAC) of the US Department of Treasury.

Evaluation of Submissions: All applications were evaluated on whether the digital tool solution proposed by the applicant can be used by smallholder farmers or stakeholders who work with smallholder farmers; whether the submission provides timely, context-appropriate, and actionable

advice to users to enable them to select among available best practices in treating incidence of FAW; whether the proposed solution demonstrates a clear understanding of end-user needs; whether the proposed solution presents a tangible response to farmers' unique experience with FAW in sub-Saharan Africa; whether the applicant has considered the commercial, sustainability (i.e., financial and environmental considerations), and growth potential of their solution; and whether applicants consider international norms with respect to digital development and FAW in their proposals. Applications went through four phases of evaluation. During Phase 1 (Assessment), every application submitted was reviewed by two assessors against the evaluation criteria above. Assessors were a hybrid group consisting of both USAID staff and external members. During Phase 2 (Judging panel), the top 36 highest-scoring applications from Phase 1 were then shared with the judging panel. Each application was reviewed by three judges, scores were compiled, and all 36 were discussed by the judging panel to determine the ultimate 20 finalists. These judges were also a hybrid group from USAID and external agencies. During Phase 3 (Field testing), the 20 finalists submitted prototypes to be tested in the field by the Centre for Agriculture and Bioscience International (CABI), a prize partner. Testing included functionality testing in CABI offices in Kampala as well as user testing among farmer and extension worker focus groups at field sites in Uganda. For Phase 4 (Judging panel), the judges will review a final development plan and video summary from each of the 20 finalists and score their final submissions against the evaluation criteria above. All 10 judges will review all 20 finalists. Their scores will be combined with the field testing results from Phase 3, and these total scores will be discussed among the judges at an in-person meeting to determine the five prize award winners.

Results: A total of 228 applications were submitted between March 28, 2018 and May 14, 2018. The Prize is still ongoing, so no awards have been awarded yet. Five prizes will be awarded.

Budget and Resources: In FY18, USAID obligated $1,000,000 of FY17 funds for the implementation of the FAW Tech Prize to an existing mechanism, Digital Frontiers, ran by DAI in the U.S. Global Development Lab. Through an open solicitation ran by DAI, Nesta was awarded a contract to implement the Prize. The contract covers all implementation costs of the Prize, including managing the application process, overseeing the web platform, facilitating a 4-day co-creation event, hosting an awards ceremony, and supporting all travel and accommodation costs of participants. In addition, $300,000 of FY17 funds have been obligated for the prize purse. The equivalent of approximately 1 FTE from USAID has also been contributed and will provide guidance, oversight, and management of the Prize. The FTE will be split across two to three individuals in the Bureau for Food Security and U.S. Global Development Lab.

Partnerships: Partners of the FAW Tech Prize include Land O'Lakes International Development; Foundation for Food and Agriculture Research (FFAR); International Maize & Wheat Improvement Center (CIMMYT); CABI; Syngenta Foundation; MEST; BRAC; and the Overseas Private Investment Corporation (OPIC). Land O'Lakes International Development, FFAR, and OPIC provided support in promoting the Prize and helping to attract applicants during the launch of the Prize. CABI and CIMMYT provided subject matter experts, and MEST and BRAC provided mentors to meet and help the 20 finalists further refine their solutions. Partners helped innovators learn about the impact of FAW, determine if their technologies would be feasible, and enhance their solutions to make sure they achieve the intended goal (i.e., to provide timely, context-specific, information about FAW). FFAR, Land O'Lakes International Development, and Syngenta Foundation also met with the finalists to provide support and expertise. During the testing phase, CABI lead the development of a testing protocol and implemented against it via functionality testing in Kampala and user experience testing among farmer focus groups. During the judging process, Land O'Lakes International Development, FFAR, OPIC, and Syngenta Foundation participated as judges. Once the final winners are announced, Land O'Lakes

International Development and FFAR will contribute a total of $100,000 in prize awards, and Syngenta will provide AgTech acceleration support for all winners.

Advancement of Agency Mission: At present, FAW in Africa threatens harvests and economic growth on a continental scale and could harm the progress of USAID. Through Feed the Future, USAID has helped aid agriculture-led growth, nutrition, and resilience developments on the continent. Feed the Future, America's global hunger and food security initiative, aims to transform lives toward a world where people no longer face extreme poverty, undernutrition, and hunger. To achieve this, Feed the Future works hand-in-hand with partner countries to develop their agriculture sectors and break the cycle of poverty and hunger. Feed the Future, specifically the FAW Tech Prize, is part of the USAID response to the FAW outbreak and aims to equip farmers to protect their yields and incomes.

Solution Types: Software and apps; Creative (design & multimedia); Technology demonstration and hardware; Business plans; Analytics, visualizations, algorithms

Plan for Upcoming 2 FYs: Not applicable in regards to the Fall Armyworm Tech Prize.

B.10.5 Global Lighting and Energy Access Partnership (Global LEAP) Off-Grid Refrigerator Competition[71]

Lead Sponsoring Agency: USAID

Authority: Innovation Incentive Award Authority in Section 7034(d)(4) of Division K of the FY16 Department of State, Foreign Operations, and Related Programs Appropriations Act at P.L. 115-131

Status: This competition was underway in both FY17 and FY18 but has not concluded.

Competition Goals: Refrigeration holds unique potential to unlock economic and social progress for billions of people globally who have no or limited access to power. The market, however, remains nascent. The Global Lighting and Energy Access Partnership (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 improve access to affordable refrigeration technology for those living off-grid in developing countries. The Off-Grid Refrigerator Competition was competed under Global LEAP, a partnership that includes the U.S. Department of Energy and Power Africa. The Off-Grid Refrigerator Competition is one component of the Scaling Off-Grid Energy Grand Challenge for Development, which will contribute to increased utility of off-grid energy systems for consumers.

Goal Types: Find and highlight innovative ideas; Solve a specific problem; Develop technology; Inform and educate the public; Engage new people and communities; Stimulate a market

Justification for Using Prizes and Challenges: Prize competitions are a tried and tested method for supporting innovation, offering a reward to those who can first or most effectively deliver a defined result. Rather than being a reward for past achievements, prize competitions act as an incentive for meeting a specific challenge. Prizes are also a means of expanding a challenge beyond the usual participants and thus facilitate the engagement and participation of anyone who can solve the challenge.

[71] The website for the Global Lighting and Energy Access Partnership (Global LEAP) Off-Grid Refrigerator Competition can be viewed at http://globalleap.org/refrigerators/.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered is $600,000. Three $100,000 innovation incentive awards from USAID have been matched by the U.K. Department for International Development (DFID) funding for a total of $200,000 for each of the three awards. Awards for Overall Value ($200,000) and Energy Efficiency ($200,000) were made in January 2018. The prize for User Appeal and Field Performance ($200,000) is still underway and will be awarded November 2018. Non-monetary incentives included complimentary testing for all competitors, which provides vital data on product performance in both lab and field conditions. In addition, finalists receive mention in the Global LEAP catalog of finalist and award-winning products, networking opportunities with manufacturers and distributors, and enrollment in a results-based financing procurement incentives program.

Solicitation of Submissions: Submissions were sought through Global LEAP, Challenge.gov, and other standard channels.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies); Other - Webinar

Participation Requirements: N/A

Evaluation of Submissions: Applications were initially screened by CLASP, the implementing partner, and USAID before evaluated for award by a panel of expert judges based on data from industry-approved lab testing. USAID confirmed the analysis. The field test was conducted by implementing partners using industry-leading testing standards in Uganda, with judges then evaluating the results to identify a winner.

Results: Of the 55 applications received between September 22, 2016 and January 20, 2017, two prizes were awarded to Sundanzer: Energy Efficiency and Overall Value. The award for Appropriate Design and User Experience will be selected in November 2018.

Budget and Resources: USAID provided $300,000 in funding to support the Prize in FY17. In addition, 1 FTE was used to support the Prize in FY17 and 0.5 FTE was used to support the Prize in FY18.

Partnerships: Partnerships played a critical role across the Prize. The U.S. Department of Energy was a Federal partner. Non-Federal partners included the U.K. Department for International Development, which contributed $300,000 to the Prize; Global CLASP; IMC Worldwide; and Energy 4 Impact. Multiple donors partnered under an existing umbrella prize program (Global LEAP) to coordinate funding and design. All partners had different implementing partners who collaborated effectively to deliver the prize.

Advancement of Agency Mission: USAID is the world's premier international development agency and a catalytic actor driving development results. USAID's work advances economic prosperity and promotes a path to recipient self-reliance and resilience. Refrigeration can prolong the nutritional value of food, diversify diets, enable income-generating activities, and reduce the time that households spend shopping or gathering food. Thus, a prize to develop the off-grid refrigeration market and unlock economic and social progress for the 600 million people living off the grid in sub-Saharan Africa advances USAID’s mission.

Solution Types: Technology demonstration and hardware; Business plans

Plan for Upcoming 2 FYs: Partners may continue prize program in outyears without USAID funding.

B.10.6 No Lost Generation Prize Competition[72]

Lead Sponsoring Agency: USAID

Authority: ADS 302.3.4.13 Grants Under Contracts (GUCs)

Status: This competition was launched in FY17 and is underway in FY18.

Competition Goals: The No Lost Generation (NLG) EdTech Summit agenda included three breakout sessions designed to bring all participants together to collaborate and form partnerships. To encourage collaboration, the NLG Prize seed funding opportunities, a prize under the All Children Reading: A Grand Challenge for Development, were provided by key sponsors, and all participants had the opportunity to apply for seed funding during the event. Basic early grade readers often focus on similar topics that could be replicated through development of Science, Technology, Engineering, and Mathematics (STEM) early reader story templates. These templates would include basic story lines but allow authors to add in images accordingly and easily translate and contextualize. Seed funding would be awarded for an innovative solution that would drive this content. The storyline templates would be made available on the Global Digital Library, providing a digital, accessible, and open source solution.

Goal Types: Solve a specific problem; Inform and educate the public; Engage new people and communities; Stimulate a market

Justification for Using Prizes and Challenges: USAID was seeking to attract innovators who likely would not be aware of or respond to other mechanisms. All Children Reading (ACR) based the rationale for a prize structure on its initial challenge funding experience; despite the numerous proposals received, very few focused on thematic areas. Smaller prize awards structured around these neglected thematic areas will encourage organizations to innovate and take more risks in implementing new ideas. Over time, ACR has used both the grant and prize mechanisms. One of the valuable aspects USAID has found in prize competitions is that they provide an easier on-ramp for organizations to partner with ACR for a competition for a shorter-term, one-off activity, and usually for a smaller financial contribution.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered and total amount awarded was $100,000. Non-monetary incentives included engagement with partners, such as the Global Digital Library, which will host these stories on their platform in both Arabic and English. This will extend the reach of this content beyond the Asafeer app and to a global audience, with the possibility of translating these stories into many different languages.

Solicitation of Submissions: The NLG Prize was designed to encourage participants to attend the EdTech Summit expecting to develop action plans during breakout sessions to be put into action following the event. Only Summit participants had the opportunity to apply for seed funding during the event, and any other organizations not participating in the Summit were ineligible. Participants were encouraged to develop action plans resulting from the creativity inspired in the breakout sessions and in partnership with other organizations wherever possible. However, the eligibility parameters, though created to inspire and maximize partnerships, may have limited opportunities to engage other viable partners or create new partnerships outside the summit.

[72] The website for the No Lost Generation Prize Competition can be viewed at https://nlgedtech.com/competition-winners.

Solicitation Types: Social media (e.g., Twitter, Facebook); Press release; Day-long event(s) prior to the competition; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies)

Participation Requirements: Only those attending the EdTech Summit were eligible to compete for the seed funding.

Evaluation of Submissions: A hybrid team of evaluators from World Vision and USAID judged the submissions. Top proposals were selected based on their scores (out of a total of 100 points). The criteria for judging was based on four categories: Innovation (30 points), based on if the approach demonstrated innovation through engagement of traditional and non-traditional writers such as youth, those with disabilities, or children in the Arab region; Feasibility (20 points), based on if the approach demonstrated feasibility by outlining a clear mechanism for engaging writers, revising content, and ensuring the production of quality STEM story templates; Scalability (25 points), based on if pitches put forward a proposed business model that could continue engagement with writers for further contribution to book/stories creation; and Diversity of themes (25 points), based on if pitches put forward proposed STEM themes and the estimated number of templates per theme.

Results: Of the six entries submitted between March 2017 and April 25, 2017, two prizes were awarded. A $50,000 prize award was made for illustrations and a $50,000 prize award was made for story development. Both prize components were awarded to Asafeer Education Technologies FZ LLC.

Budget and Resources: In FY17, USAID provided $50,000 and 0.25 FTE to support the Prize. In FY18, USAID provided $50,000 and 0.125 FTE to support the Prize. In addition, World Vision allocated roughly 20 hours a month in support of the Prize. World Vision International also contributed educational and linguistic technical expertise to support the material development.

Partnerships: This prize was made possible in partnership with the NLG Initiative, which hosted and promoted the seed funding prizes. Non-Federal partners included the Australian Government and World Vision. The estimated value of partner contributions totals $100,000.

Advancement of Agency Mission: The All Children Reading (ACR) partners' goals are to improve early grade reading outcomes. The NLG Prize incentivize participation in the NLG EdTech Summit. This Prize and Summit advanced each partners' goals to reach children in crisis, proving an excellent opportunity to leverage the NLG Ed Tech Summit to fulfill partner goals.

Solution Types: Software and apps; Creative (design & multimedia)

Plan for Upcoming 2 FYs: Additional grant-funded activities will be determined by the ACR Round 3 strategy in development in FY19.

B.10.7 Tracking and Tracing Books Prize Competition[73]

Lead Sponsoring Agency: USAID

Authority: ADS 302.3.4.13 Grants Under Contracts (GUCs)

Status: This competition was completed in FY17.

Competition Goals: The objective of this competition was to seek innovations to track books destined for early grade classrooms and learning centers in low-income countries and allow stakeholders,

[73] The website for the Tracking and Tracing Books Prize Competition can be viewed at http://allchildrenreading.org/innovation/prize-winners/#tracking_tracing_books.

ranging from parents to the Ministry of Education, to easily access tracking information. Desired outcomes included decreasing the number of books lost; improving government service delivery; finding and highlighting innovative ideas; solving a specific problem; developing technology; informing and educating the public; engaging new people and communities; and building capacity.

Goal Types: Improve government service delivery; Solve a specific problem; Develop technology; Engage new people and communities

Justification for Using Prizes and Challenges: The All Children Reading Grand Challenge for Development (ACR GCD) sought to attract innovators who likely would not be aware of or respond to other mechanisms. The ACR GCD based the rationale for a prize structure on the Round 1 experience that despite receiving numerous proposals, very few focused on the thematic areas. Smaller prize awards structured around the neglected thematic areas will encourage organizations to innovate and take more risks in implementing new ideas. ACR GCD has used both the grant and prize mechanisms. One of the valuable aspects USAID has found in prize competitions is that it provides an easier on-ramp for organizations to partner with ACR GCD for a competition for a shorter-term, one-off activity, and usually for a smaller financial contribution.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered was $100,000 and the total amount awarded was $220,000. Non-monetary incentives included global recognition from the ACR GCD; communications and marketing support; invitations to exclusive events; exposure to new partnerships through the ACR GCD partner network; and expert feedback on the proposed software from child development and digital education specialists. In FY17, both tracking and tracing books solutions were alpha tested, and recommendations were made to the finalists to refine the softwares. Final tranche payments of $25,000 each, for a total $50,000, were paid to the two finalists in FY17.

Solicitation of Submissions: InnoCentive hosted the prize competition and designed a marketing and communications plan on behalf of ACR. InnoCentive not only marketed to their network of over 100,000 solvers but also targeted the broad software and mobile app development community. InnoCentive recommended expanding efforts through targeted outreach and social media outlets to attract experts, industries, and networks in areas such as big data and predictive analytics, logistics and warehouse management, freight and transport, library sciences, and engineering. ACR simultaneously used websites, social media, webinars, information sessions, and workshops to reach a large and varied audience. A few examples of methods used to market the prize competition, mobilize potential participants, and ensure high quality submissions included marketing the prize in three editions of the InnoCentive Challenge Bulletin, which goes out to around 100,000 Solvers; posting information about the Challenge several times on InnoCentive's social media accounts;[74] sending targeted emails to international supply chain management university professors, logistics management organizations and societies, and those working with various kinds of educational technology; and posting and engaging with social media groups and organizations related to supply chain, logistics, and educational technology.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies)

[74] InnoCentive's Facebook post on the Challenge received over 10,950 likes. In addition, InnoCentive has more than 9,500 followers on Twitter.

Participation Requirements: Eligible applicants included, but were not limited to, for-profit and nonprofit organizations, non-governmental organizations and associations, academic and education research institutions, faith-based organizations, civil society organizations, and foundations. Government entities were ineligible for this opportunity, but partnerships with governments were encouraged. USAID was unable to award cash prizes to suppliers of goods and services that did not meet the nationality and source definitions as referenced in 22 CFR 228.11 and 12, specifically geographic code 937. Geographic code 937 currently excludes Cuba, Iran, Libya, and North Korea.

Evaluation of Submissions: There were four stages of the judging process. Stage I took place between April 27 and May 15, 2015. Assessors received access to the platform and training assistance for questions. Each team, consisting of three members, assessed 10 submissions. Team members within a team reviewed submissions in different orders. Nine semi-finalists were produced in Stage I. Stage II took place between May 18 and May 22, 2015. All team members across the three teams rescored the nine top submissions. Stage III took place between May 25 and May 29, 2015. All team members were made aware of the Stage II rankings and scores of the nine semi-finalists. During this stage, any team member could make a case for either moving a lower-rated submission into the top three or removing one submission from the top three. Stage IV took place between June 1 and June 5, 2015. Representatives of the partners met in-person and virtually to discuss the rankings and decide on the three top winners.

Results: Of the 10 entries submitted between January 23, 2015 and April 1, 2015, two prizes were awarded.

Budget and Resources: In FY17, 0.5 FTE supported the competition through alpha testing, solution refinement, and final payment. A total of $25,000 in funding was used to support alpha testing in the form of travel and accommodations for finalists, testing logistics, technical consulting, and reporting.

Partnerships: The prize was conducted in partnership by the USAID, World Vision, and the Australian government. The estimated value of partner contributions is $50,000. The competition was managed by InnoCentive. With over 12 years of experience pioneering the fostering of innovation and technology from external networks, in addition to previous work with ACR on the Enabling Writers Prize Competition, InnoCentive had capable staff and a highly-relevant solver community to effectively manage the Track and Trace Prize Competition. Building off of InnoCentive's expertise in running prize competitions, ACR was able to run the competition as efficiently and effectively as possible. ACR recommends this model to other prize competitions.

Advancement of Agency Mission: Each of the ACR GCD partners' goals is to improve reading. Books are essential to early grade reading instruction. However, both textbooks and supplemental reading materials ordered for low income countries often 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, including at the point-of-entry for imported textbooks; at the central warehouses for nationally-produced materials; during transportation across difficult and sometimes insecure routes; or during final distribution to regional offices and classrooms. The Tracking and Tracing Books Prize Competition spurred development of four tracking software systems tested in over 1,000 school sites in Malawi, Nigeria, and Afghanistan. To advance the mission, further integration of tracking systems requirements will be embedded into program solicitations.

Solution Types: Software and apps; Technology demonstration and hardware

Plan for Upcoming 2 FYs: All future prize activities will depend on the ACR GCD Round 3 Strategy.

B.10.8 WomenConnect Challenge[75]

Lead Sponsoring Agency: USAID

Authority: ADS 302.3.4.13 Grants Under Contracts (GUCs)

Status: This competition was launched in FY17 and is underway in FY18.

Competition Goals: Technology is revolutionizing the world by providing tools for entrepreneurship as well as access to critical health, education, and life-enhancing information. However, women increasingly have limited access to technology, resulting in a digital gender divide. There are 1.7 billion women in low- and middle-income countries who still do not own mobile phones, and the gap between the number of men and women using the internet has grown steadily over the past 3 years. The persistent digital gender divide is reinforcing or even exacerbating existing socioeconomic gaps between men and women. By reducing this divide, women and girls will have access to life-enhancing information, networks, and services, reducing poverty and driving inclusive economic growth. The WomenConnect Challenge (WCC) is a global call for solutions to improve women's participation in everyday life by meaningfully changing the ways women and girls access and use technology. USAID is looking to identify and accelerate comprehensive solutions that empower women and girls to access and use digital technology to drive positive health, education, and livelihood outcomes for themselves and their families.

Goal Types: Solve a specific problem

Justification for Using Prizes and Challenges: Given the anticipated number of awards and interest in this topic, a challenge seemed like the most favorable and fair way to address the incoming proposals. USAID also received input from teams that have previously done Grand Challenges who believed the WCC was a fit for the challenge model.

Cash Prize Purses and/or Non-Cash Prize Awards: The total prize purse offered was $1,000,000 and the total amount awarded was $900,000. Non-monetary incentives included acceleration support at a semi-finalist workshop in Washington, D.C.

Solicitation of Submissions: The Challenge call was announced online and through a social media campaign launched from USAID in Washington, D.C. in conjunction with missions around the world. There was also a launch event on International Women's Day where the USAID Administrator, the USAID Senior Deputy Assistant Administrator, and the Advisor to the President spoke. The launch garnered a large amount of attention and produced a distribution list of 10,000 interested people. Partner organizations and several newsletters also mentioned the launch.

Solicitation Types: Social media (e.g., Twitter, Facebook); Email (e.g., listservs); Press release; Day-long event(s) prior to the competition; Live video streaming; Partnership with outside organizations (e.g., private companies, non-profit organizations, other Federal agencies)

Participation Requirements: Government entities were not allowed to participate. In addition, countries needed to have USAID presence.

Evaluation of Submissions: The initial judging narrowed down the 531 proposals to 40 proposals. The evaluation was done by a recruited group of judges across USAID and private sector organizations with domain expertise in either gender, technology, and/or development. Diversity was key in recruiting judges, and at least 45% of the judges were from the Global South. The judging criteria was set by the

[75] The website for the Womenconnect Challenge can be viewed at https://www.usaid.gov/wcc.

implementing partner and approved by the WCC manager. From the top 40 proposals, a five-person Technical Evaluation Committee (TEC), consisting of higher-level experts, scored proposals and whittled the number to 20 semi-finalists using a judging matrix also developed by the implementer and approved by the WCC manager. Semi-finalists were able to rewrite proposals based on feedback, and the same TEC used a third judging matrix to select nine awardees.

Results: Of the 531 entries submitted between March 8, 2018 and May 20, 2018, a total of nine prizes were awarded. Winners included AfChix, Equal Access International, Gram Vaani, Humanitarian OpenStreetMap Team, Innovations for Poverty Action, Institute for Financial Management and Research, Mali Health, Gapi and Bluetown, and Viamo.

Budget and Resources: In FY17, $1.4 million and one FTE were used to support the Challenge. In FY18, $96,000 and one FTE were used to support the Challenge. A total of $500,000 was used to support a third-party company to manage the challenge design and operations.

Partnerships: Georgetown Business School donated classroom space for the semi-finalist workshop and reception.

Advancement of Agency Mission: This award advances USAID's mission by demonstrating the positive impact that digital technology can have on the gender digital divide, which affects approximately 1.7 billion women who are not able to use phones or the internet, through gender equity programming and the creation of new evidence to close the divide. Without this new evidence and programming, this divide will continue to grow and make it impossible for women, who are key to sustainable community development, to take advantage of all the digital international development programming that agencies are moving towards.

Solution Types: Software and apps; Creative (design & multimedia); Technology demonstration and hardware

Plan for Upcoming 2 FYs: The next phase of WomenConnect Challenge is to make the first payments to awardees and start conducting field visits with the desire to collaborate more with local missions who may be interested in augmenting these programs or making a country-specific challenge. There is interest in scaling the positive outcomes of the WCC, which would require additional USAID and partner commitment to provide the necessary funds.

C. Crowdsourcing and Citizen Science under the American Innovation and Competitiveness Act

This Appendix provides agency-submitted summaries of crowdsourcing and citizen science activities conducted in FY17 and FY18 under the authority provided in the Crowdsourcing and Citizen Science Act and does not include any activities conducted under other authorities.

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C.1 Department of Agriculture (USDA)

C.1.1 4-H Guide for NASA GLOBE Observer Clouds[1]

Lead Sponsoring Agency: National Institute of Food and Agriculture (NIFA)

Project Summary and Goals: The 4-H guide is designed to encourage youth to become citizen scientists by providing opportunities for cloud observation, data collection, and study. The program is geared toward achieving seven objectives for student participants: (1) learn what clouds are and how they form; (2) learn about the different types of clouds; (3) identify the study site, take observations of the sky, and upload data to the GLOBE database; (4) explain why cloud observations are important for understanding our changing Earth system; (5) develop an understanding of the challenge of visually estimating the percentage of cloud cover, gain experience estimating cloud cover, evaluate the accuracy of estimates, and use fractions and percentages; (6) become engaged in the process of science; and (7) become part of a worldwide community of learners and scientists.

Justification for Using Crowdsourcing and Citizen Science: Citizen science is a unique way to actively involve youth in data collection for science research while also teaching the importance of data collection. By participating in a citizen science project, youth can gain exposure to and learn more about a particular project topic. The 4-H Clouds guide is created to introduce youth to citizen science, conduct activities that provide deeper learning about the subject of clouds, and learn more about career opportunities related to the study of clouds and weather.

Status: The project launched in November 2018.

Location: The program will be available across the U.S.

Participation: The project targets U.S. 4-H youth.

Consent: N/A

Submissions: Using a mobile device, youth take images of the sky and collect other data as directed by the Clouds module in the GLOBE Observer mobile app for submission to the GLOBE Data and Information System, hosted at the National Aeronautics and Space Administration (NASA).

Budget and Resources: There is no dedicated budget or funds for this effort. Support for 4-H science education programs was provided by 4-H National Headquarters, NIFA, and USDA. Employees were used to contribute content to the guide, review drafts of the guide, and present at a poster session at a national conference of 4-H professionals. In FY17 and FY18, 0.1 full-time equivalents supported the project. No NIFA resources or funds were used for this project in FY17 or FY18. However, a small team of 4-H educators, supported by NASA GLOBE, attended a meeting at NASA Goddard to learn about GLOBE, use the Clouds module in the GLOBE Observer app, and make recommendations for the use of the app and other GLOBE resources in 4-H nationwide. The lead developer of the guide is a 4-H state specialist at Rutgers.

Partnerships: Federal partners included the Global Learning and Observations to benefit the Environment (GLOBE) Program, which is sponsored by NASA and supported by NSF, NOAA, and the U.S. Department of State. Non-Federal partners included Rutgers University 4-H.

Advancement of Agency Mission: The 4-H guide aligns with NIFA's mission: to "invest in and advance agricultural research, education, and extension to solve societal challenges." This project helps youth

[1] The website for the 4-H Guide for NASA GLOBE Observer Clouds can be viewed at https://observer.globe.gov/.

to learn about a subject area (clouds and weather) that is important to agriculture. It involves youth in science data collection and research and demonstrates how citizen science can contribute to solving societal problems.

Results: NASA scientists use the cloud observations submitted by citizen scientists, in conjunction with data gathered from satellites, to better understand the importance of clouds to our changing earth environment. Rutgers University hosted the guide on their 4-H web site and collect data from participants to gain information on the usage and application of the guide.

Data Availability: Data will be collected by 4-H youth through the Clouds module in the GLOBE Observer app. This data will be available to the public through the GLOBE visualization system on the GLOBE web site: https://vis.globe.gov/clouds.

C.1.2 Boise Multi-Party Monitoring, Boise, ID[2]

Lead Sponsoring Agency: USDA Forest Service

Project Summary and Goals: The mission of the citizen-led Boise Forest Coalition (BFC) is to provide the Boise National Forest with management recommendations that: 1) Are developed through consensus decisions involving all members of the Coalition; 2) Address natural resource, economic, recreational, and societal needs; 3) Are compatible with Forest Plan direction including implementation of the Forest's Wildlife and Aquatic Conservation Strategies; 4) Are economically realistic; and 5) Promote future collaboration during implementation and monitoring. The Emmett Ranger District is positioned to start implementing a multi-party monitoring strategy involving data collection that could include photo points, surface fuel and overstory forest conditions, wildlife surveys, economic analysis, and recreational use.

Justification for Using Crowdsourcing and Citizen Science: The agency has recently entered into a Good Neighbor Authority (GNA) agreement with the state of Idaho for one of the sale areas on the Emmett Ranger District. Given the state's different management approach and objectives, there has been uncertainty and apprehension from some members of the public with the GNA process, particularly for a project that was developed collaboratively with multiple resource objectives. Implementing a multi-party monitoring strategy would help to build trust between our stakeholders, the state of Idaho, and the USDA Forest Service. It would also provide an opportunity for international students and students from local universities to become engaged in collaboration and citizen science. Having this support could reduce costs, improve National Environmental Policy Act efficiencies, provide implementation monitoring, best management practice monitoring, and forest plan monitoring.

Status: The project started in FY18 and is ongoing.

Location: The project is taking place at the Boise National Forest.

Participation: The project targeted students, conservation groups, timber industry, recreation groups, private citizens, local and State government, other State and Federal land managers.

Consent: No volunteer hours have been recorded yet, so no consent was needed.

Submissions: N/A

Resources: Funding for CCS projects comes from congressionally appropriated dollars to USDA. There is no dedicated USDA budget line item or funding for citizen science and crowdsourcing. In FY18,

[2] The Boise Multi-Party Monitoring project was conducted under the Crowdsourcing and Citizen Science Act as well as the Volunteers in the National Forests Act of 1972, as amended, 16 U.S.C. 558a-558d.

funding in the amount of $25,000 was used in support of international forestry students, recruitment, outreach, data sharing, travel transportation, staff and personnel, external projection evaluation, and product development.

Partnerships: Non-Federal partners included Boise Forest Coalition.

Advancement of Agency Mission: The project area is identified in the Boise National Forest forest plan as a high-priority area for restoring vegetation and short-term wildlife habitat, and includes subwatersheds identified as having impaired function based on the nationwide watershed condition classification analysis. The project area includes wildland urban-interface and falls within a priority landscape designated by the Governor of Idaho and approved by the Secretary of Agriculture for forests that are at high risk of insect and disease mortality under Section 8204 of the Agricultural Act of 2014 (i.e., the Farm Bill). The project area is also under contract as a pilot GNA with the state of Idaho to improve efficiency of implementation.

Results: This project would complete implementation and effectiveness monitoring to help inform future forest management decisions, determine the need and effectiveness of project design features, and improve treatment prescriptions/best management practices. Monitoring is often not completed following project implementation due to funding constraints, a lack of resources, and prioritization of projects to attain assigned targets

Data Availability: Results can be posted to the BFC website, the Idaho Forest Restoration Partnership website, as well as potential other open-source locations. Data could also be incorporated into the forest plan monitoring report (posted on BNF website), Forest Service Activity Tracking System, and used for project implementation and compliance inspection.

C.1.3 Científicos en Familia: A Program to Engage Diverse Communities in Citizen Science and Stewardship[3,4]

Lead Sponsoring Agency: USDA Forest Service

Project Summary and Goals: Corazón Latino and NorthBay have created a pilot program to engage, train, and empower diverse families, primarily Latino, from the Washington D.C./Virginia/Maryland region to become citizen scientists, applying their acquired knowledge to support the U.S. Forest Service's (USFS) mission, information needs, and restoration efforts. Focus on forest health/human health connections and the relationship between healthy forests and clean water will provide avenues for participating families to become Citizen Science Corps members who can activate to collect meaningful data to meet USFS information needs. The bilingual strategic communications and stakeholder engagement outreach are empowering regional and national audiences using digital tools, social media, traditional media (TV, print, radio) and community outreach (events, workshops, presentations). USFS will generate a citizen science community engagement model for diverse communities that can be adapted, replicated, and scaled throughout the nation. Final deliverables and reporting will include an English/Spanish-language toolkit and project implementation manual.

Justification for Using Crowdsourcing and Citizen Science: Empowering the public to identify natural resource issues, and to be involved in science-based solutions, is a pathway to developing advocates for sustainable public land management. Empowering diverse communities to make informed

[3] The website for the Científicos en Familia: A Program to Engage Diverse Communities in Citizen Science and Stewardship can be viewed at www.corazonlatino.us.

[4] The Científicos en Familia project was conducted under the Crowdsourcing and Citizen Science Act as well as the Volunteers in the National Forests Act of 1972, as amended, 16 U.S.C. 558a-558d.

decisions about conservation issues will provide the USFS and other land management agencies with avenues to invite, include, and involve diverse audiences in public engagement activities around land management.

Status: The project started on April 29, 2018, and is ongoing.

Location: The project is located in Washington, D.C. and the George Washington Jefferson National Forest (GWJNF).

Participation: The project targeted semi-rural and urban Hispanic and African American youth and their families, including 4th graders and "Every Kid in Park" program participants. The total number of individuals involved during this period was 47.

Consent: Forty-seven individuals provided consent.

Submissions: Participants were asked to make observations in the iNaturalist app. Observations are defined as geotagged photos of various plants and animals. The data are publicly available and can be used to study biodiversity and invasive species by geographic region across the world.

Resources: Funding for CCS projects comes from congressionally appropriated dollars to USDA. There is no dedicated budget line item or funding by USDA for citizen science and crowdsourcing. In FY18, funding in the amount of $25,000 and 0.03 FTEs were used to support salaries and wages for personnel involved in the project, facility rentals, materials, and field trips to the GWJNF.

Partnerships: Non-Federal partners included Corazón Latino and NorthBay.

Advancement of Agency Mission: The pilot program is engaging diverse communities in citizen science activities that meet USFS scientific information needs focused on forest insects and disease; forest health and human health relationships; and water monitoring in the GWJNF. In the GWJNF, the gypsy moth, southern pine beetle, and hemlock woolly adelgid are all major insect pests, while oak decline, dogwood anthracnose, and shoestring root rot are major disease problems. Many of these insects and disease issues are also found in urban/suburban settings. Científicos en Familia is establishing a mechanism for forest health monitoring designed to lead to forest stewardship and restoration of urban/suburban communities and NF lands. Empowering youth and their families to become involved in monitoring activities will also create an informed public that can support sustainable forest management activities.

Results: The first year of the program was aimed at building capacity and trust and fostering environmental stewardship among participants. Participants learned the environmental context for citizen science projects (e.g., what forest health is and why it is important), why citizen science projects are important, and how they can participate using tools like iNaturalist. Participants used iNaturalist to document invasive plant species and document biodiversity in the Washington D.C.-Virginia-Maryland area.

Data Availability: These data are publicly available through iNaturalist and can be used by Federal agencies and partners to advance scientific understanding of regional biodiversity as well as the spread of invasive or non-native species of flora and fauna.

C.1.4 Citizen Science for Rangeland Health: Engaging Ranchers in Science[5]

Lead Sponsoring Agency: USDA Forest Service

Project Summary and Goals: The Citizen Science for Rangeland Health project intends to monitor resource issues of mutual concern to grazing permittees and the USFS on grazing allotments in the San Juan National Forest. Rangeland managers need data to manage resources sustainably. The USFS and rancher volunteers will work to 1) agree on a resource issue of mutual concern that can be addressed through data collection (spring 2018); 2) decide on a monitoring protocol and locations for answering questions (spring 2018); 3) host training on data collection methods (early summer 2018 and 2019); 4) collect data with data collection coordinators form Colorado State University (CSU), USFS personnel, and ranchers (summers 2018 and 2019); 5) conduct analyses on data in fall of 2018 (preliminary) and 2019; and 6) host several joint-interpretation sessions (fall/winter 2018/2019) with broader group of ranchers and community members.

Justification for Using Crowdsourcing and Citizen Science: Engaging ranchers in citizen science will generate information on important management issues in the area, empower ranchers to be stewards of the resources they manage and to take a more active role in observing land trends. The project adds value by generating data to inform decisions and increasing the efficiency and mutual respect among ranchers and agency staff. At times, USFS and ranchers disagree on assessing rangeland conditions. By agreeing on methods, locations, and jointly collecting, analyzing, and interpreting data, this project engages ranchers and USFS agency staff in building and using a data set for evidence-based decisions. It also provides a framework for enhancing collaboration among ranchers and USFS staff and empowers all parties to engage with data and decisions on the Forest.

Status: The project started in FY18 and is ongoing.

Location: The project is located in the San Juan National Forest in Dolores, CO.

Participation: The project targeted local and regional ranchers, The Rangeland Stewardship Committee, other rural residents and recreationalists, and the Local Future Farmers of America Chapter

Consent: No volunteer hours have been recorded yet, so no consent was needed.

Submissions: N/A

Resources: Funding for CCS projects comes from congressionally appropriated dollars to USDA. There is no dedicated budget line item or funding by USDA for citizen science and crowdsourcing. In FY18, funding in the amount of $23,147 was used to support technician salaries and fringe, travel, materials and supplies, rancher stipends, statistical analyses, and printing expenses.

Partnerships: Non-Federal partners included CSU Extension.

Advancement of Agency Mission: Data generated by this citizen science project will provide useful information, help correlate more quantitative monitoring methods with faster methods that ranchers can use, and develop a cohort of individuals who are making formal observations, interpreting data, and applying it in management decisions. The project will address three of USDA's strategic goals for FY14-18: 1) assist rural communities to create prosperity so they are self-sustaining, repopulating, and economically thriving; 2) ensure that national forests and private working lands are conserved, restored, and made more resilient to climate change, while enhancing water resources; 3) help America promote agricultural production and biotechnology exports as it works to increase food security.

[5] The Citizen Science for Rangeland Health project was conducted under the Crowdsourcing and Citizen Science Act as well as the Volunteers in the National Forests Act of 1972, as amended, 16 U.S.C. 558a-558d.

Results: Annual utilization measurements provide useful indicators in determining grazing impacts over time. Acquiring this information can be time consuming depending on methodology. Grazing permittees are partners that can assist in collecting and mapping this information on a yearly basis. By collaboratively educating partners to collect this information, it will provide USFS with a more robust data set for making decisions. In addition, the landscape in question currently lacks ecological site descriptions, which are often used to identify desired conditions and objectives during the planning process. An assessment of existing relict sites across the landscape will provide USFS with a better understanding of site potential. Lastly, USFS currently collects vegetation and ground cover data at various permanent transect locations to determine composition and change over time. This is one of the pieces of information used to determine the effects of grazing.

Data Availability: The public will have the opportunity to engage in data interpretation via open meetings. A final report will be made available via the CSU Extension website, the local Conservation District, and the local Forest Service Office. Data will be filed in the 2210 allotment files, and subject to the Freedom of Information Act, per all data collected on USFS land. Data collected in conjunction with USFS personnel will be filed in the respective grazing allotment 2210 file.

C.1.5 Collaborative Investigations at Admiralty Cove[6]

Lead Sponsoring Agency: USDA Forest Service

Project Summary and Goals: The Tongass National Forest and Douglas Indian Association (DIA), a federally recognized Tribal Government, will work together to document the cultural history of Admiralty Cove on the east side of Admiralty Island National Monument in Southeast Alaska. USFS will fulfill a Heritage Program management goal to complete a comprehensive inventory in an area likely to include archaeological properties with the help of DIA staff and Tribal youth as volunteers. Student volunteers will be paired with elders to collect ethnohistoric information. A field day will enable the same elder/student pairs to spend time in the Cove in the vicinity of the USFS trail and recreation cabin. Students will refine their questions and record additional on-site observations as appropriate. They will assist professional archaeologists and Tribal specialists in conducting an archaeological survey, involving the use of metal detectors, pedestrian transects, and sub-surface probing.

Justification for Using Crowdsourcing and Citizen Science: USFS Heritage Program goals include inventory, site protection, and public outreach. This project will strengthen our relationship with DIA, whose citizens belong to either the Áak'w Kwáan or the T'aaku Kwáan, the two groups of Tlingit whose territory includes the eastern coast of Admiralty Island. The USFS and DIA share the management goals of restoring, sustaining, and enhancing the forest. This project furthers a shared objective that tribes continue their traditional uses of the forest to sustain their cultural identity and continuity. The goal is to identify four Tribal youth who will interact with their elder(s) as mentors and knowledgeable guides. The cross-generational sharing of knowledge is an extremely strong Tlingit value.

Status: The project started on August 10, 2018, and is ongoing.

Location: The project is located in the Tongass National Forest, Admiralty National Monument in Juneau, AK.

Participation: The project targeted Tribal youth and elders for the ethnohistorical research and archaeological inventory phases of the project. An interpretive sign will be designed and installed on

[6] The Collaborative Investigations at Admiralty Cove project was conducted under the Crowdsourcing and Citizen Science Act as well as the Volunteers in the National Forests Act of 1972, as amended, 16 U.S.C. 558a-558d.

site aimed at public recreation cabin users. The total number of individuals involved was seven, including four youth and three elders. The total number of volunteer hours was 207.5, 82.5 of which were uncompensated and 125 of which had stipends provided by the Tribe.

Consent: All seven individuals who participated in the project provided consent.

Submissions: Interview planning, digital recordings of interviews, interview catalogues, partial transcriptions, and hands-on assistance at National Records Center including research and document scans.

Resources: Funding for CCS projects comes from congressionally appropriated dollars to USDA. There is no dedicated budget line item or funding by USDA for citizen science and crowdsourcing. In FY18, 0.11 FTEs and $46,573 supported the project in staff time, project leads and assistants, boat operator, field subsistence for USFS and volunteers, materials (e.g., digital recorders, gloves, tapes, line levels, trowels, bear fence, general camp supplies), stipends for cultural experts/elders.

Partnerships: Non-Federal partners included DIA.

Advancement of Agency Mission: The project advances USDA's mission in four ways. 1) The project enables USDA to meet obligations made under an MOA between the USFS and the Alaska State Historic Preservation Office (SHPO) to mitigate adverse effects to a National Register eligible property. In consultation, USFS and SHPO agreed to mitigation with stipulations addressing interpretive signage; training for staff; research on cultural history and survey for archaeological properties; and appropriate consultation with SHPO through a series of deliverables including site documentation and determinations of eligibility and effect. 2) The project enables USDA to meet USFS Heritage Program goals including inventory, site protection, and public outreach. 3) The project strengthens USFS's relationship with DIA, a federally recognized Tribe with whom the USFS has a government-to-government relationship formalized through a current Memorandum of Understanding. 4) The project promotes shared stewardship.

Results: The project will ensure that the USFS Heritage Program has appropriate information on which to base recommendations for management decisions for future projects in the vicinity of the recreation cabin. This will reduce the cost of future proposals within the survey area particularly for ground disturbing activities like the establishment of replacement outhouses and trail reroutes.

Data Availability: Archaeological data will be shared with the Tribal Council as well as with the Alaska State Office of History and Archeology. Participants will complete the project by designing an interpretive sign that, while protecting sensitive information, will share the results of the research with the public.

C.1.6 Culturally Responsive Citizen Science Development with Forest Inventory Analysis in Interior Alaska[7]

Lead Sponsoring Agency: USDA Forest Service

Project Summary and Goals: The Forest Inventory and Analysis (FIA) program is a nationwide inventory of forested lands which began in Interior Alaska in 2016. A culturally appropriate method of conducting citizen science in line with local priorities has not been conducted at a broad scale across rural Alaska or Alaska Native communities. FIA crews are based in rural and/or Alaska Native communities for

[7] The Culturally Responsive Citizen Science Development with FIA in Interior Alaska project was conducted under the Crowdsourcing and Citizen Science Act as well as the Volunteers in the National Forests Act of 1972, as amended, 16 U.S.C. 558a-558d.

months at a time. The short, intensive period during which employees live in communities limits time to build critical relationships, and collected data may be disconnected from community needs and priorities. A culturally-responsive citizen science approach coupled with typical data collection methods may reduce challenges FIA faces in communities, build partnerships, and increase youth opportunities. This program initiates co-creation of local forest health citizen science projects integrating local knowledge with FIA data. FIA will partner with the Global Learning and Observations to Benefit the Environment (GLOBE) citizen science program through University of Alaska Fairbanks (UAF) to facilitate projects and maintain long-term relationships.

Justification for Using Crowdsourcing and Citizen Science: FIA collects data for use by scientists and managers across the country to undertake locally or regionally relevant research or management decisions. Having local understanding would assist researchers and managers in contextualizing projects or outcomes and provide a more complete perspective. This is especially important in Interior Alaska where change is occurring rapidly and baseline data are often lacking. Enabling communities to participate in determining issues worthy of further citizen-directed research or action as well as co-create and undertake projects is an efficient and cost effective way for USFS and FIA to further our mission and collect wider and more inclusive data/knowledge, while increasing community engagement and ownership of the data and process. Partnering with a thoroughly vetted citizen science and education organization such as GLOBE increases the efficacy of conducting a citizen science project at such a large scale. GLOBE offers a range of environmental monitoring protocols (landcover, soils, phenology, hydrology, wildfire, etc.) that have been peer-reviewed, externally evaluated, and used by youth and communities in over 110 countries since 1995.

Status: The project started in FY18, and is ongoing.

Location: The project is located in Anchorage, Alaska.

Participation: The project targeted local community members including elders, adults, and youth of all ages. Most communities involved are in rural and remote Alaskan areas, not frequently visited by outsiders. In future years, communities will be Alaska Native villages.

Consent: No volunteer hours have been recorded yet, so no consent was needed.

Submissions: N/A

Resources: Funding for CCS projects comes from congressionally appropriated dollars to USDA. There is no dedicated budget line item or funding by USDA for citizen science and crowdsourcing. In FY18, funding in the amount of $9,250 was used to support travel transportation, staff and personnel, meeting costs, and materials and supplies.

Partnerships: Non-Federal partners included Alaska GLOBE Program and UAF.

Advancement of Agency Mission: This project addresses the first, second, and third strategic goals in the 2015 Integrated Strategy for Youth. 1) Build partnerships to reach all America's youth and engage them in conservation education: Alaska FIA will build a new partnership with GLOBE Alaska to reach youth in rural Alaskan communities with high proportions of Alaska Native students. 2) Develop and nurture opportunities for all youth to engage in conservation service and investigate career opportunities in natural resource management: youth will have personal interaction with FIA employees as they design GLOBE citizen science investigations to further their exposure to Forest Service career opportunities. They will apply the data they collect to a stewardship action project of their own design. 3) Build knowledge about natural resources, conservation, and stewardship of our Nation's forests and grasslands by developing and implementing effective, standards-based, contemporary conservation

education programs that reach all America's youth: youth will engage in a culturally responsive learning model for citizen science developed by the UAF GLOBE program.

Results: FIA is mandated to provide information to assess America's forests on a continuous basis. In 2016, Interior FIA was the last FIA program to be implemented nationally. This effort has the unique opportunity to inform data collection efforts by incorporating locally-identified concerns and co-creating citizen science investigations to address forest health concerns while improving community relationships. This shared customer/public role in project design meets the goal of delivering benefits to the public and excelling as a high-performing agency through exemplary public service. Today, boreal regions are subject to rapid change and current and historical data are critical. Further, a high proportion of communities in the boreal region are rural and indigenous. Citizen science, as an approach to scientific research and engagement, struggles with attracting cultural groups underrepresented in STEM careers. This is often attributed to a mismatch between scientific goals and community concerns. Establishing and evaluating a process for flexible culturally-responsive citizen science with FIA will further engage Alaska Native stakeholders in Forest Service science and scientific research. The strategic partnership with GLOBE Alaska extends data collected by community teams to a global audience, providing data on boreal forest variables for current and future research.

Data Availability: Data collected from community projects will be housed within the GLOBE database which currently houses over 130 million measurements accessible to land managers, scientists, students, and the public at www.globe.gov. FIA data will be available via FIA DataBase, and can be accessed at https://apps.fs.usda.gov/fia/datamart/. FIA data are also available via a landowner report for landowners who have an FIA plot on their land and who request it. FIA data is publically available, however the program is mandated to keep plot location and owner information confidential to comply with Federal privacy legislation and to preserve the integrity of the plot/sample.

C.1.7 Engaging Angler Scientists to Help Prioritize and Monitor the Effectiveness of Stream Reconnection Projects[8]

Lead Sponsoring Agency: USDA Forest Service

Project Summary and Goals: This project formalizes a collaboration between Trout Unlimited (TU) and the U.S. Forest Service (USFS) to empower citizen scientists, including TU anglers, college students, and other interested members of the community to 1) conduct road-stream crossing surveys to understand Aquatic Organism Passage (AOP), and 2) conduct brook trout spawning surveys to provide baseline biological data associated with barriers and to monitor the effectiveness of AOP projects and other stream treatments. USFS and TU staff have invested significant resources to assess road-stream crossings for AOP issues.

Justification for Using Crowdsourcing and Citizen Science: This project meets objectives in the 2017 Rise to the Future: National Fish & Aquatic Strategy including Goal 2: Connect People to the Outdoors Through Fishing, Boating, and Other Aquatic Activities. While some national forests have been comprehensively surveyed, many still have significant gaps in the understanding of their aquatic connectivity. Empowering citizen scientists to assist with these surveys will expand USFS capacity to understand AOP across entire forests and to better prioritize stream reconnection projects that benefit brook trout and other aquatic organisms. This project leverages TU's strong grassroots base and regional project staff to develop pilot projects in eastern National Forest lands. By developing resources

[8] The Engaging Angler Scientists to Help Prioritize and Monitor the Effectiveness of Stream Reconnection Projects were conducted under the Crowdsourcing and Citizen Science Act as well as the Volunteers in the National Forests Act of 1972, as amended, 16 U.S.C. 558a-558d.

and demonstrating the effectiveness of this approach, this project will facilitate and promote expansion of AOP assessment and monitoring to other national forests throughout the eastern U.S. Through these monitoring efforts, volunteers will gain a connection to these watersheds and the efforts to improve them, and may be further engaged in restoration projects.

Status: The project started in FY18, and is ongoing.

Location: The project is located in Pisgah-Nantahala, George Washington-Jefferson, Allegheny, and Huron-Manistee National Forests.

Participation: The project targeted outdoor recreationists, college students, high school students, rural community members.

Consent: No volunteer hours have been recorded yet, so no consent was needed.

Submissions: N/A

Resources: Funding for CCS projects comes from congressionally appropriated dollars to USDA. There is no dedicated budget line item or funding by USDA for citizen science and crowdsourcing. In FY18, funding in the amount of $24,923 was used to support salaries and wages for personnel involved in the project, travel, equipment, and volunteer expenses.

Partnerships: Non-Federal partners included TU.

Advancement of Agency Mission: This project meets objectives in the 2017 Rise to the Future: National Fish & Aquatic Strategy for the agency including Goal 1: Conserve Fish and Aquatic Resources; Goal 2: Connect People to the Outdoors Through Fishing, Boating, and Other Aquatic Activities; and Goal 4: Deliver and Apply Scientific Research. The project will enhance management decisions regarding brook trout population reconnection on National Forest lands. By increasing the capacity of the USFS to collect useful AOP data, stakeholders can better prioritize specific culverts for restoration, replacement, or further evaluation. In this way, the USFS can focus efforts in identified priority areas, resulting in a more efficient use of limited funding, and a watershed-scale management strategy for the reconnection of aquatic habitat and brook trout populations. Spawning surveys have been shown to be an effective method to monitor population trends in salmonids over time and are more cost effective than other techniques, allowing more populations to be monitored over longer periods of time.

Results: By mapping the distribution of redds (the spawning ground or nest of fish) over time, USFS can identify priority areas for stream treatment projects and document population response to our investments.

Data Availability: Barrier data entered on the mobile application form developed by Southeastern Aquatic Resources Partnership (SARP) is automatically uploaded to their Regional Barrier Inventory. Citizen science-collected data is mapped and used by USFS, TU, state agencies and others in the Southeast to aid in project selection and prioritization. SARP's database is available to the public and can be obtained by contacting SARP. TU will also develop a brook trout spawning survey protocol, resource guide, and database for use by our staff, USFS, and other partners. These resources will be piloted in the Allegheny and Manistee-Huron National Forests and will be designed to be broadly applicable throughout the east.

C.1.8 Engaging Citizen Scientists in Field Research on American Pika, an Indicator Species for Alpine Ecosystem Integrity[9,10]

Lead Sponsoring Agency: USDA Forest Service

Project Summary and Goals: The American pika, *Ochotona princeps*, is a small, charismatic mammal in western North America that is sensitive to climate-driven variation in temperature, snowpack, and vegetation composition. Extirpation of pika populations and range retraction linked to climate change has been documented in the Great Basin, Southern Utah, and California. The species may be more resilient to climate change in the extensive, high-elevation habitat found in the Southern Rocky Mountains (SRM). However, recent research predicts that pikas may be extirpated from Rocky Mountain National Park (RMNP) during this century under some climate change scenarios. There is a pressing need to assess the species' vulnerability to climate change across the SRM, particularly in National Forests, where the majority of pika habitat in the region is found. The White River National Forest (WRNF) has identified pika as a focal species and aims to determine the status of pika populations as an indicator of alpine ecosystem integrity. The Front Range Pika Project (FRPP) seeks funding to engage citizen scientists in field surveys, to collect data the WRNF needs to determine pika distribution and improve understanding of environmental variables that limit pika distribution using a vetted, peer-reviewed protocol. These data, along with long-term monitoring of occupancy trends, are essential to predicting and tracking the species' response to climate change on the WRNF. In addition, the project will establish capacity for long-term, citizen science monitoring of pika in the WRNF, and advance the Southern Rockies Pika Partnership's (SRPP) research goals.

Justification for Using Crowdsourcing and Citizen Science: This project will be implemented by the FRPP (co-directed by Rocky Mountain Wild and Denver Zoo), in coordination with the SRPP, a partnership collaborating to expand citizen science research on pika in the region. The FRPP has trained over 200 volunteers to collect high quality data since 2010 and has 80 active volunteers. Through expansion of pika citizen science research to the WRNF, the FRPP will enable the WRNF to efficiently determine current pika distribution, and lay the groundwork for long-term monitoring to discern changes in alpine ecosystems and pika distribution occurring as a result of climate change. A trained volunteer cohort will survey multiple areas across the forest using an established, scientifically rigorous protocol.

Status: The project started on August 22, 2018, and is ongoing.

Location: The project is located in White River National Forest in Glenwood Springs, CO.

Participation: The project targeted outdoor recreationists, rural communities surrounding the WRNF, urban communities in the region with a large potential volunteer base, youth, and members of local and regional nonprofit conservation and stewardship organizations. The total number of individuals involved during this period was eight, and the average number of active participants per week was five. The total number of volunteer hours was 90.

Consent: All individuals involved in the project during this period provided consent.

Submissions: Observations, data collection, and images

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[9] The website for the Engaging citizen scientists in field research on American pika, an indicator species for alpine ecosystem integrity can be viewed at www.pikapartners.org.

[10] The Engaging Citizen Scientists in Field Research on American Pika, an Indicator Species for Alpine Ecosystem Integrity project was conducted under the Crowdsourcing and Citizen Science Act as well as the Volunteers in the National Forests Act of 1972, as amended, 16 U.S.C. 558a-558d.

Resources: Funding for CCS projects comes from congressionally appropriated dollars to USDA. There is no dedicated budget line item or funding by USDA for citizen science and crowdsourcing. In FY18, 0.08 FTE and $21,334 were used to support salaries, travel, equipment, supplies and materials, training, and webpage development and maintenance related to this project.

Partnerships: Non-Federal partners included Rocky Mountain Wild and the Denver Zoo.

Advancement of Agency Mission: The American pika became a WRNF focal species with the implementation of the 2012 planning rule and replacement of Management Indicator Species with focal species. The WRNF plans to determine the status of American pika populations as an indicator of alpine ecosystem integrity per the 2016 WRNF Monitoring Plan. Pika occupancy surveys are needed to determine current pika distribution and whether distribution patterns on the WRNF are most strongly limited by climate stress, topographic constraints, habitat extent, habitat connectivity, biological interactions, or some combination of these factors.

Results: This study will also establish capacity for long-term monitoring to enable the WRNF to predict and track impacts of climate change on pika and inform potential management actions to improve pika resiliency to climate change. In summary, a WRNF partnership with Rocky Mountain Wild and Denver Zoo through the FRPP will provide vital data to discern the status of pika on the WRNF, provide the opportunity for long-term pika monitoring to increase the WRNF's understanding of climate change effects on this focal species and inform management options.

Data Availability: Data will be open-access on CitSci.org, whose audience includes researchers, managers, educational institutions, and the public. USFS will share project updates and results with volunteers and local communities through presentations at events (including at least two end-of-season volunteer events), newsletters, web pages, social media of partner and participating organizations, and local news outlets. USFS will share results with the Forest Service through a written report to WRNF Reporting in the appropriate Forest Service databases (e.g., Volunteer Services Reporting); NatureWatch, Interpretation, and Conservation Education database; and the Natural Resource Manager among others. USFS will share results with the scientific community through presentations at conferences (e.g., North American Pika Consortium Conference, CitSci 2019); reporting results to the Southern Rockies Pika Partnership; and considering publishing in a scientific journal if results merit publication.

C.1.9 Location of Plants Traditionally Used by American Indian Tribes to Improve Management of Federal Lands on the Four Forest Restoration Initiative[11]

Lead Sponsoring Agency: USDA Forest Service

Project Summary and Goals: In a consultation between the USFS and numerous Arizona and New Mexico tribes, tribes requested that the USFS collect information on traditionally-used plants for consideration in the Four Forest Restoration Initiative (4FRI) analysis to develop management protocols that preserve identified plants. This proposal responds to this information need by providing data collected by citizen scientists on the location of hard-to-locate, non-abundant, traditionally-used plants/herbs to 1) 4FRI managers to develop management protocols to ensure long-term sustainability and availability of these resources for tribes; 2) tribal members to be featured in educational materials and utilized as a repository of ecological knowledge for important plant species; and 3) researchers to devise

[11] The Location of Plants Traditionally Used by American Indian Tribes to Improve Management of Federal Lands on the Four Forest Restoration Initiative was conducted under the Crowdsourcing and Citizen Science Act as well as the Volunteers in the National Forests Act of 1972, as amended, 16 U.S.C. 558a-558d.

scientifically-based management and restoration protocols for these culturally important plant species. The 4FRI is the largest Collaborative Forest Landscape Restoration Project in the country influencing the management of 2.4 million acres in central Arizona on the Apache-Sitgreaves, Coconino, Kaibab, and Tonto National Forests. These data, therefore, have the potential to affect management at a broad geographic scale.

Justification for Using Crowdsourcing and Citizen Science: In government-to-government consultation with local tribes regarding 4FRI, tribal authorities requested that the management of traditionally-used plant species be considered during 4FRI planning to prevent population decline or extirpation during project execution. Spatial data on plant populations will allow the USFS to meet this request, as well as to identify traditional collection areas for which site-specific management protocols will be developed. Locating traditionally-used plants is challenging due to the size of the 4FRI lands and the need for experienced botanists to correctly identify plant species. By harnessing the natural history expertise of local tribes to identify populations of species of interest, USFS can meet the tribes' request with increased efficiency for USDA.

Status: The project started in FY18 and is ongoing.

Location: The project is located in Williams, AZ and Apache-Sitgreaves, Coconino, Kaibab, and Tonto National Forests.

Participation: The project targeted tribal youth, at-risk youth, underserved communities, tribal communities, and natural resource partners.

Consent: No volunteer hours have been recorded yet, so no consent was needed.

Submissions: N/A

Resources: Funding for CCS projects comes from congressionally appropriated dollars to USDA. There is no dedicated budget line item or funding by USDA for citizen science and crowdsourcing. In FY18, funding in the amount of $25,000 was used to support Forest Service co-leads' time in facilitating tribal consultation; internal/external training/education for the project; salary for a university partner; stipends and honoraria for speakers and traditional practitioners; mileage and/or vehicle rental for participants and speakers; meeting materials; and space rental.

Partnerships: Non-Federal partners included Northern Arizona University and federally recognized tribes.

Advancement of Agency Mission: This project addresses three of the four management outcomes outlined in the 2015-2020 Forest Service Strategic Plan. Natural resource decision-making is improved through the use of reliable information and applications (outcome 1) by providing USFS land managers with data on the location of traditionally-used plants, thus allowing development of strategies to protect these species during the implementation 4FRI restoration efforts, which includes potentially destructive measures like prescribed burns and mechanical thinning. Additionally, this project will strengthen the partnership between the USFS, Northern Arizona University (NAU), and federally recognized tribes by promoting an exchange of expertise on natural resource management and encouraging future collaborations to scientifically evaluate management and conservation of these species. By protecting culturally, economically, and ecologically important species and sharing distribution information with local tribes, this project will ensure that social, economic, and environmental benefits flow from forest and grassland resources (outcome 2), thus strengthening the engagement of tribal communities with public land management and promoting the connection of these communities with their natural and cultural heritage. Finally, conservation of traditionally-used

plant species promotes forest and grassland ecosystems that are resilient and adaptive in a changing environment (outcome 3), as such species contribute to ecosystem health and function.

Results: This project will add value to resource management by providing spatial data on the location of traditionally used plants on 4FRI lands to USFS land managers. Spatial data on plant populations will allow the USFS to identify traditional collection areas for which site-specific management protocols will be developed.

Data Availability: The data will be open-access for USFS employees, selected researchers, and tribal members through the iNaturalist platform. Obscured location information will be provided to the general public, in order to prevent targeted harvest of these potentially valuable species. Data will be permanently curated on the USFS's Forest ACtivity Tracking System (FACTS) to be shared at the request of land managers, tribes, and researchers.

C.1.10 Monitoring the Status of the Columbia River Gorge Pika Population After the Eagle Creek Fire[12,13]

Lead Sponsoring Agency: USDA Forest Service

Project Summary and Goals: Last fall, the Eagle Creek Fire (ECF) burned nearly the entire low-elevation distribution of pikas, small mammals which are important bellwethers to environmental changes, on the Oregon side of the Columbia River Gorge (CRG), prompting widespread public interest in the fate of CRG pikas. Following this event, this project addresses the following goals: 1) leverage an extensive pre-fire distribution dataset to document the extent of changes in CRG pika distribution, following the ECF; 2) engage citizen scientists in conducting pika surveys and collecting additional habitat data; and 3) analyze predictors of pika density and monitor recolonization of disturbed habitat.

Justification for Using Crowdsourcing and Citizen Science: American pikas create an ideal platform for citizen science. In addition to being charismatic, easily identifiable, and residents of beautiful natural areas, pikas have been shown to be vulnerable to environmental changes in some areas. These factors have motivated diverse volunteers to participate in pika watches, from hikers and outdoor enthusiasts to K-12 students and teachers. Cascades Pika Watch (CPW) is a citizen-science initiative supported by the Oregon Zoo, the Point Defiance Zoo and Aquarium, and several leading pika biologists. In the last five years, USFS has trained over 1,000 volunteers to conduct pika surveys throughout the Cascades, including scientifically-selected sites in the continentally unique, low-elevation habitat of the Columbia River Gorge (CRG). USDA's experience is that CPW volunteers enjoy being involved in this project. The active CPW Facebook group has over 500 members who enthusiastically share pika pictures and stories, accessible at: https://www.facebook.com/groups/CascadesPikaWatch/. Post-participation surveys also suggest that this project encourages a sense of stewardship and responsibility among the outdoor enthusiasts as well as a deepened awareness of the complexity of wildlife management and conservation.

Status: The project started in July 2018, and is ongoing.

Location: The project is located in the Columbia River Gorge National Scenic Area of Hood River, OR.

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[12] The website for the Monitoring the status of the Columbia River Gorge (CRG) pika population after the Eagle Creek Fire can be viewed at https://www.oregonzoo.org/cascades-pika-watch.

[13] The Monitoring the Status of the Columbia River Gorge (CRG) Pika Population After the Eagle Creek Fire project was conducted under the Crowdsourcing and Citizen Science Act as well as the Volunteers in the National Forests Act of 1972, as amended, 16 U.S.C. 558a-558d.

Participation: The project targeted youth groups from historically marginalized communities; outdoor enthusiasts; urban and rural families; and K-12 teachers/students. The total number of individuals involved during this period was 103 volunteers, and the average number of active participants was 71 volunteers per month. The total number of volunteer hours was 868 total.

Consent: All participants involved in the project during this reporting period provided consent.

Submissions: A total of 96 data sheets containing wildlife observations and site data were submitted.

Resources: Funding for CCS projects comes from congressionally appropriated dollars to USDA. There is no dedicated budget line item or funding by USDA for citizen science and crowdsourcing. In FY18, 0.02 FTE and $26,815 supported the project coordinator and technical advisor, travel for trainers, training events, and cooperator and agency indirect costs.

Partnerships: Federal partners included U.S. Geological Survey Northern Rocky Mtn. Science Center. Non-Federal partners included the Oregon Zoo and Colorado Mesa University.

Advancement of Agency Mission: The pika is currently listed as a Species of Conservation Concern (SCC) in numerous U.S. Forest Service units. Forest Service SCC's are defined as species "for which population viability is a concern, as evidenced by: 1) Significant current or predicted downward trends in population numbers or density. 2) Significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution" (Forest Service Manual [FSM] 2670.5.19). Relatively little is known about how CRG pikas might respond to contemporary environmental changes and disturbances caused by wildfire. This knowledge gap may hamper management, given that fires are predicted to increase in both frequency and severity. Through citizen science, CPW provides an early-warning system to inform the USFS about changes in pika populations. In the future, trained CPW volunteers can apply their skills to monitor pikas and other species in areas beyond the CRG, using protocols, apps, and techniques in which they have been trained. Most importantly, this project provides a wealth of data on multiple ecosystem components and fire, across a large area spanning two states, at effectively zero cost to USFS. Cost-efficiencies are created by our existing extensive network of volunteers, and process-efficiencies reflect diverse partners that this project unites towards common, multi-faceted goals.

Results: Experience in this project demonstrates that volunteers can collect high-quality data to inform management. An active social media presence is also being used to spread relevant information to participants and the community. Finally, this effort will ensure a continuous supply of trained citizen scientists for monitoring other species in the future. In addition, to share findings most widely, at least two peer-reviewed publications are anticipated describing both the immediate impact of the ECF on the CRG pika population and the factors underlying short-term declines and subsequent recovery.

Data Availability: Data will be freely available to management agencies following peer-reviewed publication, allowing these agencies (e.g., USFS, USFWS) to make evidence-based decisions on how to manage pikas and their habitat. In addition, results will be shared through presentations to zoo visitors, schools, and through social media.

C.1.11 Neighbors to Nature: Cache Creek Study[14,15]

Lead Sponsoring Agency: USDA Forest Service

[14] The website for the Neighbors to Nature: Cache Creek Study can be viewed at www.naturemappingjh.org.

[15] The Neighbors to Nature: Cache Creek Study was conducted under the Crowdsourcing and Citizen Science Act as well as the Volunteers in the National Forests Act of 1972, as amended, 16 U.S.C. 558a-558d.

Project Summary and Goals: This project will expand a partnership between the Forest Service, Friends of Pathways (FOP), Jackson Hole (JH) Wildlife Foundation, and Wildflower Watch through the use of citizen science to better inform land management decisions in the heavily used Cache Creek drainage, directly adjacent to the town of Jackson, Wyoming. The project will engage a youth crew from FOP, citizen scientists/volunteers from the JH Wildlife Nature Mapping program, and existing volunteers from Wildflower Watch to collect, analyze and interpret plant, wildlife, and trail use data. This project will help establish a baseline of observations, as well as an effective and consistent method to gather and process this data over time. Phenological observations such as leaf-out, budding, and flowering of plant species will help monitor the effects of climate change on plant communities with subsequent implications for seasonal recreation use. Approximately ten species of native and invasive plants will be located and monitored by volunteers. Trail counters will be purchased and installed in key locations to observe how the area is being utilized for recreation. Nature Mapping volunteers, as well as the FOP youth crew, will directly observe and report on wildlife movements in the area. Data will then be analyzed by volunteers and provided to the public and the Forest Service to inform future management decisions in the area.

Justification for Using Crowdsourcing and Citizen Science: Aside from informing and improving Forest Service management decisions, much of the value of this collaboration lies in the education of the local community. An educated community is more likely to comply with and support management decisions such as seasonal area or trail closures for wildlife. FOP will engage students in this project through the involvement of their youth crew, who will help install and rotate trail counters and wildlife cameras, as well as upload data into existing databases. This helps students understand data collection standards and the scientific method. Wildflower Watch will engage volunteers through direct monitoring of native and invasive flora and fauna of the forest, getting volunteers outside and participating in rigorous research efforts. Citizen scientists will also be encouraged to participate in data entry, analysis, and interpretation through additional outreach efforts led by the Wildflower Watch team. USFS hopes that participation in this project by the public will create a large community centered on the appreciation of natural resources.

Status: The project started on May 17, 2018, and is ongoing.

Location: The project is located in the Bridger-Teton National Forest (BTNF) Jackson Ranger District in Jackson, WY.

Participation: The project targeted outdoor recreationists, citizen scientists, Teton County Middle School, Teton Science School, the Teton Chapter of the Native Plants Society, Teton Botanical Garden, and the Sierra Club. The total number of individuals involved during this period was 50. Participants were all going out once a week, from mid-June to mid-September into the project study area to record observations. The total number of volunteer hours for this project is 135 hours.

Consent: All of the volunteers have signed volunteer agreements.

Submissions: Participants were asked to collect data on plant phenology, for which roughly 100 observations were collected. Participants were also asked to collect data on wildlife sightings, for which 141 observations were collected. This adds to a total of 241 observations taken.

Resources: Funding for CCS projects comes from congressionally appropriated dollars to USDA. There is no dedicated budget line item or funding by USDA for citizen science and crowdsourcing. In FY18, 0.05 FTEs and $27,440 were used to support grant administration; staff time; project management; data analysis; stipend for the youth crew; youth crew manager and foreman; web development contractor; and equipment (e.g., wildlife cameras, field guides, lenses, clipboards, printed materials, trail counters).

Partnerships: Non-Federal partners included the JH Wildlife Foundation, Wildflower Watch, and FOP.

Advancement of Agency Mission: From a recreation perspective, this project will add value to local resource management by providing an accurate, scientific view of the plant and wildlife populations in the area, and the associated recreational use patterns. Aside from informing and improving USFS management decisions, much of the value lies in the education of the local community. An educated community is more likely to comply with and support management decisions such as seasonal area or trail closures for wildlife. This directly reduces operating costs for the agency by reducing the number of field patrols and amount of signage that are necessary to maintain closures. Additionally, knowledge of the recreational patterns directly increases efficiency of the USFS unit by informing rangers and trail workers about the areas needing the most attention. From a range perspective, understanding how species composition may be altered in response to climate change will help in predicting community vulnerability to phase or state change within current ecological site descriptions. This could make risk assessments associated with proposed management activities more accurate; thus leading to better informed decisions, improved project design, and increased efficiency.

Results: The USFS Jackson District Trail Assessment was prepared to more effectively manage recreation use by establishing desired conditions for nine geographical areas on the District. The Cache Creek recreation area was further split into four zones to more closely monitor conditions and provide a diverse range of experiences close to town. This project will directly inform recreation managers of existing conditions compared with desired conditions. Additionally, this project aims to initiate citizen science observations of phenology for approximately ten species of flowering plants at Cache Creek, contributing to the greater efforts of the USA National Phenological Network (USANPN).

Data Availability: FOP will integrate trail counter data into an existing database which currently stores three years of trail count data. FOP provides a direct link to this database for managers and the public to see on their website. USFS plans to upload all phenological data to the USANPN database, which is quality assured and open source, to be easily accessed by managers, researchers, and the general public. Wildflower Watch will also keep a backup database of all field collections for use internally at the BTNF and for local partners including researchers, citizen scientists, and school groups. Wildlife data will be composed of observations made anywhere within the project area at any time. The dataset contains data collected since 2009 to the present day. Data going into the NMJH database under casual observations will be shared with the Wyoming Game & Fish Department's Wildlife Observation System to augment State data.

C.1.12 Potomac Highlands Cooperative Weed and Pest Management Area Non-Native Invasive Species Citizen Science Program[16]

Lead Sponsoring Agency: USDA Forest Service

Project Summary and Goals: For the last seven years, the Potomac Highlands Cooperative Weed and Pest Management Area (PHCWPMA) has delivered a successful citizen science program for fifth graders at an elementary school in Grant County, West Virginia. After a four-week series of lessons about local non-native invasive species (NNIS) in the classroom, the students apply what they have learned on a day-long field trip to identify, map, and remove NNIS on the Monongahela National Forest. With the support of the CitSci Fund, the PHCWPMA plans to purchase additional educational materials, expand the program to other schools in and around the Monongahela National Forest, and use the latest

[16] The Potomac Highlands Cooperative Weed and Pest Management Area Non-Native Invasive Species Citizen Science Program was conducted under the Crowdsourcing and Citizen Science Act as well as the Volunteers in the National Forests Act of 1972, as amended, 16 U.S.C. 558a-558d.

technology for gathering and sharing NNIS data. Working with teachers, these activities have been correlated with the Next Generation Content Standards and Objectives for the State of West Virginia. The PHCWPMA will continue working with students in Grant County and expand to students in Pocahontas, Fayette, Greenbrier, and Hardy counties by 2019, serving primarily rural and low-income students.

Justification for Using Crowdsourcing and Citizen Science: Currently, a successful version of this program already exists through the PHCWPMA partnership at another elementary school. Expansion of the project to more schools will allow for students to be engaged that come from an area in West Virginia that is primarily rural and low-income. This project creates public engagement and learning/training opportunities in the classroom and field trip into the forest where the students will use what they have learned to identify and be land stewards by removing NNIS.

Status: The project started in FY18, and is ongoing.

Location: The project is located in the Monongahela National Forest in Elkins, WV.

Participation: The project targeted middle school-age students from schools located in or near the Monongahela National Forest. These children reside in rural, low-income regions of West Virginia.

Consent: No volunteer hours have been recorded yet, so no consent was needed.

Submissions: N/A

Resources: Funding for CCS projects comes from congressionally appropriated dollars to USDA. There is no dedicated budget line item or funding by USDA for citizen science and crowdsourcing. In FY18, funding in the amount of $32,600 was used to support salaries and wages of personnel involved in the project; USFS vehicles; tablets; educational trunks; NNIS identification guides; weeding tools; and protective wear.

Partnerships: Non-Federal partners included Appalachian Forest Heritage Area; AFHA AmeriCorps; and WV Division of Forestry.

Advancement of Agency Mission: The Monongahela National Forest has a target to treat NNIS on over 1,000 acres of National Forest land. The students would directly contribute to this target and improve the forest by recording and voluntarily removing the NNIS on field trips. An important part of reporting to the Forest Service is recording the spatial data of area treated. By using the EDDMapS application, students would provide ArcGIS data to the Forest Service and other interested parties. Having this spatial data will allow for field crews or other volunteers to come in later to finish removal. This recorded data would also provide more information and greater efficiency for the PHCWPMA field crew so that they can better prioritize their efforts based on the location and extent of NNIS populations.

Results: This will improve USFS's data management for NNIS and allow retrieval of spatial data from the website; it qualifies for the USFS's targets for national reporting.

Data Availability: The students will use tablets to collect and store information using the EDDMapS application. The data are accessible by the public, scientists, and other NNIS specialists; such spatial data were not previously available to the Forest Service for the reporting of NNIS treatment and removal. Specifically, they can assist The Nature Conservancy of West Virginia, in partnership with the Monongahela National Forest, in directing their PHCWPMA field crew specializing in weed and pest management to sites that are in need of treatment for NNIS.

C.1.13 Tracking the Vernal Window with a Low-Cost Instrumentation Suite[17]

Lead Sponsoring Agency: USDA Forest Service

Project Summary and Goals: The vernal window marks the end of winter and the start of the growing season, defined as the time between snowmelt and canopy closure. Weather variability in winter and spring could lengthen the vernal window and impact forest ecosystem functions such as nutrient and water cycling. A changing vernal window could affect economic activities that requires frozen conditions (i.e., winter logging) or snowmelt and soil thaw (i.e., maple sugaring). Additional research is needed to understand how the vernal window responds to changes in snow, soil frost, soil biological activity, and canopy green-up, and could affect forest management and long-term forest health. The goal of this project is to enhance collective understanding of the vernal window by providing New England high schools with low-cost instrumentation to track changes in 1) snow depth, 2) soil frost depth, 3) soil biological activity, and 4) forest canopy green-up. Participants are recruited from the established Community Collaborative Rain Hail and Snow Network (CoCoRaHS) and train students to measure soil frost via the frost tube method, soil biological activity using soda lime base traps, and canopy green-up by observing phenophases.

Justification for Using Crowdsourcing and Citizen Science: Classrooms are an ideal venue for this research because the vernal window coincides with school semesters and engages students in outdoor scientific inquiry. Data will be synthesized in an open-source framework that will allow classrooms to track changes in the vernal window using a lesson plan that meets Next Generation Science Standards.

Status: The project started in FY18, and is ongoing.

Location: The project is located in Durham, NH.

Participation: The project targeted five high school (grades 9-12) classrooms. Two New England teachers have been recruited and three more high schools in New England will be recruited by the end of spring 2018 from a network of teachers in the community.

Consent: No volunteer hours have been recorded yet, so no consent was needed.

Submissions: N/A

Resources: Funding for CCS projects comes from congressionally appropriated dollars to USDA. There is no dedicated budget line item or funding by USDA for citizen science and crowdsourcing. In FY18, funding in the amount of $24,646 was used to support travel transportation, staff and personnel, and materials and supplies related to the project.

Partnerships: Non-Federal partners included the University of New Hampshire.

Advancement of Agency Mission: The information obtained from this work will help inform the management of Forest Service lands, most notably, the White Mountain National Forest (WMNF) in New Hampshire. A coordinated effort has been underway since 2008 to improve the discussion of climate change in National Environmental Policy Act analysis and decision-making on the WMNF. Winter recreation is important to the regional economy and the management of the WMNF. Increased attention has been going into infrastructure-related issues associated with stream crossings (roads and trails) largely because of the increased frequency of events, such as rain-on-snow that result in major floods. The WMNF is focusing attention to snowmobile trails (400 miles on the WMNF) as many current

[17] The Tracking the Vernal Window with a Low-Cost Instrumentation Suite project was conducted under the Crowdsourcing and Citizen Science Act as well as the Volunteers in the National Forests Act of 1972, as amended, 16 U.S.C. 558a-558d.

routes are over wetlands or other water bodies which are no longer reliably freezing. The WMNF is also investing in trail reroutes and better crossing designs on both nordic ski and snowmobile trails across the unit as funding permits. More attention needs to be paid to snow related issues particularly in regards to snowmobiling and cross country skiing, both sports which are not supported by artificial snow making.

Results: Increasing evidence suggests that variability in winter snow and soil frost dynamics exerts important controls on wintertime root and microbial activity and nutrient loss from soils, which in turn affect forest health. More information on the relationships among snow depth, soil frost, and soil CO_2 efflux (a proxy for winter soil biological activity) can help inform our understanding of how winter weather influences forest productivity. Winter conditions, including duration of snowpack and frozen soil, are also important determinants of forest operations planning. Snow and soil frost control winter access for timber harvest, and predictable timing of frozen ground and snowmelt is important for the safety and efficiency of harvest operations. Additionally, sap flow necessary for maple syrup production requires a combination of warm days and freezing nights that is highly seasonal. Weather records show such conditions now occur earlier than in the past and this trend is projected to continue; however, it is unclear whether the season will be shortened or sap yield reduced. Maple producers report that their current ability to adapt to changing weather conditions is largely related to the health of the forest and the ability of producers to adopt new technologies.

Data Availability: Classrooms will follow the existing National Phenology Network Nature's notebook reporting protocols to track three phenophases: breaking leaf buds, leaves, increasing leaf size of trees in outdoor classrooms. Trees will include maple, oak, and poplar, subject to availability on school grounds. Participating classrooms will receive in-class training in the fall and follow-up data analysis sessions in late spring. All data will be uploaded to GoogleSpreadsheets. The research team will perform quality assurance and quality control on the data, and develop scripts to process data into graphs, and made publicly available via a GitHub repository. Researchers and teachers will create a comprehensive Vernal Window Teacher Guide including protocol training slides, datasheets, content presentations, analysis instructions, and a comprehensive equipment list to implement in other classrooms across the Northeastern U.S. Snow depth and phenophase data are available at www.cocorahs.org and www.naturesnotebook.org, respectively. The proposed project will centralize the above vernal window indicators in a single open-access GitHub repository for other educators, managers, researchers, and the general public.

C.2 Department of Commerce (DOC)

C.2.1 Urban Heat Island Mapping Campaign[18]

Lead Sponsoring Agency: National Oceanic and Atmospheric Administration (NOAA)

Project Summary and Goals: On two of the hottest days of summer in 2018 (August 21–23), a NOAA-sponsored team of scientists and volunteer citizen scientists conducted a field campaign to measure and map the urban heat islands of Washington, D.C. and Baltimore, Maryland. The campaign had three main objectives: (1) produce very detailed heat maps of D.C. and Baltimore, quantifying the heat differences across the cities; (2) provide residents and city officials with a resource for assessing the risks from extreme heat and identifying the necessary actions to protect people, property, and

[18] The website for the Urban Heat Island Mapping Campaign can be viewed at https://research.noaa.gov/article/ArtMID/587/ArticleID/2385/High-temperatures-bring-citizen-scientists-to-map-the-hottest-places-in-Baltimore-and-DC.

infrastructure; and (3) improve understanding of the changes in temperature of those urban heat islands through the course of an entire day as a function of different land cover types. Citizen scientist volunteers also participated in a pilot urban heat island mapping campaign, funded by a NOAA Environmental Literacy Grant, in Richmond, VA, on July 13, 2017. Hosted by the Science Museum of Virginia, the mapping effort showed that temperature differences of up to 16°F occurred during the same time of day in different parts of the city. The campaign also found that the orgins of the majority of heat stress-related 911 emergency calls coincided with the locations of the city's heat islands. Thus, city residents and officials are using these findings to begin a new dialog about actions that can be incorporated into the city's long-term master plan to protect its citizens from extreme heat. The full Richmond urban heat island mapping case study can be found at https://toolkit.climate.gov/case-studies/where-do-we-need-shade-mapping-urban-heat-islands-richmond-virginia.

Justification for Using Crowdsourcing and Citizen Science: The decision to utilize a citizen science approach to the Urban Heat Island Mapping Campaign was justified by the scope, design, and nature of the experiment. To achieve the campaigns goals, temperature measurements, taken simultaneously every second all over both cities for three one-hour periods, needed to be collected. This very high-resolution data in both time and space could not have been collected without volunteer drivers. In addition, the experiment needed to be flexible enough to wait for clear, very hot (≥95°F) days, so participants needed to be available in two days notice. Lastly, local citizens want to ensure a high quality of life in the places where they live, work, and play. Thus, local volunteer citizen scientists take ownership of the resulting temperature maps and are likelier to have a vested interest in ensuring that these maps are considered and used by city government officials in their long-range planning.

Status: The project took place between August 20, 2018 and August 23, 2018, and is complete.

Location: The project is located in Washington, D.C. and Baltimore, Maryland.

Participation: The project targeted local citizens from D.C. and Baltimore. The total number of individuals involved during this period was 29, with 9 citizens from D.C. and 20 citizens from Baltimore. The total number of volunteer hours was approximately 85.

Consent: Twenty-nine participants provided consent during this period.

Submissions: Participants were asked to mount thermocouple devices, which were specially designed thermometers in modified PVC pipes, in their front, passenger side windows. These devices measured temperature once per second as well as the precise time of day and precise latitude and longitude location. Participants drove three one-hour traverses through D.C. and Baltimore on selected, very hot days, resulting in the collection of about 75,000 data points throughout both cities.

Resources: A one-time allocation of $30,000 was dedicated in FY17 to cover costs of conducting the Urban Heat Island Mapping Campaign in D.C. and Baltimore. Funds were used to support the work and responsibilities of the principal investigators, including equipment preparation, travel, training workshops, data analysis, and documentation of findings. Less than 0.5 FTEs were needed to support the campaign. Other resources required for the campaign included equipment (e.g., thermocouples, PVC pipes, data loggers, and GPS sensors), specialized software, and LIDAR data.

Partnerships: Non-Federal partners included Portland State University, Science Museum of Virginia, Smithsonian Institution, Baltimore Aquarium, D.C. and Baltimore city governments, and Casey Trees.

Advancement of Agency Mission: NOAA's mission is to share scientific data and information to help the nation plan and respond to environmental hazards. NOAA hosts and maintains the U.S. Climate Resilience Toolkit with the intent to help communities, businesses, and government organizations understand their exposure to climate-related hazards and assess the actions needed to adapt to or

mitigate the consequences of these hazards. The urban heat island mapping campaign contributed to this mission by helping citizens and government officials in D.C. and Baltimore with precisely measuring and mapping their urban heat islands, which can get anywhere from 15°F-20°F hotter than other areas on the hottest days of summer. With a greater understanding of the likelihood and consequences of extreme heat, residents and leaders can properly weigh the risks and identify effective prevention efforts.

Results: NOAA intends to publish the resulting heat maps in the U.S. Climate Resilience Toolkit's Climate Explorer, a web-based mapping and graphing tool. The heat maps will also be shared with the residents and the city governments of D.C. and Baltimore for use in their dialogs and deliberations.

Data Availability: The data will be freely shared with the public in easily accessible and interactive ways for both education and long-term planning purposes.

C.3 Department of Homeland Security (DHS)

C.3.1 FEMA Crowdsourcing Unit and Playbook for Emergency Management

Lead Sponsoring Agency: Federal Emergency Management Agency (FEMA)

Project Summary and Goals: The goal of the project was to develop a playbook outlining how to leverage crowdsourcing networks that support decision making and response during disasters and emergencies for all levels of emergency management. This includes how the agency organizes information required for decision making and the types of crowdsourced data available to support those requirements. Combined with an outline of our Digital Volunteer Network (DVN) partners and the platforms used to share data, the playbook provides a roadmap on how to be successful when operating in the crowdsourcing space.

Justification for Using Crowdsourcing and Citizen Science: Crowdsourcing has evolved to a point where groups of individuals armed with unique skills have self-organized into networks with a mission to leverage data from the crowd to drive positive outcomes. Some networks are well established with well-codified organizational structures and mission sets while others are ad-hoc, organized at time of incident in response to a perceived gap in operations (e.g., the numerous networks organized to identify people in need of rescue during the 2017 hurricane season). This self-organizing of crowdsourcing networks has proven to be an opportunity for emergency managers. Previously, crowdsourcing meant dedicating analytical data and application development capabilities to the effort, which for most emergency managers is either in short supply or non-existent. DVNs facilitate collaboration among thousands of individuals with those precise capabilities. Instead of performing the crowdsourcing, emergency managers can leverage the efforts of DVNs who provide exponentially more robust capabilities than any single emergency management agency could expect to provide. The key is understanding how DVNs operate, why they operate, what their capabilities are, and how to collaborate for mutually beneficial outcomes.

Status: The project started on March 01, 2018, and is ongoing.

Location: The project is located across U.S. states and territories.

Participation: The project targeted FEMA, self-organizing crowdsourcing networks, DNVs, and National Voluntary Organizations Active in Disasters. The total number of active participants during this period was 4.

Consent: All participants for this project provided consent.

Submissions: While FEMA cannot task or ask for deliverables from volunteers, FEMA's crowdsourcing coordinators facilitated a daily coordination call. This call was a collaborative forum of participant volunteers to share activities, data collection methodology, and products across the group. FEMA, among others, used these products to assist in cross-validating official information source and supporting data-driven decision making during Hurricanes Maria, Lane, Florence and National Level Exercise 18.

Budget and Resources: FY17 resources were used for research, planning, and coordination call facilitation. FY18 resources were used for planning, development of a draft Crowdsourcing Playbook, organization of data teams, and coordinators during hurricane preparation and response. A total of 0.2 FTEs supported the program in FY17, and 0.6 FTEs supported the program in FY18.

Partnerships: Federal partners included the U.S. Geological Survey and the Department of Homeland Security. Non-Federal partners included various digital volunteer networks/coordinators.

Advancement of Agency Mission: The unprecedented disaster response requirements experienced during the 2017 hurricane season, particularly in Puerto Rico, led to gaps and delays in gaining critical information necessary to inform operational decision making. As a result, FEMA made the decision to actively participate in ongoing crowdsourcing efforts occurring outside of the Federal Government in order to close these information gaps. Information attained through crowdsourced efforts was used as a placeholder until information obtained through official, vetted sources was available. Crowdsourced information was analyzed and proven highly accurate, nullifying the organizational concern that unofficial information sources were inherently inaccurate. Most recently, FEMA utilized crowdsourcing information for leadership decision making prior to and during the landfall of Hurricane Florence.

Results: Still under development.

Data Availability: Still under development.

C.4 Department of Interior (DOI)

C.4.1 Project eTrout[19]

Lead Sponsoring Agency: U.S. Geological Survey (USGS)

Project Summary and Goals: Virtual reality (VR) platforms provide powerful new opportunities for ecological research and education. The goal of Project eTrout is to engage students in fish biology research using VR and crowdsourcing platforms to generate data for ecological analysis by USGS while achieving educational objectives for participants. The pilot project will take place from 2018 to 2019 and entails 3 steps: (1) USGS researchers collect underwater, 360-video from targeted stream sites in Shenandoah National Park and provide video samples to participating schools; (2) participants watch video samples and collect data on trout abundance, behavior, and habitat use; and (3) USGS summarizes the crowdsourced data and reports results back to participants. This project provides a powerful new link between ecological research and education by enabling fish biology research across large regions while providing students and citizen scientists a new way to experience stream ecosystems. This effort could be expanded to include video collection by visitors to National Forests and National Parks as well as NGO partners at the national and international level.

[19] The website for Project eTrout can be viewed at www.usgs.gov/eTrout. Project eTrout is conducted under the Crowdsourcing and Citizen Science Act as well as the Organic Act of 1879.

Justification for Using Crowdsourcing and Citizen Science: Stream ecosystems are spatially complex and therefore an understanding of stream fishes requires data from many locations. Collection of such spatially-distributed data is not feasible by any single agency or university alone. Instead, stream ecosystems require a collaborative effort across many institutions for analysis at the landscape scale. Moreover, prior efforts in this regard have been criticized for a lack of independently verifiable results. Project eTrout overcomes both of these limitations by using video data collected at a low cost from many locations with empirically verifiable archived records.

Status: The project started in September 2018.

Location: The project takes place in the Eastern United States.

Participation: The project targets students ranging from elementary school to college level. Over 50 schools will be involved with this project beginning in January 2019. Following that, the number of schools involved is expected to increase.

Consent: Consent will be obtained via collaboration with Virginia Tech's Institutional Research Review Board. No personally-identifiable information will be collected.

Submissions: Students and citizen groups will provide data on fish abundance, behavior, and habitat use from 360-degree underwater videos collected by USGS.

Resources: The launch of Project eTrout in FY18 utilized funding from the USGS Ecosystems Mission Area. The total funding in FY18 is $4,500. FTE staffing was used to start organizing the participant network in FY18. Additional funding was used to collect 360-video samples from streams in Shenandoah National Park. A non-Federal partner, Trout Unlimited, contributed in-kind staff support through their Trout In the Classroom program and Virginia Tech Advanced Research Computing Group contributed in-kind support for website hosting and VR website development. Future development of this project will benefit from in-kind support by NGO partners to leverage Federal resources.

Partnerships: Federal partners included the National Park Service. Non-Federal partners included Trout Unlimited and Virginia Tech Advanced Research Computing Group.

Advancement of Agency Mission: A core mission of the USGS is to help America achieve sustainable management and conservation of its biological resources. Specifically a goal of the USGS Ecosystems Mission area is to conduct “cutting-edge research that leads to the protection and restoration of our Nation’s fisheries and aquatic resources.” Project eTrout advances this mission by applying new camera technology in stream ecosystems and crowdsourcing the analysis of large imagery datasets from students and citizen scientists. This project empowers youth as part of a large research team, and enables new spatial analysis of fish abundance, behavior, and habitat use by USGS researchers.

Results: N/A

Data Availability: N/A

C.5 National Aeronautics and Space Administration (NASA)

C.5.1 Backyard Worlds: Planet 9[20,21]

Lead Sponsoring Agency: NASA

Project Summary and Goals: The Backyard Worlds: Planet 9 citizen science project scours data from NASA's Wide Field Infrared Survey Explorer (WISE) mission to search for moving objects, primarily nearby ultracool brown dwarfs. NASA estimates that BackyardWorlds.org will yield more than 1,000 objects that demand publication and that candidates will roughly double the sample of known brown dwarfs cooler than spectral type L5. These discoveries will help NASA understand how planets form and provide analogs to help interpret specta of exoplanet atmospheres. Backyard Worlds: Planet 9 is also the deepest all-sky infrared search for new planets in the solar system, such as the proposed Planet Nine.

Justification for Using Crowdsourcing and Citizen Science: The deepest WISE brown dwarf search prior to this project involved visual inspection of roughly one million images. Thus, NASA recognized that volunteer help with the inspection process would be necessary to go deeper.

Status: The project started on February 14, 2017 and is ongoing.

Location: Participation in the project is available globally through internet access.

Participation: The project targeted the general public. The total number of individuals involved during this period was estimated to be 150,000. However, estimation is based on IP addresses that have accessed the site, so the exact number of participants is difficult to measure. The average number of active participants per day was between 50 and 60. The total number of volunteer hours was 83,000 hours for the classification work on the Zooniverse site alone, plus approximately the same among of time for the effort contributed by the advanced user group on various side projects.

Consent: All participants consented to participate.

Submissions: The project has received roughly 5 million online classifications of image sets from NASA's Wide-Field Infrared Survey Explorer (WISE) mission and Near Earth Asteroid-WISE (NEOWISE) project.

Resources: In FY17 and FY18, the project was supported by NASA's Science Mission Directorate (80%) and NASA's Office of the Chief Scientist/Science Innovation Fund (20%). Extramural funding for FY17 totaled $35,000, and 0.35 internal FTEs supported the project. Extramural funding for FY18 totaled $6,000, and 0.25 internal FTEs supported the project. Both FY17 and FY18 FTEs have gone to support labor for the principal investigator. In addition to providing funding to Zooniverse (zooniverse.org) to develop and use the Zooniverse platform for this project, the project took advantage of a project builder tool Zooniverse has made available at no charge. Additional funding has been used for publication costs and travel.

Partnerships: Non-Federal partners include Zooniverse, American Museum of Natural History, Arizona State University, University of Oklahoma, University of Montreal, UC San Diego, and Bucknell University.

Advancement of Agency Mission: The project addresses NASA's mission to understand the solar system and the universe by finding ultracool brown dwarfs and searching for new planets orbiting the sun.

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[20] The website for the Backyard Worlds: Planet 9 can be viewed at Backyardworlds.org.

[21] The Backyard Worlds: Planet 9 project was conducted under the Crowdsourcing and Citizen Science Act as well as 51 USC § 20112(a).

Results: This project is used to advance scientific understanding and has been cited in a scientific journal publication.

Data Availability: The final list of brown dwarfs discovered by the project will be published in the scientific literature. NASA also plans to create a public archive of potentially useful false positives (e.g., active galactic nuclei, M dwarfs) for use by future astronomers. This archive will be hosted by the NASA/ Infrared Processing & Analysis Center Infrared Science Archive.

C.5.2 Landslide Reporter[22,23]

Lead Sponsoring Agency: NASA

Project Summary and Goals: Historical data on landslide events are vital for landslide hazard and risk assessment and response. However, there is currently a dearth of information at the global scale of when and where landslides occur. Landslide Reporter is a web application that invites citizen scientists to contribute landslides, mudslides, rockfalls, and other events to the NASA Cooperative Open Online Landslide Repository (COOLR) to help build the largest open global landslide catalog. When a citizen scientist finds a landslide in an online news source or sees a landslide in person, they can describe its location, type of landslide, and more details and submit it for review. Their submissions are checked and added to the repository. The COOLR project extends from the NASA Global Landslide Catalog (GLC), an open global catalog of rainfall-triggered landslides compiled by members of the Hydrological Sciences Laboratory at Goddard Space Flight Center since 2007. The goal of Landslide Reporter is to improve the quality and quantity of landslide data globally, to be a tool and resource for local communities to use to monitor and research landslides, and for collective landslide reporting during disasters. Lastly, Landslide Reporter strives to be an educational resource to increase the public's awareness and knowledge about landslides as a hazard.

Justification for Using Crowdsourcing and Citizen Science: Although landslides occur frequently, many landslides go unreported by newspapers or are grouped together with other natural hazards. Thus, people over a wide geographic range are needed to better capture an accurate count of landslides. The massive collection of data from citizen scientists increases the robustness of NASA's global landslide efforts farther than possible with the team at Goddard Space Flight Center alone. NASA's previous methodology for the Global Landslide Catalog (GLC) limited the collection of landslide reports to those found with Google Alerts and by the time availability of scientists and interns in NASA's laboratory. Citizen science enables the amassing of information from many different sources, including local first-hand accounts, reports in non-English languages, and points from other inventories, and lessens the data collection bias. Citizen scientists have a better local understanding of their region, which may result in improved accuracy of the location and details of the landslide. Citizen science also enables more hands to collect reports, leading to a more up-to-date inventory and less reliance on the availability of the landslides team. Lastly, a citizen-aided effort creates more awareness and education about landslides as a natural process and natural/man-made hazard. From the initial findings, citizen scientists are already bringing in new data from areas that have been underreported in the past with great accuracy and detail.

Status: The project started on March 22, 2018 and is ongoing.

Location: The project collects information on a global scale.

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[22] The website for the Landslide Reporter can be viewed at https://landslides.nasa.gov/reporter.

[23] The Landslide Reporter project was conducted under the Crowdsourcing and Citizen Science Act as well as 51 USC § 20111, et seq.

Participation: The project targeted the general public with at least a high school education. The total number of individuals involved during this period was 35, which reflects the total number of participants that have successfully contributed reports. The total number of volunteer hours was 43 hours, assuming each of the 129 submitted landslide reports took an average of 20 minutes to complete.

Consent: All participants are required to agree to the Posting, Privacy, and Takedown Policy before using Landslide Reporter.

Submissions: Citizen scientists are asked to mark where a landslide occurred on a map and fill in information about the date, time, description, type, trigger, fatalities and injuries, and surrounding environment of the landslide. Only the location and source of the event are required to complete the submission. A total of 129 landslide reports have been submitted.

Resources: Total project funding for FY17 and FY18 was approximately $186,000. The funds came from several different sources, but there is not one single funding source specifically designated to support this project. The funding has been acquired through the Presidential Early Career Achievement Award (PECASE), an "Innovation Seedling on Citizen Science" award ($19,000) from NASA Goddard Space Flight Center's Chief Technologist Office, NASA Center for Climate Simulation (NCCS), and the precipitation measurement missions. All resources for this project have been used to support labor (contractor and civil servant labor), including the support received in kind from the system developer partners at NASA as well as the internal group's effort. The FY17 resources were used to develop a first proof-of-concept for this project and back-up documentation for fields to be included. A total of 0.08 FTEs and 0.08 WYEs supported the project in FY17. FTE support and WYE support in FY17 amounted to $10,000 each. The FY18 resources were used to support one full-time contractor to develop the materials supporting this citizen science project. A total of 0.1 FTEs and 1.2 WYEs supported the project in FY18. The FTE contribution was used to manage the project, and the WYE contribution was used to develop the tools using ESRI Citizen Science applications and to support scientific oversight and testing. FTE support amounted to $10,000 and WYE support amounted to $156,000 in FY18.

Partnerships: N/A

Advancement of Agency Mission: Landslide Reporter advances NASA's mission to discover and develop Earth science datasets to better understand the Earth. With the goal to expand the consistency and accuracy of a global open landslide catalog, Landslide Reporter is aiding the discovery of the Earth by helping validate and improve NASA's landslide modeling capabilities. Landslide Reporter also directly aids NASA's response to the 2017–2027 Decadal Survey for Earth Science and Applications from Space, which prioritizes the "forecasting and monitoring of landslides, especially those near population centers." Landslide Reporter fulfills NASA's objective to inspire and engage the public in science by involving the public in contributing data towards NASA's scientific research. In addition to learning about individual landslide events, the public becomes more knowledgeable about landslide hotspots and how landslides occur. The availability of data from Landslide Reporter can be used by citizen scientist landslide experts to conduct investigations. Furthermore, Landslide Reporter supports applications of the Global Precipitation Measurement (GPM) Mission, as COOLR provides validation for NASA's Global Landslide Susceptibility Map and the Landslide Hazard Assessment for Situational Awareness (LHASA) Model, both which use GPM rainfall data for landslide susceptibility and nowcasting.

Results: Data are quality-checked, added to COOLR, and made available to the public. Foremost, COOLR data supports the continued development of the LHASA model, which uses GPM rainfall data to make a nowcast of where landslides are most likely to occur globally. The open data can also be downloaded by anyone for other landslide research.

Data Availability: The data are open to the public for download or referenced from the web application, Landslide Viewer, at https://landslides.nasa.gov/viewer. All information about the project and data are available at https://landslides.nasa.gov.

D. Crowdsourcing and Citizen Science under Other Authorities

This Appendix provides summaries of select crowdsourcing and citizen science activities voluntarily submitted by agencies that were conducted in FY17 and FY18 under authorities other than that provided by the Crowdsourcing and Citizen Science Act. Agency reporting on crowdsourcing and citizen science activities under other authorities was optional, and therefore the activities presented here are representative rather than comprehensive.

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D.1 Department of Agriculture (USDA)

D.1.1 Invasive Mosquito Project[1]

Lead Sponsoring Agency: Agricultural Research Service (ARS)

Authority: 7 U.S.C. 2272 (Volunteers for Department of Agriculture Programs)

Project Summary and Goals: The Invasive Mosquito Project (IMP) is a public education and national mosquito monitoring program that partners local professionals with high school teachers and community educators to teach about mosquito-borne disease and public health. The project provides teachers with educational materials that meet Next Generation Science Standards and creates community outreach opportunities that benefits mosquito control and public health agencies. The IMP website serves as both an informational resource and a connection platform for teachers and professionals.

Justification for Using Crowdsourcing and Citizen Science: During the summer of 2012, the USDA sampled mosquitoes throughout the entire continental United States using a network of citizen scientists and crowdsourcing. Learning from the effectiveness of this effort, the IMP was formed to make an even larger and more sustainable network at lower cost.

Status: The project started in April 2016 and is ongoing.

Location: The IMP monitors invasive mosquito species across the United States.

Participation: The project targeted middle and high school students, boy scouts, master gardeners, and other community groups. The total number of individuals involved during this period was 2000, and the number of active participants was 50.

Consent: No consent is needed.

Submissions: The IMP collected participant observation data as well as mosquito eggs, mosquito larvae, and adult mosquito samples.

Resources: There is no dedicated budget to support the IMP. However, the use of crowdsourcing and citizen science (CCS) allows USDA-ARS to support the project. By relying on citizens for monitoring and data collection, USDA-ARS saves approximately $15,000 per year in technician travel and equipment related costs. The project costs to raise the mosquitoes is approximately $2,000 per year and 0.1 FTE of a technician. Both FY17 and FY18 resources were used to rear the submitted mosquito egg samples to adults for identification.

Partnerships: Non-Federal partners included Kansas State University.

Advancement of Agency Mission: The USDA uses the submitted mosquito samples for population genetics studies, helping to raise awareness about public health risks through agricultural research.

Results: In addition to helping teach students and communities about the risk of mosquito transmitted pathogens and building a strong network of schools, the IMP allowed the USDA to find the origins and subsequent geographic expansion of two mosquito species in the United States. The USDA is in the

[1] The website for the Invasive Mosquito Project can be viewed at http://www.citizenscience.us/imp/.

process of using the samples to determine which traits are needed for population expansion to new geographic areas, which will help predict future at risk populations.

Data Availability: The data is currently maintained as paper records and is not available at this time.

D.1.2 Collaborative Adaptive Rangeland Management (CARM)[2]

Lead Sponsoring Agency: ARS

Authority: 7 U.S.C. 2272 (Volunteers for Department of Agriculture Programs)

Project Summary and Goals: The CARM study was devised to compare traditional rangeland management used by local ranches with season-long, continuous grazing. A team of stakeholders and scientists were selected to manage yearling cattle for beef production, grassland diversity, and bird conservation. For the experiment, approximately 230 yearling cattle graze 10 130-hectare pastures from mid-May to October; and researchers measure outcomes on grassland birds, vegetation composition and structure, cattle production, and social learning. Decisions to be determined include pasture sequence (what order a pasture is grazed or rested), when to move cattle between pastures, and vegetation management actions (e.g. prescribed burning). Decisions are based on monitoring data and stakeholders' local knowledge. This project is the core common experiment for the USDA-ARS Central Plains Experimental Range Long-Term Agroecosystem Research (LTAR) network. The first stakeholder group meetings were held in 2012, and the experimental baseline sampling began in 2013. Treatments were initiated in 2014 and have been ongoing, with the intent to continue for at least 5 more years.

Justification for Using Crowdsourcing and Citizen Science: The use of citizen science in this study demonstrates how science can be conducted in a real-world manner. Local ranchers across the region are the ultimate end users of the information to be gained from these studies. Engaging a group of local ranchers in the research and data collection helps ensure that the data and analyses are relevant and applicable to managers throughout the region. By allowing the ranchers to engage in the data collection also effectively expands the study area and the number of samples to be analyzed.

Status: The project started in 2012 and is ongoing.

Location: The study is focused in the rangelands of the western Great Plains of North America.

Participation: The project targeted stakeholders of complex rangeland systems, including ranchers, public land managers, conservation organizations, and nongovernmental organizations. The total number of individuals involved during this period was 225, with 164 field day participants, 11 CARM project participants, and approximately 50 guests from associated organizations. The active CARM project participants included 11 CARM stakeholders, 9 non-ARS scientists, and 4 graduate students. The total number of volunteer hours for FY17 and FY18 was 1,400. Volunteer hours only include the hours of persons not employed by an organization where their time was covered.

Consent: All active participants provided consent.

Submissions: Submissions for the CARM study include observations of cattle behavior, grassland birds, and vegetation. CARM stakeholders planned and excuted the Field Day last fiscal year.

Resources: FY17 and FY18 funding, not including full-time equivalent (FTE) time, totaled $425,000 and $450,000, respectively. Additional funding was provided through USDA-NIFA grants: one grant for

[2] The website for Collaborative Adaptive Rangeland Management (CARM) can be viewed at https://www.ars.usda.gov/plains-area/fort-collins-co/center-for-agricultural-resources-research/rangeland-resources-systems-research/docs/range/adaptive-grazing-management/research/.

$350,000 over three years, and a second grant for $460,101 over four years. In FY17, $117,000 and $115,000 in funding came from the two grants. USDA-ARS base funds support approximately 8 FTEs from ARS, with about 4 FTEs in Scientist Year and technician time and 4 FTEs in summer students. USDA-ARS base funds also are used through Non-Assistance Cooperative Agreements (NACAs) to support graduate students addressing livestock behavior, economics, ecosystem modeling, and livestock diet selection and quality. USDA-ARS base funds have been used for (1) sample analyses (soils, fecal material, and diet quality); (2) monitoring networks of soil, climate and greenhouse gas fluxes; (3) infrastructure maintenance and upgrades (livestock facilities, fencing, roads, vehicles, and communcation networks); (4) data management and storage; and (5) travel to producer and professional meetings. Soft funds from grants via USDA-NIFA were used to enhance sampling of grassland birds (e.g., number, nest success, and habitat) and social sciences (e.g., participatory research emphasis and collaborative learning).

Partnerships: Federal partners included USDA-NRCS and USDA-FS. Non-Federal partners included The Nature Conservancy, Colorado State Extension, Colorado State Land Board, Crow Valley Livestock Cooperative (4 ranchers), Bird Conservancy of the Rockies, and Environmental Defense Fund.

Advancement of Agency Mission: The mission of the USDA-ARS Center for Agricultural Resources Research (CARR) is to develop and transfer science-based management strategies to improve resiliency, reduce risk, and provide ecosystem goods and services from semiarid rangelands. The CARM project contributes to the CARR mission by examining how grazing management can be implemented in a manner that responds to current and changing rangeland conditions, incorporating active learning, and making decisions based on quantitative, repeatable measurements collected at multiple spatial and temporal scales.

Results: The information obtained by the scientist-stakeholder team is used by land managers using monitoring-informed adaptive management to enhance decision-making, improve resiliency, and reduce risk for rangelands in a changing climate.

Data Availability: Near real-time rangeland data can be accessed at https://www.ars.usda.gov/plains-area/fort-collins-co/center-for-agricultural-resources-research/rangeland-resources-systems-research/docs/near-real-time-data/.

D.1.3 FarmLab

Lead Sponsoring Agency: ARS

Authority: 7 U.S.C. 2272 (Volunteers for Department of Agriculture Programs)

Project Summary and Goals: The FarmLab is a new initiative of the U.S. Dairy Forage Research Center, based at the Prairie du Sac research farm. The FarmLab will serve as a farm-scale laboratory for study of the long-term economic, environmental, and social outcomes associated with land use and farming practices. The FarmLab has three priority research areas: (1) soil health; (2) biological diversity; and (3) farm systems research. Efforts will explore the relationships between land cover, land management, soil health (nutrient cycling, carbon sequestration, water infiltration, erosion, soil biota), biodiversity (genetic, species, landscape), and the production of commodities and ecosystem services, examine the social, economic, agronomic, and ecological trade-offs associated with farming practices, and provide decision-making tools and support for producers.

Justification for Using Crowdsourcing and Citizen Science: Several reasons serve as justification for engaging citizens in the data collection, land stewardship, ecological restoration, and outreach programming aspects of the FarmLab project. The long history of public engagement in the reuse of the former Badger Army Ammunition Plant, of which the U.S. Dairy Forage Research Center's Prairie du Sac

research station is a part, provides a foundation for a successful citizen science program. Citizen engagement in matters of agricultural research is especially important for informing the public about the challenges and opportunities agricultural producers face in managing economically and environmentally sustainable agricultural operations. Researchers hear and integrate farmers' concerns and expertise into research design, and farmers hear researchers' expertise and experiences in investigating issues of agricultural sustainability. Engaging agricultural producers in ARS research through farmer-citizen science and outreach events then provides a means of direct communication between researchers and practitioners and builds trust around research design, implementation, and practicality of farm management recommendations.

Status: The project started in 2017 and is ongoing.

Location: The FarmLab is located on former Badger Army Ammunition Plant lands in Wisconsin.

Participation: The project targeted citizens interested in stewardship activities. The total number of individuals involved since 2017 has been 25, and the average number of active participants during 2 consecutive heirloom apple growing seasons has been about five. The FarmLab will begin tracking the total number of volunteer hours in FY19.

Consent: All volunteers have signed a waiver form before contributing volunteer hours.

Submissions: The FarmLab receives four categories of submission data: (1) bluebird monitoring; (2) invasive species management; (3) heirloom apple inventory and stewardship; and (4) farm biomass models.

Resources: There is no dedicated budget for the FarmLab. Funding and in-kind support has been provided by nonprofit partners: two full-time equivalent (FTE) employees supported the effort in FY17 and FY18, with one FTE overseeing the FarmLab project and one FTE conducting the FarmLab research.

Partnerships: A partnership with USDA Natural Resources Conservation Service (NRCS) is in development. Non-Federal partners include Wisconsin Department of Natural Resources, Ho-Chunk Nation, Sauk Prairie Conservation Alliance, Seed Savers, and The Savanna Institute.

Advancement of Agency Mission: FarmLab contributes to the accomplishment of two ARS strategic goals outlined in the ARS Strategic Plan. The first is Goal 4.1, which is to "provide scientific information and biotechnologies to enhance management practices that will ensure an abundant supply of competitively priced animal and aquaculture products: (Animal Production and Aquaculture – NP 101 & 106)". The second is Goal 2.5, which is to "develop and transfer economically viable and environmentally sustainable production and conservation practices, technologies, plant materials and integrated management strategies, based on fundamental knowledge of ecological processes, that conserve and enhance the nation's diverse natural resources found on its range, pasture, hay and turf lands (Rangeland, Pasture, and Forages – NP 215)".

Results: The data will be used to inform farm models, on-farm decision-making, and recommendations about practices that can improve whole-farm, agroecosystem sustainability.

Data Availability: Data will be made available to the public.

D.2 Department of Commerce (DOC)

D.2.1 Cyclone Center[3]

Lead Sponsoring Agency: Citizen Science Alliance

Authority: Weather Service Organic Act, 15 U.S.C. § 313

Project Summary and Goals: Due to the inconsistency of scientific research on tropical cyclones, specifically about the wind speeds of these storms through time, the effects of climate change on the nature and strength of cyclones is not well understood. NOAA has accumulated nearly 300,000 satellite images of tropical cyclones since 1978, and when these images are classified with the "Dvorak technique," critical information about the storms can be extracted. Through the work of volunteers, Cyclone Center will help create a new database of information about cyclones. By answering a few simple questions, volunteers can apply a modified Dvorak technique to interpret satellite images even more effectively than the best computers, ultimately aiding climatologists in the estimation of future storm intensity.

Justification for Using Crowdsourcing and Citizen Science: Citizen Science exists as an efficient and effective means for performing a human analysis of all 300,000 images.

Status: The project started on September 26, 2012 and is ongoing.

Location: The program is managed in North Carolina, but the data analyzed is global in scale.

Participation: The project targeted internet users with an interest in weather or climatology. The total number of individuals involved was 6,700 in FY17 and 7,000 in FY18. The total number of volunteer hours was 1,200 in FY17 and 1,300 in FY18 (assuming 100 image classifications per hour).

Consent: Consent is implicit upon input of data into the web application. The project operates on the condition of anonymity, so no formal consent was sought.

Submissions: Participants view tropical cyclone images and respond to prompts/questions based on the images. They answer approximately 2–5 questions for each image. These responses are used to help determine the strength of the cyclone. The total number of submissions was 120,000 in FY17 and 130,000 in FY18.

Resources: There is no dedicated budget for Cyclone Center. Development was completed five years ago. Initial development of the website was funded and completed by the Citizen Science Alliance with advice from Federal and university partners. Research partners, including university partners and a Federal employee, now work on the project at a very low level of commitment. The project generally receives 0.01 full-time equivalent (FTE) support from a Federal employee and 0.05 FTE support from a non-Federal employee.

Partnerships: Non-Federal partners include the Citizen Science Alliance, the University North Carolina Asheville (UNCA), and the Cooperative Institute for Climate and Satellites - North Carolina (CICS-NC).

Advancement of Agency Mission: Cyclone Center is striving to improve understanding of historical observations of tropical cyclones, which has a direct impact on NOAA's mission to better understand hurricanes, climate, and to some degree, weather.

Results: The most recent efforts have produced a research paper in October 2016, in which results were used to identify the development characteristics of hurricanes/tropical cyclones. Work is ongoing by

[3] The website for the Cyclone Center can be viewed at https://www.cyclonecenter.org/.

university partners to develop more thorough analyses of classifications to determine cyclone intensity estimates.

Data Availability: Data are available to the public upon request.

D.2.2 Meteorological Phenomema Identification Near the Ground[4]

Lead Sponsoring Agency: National Oceanic and Atmospheric Administration (NOAA)

Authority: Weather Service Organic Act, 15 U.S.C. § 313

Project Summary and Goals: Meteorological Phenomena Identification Near the Ground (mPING) is a project to collect weather information from the public through smart phones and mobile devices. The free mPING mobile app was developed through a partnership between the National Severe Storms Laboratory (NSSL), the University of Oklahoma, and the Cooperative Institute for Mesoscale Meteorological Studies. mPING collects observations to aid research into winter precipitation type, frequency, and area, as well as hail occurrence, location, time, and size. Observations are used to develop better forecasts of winter precipitation type and better radar algorithms for discriminating between precipitation types that reach the ground.

Justification for Using Crowdsourcing and Citizen Science: Deploying trained observers in this number and across the continental U.S. is impractical; voluntary observations are the only way to reach necessary coverage.

Status: The project started on December 19, 2012 and is ongoing.

Location: Respondents are global, but research focus is in North America.

Participation: The project targeted anyone with an interest in participating and who owned a mobile device. The app was downloaded approximately 90,000 times, but the application program interface (API) has been included into RadarScope (a private weather provider app) that has an installed user base of over 500,000.

Consent: Consent is implicit upon download of the app or submission of data. The project operated on the condition of anonymity, so no formal consent was sought.

Submissions: Repondents provide precipitation type, flooding severity, wind damage severity, hail size, visibility restrictions, and tornado and waterspout observations. Approximately 1.7 million reports have been received to date.

Resources: All funding is provided via a Director's Discretionary Research Fund. A total of 0.1 FTEs are used each year for app maintenance, database support, and applied research for forecast improvement.

Partnerships: Non-Federal partners include the University of Oklahoma Cooperative Institute for Mesoscale Meteorological Studies.

Advancement of Agency Mission: Better winter precipitation type forecasts from the National Weather Service (NWS) are crucial to maintining infrastructure during winter storms. Knowing precipitation types that are not reported by automated surface observing systems, such as ice pellets, yield important information to NWS forecasters about current conditions. Extended records provide a better climatology of precipitation type and may ultimately help humans better understand and respond to

[4] The website for Meteorological Phenomema Identification Near the Ground can be viewed at https://mping.ou.edu.

climate change. Furthermore, verifying the precipitation type produced by numerical weather prediction models helps refine and improve the performance and utility of those models, the algorithms for remotely sensing precipitation type reaching the surface, and the quantitative precipitation estimation.

Results: All mPING data are received in real time at all NWS weather forecast offices, the Storm Prediction Center, and the Weather Prediction Center. An operational numerical weather prediction model has been directly improved using mPING data and verification. Over 20 formal publications have used mPING data.

Data Availability: Data are available publicly via web display. Upon request, data can be downloaded by users and institutions using a public API key.

D.2.3 Old Weather[5]

Lead Sponsoring Agency: NOAA

Authority: Weather Service Organic Act, 15 U.S.C. § 313

Project Summary and Goals: Nearly everything known about the Global Ocean prior to the satellite era can be linked to a single document type: a ship's logbook. Related primary documents, including muster rolls, field notebooks, photographs, and artwork, often depend on logbooks for context and interpretation. This project focused on historical weather data recovery from the logbooks and muster rolls of U.S. naval vessels (currently 1861-1879 and selected related assets between 1801 and 1940) located at the National Archives. In addition to creating high-resolution digital analogs of unique historical documents of national significance, participants recovered geospatial references, weather and ocean data, and other historical information through Old Weather, our citizen-science program. These data are suitable for computationally intensive retrospective analysis (reanalysis) systems, such as the NOAA/CIRES/DOE 20th Century Reanalysis, and for enhancing the discoverability and application of information from the logbooks. Images and data will be integrated into existing national and international data infrastructure. Large-scale manuscript-to-digital data conversion has great potential to foster new scientific and historical understanding and provide enhanced access to our shared maritime and cultural heritage.

Justification for Using Crowdsourcing and Citizen Science: Manuscripts cannot be read by machine systems at the present time.

Status: The project started in 2010 and is complete.

Location: The data was collected from the Arctic region and the Global Ocean.

Participation: The project targeted interested persons worldwide. The total number of individuals involved was 23,000 over the life of the project. A total of 50 participants are currently working on special tasks off-line.

Consent: Consent is implicit upon download of the app or submission of data. The project operated on the condition of anonymity, so no formal consent was sought.

Submissions: Participants transcribed marine-meteorolgical data and other environmental observations from U.S. Federal ship logs (e.g., Navy, Coast Guard, Coast Survey).

Resources: The various aspects of the project have been funded by a range of competititve grants from public, non-Federal, and foundation sources including the North Pacific Research Board, Alfred P. Sloan

[5] The website for Old Weather can be viewed at www.oldweather.org.

Foundation, National Science Foundation, Department of Energy, Council on Library and Information Resources, Andrew W. Mellon Foundation, and a number of other United Kingdom (UK) and European Union (EU) sources via the UK Met Office. The primary contribution by NOAA has been through occasional support from the Office of Oceanic and Atmospheric Research (OAR) Communications to publicize the project. NOAA/ESRL/PSD has provided support to various researchers to test the resulting weather observations in the NOAA/CIRES/DOE 20th Century Reanalysis Project. An incidental amount of effort was required to put in place a Letter of Agreement between NOAA and the National Archives and Records Administration to facilitate operations at the National Archives (i.e., digital imaging of assets).

Partnerships: Non-Federal partners included the University of Washington's Joint Institue for the Study of the Atmosphere and Ocean (JISAO), the University of Colorado's Cooperative Institute for Research in Environmental Science (CIRES), and the UK Met Office, which funded the Old Weather interface.

Advancement of Agency Mission: Increased understanding of weather in the past is integral for improved modeling and forecasting in the future and the proper diagnosis of extreme events and decadal variability.

Results: Data generated by this project was integrated into the International Comprehensive Ocean Atmosphere Data Set (ICOADS) and the International Surface Pressure Databank (ISPD). The data was then assimilated by high-performance retrospective analysis systems operated by the NOAA Earth System Research Laboratory (e.g., the NOAA/CIRES/DOE 20th Century Reanalysis), by NOAA GlobalTemp and NOAA/NCEI's ERSST, and by the European Center for Medium Range Weather Forecasts (e.g., CERA-20C), among others.

Data Availability: Extracted data are available from ICOADS (Deck 710) and ISPD. Primary source images are integrated into the National Archives digital catalog https://www.archives.gov/research/catalog.

D.2.4 Community Collaborative Rain, Hail and Snow (CoCoRaHS) Network[6]

Lead Sponsoring Agency: NOAA

Authority: Weather Service Organic Act, 15 U.S.C. § 313

Project Summary and Goals: The major goals of CoCoRaHS are to provide high quality precipitation data (at least one gauge every square mile in urban areas and one every 36 square miles in rural areas) and offer educational opportunities focused on climate literacy to project volunteers and the general public. Volunteers register their location on the project website and receiving training online or in-person with a local coordinator. By following a set of simple procedures and using a standardized rain gauge, volunteers measure and report their daily amount of rain (or melted snow) onto the project website, making it readily available in a centralized database. Options to report hail and/or other significant weather are also available, as well as advanced options such as evapotranspiration and drought impact reports.

Justification for Using Crowdsourcing and Citizen Science: The traditional spacing of weather stations in the U.S. has been roughly one every 1,000 to 1,500 square kilometers. With the help of participating volunteers, CoCoRaHS strives to increase spatial resolution to one station per 2–100 square kilometers to allow the true nature of local variability in precipitation to be observed. Automated weather stations, particularily automated rain gauges, have been found to be less accurate than the 4-inch manual guage that is required by CoCoRaHS and approved by the National Weather Service. The atmospheric science

[6] The website for the Community Collaborative Rain, Hail and Snow (CoCoRaHS) network can be viewed at https://www.cocorahs.org/.

community values the CoCoRaHS high-density data source at the same time that the science education community is setting goals for climate literacy.

Status: The project started on June 17, 1998 and is ongoing.

Location: Participants located in the United States (all 50 states, D.C., Puerto Rico, U.S. Virgin Islands), Bahamas, and Canada (all provinces) can participate in CoCoRaHS.

Participation: The project targeted any member of the public with the desire and ability to set up a manual rain gauge and report data by web, smartphone, telephone, or email. The total number of individuals involved was 19,213 in FY17 and 19,765 in FY18. The total number of volunteer hours ranged bewteen 142,904 and 357,261 in FY17 and 140,217 and 350,543 in FY18.

Consent: Consent was received by all participants.

Submissions: The primary data are 24-hour precipitation measurements (rain, hail, and snow), but additional options include real-time hail and intense precipitation reports, evapotranspiration, drought condition monitoring, soil moisture, frost, optics (e.g., rainbows), thunder, and snowflake type.

Resources: There is currently no direct Federal support for CoCoRaHS. Estimates of the funding for the period from June 2017 to May 2018 include four sources: (1) the PRISM Climate Group at Oregon State University ($180,000 subcontract); (2) the National Mesonet Program, via Synoptic Corporation ($60,000); (3) donations from the year-end fundraiser "$5 for CoCoRaHS" ($112,000); and (4) local Colorado data user fees ($26,000). Operational expenses during this period were approximately $415,000, with $354,000 of expenditures and $61,000 of indirect costs. CoCoRaHS is staffed by 2 FTEs, but only a small percentage comes from Federal support.

Partnerships: Federal partners include the National Oceanic and Atmospheric Administration, National Science Foundation, Bureau of Land Management, National Park Service, United States Geological Survey, Department of Agriculture, and United States Army Corps of Engineers. Non-Federal partners include State water agencies, natural resources agencies, universities, local water utilities, regional water utilities, watershed protection groups, Master Gardener, Master Naturalist, K-12 schools, museums, community groups, and other private companies.

Advancement of Agency Mission: CoCoRaHS data is widely used by NOAA entities for a variety of purposes, including rainfall estimation, flood forecasting and warning, and research. The regular, high-resolution collection of precipitation data, and the sharing of that data, advances NOAA's missions to understand and predict changes in climate, weather, oceans, and coasts and to share that knowledge and information with others.

Results: CoCoRaHS precipitation data is used widely by the National Weather Service and other NOAA entities for real-time precipitation monitoring, use in flood warning and prediction, and improvement of operational and experimental quantitative precipitation estimation systems (such as the Multi-Radar Multi-Sensor). The data are also used in national drought monitoring efforts through Federal and State agencies. Several publications have referenced the data from CoCoRaHS.

Data Availability: The data gathered by volunteer observers through the CoCoRaHS network are freely available to governments, academic institutions, and the private sector as well as participants and the general public for the purposes of promoting learning, enhancing scientific knowledge, and protecting life and property. CoCoRaHS data are made available to the public online (www.cocorahs.org). However, NOAA requires all who uses CoCoRaHS data to acknowledge the source when displaying it. Unless otherwise noted, all CoCoRaHS content and data are released under a Creative Commons Attribution 3.0 License. The data are provided "as is, and in no event shall the providers be liable for any damage or loss due to missing data or misinterpretation of its content.

D.2.5 CrowdMag[7]

Lead Sponsoring Agency: NOAA

Authority: Coast and Geodetic Survey Act, 33 U.S.C. § 883a et seq.

Project Summary and Goals: In partnership with the Cooperative Institute for Research in Environmental Sciences (CIRES), NOAA's National Centers for Environmental Information (NCEI) started a crowdsourcing project to collect vector magnetic data from digital magnetometers in smartphones. The aim is to distill meaningful magnetic data from a large number of noisy measurements and use these data to fill gaps in the coverage of global geomagnetic data. Data from a typical phone gives the three components of the local magnetic field with a sensitivity of about 150 to 600 nanotesla (nT), although newer phones are becoming more accurate. Smartphones combine magnetic data and accelerometer data to determine the phone's orientation. CrowdMag uses the phone's internet connection to send magnetic and location data to NCEI. NOAA checks the quality of the magnetic data from all users and makes the data available to the public as aggregate maps. Currently, the CrowdMag project has about 28,000 enthusiastic users who have contributed more than 31 million magnetic data points from around the world.

Justification for Using Crowdsourcing and Citizen Science: Professionally collecting magnetic data at urban and local (<20 km) resolution is prohibitively expensive. Modern smartphones come with digital magnetometer for pedestrian navigation. Citizen-scientists contributing magnetic data from their phones using CrowdMag technology is a cost-effective way to improve NCEI's high-resolution magnetic data coverage.

Status: The project started in January 2015 and is ongoing.

Location: Data is collected on a global scale.

Participation: The project targeted any interested member of the public with a smartphone. The project has had 36,850 application installs (19,150 Android and 17,700 iOS) since inception. A total of 8,342 installs (5,192 Android and 3,150 iOS) occurred in FY17 and 15,171 installs (5,521 Android and 9,650 iOS) occurred in FY18. The average number of active participants at any time was about 7,000.

Consent: Consent to send data to NOAA is received by all participants upon installation of the application.

Submissions: Submission information includes the time stamp, location information (latitude, longitude), location accuracy (in meters), magnetic data (in nano-Tesla), and phone's make (e.g., iPhone 5.2).

Resources: CrowdMag has never received dedicated funding, and the funding has come from small, one-time grants and general funding to the CIRES geomagnetic group. Minimal support from a NOAA software engineer is used to maintain the CrowdMag database hosted at NCEI-CO (0.01 FTE per year). The CrowdMag project uses an NCEI web server and a database system to gather data and host its website, which requires 0.15 FTE of a CIRES Research Scientist and 0.2 FTE of a CIRES professional research associate.

Partnerships: Non-Federal partners include the Cooperative Institute for Research in Environmental Sciences (CIRES) at the University of Colorado.

Advancement of Agency Mission: NCEI is the national archive for geomagnetic data and information with primary roles in geomagnetic research and modeling. NCEI uses magnetic data collected by

[7] The website for the CrowdMag can be viewed at https://www.ngdc.noaa.gov/geomag/crowdmag.shtml.

observatories, satellites, and ship/airborne surveys to develop magnetic models. However, the available measurements leave gaps in coverage, particularly for crustal and man-made magnetic signal sources. CrowdMag aims to fill the gaps in magnetic data coverage by capitalizing on existing technology and citizen science. Improved magnetic data coverage will lead to better magnetic models to aid navigation. This effort will benefit NOAA, the nation, and the international community.

Results: Since its inception in 2015, the CrowdMag app has been downloaded by more than 36,850 iOS and Android users, making it NOAA's most downloaded mobile app. There are currently about 7,000 active CrowdMag users worldwide. Users have contributed more than 30 million magnetic data points to NOAA's CrowdMag database. CrowdMag data coverage within the contiguous United States is sufficient to identify the broad scale magnetic features of the 48 contiguous states. In the Boulder, Colorado region, the significant concentration of CrowdMag participants has enabled NOAA to make magnetic feature maps with about a 100 m grid cell resolution. Globally, NOAA has sufficient CrowdMag users to define a very coarse but global magnetic model which underscores the potential of the application for mapping the Earth's magnetic field. The current CrowdMag user community is mainly based and sustained by word of mouth communication. However, a few presentations at international scientific meetings, a YouTube video release, and various NOAA and CIRES outreach releases have worked to publicize CrowdMag. The CrowdMag project was cited in the 2015 Colorado Governor's award for high-impact research by the NOAA/CIRES geomagnetism group. The current users consist primarily of people who already identify as STEM professionals or hobbiests. The transformation of the user base from experts to general public users will be of broad interest in the citizen science community.

Data Availability: CrowdMag data are saved at NCEI-CO in an internal database. The data are quality-controlled and provided to the public via ESRI web-maps.

D.2.6 Crowdsourced Bathymetry[8]

Lead Sponsoring Agency: NOAA, National Centers for Environmental Information (NCEI)

Authority: Coast and Geodetic Survey Act of 1947

Project Summary and Goals: The key to successful crowdsourced bathymetry (CSB) efforts are volunteer observers who operate vessels-of-opportunity in places where nautical charts are poor or where the seafloor is changeable and hydrographic assets are not easily available. Most ships and boats are already equipped to measure and digitally record depth in coastal waters, and the measurement capabilities of vessels have been increasing. The CSB vision is to tap into the enthusiasm for mapping the ocean floor by enabling trusted mariners to easily contribute data and augment current bathymetric coverage. The success and usefulness of this data is highly dependent on a bathymetry database, hosted by NOAA's National Centers for Environmental Information (NCEI), with a robust infrastructure and user interface to accommodate the safe archive and distribution of the resulting data. Therefore, the main project objective has been for NCEI to provide archiving, discovery, display, and retrieval capabilities of global CSB data contributed from mariners around the world. Currently, the database contains more than 117 million points of depth data, which have been used by hydrographers and cartographers to improve nautical chart products and knowledge of the seafloor. The goal moving forward is to continue to encourage participation from the maritime community and to explore options for scalable storage as the data volumes continue to grow.

[8] The website for the Crowdsourced Bathymetry can be viewed at https://www.iho.int/srv1/index.php?option=com_content&view=article&id=635&Itemid=988&lang=en and https://maps.ngdc.noaa.gov/viewers/iho_dcdb/.

Justification for Using Crowdsourcing and Citizen Science: In 2014, the International Hydrographic Organization (IHO), at its Fifth Extraordinary International Hydrographic Conference, recognized that traditional survey vessels alone could not be relied upon to solve data deficiency issues and agreed on the need to encourage and support all mariners in an effort to "map the gaps". The International Convention for the Safety of Life at Sea (SOLAS) 1974 carriage requirements oblige all commercial vessels to be equipped with certified echo-sounders and satellite-based navigation systems. As a result, the world's commercial fleet represents a significant, untapped source of potential depth measurements. Most non-commercial ships and boats are already equipped to measure and digitally record their depth in coastal waters, the measurement capabilities of vessels have been increasing. One outcome of the Conference was an initiative to support and enable mariners and professionally manned vessels to collect crowdsourced bathymetry (CSB) to be used as a powerful source of information to supplement the more rigorous and scientific bathymetric coverage done by hydrographic offices, industry, and researchers around the world.

Status: The project started in 2016 and is ongoing.

Location: Data for CSB is collected on a global scale.

Participation: The project targeted mariners and vessel operators of ships and boats in navigable waters. The total number of individuals involved was over 100.

Consent: Consent is received by all participants when the data is submitted.

Submissions: Submission include observations of water depth/bathymetry, location, and time. Approximately 2,300 data submissions have been received.

Resources: In FY17 and FY18, NOAA's Office of Coast Survey (OCS) provided funds to NOAA's National Centers for Environmental Information in order to cover salary support for a data manager, software developers, and GIS staff. Both OCS and NCEI provided FTE in-kind support to manage the project. In both FY17 and FY18, around 24 weeks of development work was required to enhance the infrastructure and interface of the CSB data repository to provide archiving, discovery, display, and retrieval of global crowdsourced bathymetry data contributed by mariners around the world. Support also covered partial salary for a data manager and in-kind FTE for database and international working group support. In FY18, a paid internship was used to program a crowdsource module intended to facilitate mariners submitting their data. Total funding was $200,000 in FY17 and $230,000 in FY18.

Partnerships: Federal partners include the National Geospatial-Intelligence Agency. Non-Federal partners include the University of Colorado's Cooperative Institute in Environmental Science and the International Hydrographic Organization.

Advancement of Agency Mission: This project aligns with NOAA's Office of Coast Survey Strategic Plan priority to Innovate Hydrography, which aims to expand access to data from a broad range of data sources, such as Automatic Identification Systems (AIS), satellite-derived bathymetry, and crowdsourcing, to identify chart discrepancies, update charts, inform product development, and revise hydrographic survey priorities. Enhancing NCEI's database to accommodate the stewardship of crowdsourced bathymetry data, including data collected from AIS, will make it much easier for NOAA to attain this goal. The project directly supports the establishment of a global crowdsourced bathymetry database detailed in this OCS strategic priority. This project also aligns with NOAA/DOC priorities and corporate interests to advance data integration and services and improve decisions by transforming data capabilities to support resilient coastal communities and economies for a data-enabled economy.

Results: The crowdsourced bathymetry database now contains more than 117 million points of depth data, which have been used by hydrographers and cartographers to improve nautical chart products and knowledge of the seafloor. NOAA, working with George Mason University, is using the database depths to assess nautical chart adequacy, determine when areas require updated survey information, and identify chart discrepancies before an incident occurs. The Canadian Hydrographic Service has also used this dataset to update several Inside Passage charts along the coastal routes stretching from Seattle, Washington, to Juneau, Alaska.

Data Availability: In FY18, NOAA announced the end of a testing phase for the development of a new crowdsourced bathymetry database. The public can now access the bathymetric observations and measurements from citizen science volunteers and crowdsourcing programs through the International Hydrographic Organization (IHO) Data Centre for Digital Bathymetry (DCDB) Data Viewer (https://maps.ngdc.noaa.gov/viewers/iho_dcdb/). This operationalized database allows free access to millions of ocean depth data points. The database also serves as a powerful source of information to improve navigation products and the general knowledge about seafloors.

D.2.7 Steller Watch[9]

Lead Sponsoring Agency: NOAA Fisheries

Authority: Endangered Species Act

Project Summary and Goals: The Steller sea lion population in Alaska began to decline in the 1970s with the steepest drops observed in the 1980s. Since 2002, eastern populations began to stabilize or recover, but those in the Aleutian Islands have continued to decline. In response, the Marine Mammal Laboratory (MML) in the Alaska Fisheries Science Center (AFSC) of NOAA Fisheries began a long-term life history study. With a mark-recapture method of hot-branding sea lions and observing these sea lions throughout their lifetime, NOAA can understand the movements of the sea lions, estimate the survival and birth rates of this population, and collect information helpful for determining the cause of the continuing population decline. Unfortunately, the Aleutian Islands are extremely remote, and MML only accesses this area once a year at most. Thus, sighting these marked animals proves to be a challenge.

Justification for Using Crowdsourcing and Citizen Science: CCS was considered as an option to help with the burden of analyzing large sets of imagery. Rather than developing machine learning or automated techniques, operating a platform where participants can help review and classify images was found to be more efficient. In addition to the crowdsourcing website, an in-person volunteer program in the Seattle-based office hosts one to four volunteers to review images.

Status: The project started on March 15, 2017 and is ongoing.

Location: The sets of imagery come from the Aleutian Islands, Alaska, USA.

Participation: The project was open to participants across the world. A total of 8,163 volunteers have participated as of August 31, 2018. Anywhere from 500–2,000 classifications are completed by volunteer(s) per day. In the first year, participants saved over 300 hours of processing time.

Consent: N/A

Submissions: Participants can work on either of two workflows. These workflow activities involve looking at images (in random order) and answering one to three multiple choice questions about each image. Each single image completed by one user is called a "classification." Several independent

[9] The website for the Steller Watch can be viewed at https://www.zooniverse.org/projects/sweenkl/steller-watch.

classifications are necessary to retire an image for that workflow. In the first year, participants classified 340,000 images

Resources: This project was developed with NOAA High Performance Computing and Communications (HPCC) grant funding and receives support for the primary FTE employee. Two Federal employees were also involved in the developing and launching phases and provided continued support during FY17. There have been primarily a total of three staff involved. Future investment into the project may be beneficial or necessary to update or upgrade the process (e.g., online viewing tools, data processing). Other FTEs may be brought in to help with streamlining the image upload or data compiling processes. The website is hosted at no cost by Zooniverse.org and is operated and maintained by one FTE.

Partnerships: N/A.

Advancement of Agency Mission: This public crowdsourcing website is helping achieve NOAA's mission to conserve the endangered Steller sea lion population in Alaska. The eastern Steller sea lion population was removed from the threatened species listing in 2013 since the population showed 30 years of recovery, but the western stock continues to decline in the Aleutian Islands (Alaska). This population interacts or has potential to interact with commercially important fish species such as walleye pollock, Atka mackerel, and Pacific cod throughout its range. Steller sea lions are also a very important species to the ecosystem, and declines in this population indicate a greater problem in the ecosystem that could also impact commercially vital species.

Results: The final results from Steller Watch are a product of many classifications. Each image is classified by 7–13 participants. Images that are deemed to have a sea lion present are ran through a secondary workflow where participants classify if there is a marked sea lion present, and if so, if the mark is readable. These classifications are then compiled to find the average answer for each image, and images with readable marked sea lions present will be further analyzed by biologists or in-house volunteers to record sightings. These sightings will be used in a larger dataset to calculate vital rates, or survival and birth rates, of Steller sea lions in the western and central Aleutian Islands, Alaska.

Data Availability: The imagery and classification information collected from participants is public information, but the raw data are not publically accessible. Classifications are not intuitively informative in the raw format. When these classifications are processed by MML, sightings of marked animals from the select images can be recorded. These sightings of marked animals will be included in analysis of survival rates and birth rates of the population and published in a scientific journal or government technical memorandum. Currently, the remote camera images are not publicly available online because there is no mechanism or platform to share terabytes of high-resolution imagery online. A select set of these images can be viewed on the Steller Watch site in random order.

D.2.8 Hawaii Bottomfish Heritage Project: Tracing Traditions and Preserving Culture[10]

Lead Sponsoring Agency: NOAA Fisheries, Pacific Islands Fisheries Science Center

Authority: MSA NS-8; MSRA Section 318, Regional Priorities and Management Needs

Project Summary and Goals: The project explores how the culture, traditions, and fishing techniques for the Hawaii bottomfish fishery have evolved from Native Hawaiian populations to modern times. Documenting the bottomfish "family tree", traditional knowledge, techniques, adaptations, culture, and traditions (e.g., fish sharing), will improve the understanding of changes in the fishery over time. Specifically, the project will allow for consideration of traditional values in management programs,

[10] The website for the Hawaii Bottomfish Heritage Project: Tracing Traditions and Preserving Culture can be viewed at https://www.fisheries.noaa.gov/feature-story/hawaii-bottomfish-heritage-project.

improve interpretation of historical data, and ensure sustainable management for the future. The project showcases cooperative research by having people within the bottomfishing community conduct semi-structured interviews with elder fishermen to ensure that the information gathered supports improved management and passes on to future generations of the community. Local fishery knowledge is an important heritage resource often lost forever when elders in the fishing community pass away. In addition, insights gathered through this research could directly support Pacific Islands Fisheries Science Center (PIFSC) stock assessment efforts, which currently work with historical commercial catch data that is lacking in context with respect to community norms and behaviors that may have influenced fisher behavior, reporting, and targeting over time.

Justification for Using Crowdsourcing and Citizen Science: This social science research project relies on the contributions of Hawai'i bottomfish fishermen and Council members to ensure that the research questions would be relevant to the bottomfishing community. To further ensure participation by pioneers in the fishery and exploration of topics of greatest interest to fishermen and managers, fishermen were the primary points of contact and were trained to conduct the oral history interviews.

Status: The project started in January 2016 and is ongoing. Participants volunteered time to help develop the research proposal, research questions, and project design.

Location: The project is based in Hawai'i, USA.

Participation: The project targets Council members and fishermen who are leaders in the bottomfish community. The total number of individuals involved during this period was five. The total number of volunteer hours was 1,250.

Consent: Formal consent was not required. Participants assisted in enabling the formulation of research questions, proposal writing, creating and refining project design, and collecting and interpreting data.

Submissions: N/A

Resources: There is no dedicated funding or account for this project. Project partners and citizens helped write successful proposals that were funded by the Cooperative Research Grant ($44,000) and Preserve America Grant ($8,000) for participants to oversee project, assist in developing protocols, conduct interviews, travel to islands throughout Hawai'i, prepare and review video archives, transcribe videos, purchase supplies, and develop outreach products. Other Federal funds were used for staff travel to assist in interviews and reporting ($4,000), a contract to produce spotlight videos ($115,000), and a contract for data analysis ($51,000). Project partners donated a total of $40,000 worth of time in 2017 and 2018. Full-time equivalent (FTE) time (0.15 FTE in FY17 and 0.1 FTE in FY18) was used for project coordination, development of protocols, and assistance in interviews ($3,000 for travel). A $61,000 contract was also initiated to develop spotlight videos of individual fishermen, the Maui Bottomfish Cooperative, and fishing in the Northwest Hawaiian Islands. In addition, a $51,000 contract was initiated for a social scientist to conduct qualitative data analysis of interview transcripts beginning in FY19. FY17 funding totaled $116,000, and FY18 funding totaled $106,000.

Partnerships: Non-Federal partners included Western Pacific Regional Fishery Management Council, Pacific Islands Fisheries Group, Maui Bottomfish Cooperative, and University of Hawai'i, Hilo.

Advancement of Agency Mission: Research findings will support NOAA's mission to conserve and manage coastal and marine resources and foster NOAA's vision of healthy ecosystems, communities, and economies that are resilient in the face of change.

Results: A report summarizing efforts to quantify the history of participation and technical change in the fishery will be provided to stock assessment scientists at the PIFSC. Fishery history and traditions as told from the fisherman's perspective will be produced and packaged utilizing multiple media

formats. A web story and blog series has been initiated at https://www.fisheries.noaa.gov/feature-story/hawaii-bottomfish-heritage-project. Audio products developed will include recorded stories and conversations contributed to the National Marine Fisheries Service "Voices from the Fisheries" online portal, and topic-specific segments could be developed and presented on the "Go Fish with Mike Buck" radio show to cover elements such as fishing legends, traditional practices, technology development, and cultural significance. Fishing technology timelines and narratives can be packaged into PIFSC data reports and popular press media for distribution to the fishing community to include Lawai'a Magazine and Hawaii Fishing News. Video segments could also be prepared for "Hawaii Goes Fishing" broadcasts on the Oceanic Cable network. Research brochures and links to research findings will be disseminated through agency websites, including the informational website designed specifically for the Hawaii bottomfish community (http://hawaiibottomfish.info). Outreach products will be made available at future public events such as the Honolulu Ocean Expo. The Council has agreed to formally integrate project outputs in its education and outreach program.

Data Availability: Videos will be available through the "Voices from the Fisheries" website: https://www.st.nmfs.noaa.gov/humandimensions/voices-from-the-fisheries/index

D.2.9 Cooperative Research Provides New Data for ESA-listed Rockfish in Puget Sound, WA[11]

Lead Sponsoring Agency: NOAA Fisheries, Northwest Fisheries Science Center, Conservation Biology Division

Authority: Magnuson Stevens Act Sec 318 (Sec 318, MSA, 16 USC 1867)

Project Summary and Goals: The primary goal of the research program is to collect new data capable of answering questions related to the recovery of Endangered Species Act (ESA)-listed rockfish in the Puget Sound (PS), WA region. Additionally, the program is broadly interested in forming working relationships with user and stakeholder groups (recreational fishing and SCUBA diving communities) within PS in order to develop recovery actions that will lead to the sustainability of these populations. The knowledge and expertise of these groups have allowed NOAA to collect new data on the life-history characteristics, population abundance, fisheries interactions and genetic structure of ESA-listed rockfish in PS. These groups have successfully helped collect specimens and data across four research projects to date. First, genetic samples of ESA-listed rockfish were collected to determine whether each species met the first criterion of the ESA, which has led to the first de-listing of a marine fish species under the ESA. Second, yelloweye rockfish were targeted, collected, and tagged with acoustic transmitters to monitor movement patterns that could provide new information relevant to the identification of critical habitat. Third, citizen scientist SCUBA surveys have begun to collect new data on the spatial and temporal distribution of young-of-year, juvenile, and adult rockfish in nearshore habitat of PS. Fourth, volunteer anglers are participating in a project targeting lingcod (a species with an active fishery that lives in similar habitats as protected rockfish) using different bait types to examine whether bycatch of rockfish can be limited during this fishery while still maintaining adequate opportunities to fish for lingcod. Each project has been successful due to the local ecological knowledge and angling expertise of these groups.

Justification for Using Crowdsourcing and Citizen Science: Professional charter boat captains are used to provide safe, efficient platforms for fishing and collection of biological samples across three of the projects. NOAA does not have the necessary personnel time or angling expertise within the staff at the

[11] Information relevant to the Cooperative Research Provides New Data for ESA-Listed Rockfish in Puget Sound, WA can be viewed at: https://www.westcoast.fisheries.noaa.gov/protected_species/rockfish/rockfish_in_puget_sound.html.

Northwest Fisheries Science Center (NWFSC) to collect the necessary samples, and paying for extra deck hands as professional anglers would be cost-prohibitive. Thus, NOAA has relied on the engaged recreational fishing community to volunteer their time and angling expertise on each of the fishing days. This provides a collaborative framework to work together with the recreational fishing community, learn from each other, and collect the needed samples to answer policy-relevant questions to rockfish management in the Puget Sound region. This collaboration of scientists, captains, and volunteer anglers brings together all the skills necessary to make these studies a success and provides a better understanding to the public about how these new data will be used to inform management decisions. The days on the water build strong relationships between NOAA scientists and managers and the recreational fishing community in Puget Sound. These relationships have subsequently led to the successful drafting of a Rockfish Recovery Plan for the ESA-listed species and have created an environment where the public has brought forward questions they think are relevant to the recovery of these species. NOAA has evaluated those questions and, when warranted, moved forward with subsequent research studies (e.g., rockfish bycatch project). The recovery of ESA-listed rockfish will be a long process due to their life-histories, and having a respectful and trusting relationship between the scientific, management, and stakeholder communities will help NOAA meet interim recovery goals and ultimately recover these populations such that they can be managed under normal fisheries management conditions.

Status: The project started in April 2014 and is ongoing.

Location: The data for the project was collected in Puget Sound, WA.

Participation: The project targets anglers with bottomfishing experience who either know where to catch threatened and endangered rockfish or have expert angling skills. Approximately 150 volunteer anglers have participated in 104 fishing days since 2014. A total of 50 participants were involved during FY17 and FY18, with three to four volunteer anglers participating each fishing day. The total number of volunteer hours since the start of the project was approximately 3,328 hours. The total number of volunteer hours for FY17 and FY18 was approximately 1136 hours.

Consent: Consent was received by all participants.

Submissions: No official submissions were collected; anglers were only asked to catch fish.

Resources: There are no specific funding sources for this program, and all staffing is funded through base personnel funds of the scientist's division. The NWFSC has received funding from two primary sources to carry out this work to date: NOAA's Cooperative Research Program and NOAA's West Coast Regional Office. The genetics study received $125,000 through the NOAA Cooperative Research Program's annual competition for grants in the FY14 funding cycle. This funding paid for contracts to charter boat captains ($83,000), supplies and processing of genetic samples ($35,000), and travel funds for fieldwork and presentation of results ($7,000). The rockfish bycatch study received $50,000 in FY16 through a grant from NOAA's West Coast Regional Office. This funding paid for contracts to charter boat captains ($48,000) and fishing supplies ($2,000); travel to fieldwork sites was funded out of base funds of the Division. The acoustic telemetry study was funded by two grants from NOAA's West Coast Regional Office ($20,000 in FY15 and $8,000 in FY17). FY15 funding paid for the acoustic transmitters and acoustic releases, and FY17 funding paid for the analyses of the collected data.

Partnerships: Federal partners included NOAA Fisheries West Coast Regional Office. Non-Federal partners included Washington Department of Fish & Wildlife, Puget Sound Anglers, Harbor WildWatch, and REEF.

Advancement of Agency Mission: One mission of the NWFSC is to provide reliable science to help decision-makers and managers build sustainable fisheries and recover endangered and threatened

species. At the time of the ESA listings of three rockfish species, there was uncertainty about the distinctness of these populations in Puget Sound relative to the outer coast. Working with knowledgable captains and expert volunteer anglers allowed NOAA to collect enough samples to answer genetic questions related to the population structure of these fish and led to two new final rulings issued by NOAA concerning them. These data filled gaps that were missing during the initial listing process. A second mission of the NWFSC is to enhance public awareness, education, and stewardship of our marine resources. Including public volunteers during data collection has provided an immeasurably valuable platform for two-way education between scientists and the public. For example, one of the most asked questions by volunteers on these fishing trips is "How old is that fish?". Rockfish are generally long-lived, slow-growing, and slow-to-mature. A 45 cm yelloweye rockfish can be anywhere from 10–80 years old and has a 50/50 chance of being mature. When informed of this fact, anglers begin to understand that these rockfish species will have a difficult time recovering and returning to historical levels of abundance if overfished. These "on the water" moments create lasting impacts and teach the importance of responsible stewardship.

Results: The results of the genetics study have been used for two policy decisions. First, the genetics study showed that canary rockfish collected in the Puget Sound region were not genetically different from canary rockfish collected on the outer coast of Washington state. This provided one piece of new information suggesting that canary rockfish did not meet the first criterion of the Endangered Species Act; in order to be considered a "listable unit", a vertebrate population must be markedly different from other populations of the same species. Using this new information and considering other life history characteristics of canary rockfish (e.g., adults have been shown to move 100's of km), NOAA's West Coast Regional Office (WCRO) issued a final rule in 2017 to de-list canary rockfish in Puget Sound from the endangered species list. Second, the genetics study showed that yelloweye rockfish collected in the Puget Sound region were genetically different from yelloweye rockfish collected on the outer coast. This provided new information directly supporting the listing of yelloweye rockfish under the ESA. However, this new research also showed that yelloweye rockfish in Puget Sound were genetically similar to yelloweye rockfish in other inland waterways of British Columbia that were farther north of the original boundary set for the yelloweye rockfish. Thus, NOAA's WCRO issued a final rule in 2017 to expand the geographical boundaries of the yelloweye rockfish distinct population segment to account for these new findings. Data from the movement and bycatch studies are still being analyzed and have not been used in any management decisions to date. Data collection by volunteer SCUBA divers and analyses to combine formal scientific and citizen science SCUBA surveys into models calculating population abundance have just begun and will be used to estimate the status and trends of the population going forward. These efforts will help identify if or when recovery goals have been met for these populations to downlist or delist.

Data Availability: Some of the data from this program is publicly available. The results from the genetics study were published in the journal Conservation Genetics (https://link.springer.com/article/10.1007/s10592-018-1060-0), and the raw genetic data has been published on the website of the National Center for Biotechnology Information (https://www.ncbi.nlm.nih.gov/bioproject/PRJNA451040). Data collection from the rockfish bycatch study is not complete, but the results will also be published in a peer-reviewed journal. Data from the acoustic telemetry project is still being analyzed but will be published and available upon completion. Individual life history data on each collected fish is publicly available upon request in accordance with Public Access to Research Results (PARR). The only piece of information that will not be available is latitude/longitude information for each fish, as publicly providing this information is against Washington state laws.

D.2.10 NWS Cooperative Observer Program[12]

Lead Sponsoring Agency: NOAA National Weather Service (NWS)

Authority: Organic Act of 1890

Project Summary and Goals: The Cooperative Observer Program (COOP) provides two sets of data: (1) weather observational data, usually consisting of daily maximum and minimum temperatures, snowfall, and 24-hour precipitation totals, required to define the climate of the United States and to help measure long-term climate changes; and (2) weather observational data to support forecast, warning, and other public service programs of the NWS.

Justification for Using Crowdsourcing and Citizen Science: Volunteers have been informally used to record climatic data long before the Weather Bureau was created. The program was codified in the Organic Act of 1890 and is still used today. Many of the volunteers enjoy being part of the program and part of the NOAA mission, and some of the volunteers are multi-generational observers.

Status: This Citizen Science project has formally been in existence for over 125 years, with informal participation at some sites of up to 200 years. The project is ongoing.

Location: Over 8,000 sites across the nation provide daily observation data.

Participation: The project targets volunteer observers who are recruited by NWS Weather Forecast Offices to provide daily observations to support hydrological and climatic missions. Over 8,000 participants are part of this program, and daily participation is required of all volunteer observers. The total number of volunteer hours exceeded 8,000 hours and was based on one hour per day for all volunteers.

Consent: Consent was received from all participants.

Submissions: Submissions included weather observations of daily maximum and minimum temperatures and/or daily precipitation amount, as well as snowfall in some locations.

Resources: Funding for support to the program management and equipment maintenance comes from two portfolios in the NWS budget allocation. A multitude of personnel (both full-time and part-time) from across the agency contribute to this program, including programmatic staff, data system administration staff, logistics staff, repair staff at the NWS headquarters, and focal points at regional headquarters. NOAA provided $2.5 million in FY17 and $2 million in FY18, and the U.S. Army Corps of Engineers and Bureau of Reclamation provided $247,000 in assistance to maintain COOP sites of interest.

Partnerships: Federal partners included United States Geological Survey and Bureau of Reclamation (by interagency agreements).

Advancement of Agency Mission: Observing programs, such as COOP, provide observations that feed into the NWS mission of providing weather watch and warning information for protection of life and property.

Results: Aside from use by NWS, the Federal Emergency Management Agency relies on COOP rainfall and snowfall data as the primary source for disaster declaration and relief efforts. The United States Department of Agriculture risk management models get 80% of their data from COOP for agricultural disaster relief and for baselines with the related insurance and reinsurance industries.

[12] The website for the NWS Cooperative Observer Program can be viewed at https://www.weather.gov/coop/.

Data Availability: Data are free and open to the public and made available via National Center for Environmental Information websites.

D.3 Department of Energy (DOE)

D.3.1 The Open PV Project[13]

Lead Sponsoring Agency: Office of Energy Efficiency and Renewable Energy (EERE)

Authority: Unknown

Project Summary and Goals: The Open PV Project is a collaborative effort between government, industry, and the public that continues to compile a database of available public data for photovoltaic (PV) installation data for the United States. Data for the project are voluntarily contributed from a variety of sources, including solar incentive programs, utilities, installers, and the general public. This database serves as a web-based resource for users to easily explore and understand the current and past trends of the U.S. PV industry. The data collected are actively maintained by the contributors and are always changing to provide an evolving, up-to-date snapshot of the U.S. solar power market.

Justification for Using Crowdsourcing and Citizen Science: Due to the increased rate in PV installations in the United States, the best way to collect updated information on installations is to retrieve installation data from the installers and provide a platform for the public to upload their own PV installation information. However, the fast-paced market necessitates a means for the public to add newly installed systems or systems not captured in other data-collection methods.

Status: The project started in 1998, and is ongoing.

Location: The database comprises information contributed by users across the U.S.

Participation: The project targeted solar-sector stakeholders, including industry, nonprofits, installers, policymakers, and the general public. Twenty-nine individuals provided submissions in FY17, and nine individuals provided submissions in FY18. The National Renewable Energy Laboratory (NREL) staff uploads most data that originates from multiple different sources as part of the Tracking the Sun report. Participation above is for active participants during this time period. Typically, some solar installers are active. The Open PV Project is collecting data from any willing contributor of available information. The core dataset is provided by Lawrence Berkeley National Laboratory (LBNL), which annually produces the Tracking the Sun report, now in its ninth year. LBNL collects data from most state run incentive programs, large utilities, and other organizations. Data are also provided directly by the PV community, including installers, businesses, and consumers. The installations represented in the LBNL dataset comprise about 78% of the more than 1 million installations in the Open PV database, with the rest coming from the community. It is our hope that the database will continue to grow through contributions from the PV community.

Consent: N/A

Submissions: Members of the public are asked to input information about their solar installations on a volunteer basis. In total, there are 1,020,717 installation records that were either uploaded by the public or NREL staff in coordination with installer or research entities.

Budget and Resources: There is no dedicated budget for the continued maintenance of the Open PV Project. Funding for general maintenance tends to come from solar projects within the NREL. The NREL

[13] The website for the The Open PV Project can be viewed at https://openpv.nrel.gov/.

has received maintenance funds for the last several years and anticipates minimal funding for the next few years. Funding for FY17 and FY18 totaled $4,500 each fiscal year and was used for server maintenance, data cleaning, data uploads, user requests and answering user questions. In addition, 0.01 FTE employees were used each year.

Partnerships: Non-Federal partners included community groups, for-profit entities, and State or local governments.

Advancement of Agency Mission: The Open PV Project is working to advance the agency's mission—to ensure America's security and prosperity by addressing energy, environmental, and nuclear challeneges through transformative science and technology solutions—by engaging the public to share information about their PV installations and providing a platform for other members of the public to see general trends in PV installation data addressing American energy challenges. LBNL also makes data from the annual Tracking the Sun report available for download by the public.

Results: Data provided to the Open PV Project is available for download by the public, including data uploaded to the database and from the LBNL Tracking the Sun public data file. The most common request for data is for research and analysis of small-scale PV installation trends. Note that most of the data is not crowdsourcing and citizen science results, but those results are integrated into the larger dataset.

Data Availability: Data is made available to the public through the download portal: https://openpv.nrel.gov/search.

D.4 Department of Health and Human Services (HHS)

D.4.1 Crowdsourcing Optimal Cancer Treatment Strategies that Maximize Efficacy and Minimize Toxicity[14]

Lead Sponsoring Agency: NIH, National Cancer Institute (NCI)

Authority: NIH UH2 Exploratory/Developmental Cooperative Agreement

Project Summary and Goals: The Treatment Simulator game enables volunteers to manipulate dosing and treatment scheduling to find optimum cancer treatments that result in slowing or stopping tumor growth. These data are sent directly back to the Moffitt Cancer Center where it is used to improve algorithms that predict better treatment strategies. Additional outcomes include increased user education about cancer and cancer treatment and a pending collaboration on deep learning with the Lawrence Livermore National Laboratory.

Justification for Using Crowdsourcing and Citizen Science: This form of gamified distributed computing is the most effective way to get the input necessary to better predict treatment schedules. Doing so in a more traditional fashion is time consuming and limiting. The game is open to anyone with a smartphone who wishes to play, and volunteers do not need to have any particular expertise to participate.

Status: The project was awarded on April 1, 2017 and the public game launch took place on March 24, 2017.

Location: The project took place on a virtual mobile app.

[14] The website for the Crowdsourcing Optimal Cancer Treatment Strategies that Maximize Efficacy and Minimize Toxicity can be viewed at http://cancercrusadegame.com/.

Participation: The project engaged anyone with a smartphone. The app was available for both Android and Apple devices and received over 350 downloads.

Consent: Players give their consent to participate by downloading the game.

Submissions: All participation is voluntary.

Resources: Total funding from NCI in FY17 to support this activity was $268,901.

Partnerships: N/A

Advancement of Agency Mission: NIH's mission is to seek fundamental knowledge about the nature and behavior of living systems and the application of that knowledge to enhance health, lengthen life, and reduce illness and disability. A piece of this mission centers on the advancement of scientific knowledge through innovation, something this project highlights through its creative use of crowdsourced creativity.

Results: The results of this project will be used by the researchers to further scientific knowledge and advancement.

Data Availability: N/A

D.4.2 Applying Protein Databases to Crowdsourcing Structural Protein Design[15]

Lead Sponsoring Agency: NIH, National Cancer Institute (NCI)

Authority: NIH UH2 Exploratory/Developmental Cooperative Agreement

Project Summary and Goals: This project aims to significantly adapt the existing proteomics video game Foldit to incorporate big data from protein databases into computational structural protein design. This data will be used to inform the manipulation of structural components of proteins. Foldit, a scientific discovery game featuring an interactive protein manipulation interface, allows the public to contribute directly to scientific research involving the study of proteins. Previous work with Foldit has shown that with an appropriate interface and introduction, even amateur players with no formal background in biochemistry can make contributions to our knowledge of proteomics. Additionally, preliminary protein design work has shown that players can contribute to the successful redesign of existing protein enzymes. The investigators aim to build upon the existing successes of Foldit in crowdsourcing protein design by leveraging the massive amount of data on protein structures that exists in protein databases like the RCSB Protein Data Bank. By integrating this data into the mechanics of the Foldit game, researchers are hoping to both improve the tools available to the players and allow them to construct more realistic protein-like structures.

Justification for Using Crowdsourcing and Citizen Science: The amount of work could not have been accomplished using traditional methods. By opening up the puzzle solving game to anyone who wishes to play, the project expanded the possibilities for creating novel and creative solutions in protein folding not possible through traditional means, such as utilizing a small group of lab assistants, or running computer simulations, but instead by leveraging the creative intuition and visual processing skills of the human brain across a vast group of online volunteers.

Status: The project started on May 1st, 2017, and is ongoing.

Location: The project takes place online, virtually.

[15] The website for Applying Protein Databases to Crowdsourcing Structural Protein Design can be viewed at https://fold.it/portal/.

Participation: The project engaged anyone with a computer and internet access. The total number of individuals involved during this period was over 700,000 players.

Consent: By using the website and downloading the game, players give their consent to participate.

Submissions: Players are asked only to fold digital models of protein structures, whenever and however each player chooses. There is no set minimum, all participation is voluntary.

Resources: NCI FY17 total cost funding for this project was $293,970. The project is overseen by one FTE NCI program officer, with 10 other program officers from across the NIH acting as secondaries.

Partnerships: N/A

Advancement of Agency Mission: NIH's mission is to seek fundamental knowledge about the nature and behavior of living systems and the application of that knowledge to enhance health, lengthen life, and reduce illness and disability. A piece of this mission centers on the advancement of scientific knowledge through innovation, something this project highlights through its creative use of crowdsourced creativity.

Results: The results of this project will be used by the researchers to further scientific knowledge and advancement.

Data Availability: N/A

D.4.3 OMics Compendia Commons[16]

Lead Sponsoring Agency: NIH, National Institute of Allergy and Infectious Diseases (NIAID)

Authority: Public Health Services Act

Project Summary and Goals: OMiCC is a community-based, biologist-friendly web platform for analyzing annotated gene-expression data sets across multiple studies (meta-analysis) and technology platforms. The OMiCC platform can access more than 24,000 human and mouse studies from the Gene Expression Omnibus (GEO), a database repository that houses data from high-throughput functional genomic studies. An important feature of OMiCC is that it allows users to contribute to the community by sharing meta-data essential for data collation, reuse, and (meta-) analysis across studies. Thus, users of OMiCC can reuse sample groupings and pairings created by other users to construct cross-study data sets. NIH envisions that as more users take advantage of OMiCC to perform biological hypothesis generation and discovery, more users will create and share such meta-data as well as data compendia and analyses with the biomedical research community.

Justification for Using Crowdsourcing and Citizen Science: The cowdsourced nature amplifies the power of the OMiCC platform. As more users use the OMiCC resource and annotate data sets, these data can be effectively transformed into biological insights.

Status: The project started 2016 and is ongoing. The NIH OMiCC Jamboree was held in April 2016, and the OMiCC online resource was published in August 2016.

Location: The NIH Jamboree was held in the Washington, D.C. metro area. The online database comprises information contributed by users worldwide.

Participation: Twenty-nine individuals from the Washington, D.C. metro area participated in the NIH Jamboree, and consisted of faculty, fellows, and students. Participants attended a half-day group training session on using the OMiCC platform followed by a day-long jamboree, where volunteers

[16] The website for the OMics Compendia Commons can be viewed at https://omicc.niaid.nih.gov/.

provided a total of 349 hours of time. The targeted participants for the OMiCC website include biologists and interested citizens around the world. There are currently 421 registered users of the OMiCC website.

Consent: None of the participants were required to complete informed consent.

Submissions: Participants annotate samples in published gene expression studies (e.g. cell types) and create comparison groups between case and control samples. Further analyses can be performed using the comparison groups, either by users or the public, and results can be shared via the OMiCC platform.

Budget and Resources: In FY17, an estimated $16,800 of funds and 0.1 FTEs were used to develop new features, import data, test, and promote the OMiCC platform. In FY18, an estimated $48,000 of funds and 0.24 FTEs were used develop new features, import data, test, and promote the OMiCC platform, as well as develop a manuscript describing recent updates and new features. Other resources contributed over FY17 and FY18 included website hosting and maintenance, provided by the Office of Cyber Infrastructure and Computational Biology, NIAID/NIH.

Partnerships: N/A

Advancement of Agency Mission: This activity addresses facets of the NIH mission, including the application of fundamental knowledge of the behavior of living systems to enhance health and reduce illness. NIH envisions that as more users take advantage of OMiCC to drive biological hypothesis generation and discovery, the more they can increase the ability to obtain new and robust biological insights not discernable from the analysis of any one study. These meta-analyses can also inform the design of new experiments. Previous studies have successfully combined publicly available data from published studies to both reposition drugs and identify robust gene-expression signatures of transplant rejection, infection status, tumor subtypes, and cancer progression. Thus, OMiCC has the potential to grow organically into an increasingly rich resource to help add cross-study, meta-analysis approaches to a biologist's toolbox and thus enable more effective transformation of the increasing amounts of public data into biological insights.

Results: Using the OMiCC platform, researchers tested the idea of using crowdsourcing for exploratory data analysis of public data sets by organizing a jamboree which was advertised to the NIH immunology community. The group focused on using OMiCC to search for and identify/annotate data from five autoimmune diseases and corresponding mouse models of these diseases. The volunteers used meta-analysis to combine data from multiple studies within OMiCC to derive (1) robust gene expression signatures for each disease (disease versus healthy control comparisons) and (2) conserved gene expression signatures across all diseases within each species (pan-disease signatures). The volunteers also examined signature conservation between human and mouse. The jamboree experiment suggests that there are potentially interesting and robust signals to be mined. Given a programming-free, didactic, community-based platform such as OMiCC, together with some upfront training on the platform, biologists with any level of bio- informatics experience can benefit from and contribute to utilizing public data for hypothesis exploration that can be translated into powerful insights about disease and biological processes.

Data Availability: The OMiCC platform and data are freely available to the public at https://omicc.niaid.nih.gov/. Initial results of analyses using the OMiCC platform have been published in a peer-reviewed journal, accessible at https://f1000research.com/articles/5-2884/v1. Articles about OMiCC and a perspective on crowd-sourced data reuse can be found at https://www.nature.com/articles/nbt.3603, and https://www.cell.com/immunity/fulltext/S1074-7613(16)30491-5.

D.4.4 NIDCR 2030: Envisioning the Future, Together[17]

Lead Sponsoring Agency: NIH, National Institute of Dental and Craniofacial Research (NIDCR)

Authority: NIDCR strategic planning

Project Summary and Goals: NIDCR 2030 is a strategic visioning initiative designed to advance dental, oral, and craniofacial research over the next 10-15 years. In 2030, NIH imagines a world where dental, oral, and craniofacial health and disease are understood in the context of the whole body, and research transforms how the United States promotes health, treats disease, and overcomes health disparities, so all people have the opportunity to lead healthy lives. To achieve this, better engage the public, and expand stakeholder outreach, NIDCR obtained and continues to seek input from researchers, faculty, students, healthcare providers, professional and nonprofit organizations, industry representatives, government officials, patients, and other community members. Hundreds of research ideas and comments have been received in the following five goal areas: Oral Health + Overall Health; Precision Health; Autotherapies; Oral Biodevices; and Workforce Diversity. In response to ideas submitted to NIDCR 2030, the Institute has started to identify topical themes for development into symposia, workshops, and research initiatives.

Justification for Using Crowdsourcing and Citizen Science: NIDCR recognizes the unique benefits of crowdsourcing and citizen science, including accelerating scientific research and data acquisition, improving science literacy, and connecting citizens to the mission of NIDCR. Crowdsourcing and citizen science helps advance the Institute's mission and stimulate and facilitate broader public participation in the innovation process, while protecting human subjects and other ethical considerations.

Status: The project started on March 22, 2017, and is ongoing.

Location: The project sources ideas from across the United States.

Participation: The project targets academia and researchers, patients and community members, government representatives, dental care providers, other healthcare providers, professional and nonprofit organizations, and industry. The total number of individuals involved is over 800 and continues to increase. The average number of active participants since the launch date is about 425.

Consent: Approximately 800 participants consented to register and participate in online IdeaScale community via NIDCR's Terms and Conditions of Use.

Submissions: NIDCR requested ideas, comments, and votes on what it will take to reach specific NIDCR research and training goals. A total of over 300 ideas, 300 comments, and 1,300 votes have been received to date.

Budget and Resources: Budget and resources used to support the NIDCR 2030 crowdsourcing project came from NIDCR's Office of the Director. In FY17, $30,000 in funding and 1.5 FTEs were dedicated to execute the project. Funding was used to license the IdeaScale crowdsourcing software and create communication materials (website, fact sheets, etc.) to promote the project and engage with stakeholders. FTE time was used to develop, launch, and implement the NIDCR 2030 crowdsourcing initiative, create communication strategies, and directly engage with the community. In FY18, approxiamately $50,000 in funding, and 0.5 FTEs were dedicated to continuing the project. Funding was used to cover the IdeaScale license fee and renew NIDCR's subscription to the platform. FTE time was dedicated to continuing the implementation of the NIDCR 2030 strategic planning initiative. This included analyzing the results from the community engagement and updating the community, as well

[17] The website for NIDCR 2030: Envisioning the Future, Together can be viewed at https://nidcr2030.ideascale.com/.

as identifying new research and training priorities. In FY17 and FY18, a public health analyst was hired as a contractor to support NIDCR 2030 communications and IdeaScale community website setup and moderation.

Partnerships: N/A

Advancement of Agency Mission: The mission of NIDCR is to improve dental, oral, and craniofacial health through the support of research, training, and dissemination of information. NIDCR 2030 is a strategic visioning initiative designed to advance dental, oral, and craniofacial research over the next 10-15 years. In response to ideas submitted to NIDCR 2030, the Institute is identifying topical themes for development into symposia and workshops, research initiatives, and communications of our ongoing research. Proposed research initiatives are posted to IdeaScale for public comment, along with announcements of upcoming symposia and workshops, as a part of stakeholder engagement.

Results: NIDCR's crowdsourcing outreach efforts have been tremendously successful and resulted in the following accomplishments. (1) Engagement with a large diverse group of stakeholders. Notably, many of these stakeholders represent communities that have been challenging to reach, including dental practitioners and patients. (2) Increased visibility of NIDCR research and training investments across the Federal Government and with policy makers, patients, and the general public. (3) Development of several new government and industry interactions with potential for public-public and public-private partnerships. (4) A focused symposium and workshop on autotherapies, an exciting emerging research area that was highlighted in NIDCR 2030. (5) New initiatives to increase oral health workforce diversity in extramural and intramural research communities. (6) Additional research inactives on a variety of topics that came from NIDCR 2030 stakeholder input, including oral biodevices and digital dentistry. and (7) Gathering of critical community ideas to help develop the next NIDCR strategic plan.

Data Availability: All research ideas and comments are publicly available on the NIDCR 2030 website, which is available to the public at https://nidcr2030.ideascale.com/a/index. Future workshops, research initiatives, and other updates are also available at https://nidcr2030.ideascale.com/a/pages/updates.

D.4.5 Community Mapping Project: Engaging Students in Citizen Science for Safe Routes to School

Lead Sponsoring Agency: NIH, National Library of Medicine (NLM)

Authority: NLM operating budget

Project Summary and Goals: The overall goal of this project is to engage high school students in a coordinated effort to promote public health, walking to school, and identifying local walking conditions using community based participatory mapping. Twenty high school students were educated on the importance of safe walking routes and its impact on physical activities and health via community based participatory mapping. After instruction on the use of Mappler, students took a pre-test survey and were separated into groups of five. They were given a map of the area they were responsible for gathering data on sidewalk conditions. During the community mapping process, the student health ambassador (SHA) and students from Meharry Medical College communicated with high school students about community health issues. Students surveyed and uploaded information using photos about the conditions of street safety. Data were uploaded into an interactive online mapping tool where anyone can view and analyze the information collected. After recording their data, the groups came back for debriefing and a post-test survey. During the debriefing, students were asked what they learned from

the community mapping project and if they had a better understanding or appreciation for public health. Students received four hours of community service for their work.

Justification for Using Crowdsourcing and Citizen Science: By using crowdsourcing and citizen science methods, the project leads were able to engage students in a citizen science project that helped to gain insight into a public health issue in their community. Students were able to investigate the issue and produce maps on safe routes to school and libraries that were shared locally and nationally with the public.

Status: The project started on September 20, 2017, and is ongoing.

Location: The project is located in Nashville, TN.

Participation: The project engaged students from Gallatin High School and Stanton Camp High School, faculty in the Health Disparities Research Center of Excellence at Meharry in collaboration with the National Community Mapping Institute, and students enrolled in health professions. The total number of individuals involved during this period was 20 high school students. The total number of volunteer hours was 200.

Consent: All permissions were given by participants of the project.

Submissions: Students were taught how to use GIS and Mappler mobile app to collect data. They tracked and mapped safe routes to school and neighborhood libraries.

Resources: There is no dedicated CCS resources in the NLM Specialized Information Services budgeted. In FY17, 0.01 FTEs and $7,500 in funding were used to support after hour school activities, to obtain supplies for the project, and to support the subcontractor's overhead costs.

Partnerships: Non-Federal partners included Meharry Medical College.

Advancement of Agency Mission: Goal 3 of the NLM strategic plan is to build a data ready workforce for the future. The project introduced students to the principles of data science, the power of visualization data and the use of data for discovering safety hazards in their community.

Results: This project results will be shared with the national Safe Routes to School Program focused on making walking and bicycling to school fun, accessible, and safe.

Data Availability: Data are available at http://www.immappler.com/srtsnashville/.

D.4.6 NNLM Wikipedia Edit-a-thon[18]

Lead Sponsoring Agency: NIH, National Library of Medicine (NLM)

Authority: Unknown

Project Summary and Goals: The National Network Libraries of Medicine (NNLM) held its first online Wikipedia edit-a-thon on April 17, 2018 to improve consumer health information on Wikipedia. By adding or updating citations using NLM resources, the eight health science libraries that function as Regional Medical Libraries (RML) under NNLM, provided one more way to reach more people through enhanced dissemination and engagement. After months of planning and collocating with the Wikipedia's Medical Wikimedia Community, NNLM offered pre-training to inform interested participants of what to learn and how to prepare for the event. A project page provided links to training, citation editing and rare disease resources. On the day of the edit-a-thon, librarians visited an online dashboard and saw in real time the edit-a-thon, chat with peers, and more. The edit-a-thon promoted

[18] The website for the NNLM Wikipedia Edit-a-thon can be viewed at https://nnlm.gov/wiki.

NLM's trusted health information and tools such as Genetics Home Reference, MedlinePlus, PubMed, and NIH's Genetic and Rare Diseases Information Center. Another edit-a-thon took place November 7, 2018.

Justification for Using Crowdsourcing and Citizen Science: When medical librarians from joined forces through NNLM for the all-day Wikipedia edit-a-thon, this increased access to credible, evidence-based information on rare diseases for people around the world.

Status: The project started in January 2018, and held its first event on April 7, 2018. The project is still ongoing and additional events are being scheduled.

Location: The event took place nationwide.

Participation: The project targeted NNLM staff and members. Over 50 individuals were involved during the first event, and the total number of volunteer hours is 12.

Consent: N/A

Submissions: N/A

Budget and Resources: In FY18, two FTEs were used for event planning and organizing.

Partnerships: Non-Federal partners included the Wikipedia Medical Wikimedia Community.

Advancement of Agency Mission: A major strategic goal of NLM is to "reach more people in more ways through enhanced dissemination and engagement pathways." This project is aimed to improve the use of NLM resources, engage NNLM members, utilize librarian research skills, and make Wikipedia a better, evidence-based resource. Updating and adding credible, evidence-based information on rare diseases to Wikipedia is just one way that NNLM is actively engaged in providing equal access to biomedical information and improving individual's access to information to enable them to make informed decisions about their health.NNLM offers funding, training, community outreach, partnerships to increase health awareness and access to NLM resources.

Results: The April Edit-a-thon resulted in 111 articles edited, including 736 total edits, 43,500 words added, and 838,000 article views, increasing access to credible, evidence-based information on rare diseases. Because of our promotion, an education session was held on using Wikipedia to keep up reference skills and learn about NLM databases.

Data Availability: Data is available on the NNLM Wikipedia Edit-a-thon project page. As the project moves to futures events, NLM will continue to track and show how NNLM can help improve access to consumer health information on Wikipedia.

D.5 Department of Interior (DOI)

D.5.1 Battle of the Atlantic Expedition[19]

Lead Sponsoring Agency: Bureau of Ocean Energy Management (BOEM)

Authority: National Historic Preservation Act (NEPA)

Project Summary and Goals: BOEM and NOAA's Monitor National Marine Sanctuary have committed to a multi-year project to document the Battle of the Atlantic by conducting archaeological investigations

[19] The website for the Battle of the Atlantic Expedition can be viewed at https://marinecadastre.gov/espis/#/search/study/100056.

of both Axis and Allied losses during World War II offshore North Carolina. An Interagency Agreement was developed in 2010 to provide support over a five-year period toward documenting these casualties.

As the longest military campaign of World War II, the Battle of the Atlantic was waged from the waters off England to the east coast of the United States and into the Gulf of Mexico. From its beginnings in 1939 through the end of the war with Germany, hundreds of vessels were lost and are now located on the seafloor as archaeological resources. Given the violent nature of these vessel losses, many are also war graves. The area offshore North Carolina was the closest theater of war to the continental United States. This expedition has identified and investigated Axis and Allied losses in the Graveyard of the Atlantic. The objectives of this project are to collect detailed documentation of these vessels and to develop a complete inventory of WWII losses in the region.

Justification for Using Crowdsourcing and Citizen Science: Crowdsourcing and citizen science techniques were selected to achieve project goals because it allowed BOEM to leverage pre-existing citizen efforts better than other available mechanisms. Specifically, recreational SCUBA diving groups had already formed with an express interest in mapping and documenting WWII Battle of the Atlantic shipwrecks. BOEM and NOAA were able to partner with these citizen scientists to gain the benefit of their expertise and enthusiasm.

Status: The project started in July 2008, and is ongoing.

Location: The project takes place in waters offshore North Carolina

Participation: The project targets recreational technical SCUBA divers with an interest and skill set in shipwreck diving. Over 20 individuals have participated in the project since its inception with an average of 15 active participants per year. Over 1,000 volunteer hours have been contributed.

Consent: All participants provided consent.

Submissions: Submissions by citizen scientists included observations, data, video, still photography, historical research, and drawings.

Resources: FTE resources included scientific support, SCUBA diving support, and financial/contract management. Funding was paid via an Interagency Agreement for resources including equipment, supplies, and services necessary for SCUBA diving fieldwork offshore; specialized software; and consumables necessary to draft maps of the shipwreck sites. In FY17, the funding was $100,000 with approximately 0.2 FTEs. The funding and FTEs were the same in FY18. IT resources, pre-existing agency SCUBA diving supplies and specialized training costs, and access to specialized subject matter references (e.g., scientific literature) were used to support the project.

Partnerships: Federal partners included the National Oceanic & Atmospheric Administration (NOAA). Non-Federal partners included the Battle of the Atlantic Research & Expedition Group (BAREG).

Advancement of Agency Mission: An inventory and evaluation of World War II vessel losses offshore North Carolina is needed to inform BOEM's consideration of historic properties under the National Historic Preservation Act (NEPA). This information is timely and relevant as BOEM is currently considering renewable energy activities in this area.

Results: These results are being used to produce an inventory and evaluation of World War II vessel losses offshore North Carolina needed by BOEM to inform its consideration of historic properties under the National Historic Preservation Act. This information is being used by BOEM to manage the development of offshore energy and marine minerals activities in these areas offshore.

Data Availability: Data will be made publically available via BOEM and NOAA's websites, which are accessible at https://marinecadastre.gov/espis/#/search/study/100056 and https://oceanexplorer.noaa.gov/explorations/16battlefield/.

D.5.2 Aquatic Insect Monitoring in Grand Canyon[20]

Lead Sponsoring Agency: Bureau of Reclamation (USBR), Glen Canyon Dam Adaptive Management Program

Authority: Organic Act of 1879, The Grand Canyon Protection Act of 1992 (Public Law 102-575)

Project Summary and Goals: The goal of this project is monitoring the Colorado River ecosystem and its response to flow management from dams, particularly Glen Canyon Dam. Aquatic insects are the cornerstone of food webs in and around rivers. Quantifying the abundance and diversity of aquatic insects over time and space is important to understanding the health of river ecosystems and how rivers are affected by dam management policies. This dataset is based on simple light traps set at the river's edge every evening by river rafters. Currently, the dataset contains over 10,000 samples of adult aquatic insects and several million individual insects. This citizen science effort allows us to ask and answer questions about the Colorado River that are truly unprecedented in scale, such as how hydropower releases from Glen Canyon Dam affect aquatic insect populations and the health of river food webs, how the phenology (seasonal timing) of aquatic insects varies by species and with distance downstream from the Dam, and how aquatic insect populations vary from year-to-year throughout the entire Grand Canyon.

Justification for Using Crowdsourcing and Citizen Science: Citizen Science has been essential and critical to the success of this project. Sampling aquatic insects on a large scale over long periods of time is impossible for typical research groups of only a few people. However, sampling aquatic insects on a large scale, over long periods of time, can be achieved by working cooperatively with people who are on the river every day, like professional river guides and private boaters. Because of this citizen science collaboration, USGS researchers have been able to collect samples of aquatic insects across the entire Colorado River Basin throughout the entire year.

Status: The project started in April 2012, and is ongoing.

Location: This project takes place in the Colorado River Basin in Arizona, Utah, Colorado, Wyoming, and New Mexico.

Participation: The project targets anyone river rafting on the Colorado River. Over 250 people have participated in the project since it was started in 2012, and the average number of active participants per day is around 5 people collecting light trap samples. The number of volunteer hours is around 10,000. Although some participants are truly unpaid volunteers, USGS does offer a modest stipend for each sample provided and most participants chose to accept the stipend.

Consent: All participants provided formal consent. USGS advertised the opportunity through rafting publications and public lectures and then participants contact the agency if they were interested in helping.

Submissions: Light trap samples of emergent aquatic insects are the primary submission of participants. Participants are provided with a simple light trap that they deploy each night during their rafting trip.

[20] The website for the Aquatic Insect Monitoring in Grand Canyon can be viewed at https://www.usgs.gov/centers/sbsc/science/citizen-science-light-trapping-grand-canyon?qt-science_center_objects=0#qt-science_center_objects.

After one hour, the light trap is turned off, the sample is put in an individual bottle, and at the conclusion of the river trip bottles are returned to the USGS Grand Canyon Monitoring and Research Center for laboratory processing. Since 2012, over 10,000 light trap samples have been collected by citizen scientists.

Resources: Funding for this project in FY17 was provided by the Bureau of Reclamation's Glen Canyon Dam Adaptive Management Program ($200,000) and the Department of Energy's Western Area Power Administration ($50,000). In FY18, funding was provided by the Bureau of Reclamation ($200,000) and the U.S. Fish and Wildlife Service ($75,000, via a FWS and USGS Strategic Science Partnership Award). For both years, around $15,000 was given to citizen science participants as a stipend for collecting samples while the remainder of project funding went towards covering salaries of approximately 3 FTEs each year. FTEs coordinated collection of samples, performed laboratory processing of samples, and conducted the analysis, interpretation, and writing up the data.

Partnerships: Federal partners include the U.S. Geological Survey scientists funded by USBR and the Department of Energy - Western Area Power Administration, which provided funding in FY17 for work in the Upper Colorado Basin in Utah, Colorado, and Wyoming. In FY18, the Fish and Wildlife Service provided funding for work in the Upper Colorado Basin through a Strategic Science Partnership award. The National Park Service is also a partner on this project because the work occurs in National Park Service units including Dinosaur National Monument, Canyonlands National Park, Glen National Recreation Area, and Grand Canyon National Park. Non-Federal partners included Grand Canyon River Guides, which helped facilitate this project by connecting USGS scientists with citizen scientist river guides.

Advancement of Agency Mission: The mission of the USGS Grand Canyon Monitoring and Research Center is providing science in support of adaptive management experimentation at Glen Canyon Dam. This project has fundamentally advanced this mission by identifying links between flow management policies and the health of river food webs, including native endangered fish and highly valued sport fish like rainbow trout.

Results: This project led to a change in flow management policies at Glen Canyon Dam starting in 2018. Specifically, during times when hydropower demands were lowest, flow releases were adjusted to try to enhance aquatic insect abundance and diversity. These Bug Flows were tested at Glen Canyon Dam from May to August 2018 and news of the flow experiment was widely reported in mass media including the *New York Times*, *Washington Post*, and *US News & World Report* (https://www.usnews.com/news/best-states/arizona/articles/2018-04-30/low-steady-flows-from-arizona-dam-could-benefit-bugs).

Data Availability: These data report the abundance and diversity of aquatic insects captured in each of the individual light trap samples. Data are available at https://www.sciencebase.gov/catalog/item/570fe1a6e4b0ef3b7ca3580c.

D.5.3 Archaeology Citizen Science at Fort Vancouver[21]

Lead Sponsoring Agency: National Park Service (NPS)

Authority: 54 U.S.C. 100101, 54 U.S.C. 100301, 54 U.S.C. 100701-706, and 54 U.S.C. 103102(4)

Project Summary and Goals: The NPS is mandated to preserve and interpret cultural resources of park units and affiliated sites for current visitors and future generations. The NPS provides technical

[21] The website for Archaeology Citizen Science at Fort Vancouver can be viewed at https://www.nps.gov/fova/learn/historyculture/archaeology-and-collections-a.htm.

assistance and training in the field of cultural resource management, including archaeology. The Public Archaeology Field School and research project at Fort Vancouver National Historic Site provides an intensive program to teach citizen scientists archaeological field techniques, including surveying, testing, and excavating, while recovering scientific data from one of the most significant archaeological sites in the Pacific Northwest. The project's goals include archaeologically testing portions of the Vancouver Barracks to assess the scientific and historical value of the resources and gathering data on areas that may be affected by utilities upgrades and related construction activities tied to building rehabilitation, landscaping, and parking. Citizen scientists collected evidence of the tangible remains of the Vancouver Barracks and earlier Hudson's Bay Company Fort Vancouver in the summer of 2017 and processed the artifacts in the park's archaeological laboratory in 2017 and 2018. The effort aims to improve the interpretation of U.S. military and fur trade history at Fort Vancouver.

Justification for Using Crowdsourcing and Citizen Science: Citizen science is a valuable tool to augment and integrate into existing archaeology work to meet multiple NPS goals. The project synergistically uses cooperative agreements, staff full-time equivalents (FTEs), and citizen scientists. This structure allows citizen scientists to contribute successfully to the project while ensuring good data quality through data collection and analysis training. By engaging with universities that are dedicated to training future scientists through citizen science, the project also fulfills an on-going desire by the public to participate in archaeological fieldwork and laboratory analysis. Overall, the use of citizen science is a cost-effective means to conduct archaeological science and contribute to park interpretation.

Status: The project started in June 2017 and is ongoing.

Location: The program is located at the Fort Vancouver National Historic Site in the Pacific Northwest region of the United States.

Participation: The project targets university students and the general public interested in archaeology, history, and historic preservation. The total number of individuals involved during this period was 53, and the average number of active participants was about 18 per quarter. The total number of volunteer hours was 4005.

Consent: All 53 participants consented to participate.

Submissions: Citizen archaeologists created and submitted 223 digital excavation level and feature forms, 21 iDraw digital excavation profiles, 248 digital cemetery headstone recording forms, 1,666 digital images, and 4,937 archaeological laboratory recording form lines of data. Additional laboratory recording lines of data from other NPS partnership projects were created and submitted.

Resources: The project is funded through park and region base funds, a cooperative agreement, and non-NPS funds and in-kind services provided by the university partners. University partners also provide graduate student and instructor support for field work. Portland State University provides field equipment and some graduate research assistant (GRA) services in support of the project. In FY17, a GS-12 regional archaeologist served as project manager and PI for project, and a GS-7 park archaeological technician provided field crew support and helped with archaeological laboratory training. Together, the two staff contributed 0.25 FTEs to the project. Funding for FY18 totaled $33,078, and 0.15 FTEs supported the project. A cooperative agreement with Portland State University included funding for a 0.3 FTE GRA to run the archaeological laboratory during the 2017–2018 academic year (October through June).

Partnerships: Federal partners include USFS, Gifford Pinchot National Forest. Non-Federal partners include Portland State University, Washington State University Vancouver, Friends of Fort Vancouver National Historic Site, Oregon Museum of Science and Industry, Vancouver Parks and Recreation, Bike Clark County, and Clark College.

Advancement of Agency Mission: The project serves to further the NPS mission to share information on NPS resources and to conduct scientific outreach to children and adults. The project fosters relationships with conservation partners tied to science and education, provides interpretative programs to improve public access to archaeological sites, and builds new dialog with community members through citizen science. Visitors to the site are encouraged to interact with the citizen scientists who had been trained in modern interpretation and communication skills by NPS staff. Formal tours of the site associated with the project were held with youth from the Fur to Fossil Summer Camp (Oregon Museum of Science and Industry), Bike Skills 101 (Vancouver Parks and Recreation and Bike Clark County), and the Clark College STEM Camp (Clark College). Citizen Scientists share their knowledge with children at the Kids Dig program funded by the Friends of Fort Vancouver National Historic Site.

Results: The citizen scientists collected data from a highly significant archaeological site and interpreted the archaeological program to the public. The student graduate research assistant coordinated and managed citizen scientists in the Fort Vancouver Archaeological Laboratory, assisted and mentored by NPS archaeologists. Multiple collections were cleaned and analyzed and were incorporated into technical reports supporting the adaptive reuse of historical structures and infrastructure upgrades to the East Vancouver Barracks. Results were shared at the 2018 Archaeology Roadshow, a public archaeology event hosted by Portland State University. Data continue to be used in site planning at the Vancouver Barracks.

Data Availability: Data collected from the archaeological site are protected under two Federal laws, the Archeological Resources Protection Act and the National Historic Preservation Act, to prevent looting or other disturbance of sensitive archaeological resources. Professional archaeologists and student researchers affiliated with an accredited University with a mentoring professional archaeologist may be given access to the data for research purposes. Those interested in the results may contact the park cultural resources branch.

D.5.4 Biodiversity Discovery and Phenology in Acadia National Park

Lead Sponsoring Agency: NPS

Authority: National Park Service Organic Act

Project Summary and Goals: Biodiversity discovery and phenology in Acadia National Park engages the public in recording observations of plants and animals in Acadia. Volunteers can participate through a variety of methods, including by participating in targeted bioblitzes such as an intertidal blitz or moth blitz, by attending ranger-led or Schoodic Institute-led programs such as Sea Watch or Hawk Watch, or by submitting observations on their own through iNaturalist, eBird, or Nature's Notebook. In each of these methods, volunteers follow standardized procedures for recording observations of plants and animals. Observations are often accompanied by photographs, and all observations are subject to quality control and data management after submission. The goal of the project is to document biodiversity and phenology in Acadia National Park to: (1) improve understanding of park resources; (2) inform decisions regarding the management of park resources; and (3) provide educational and inspirational experiences for park visitors. These project goals derive from the mission of the National Park Service.

Justification for Using Crowdsourcing and Citizen Science: Citizen science is particularly appropriate for documenting biodiversity and phenology for a number of reasons. Park managers require information on a large number of species and from a large number of locations—more than park staff or cooperating professional scientists can observe on their own. Furthermore, engaging volunteers in the documentation of biodiversity and phenology, especially with additional communication through

interpretation, education, or other means, can help participants learn about natural resources and good stewardship. Studies have established that volunteers with little training can readily document biodiversity and phenology, supporting the use of citizen science for this project.

Status: The project started in June 2004 and is ongoing.

Location: The project is located in Acadia National Park, Maine.

Participation: The project targeted park visitors and local residents. The total number of individuals involved during this period was approximately 10,000, and the average number of active participants per year was about 5,000. However, participation is seasonal, and most participation occurs during the fall.

Consent: All participants provided consent through user agreements and other mechanisms associated with data collection tools (e.g., iNaturalist, eBird, Nature's Notebook) and signed Volunteer agreements.

Submissions: The project received observations on species occurrence and information on timing of seasonal life cycle events.

Resources: There is no dedicated budget for biodiversity discovery and phenology in Acadia National Park. Funding, staff time, and supplies came from a variety of Federal and private sources. In FY17 and FY18, NPS contributed a total of $44,000 ($37,000 in FY17 from Acadia accounts, $7,000 in FY18 from non-Acadia accounts) through Task Agreements to Schoodic Institute. These task agreements supported personnel, methods refinement, training workshops for participants, data management, and communication. NPS contributed staff time and supplies through the Resource Management Division and the Interpretation and Education Division of Acadia National Park, mainly staff and supplies associated with the Research Learning Center in Acadia. Agency full-time equivalents (FTEs) were used to help coordinate the project and run some biodiversity discovery interpretive programs, and 0.5 FTEs supported the project in FY17 and FY18. Schoodic Institute led the implementation of the project and provided additional support for the project through its own funding, staff time, and supplies.

Partnerships: Non-Federal partners included Schoodic Institute.

Advancement of Agency Mission: The project directly supports three major components of the NPS mission by: (1) using the data to inform the management and preservation of natural resources; (2) helping volunteers enjoy, learn, and become inspired about the natural resources in Acadia National Park; and (3) cooperating with partners to extend the benefits of conservation throughout the country, especially when volunteers continue to make observations and otherwise contribute to science, stewardship, and education when they go home.

Results: NPS, Schoodic Institute, and partner scientists and educators use the data generated by this project to understand what species occur in Acadia National Park and when they exhibit different phenological behaviors (e.g., migration, flowering, and fruiting). This information helps to manage natural resources by identifying invasive and vulnerable species, informing restoration projects and assessing their success, and timing fieldwork. Additionally, NPS and Schoodic Institute staff communicate the results to participants and to the public, providing valuable educational experiences. Project results are all important to advancing the NPS mission in Acadia National Park.

Data Availability: Data from this project can be found in free public databases managed by iNaturalist, eBird, USA National Phenology Network, and Hawk Count (Hawk Migration Association of North America). In each of those databases, users can search for data from Acadia National Park; in iNaturalist, users can additionally find data under the project Downeast and Acadia. There are smaller amounts of

data managed by individual researchers who are involved in the project. Those data will be shared at the completion of their projects, if not sooner, in accordance with the conditions of the researchers' permits.

D.5.5 Dragonfly Mercury Project: Engaging Citizens with Resource Conservation[22]

Lead Sponsoring Agency: NPS

Authority: NPS Organic Act (54 U.S.C. 100101(1916))

Project Summary and Goals: Mercury, a toxic pollutant that can harm human and wildlife health, often enters parks as air pollution from distant, human-caused sources, such as coal-burning power plants, and can enter the food web and build up in top predators. The Dragonfly Mercury Project (DMP) is a dynamic national scale program to understand mercury pollution risks to protected areas. Developed in collaboration with the U.S. Geological Survey (USGS), the University of Maine (UMaine), and the National Park Service, and implemented at more than 100 national parks across the country, the DMP engages citizen scientists as key participants in data collection of dragonfly larvae, which serve as indicators of mercury in aquatic food webs. Activities include hiking and sampling a national park waterbody, donning waders and using a net to collect dragonfly larvae from the water's bottom, using approved methods to sort and identify samples, preserving specimens, and filling out a field data sheet. This research helps the NPS better manage risk and protect resources and park visitors from the ill effects of mercury. The DMP was initiated with three main objectves: (1) increase understanding of mercury contamination in national parks across the United States using dragonfly larvae as biosentinels; (2) engage and educate citizen scientists in the collection of scientific data to increase their understanding of field ecology, wetland ecosystems, data literacy, conservation, and the impacts of air pollution; and (3) inform NPS policy and management decisions, such as determining when and where to provide warnings on fish consumption, identifying areas where mercury contamination may be harming wildlife, and identifying sites where mercury remediation may be appropriate. Entering its ninth field season in 2019, the DMP seeks to expand its impact by increasing data relevancy, enhancing the experience of the public participants, expanding partnerships, and informing sound resource management decisions.

Justification for Using Crowdsourcing and Citizen Science: The DMP is conducted via an Interagency Agreement with the U.S. Geological Survey. The scope and broad geographic coverage of this sampling is only possible because of public participation. Participation enables the NPS to foster teachable moments on the management of air, water, and biological resources and connect people to parks using parks as outdoor classrooms and living laboratories. This is a highly cost-effective study that leverages citizen participation to implement a national scale assessment of mercury bioaccumulation in biosentinel organisms across multiple national parks. The full cost of a study of this magnitude that relied solely upon USGS or UMaine technical staff to conduct all aspects of data collection would exceed $1.5 million in technician salary, lab analyses, and travel costs. Additionally, this project benefits from substantial in-kind contributions by the principal investigator's team. Citizen scientists gain new perspectives and practice civic skills, while project scientists gain additional data and insights on mercury in the food web.

[22] The website for the Dragonfly Mercury Project: Engaging citizens with resource conservation can be viewed at https://www.nps.gov/articles/dragonfly-mercury-project.htm.

Status: The project started in May 2011 at four pilot parks in the eastern United States: Acadia National Park, Marsh-Billings-Rockefeller National Historic Park, Saint-Gaudens National Historic Site, and Great Smoky Mountains National Park. The DMP is ongoing.

Location: Participation in the project is possible throughout the United States. All seven NPS Regions, 30 of 32 Inventory & Monitoring Networks, and National Parks in 43 U.S. states and the District of Columbia have participated.

Participation: The project targeted high school students, interns and youth groups, and local community groups. More than 4,000 citizen scientists have engaged in the DMP since the project's inception in 2011. Approximately 600 citizen scientists engaged in FY17, and current reports estimate at least 700 participants in FY18. The average number of active participants per month (May–September) was approximately 200. More than 10,000 volunteer hours have been dedicated to the DMP since 2011. FY17 recorded 3,755 volunteer hours, and current reports estimate at least 4,160 volunteer hours in FY18.

Consent: All participants consented.

Submissions: Over the course of FY17 and FY18, participants submitted about 4,270 dragonfly larvae samples for mercury analysis, 300 field data forms, and 30 observations on iNaturalist for an approximate total of 4,600 submissions.

Resources: Funding for the Dragonfly Mercury Project has been varied and adaptively implemented. The Maine Agricultural and Forest Experiment Station and faculty research funds from the UMaine provided initial support for the project in 2011. Funding responsibilities then shifted to the National Park Service, followed by the USGS/NPS Water Quality Partnership from FY14 to FY16. In-kind contributions from the USGS Environmental Health Mission Area Contaminant Biology Program, UMaine, and the NPS provided additional support during these years. Since FY16, the DMP has been distinctly funded through a combination of park discretionary funds (i.e., parks, regions, networks), other NPS funds (WASO), and non-NPS funds (i.e., in-kind contributions from USGS, NPS, UMaine, and citizen scientists). Funding for FY17 totaled $204,319, and funding for FY18 totaled $353,700. Park funds contributed to 54% of the total NPS funding, while other NPS funds covered the remaining 46%. A total of $558,019 of direct in-kind contributions was obtained over two years, and an estimated $827,381 in matching support (148% of budget, 60% of total project costs) was secured over that same time. This project is heavily leveraged by matching support in the form of NPS staff time and field gear; citizen scientist time; USGS reduced analytical costs, principal investigator (PI) salary, data management, quality assurance; UMaine reduced indirect, graduate student and research support, and project communication. Matching in-kind support included $397,000 (29% of project total) from park staff, $158,300 (11% of project total) from citizen science, $26,250 (2% of project total) from sampling supplies provided by parks, $164,215 (12% of project total) from USGS, and $81,616 (6% of project total) from UMaine. The FY17 and FY18 budgets covered project oversight by USGS and UMaine, PI salaries and a project coordinator, staff training, lab analysis, supplies, data management, reporting, and travel to a DMP core team meeting. FY18 funds also supported affiliated research endeavors. FY17 support was provided by 2.6 full-time equivalents (FTEs), including NPS staff support at 56 parks, five regions, and one NPS Air Resources Division DMP project coordinator. FY18 support was provided by 3.0 FTE, including NPS staff support at 64 parks, five regions, and one NPS Air Resources Divsion DMP project coordinator. Citizen scientists contributed an additional 1.8 and 2.0 FTEs, respectively.

Partnerships: Federal partners included U.S. Geological Survey. Non-Federal partners included the University of Maine, Dartmouth College, and University of Wisconsin-LaCrosse.

Advancement of Agency Mission: The NPS preserves the natural and cultural resources and values of the national parks for the enjoyment, education, and inspiration of current and future generations. Mercury (Hg) is a globally distributed, toxic contaminant that threatens resources the NPS is charged with protecting. The DMP aligns with this NPS mission by advancing scientific understanding of the spatial distribution of Hg contamination in the national parks and creating next generation stewards, enlightening a mainly youth-based pool of citizen scientists about the connection among all living things, the influence humans have upon natural systems, and how environmentally-responsible decisions can protect our parks and the planet. Beyond increasing the understanding of Hg risk across the national parks and informing policy and management decisions, the DMP fosters a deepened engagement with citizen scientists and educators, ultimately advancing an appreciation of national parks and the diversity of resources they contain for thousands of youth across America.

Results: Three conclusions can be drawn from study *Results:* (1) dragonfly larvae are widespread and effective bioindicators of ecosystem risk to Hg; (2) the risk from Hg varies widely across the landscape, influenced by a combination of Hg emissions and deposition, landscape processes that control the entry of mercury into aquatic food webs, and food web structure; and (3) concentrations vary as widely within parks as across parks. Data from the DMP are used by researchers, resource managers, and classrooms and interns to further knowledge of mercury distribution, understand the vulnerability of waterbodies to mercury accumulation in foodwebs, protect resources and park visitors from the ill effects of mercury; and advance environmental literacy on local, regional, and national scales. Annual project-based outcomes include dragonfly larvae sample analysis and subsequent data results, data flyers that interpret results for each individual participating park, a technical report, and a DMP webinar. Core findings have been summarized in numerous national and international presentations at scientific meetings, a USGS fact sheet, a project report, and several pending journal articles. Given the project's wide geographic scope, the resultant data provide a nationwide snapshot of mercury in biota, primarily from undeveloped watersheds. Since the larvae are important prey for fish, and thus can be used as a surrogate for mercury levels in fish, the data can be used to eventually inform the NPS about park- and site-specific threats from mercury to human and wildlife health. Results also provide the foundation for a DMP steering committee, transitioning this NPS-centric project to a more influential, multi-agency program that carries the endeavor into the future.

Data Availability: Data flyers and park data files, organized by park and year, are available only to internal DOI partners. These data are still provisional and are currently undergoing the final review and approval process. The full data release will occur with impending publications and made publicly available. The Dragonfly Mercury Project Data Web Map, a dynamic tool for accessing and visualizing data on mercury in dragonfly larvae, is available to the public at: https://www.nps.gov/articles/dragonflymercury-map.htm. A summary data release is provided by the following article: https://doi.org/10.5066/P9TK6NPT. Other data products are available at: https://irma.nps.gov/DataStore/Collection/Profile/4082. Interpretive products and publications are being finalized now and will be used to put these data in the context of environmental health risk and utility for biomonitoring applications.

D.5.6 Glacier National Park Common Loon Citizen Science[23]

Lead Sponsoring Agency: NPS

Authority: National Park Service Organic Act

Project Summary and Goals: The Common Loon (*Gavia immer*) is considered a "Species of Special Concern" by Montana Fish, Wildlife and Parks due to the species' sensitivity to disturbance during nesting season and its low reproductive and recruitment rates. A volunteer-based annual loon survey began in 1988, which indicated that Glacier National Park (GNP) hosts 20% of the state's loon population and that reproductive rates were low (five chicks per year). The citizen science pilot program started in 2005, the first in Glacier and one of the first in any national park, to increase monitoring of this sensitive species. In 2006, Glacier National Park established the Common Loon Citizen Science project to train volunteers and GNP staff to gather baseline data on population and distribution of common loons, to improve accuracy during an annual Loon Day count, and to increase survey coverage of lakes with loons. The program has established significant baseline data on loon population status, nesting areas, chick hatch and migration dates, and areas of concern for human disturbance, and the goal is to continue this long-term record to provide management recommendations about issues that may affect loon nesting success and habitat, an indicator of lake ecosystem health.

Justification for Using Crowdsourcing and Citizen Science: Long-term monitoring of Common Loons provides a vital insight into the health of freshwater lake ecosystems. Glacier has 45 freshwater lakes across its 1.1 million acres with the potential to support breeding Common Loons. Capacity within current staffing budgets and funding for grants or cooperative agreements for this kind of large-scale monitoring over a long-time period is not available. Prior to the establishment of the project, staff and a small number of untrained volunteers were conducting one annual Loon Day count at each lake to provide information about where loons were located in the park. That information was insufficient for making management decisions about long-term loon conservation. In 2006, Glacier National Park established the Common Loon Citizen Science project to obtain information about nest locations, nesting success, and chick survival rates, which are vital to conservation of the species, using trained volunteers who collect data at lakes more frequently. Common Loons are a good fit for citizen science engagement because they are a highly visible and charismatic species that are of interest to park visitors and the local community.

Status: The project started in May 2005 and is ongoing.

Location: The program is based in Glacier National Park, Montana.

Participation: The project targeted park visitors, local community members, service groups, and students. Participants totaled 117 in 2017 and 140 in 2018, and the average number of active participants per month between June and August was approximimately 50. The total number of volunteer hours equaled 2,192 hours in 2017 and 2,797 hours in 2018.

Consent: All participants provide formal consent to participate.

Submissions: Participants submit observational data and images. A total of 178 submissions were received in 2017 and 233 were received in 2018.

Resources: Agency funding for FY17 totaled $2,000, supplemented by a $12,000 private donation from the Glacier National Park Conservancy. Recreational Fee Program Personal Services amounted to $15,000. Agency funding for FY18 totaled $2,500, supplemented by a $12,000 private donation from the

[23] The website for Glacier National Park Common Loon Citizen Science can be viewed at https://www.nps.gov/rlc/crown/citizen-science.htm.

Glacier National Park Conservancy. Recreational Fee Program Personal Services amounted to $18,000. Resources in both years were used for rental vehicles, fuel, backcountry per diem, field equipment, and supplies. A total of 0.7 full-time equivalents (FTEs), split between a GS-4 Project Coordinator and a GS-7 Program manager, supported the project in FY17 and FY18.

Partnerships: Federal partners include the Common Loon Working Group, whose members include the US Forest Service, US Fish and Wildlife Service, and Confederated Salish and Kootenai Tribes. Non-Federal partners include Glacier National Park Conservancy, Montana State Fish, Wildlife and Parks, and Blackfeet Tribal Community College. The Montana Department of Natural Resources, Weyerhaeuser Timber Company, and the Montana Loon Society also participate in the Common Loon Working Group.

Advancement of Agency Mission: The project advances the NPS's mission to conserve wildlife and natural resources, in this case by engaging the public directly in collecting population data. Conservation of Common Loon populations in an unimpaired state ensures that they are available for the enjoyment of future generations. The project also fosters enjoyment of wildlife and natural resources by participants.

Results: The data gathered by this project have been used as an indicator of the health of freshwater lake ecosystems. They have also been used to inform management decisions, such as trail locations and fishing access planning through the compliance process. Knowledge of loon nesting sites and success rates has informed planning for conservation of other species that also use freshwater lake habitats. The data have also informed a broader understanding of loon population status, breeding success, and migration timing across the state of Montana and on the adjacent Blackfeet Reservation.

Data Availability: Metadata for all data collected for the project are published in the National Park service Integrated Resource Management Applications (IRMA) data portal: https://irma.nps.gov/DataStore/Reference/Profile/2194764. The full dataset is provided to interested parties upon request. An annual summary report of all data is also published each year in the Integrated Resource Management Applications (IRMA) data portal.

D.5.7 Did You Feel It? (DYFI)[24]

Lead Sponsoring Agency: U.S. Geological Survey (USGS)

Authority: Organic Act of 1879, The National Earthquake Hazards and Reduction Program (NEHRP), 42 U.S.C § 7701

Project Summary and Goals: The Did You Feel It? (DYFI) project is designed to gather information available about earthquakes from the people who experience them. By tapping an immense number of users online, DYFI can get a detailed characterization of what people were experiencing during the earthquake, the impacts of the earthquake, and the amount of damage it caused, beyond the scope of traditional information gathering techniques. Data input from users is immediately available on the website, and its interactive platform encourages users to gain a deeper understanding of earth sciences while they participate. The DYFI data are used to inform earthquake response and scientific studies about earthquake shaking and damage.

Justification for Using Crowdsourcing and Citizen Science: The DYFI project taps into a natural crowdsourcing and citizen science (CCS) audience to report the shaking experienced at their location immediately after felt earthquakes. It is one of the most suitable and cost effective uses of CCS, since

[24] The website for the Did You Feel It? online report form is accessible at https://earthquake.usgs.gov/data/dyfi/.

participants are eager to share their observations with the Federal Government, and USGS seismologists and scientists benefit from these citizen science data.

Status: The project started in 1999 in California and then expanded in 2003 for the rest of U.S. and the world, and is still ongoing.

Location: The project takes place internationally, particularly in locations where earthquakes occur.

Participation: The project targets populations affected by an earthquake. The total number of individuals involved is over 4.5 million since 1999, and approximately 650,000 in the 2017 to 2018 reporting period. The average number of active participants per month was approximately 33,000 in 2017 and 2018. The total number of volunteer hours was about 5,400 hours based on an average of approximately 30 seconds per response.

Consent: All participants consent to participating by submitting a report on the DYFI website with the option to provide contact information.

Submissions: Participants answered at least one and up to 15 questions about their earthquake experience. There were approximately 650,000 submissions in the 2017 to 2018 reporting period.

Resources: The DYFI project is extremely cost-effective. Total operations including web support, software design and upkeep, as well as user support for data requests and outreach amounts to less than one 1 FTE, since data are automatically processed.

Partnerships: DYFI is a USGS project and does not have any federal or non-federal partnerships associated with this project.

Advancement of Agency Mission: The DYFI project is one of the USGS's premiere citizen science projects. It is one of the first, most well-known, and well subscribed in the U.S. Government. DYFI takes advantage of the unique opportunity to help and learn from citizens, often by the tens of thousands, immediately after they experience shaking during an earthquake. Both the government and the population benefit from this collaborative relationship. DYFI is also a very cost-effective use of government resources, since three orders of magnitude more macroseismic data are collected in the U.S. as a result of this program, with many fewer personnel than were needed in the past.

Results: The scientific uses of DYFI data have been documented in several scientific publications and scores of scientific peer-reviewed papers use the DYFI data (see https://pubs.er.usgs.gov/publication/70032440 and https://earthquake.usgs.gov/static/lfs/data/pager/AtkinsonWaldDYFI.pdf). Hundreds of abstracts and meeting presentations employ DYFI data as well. The studies use DYFI data to analyze shaking intensity and wave propagation, the relationship between shaking and damage, induced earthquakes, social sciences of human risk perception, and the use of crowdsourcing and citizen science itself.

Data Availability: The DYFI data are documented in various scientific publications, such as https://pubs.er.usgs.gov/publication/70032440. All DYFI data are available at https://earthquake.usgs.gov through the USGS Earthquake Program Comprehensive Earthquake Catalog (ComCat).

D.5.8 iCoast - Did the Coast Change?[25]

Lead Sponsoring Agency: USGS, St. Petersburg Coastal and Marine Science Center

Authority: Organic Act of 1879; National Climate Program Act of 1978; Coastal Zone Management Act of 1976

Project Summary and Goals: The value of iCoast is two-fold: (1) iCoast serves as a communication tool to explain to a broad audience what processes change the coast during major storms, and (2) the oblique imagery data sets contain the information necessary for storm impact model verification. Classification of large volumes of photographs covering a wide area is impractical without employing citizen scientists. iCoast successfully engaged the general public to assist in the classification of coastal oblique aerial imagery collected after Hurricane Sandy made landfall in November 2012. Users were able to match and classify nearly all the images along the coast. The work done by users in classifying the imagery collected after Hurricane Sandy has helped USGS scientists understand the impact of the storm. iCoast users correctly identified mainland and narrow barrier islands along the coast with a high degree of confidence. Our analysis also showed that users could reliably identify all four coastal processes, namely beach erosion, dune erosion, overwash, and inundation. Classifications generated from iCoast users are being used to test the predictive models of storm impacts along the coast by identifying differing levels of geomorphic impacts (e.g., collision, overwash, inundation) along undeveloped and developed coasts and damage to infrastructure caused by a storm.

Justification for Using Crowdsourcing and Citizen Science: iCoast is a cost effective way to classify large volumes of photographs covering a wide area, which was previously impractical due to the number of hours that it would have required for a staff scientist to complete the task. iCoast was developed by the USGS using citizen science and user experience expertise already available to the USGS St. Petersburg Coastal and Marine Science Center. The iCoast interface was designed using human-centered design techniques and by conducting usability testing with USGS scientists and existing iCoast users to ensure iCoast was user-friendly.

Status: The project started in June 2014 to classify images from Hurricane Sandy. This is still an ongoing project, collecting input from users, mostly with regard to Hurricane Joaquin.

Location: The project takes place on online but focuses on imagery collected along the U.S. east coast in areas affected by Hurricane Sandy (Cape Lookout, North Carolina to Montauk Point, New York) and Hurricane Joaquin (South Carolina/North Carolina border to Montauk Point, New York). Since this is an online project, volunteers can be from anywhere around the world that have access to the internet.

Participation: The project targets citizen scientists interested in contributing to the understanding of coastal processes and people interested in learning the impacts of Hurricane Sandy, Hurricane Joaquin, and other extreme storms. Of the 1,630 total users, 1,020 have completed at least one classification in iCoast (i.e., 62% of the people who signed on to iCoast have contributed to the collected data). When iCoast was first released, participation was higher than current numbers. All of the Hurricane Sandy images were classified by October 2015 (1 year and 4 months). Hurricane Joaquin is also 100% classified. The total number of volunteer hours was over 2,867 hours since June 2014, where it takes approximately two and a half minutes per classification.

Consent: All participants had to login and register with iCoast, therefore all participants consented to participate in iCoast.

[25] The website for the iCoast - Did the Coast Change? is accessible at https://coastal.er.usgs.gov/icoast/

Submissions: iCoast users are asked to check for spatial correspondence between image pairs from before and after Hurricane Sandy or Hurricane Joaquin (image matching) and then users are presented with a set of specific tasks to classify the pre-event scene, detect changes, and interpret the process or processes responsible for the changes to the coast. Approximately 69,000 classifications of image pairs have been submitted, although it should be noted that an image pair can have more than one classification by multiple users.

Resources: iCoast is monitored for input from users and to be certain that it is continuing to function. A database programmer is utilized if there is a problem with the functionality of the website. A researcher is available to address any images flagged by users as unusable. iCoast is very low maintenance and functions without daily input from researchers. Other than maintenance work, no funding was provided for iCoast. There is less than 0.4 FTE annually because the project does not require a lot of attention.

Partnerships: No federal or non-federal partnerships associated with this project.

Advancement of Agency Mission: The information iCoast provides allows researchers to focus on derived information contained in the oblique aerial imagery that is collected after a storm. Analysis of user input shows that iCoast users can provide valid information, which can then be used by researchers to increase understanding of coastal storm response. The USGS Coastal and Marine Geology Program is actively engaged in research to further understand storm events and to develop models to predict coastal change hazards. iCoast was developed to further inform coastal change hazards research as well as raise awareness to the public about how extreme storms affect US coastlines. More information about the purpose of iCoast, can be found at https://coastal.er.usgs.gov/icoast/about.php.

Results: The Storm-Induced Coastal Change Hazards component of the of the National Assessment of Coastal Change Hazards project focuses on understanding the magnitude and variability of extreme storm impacts on sandy beaches. The overall objective is to improve real-time and scenario-based predictions of coastal change to support management of coastal infrastructure, resources, and safety (https://coastal.er.usgs.gov/hurricanes/overview.php). Classifications generated from iCoast users are being used to test and validate the predictive models of storm impacts along the coast by identifying differing levels of geomorphic impacts (e.g., collision, overwash, and inundation). Validation of these models is an important part of the research and response to extreme storms.

Data Availability: A Data Release containing the Hurricane Sandy iCoast classifications is available at https://coastal.er.usgs.gov/data-release/doi-P93A9MPE/. iCoast data for Hurricane Joaquin will be made available in the future..

D.5.9 Nature's Notebook[26]

Lead Sponsoring Agency: USGS

Authority: Organic Act of 1879

Project Summary and Goals: The USA National Phenology Network (USA-NPN) is a national-scale monitoring and research initiative focused on collecting, organizing, and delivering phenological data, information, and forecasts. It supports natural resource management and decision-making to advance the scientific field of phenology and promote the understanding of phenology to a wide range of audiences, including researchers, resource managers, educators, communication specialists, non-profit organizations, human health organizations, science networks, and the public.

[26] The websites for the Nature's Notebook are accessible at http://www.naturesnotebook.org, and http://www.usanpn.org.

Justification for Using Crowdsourcing and Citizen Science: USGS has opted to develop and maintain a citizen science program for collecting phenology observations because citizen scientists can collect data at a national scale at a relatively low cost. Engaging volunteers in collecting observations of plant and animal phenology dramatically increases the volume and taxonomic and geographic breadth of data. Furthermore, volunteers are directly involved in conservation science and management, leading to increases in scientific and environmental literacy.

Status: The project started in March 2009, and is ongoing.

Location: The project takes place across the United States.

Participation: The project targets professional scientists, natural resource managers, and amateur naturalists. The total number of individuals involved over the reporting period of FY17 to FY18 was 10,278, and the number of active participants was 3,349. The total amount of volunteer time was 184,140 hours, where it takes approximately two minutes per record.

Consent: All participants are required to agree to the USA-NPN's Terms of Use https://www.usanpn.org/terms. From FY17 to FY18, 10,278 individuals provided formal consent to participate.

Submissions: Participants submit observations of plants and animals. Over the reporting period of FY17 to FY18, participants submitted 5,524,201 records.

Resources: National Coordinating Office staff includes one USGS staff member (1 FTE) and 10 staff members who work for the University of Arizona (8.125 FTE total). The USGS staffer serves as Director, and University of Arizona staff members are managers, programmers, data product developers, outreach and partnership coordinators, researchers, and students. USGS funds not allocated toward salary amounted to $208,509 for each fiscal year. Funding from all sources not allocated toward salary was $437,488 for each fiscal year. FY17 and FY18 combined was $1,424,356 from USGS; $625,476 from FWS; $9,889 from NSF; and $120,780 from NASA.

Partnerships: Federal partners included DOI-USFWS, DOI-NPS, NASA, NOAA, USDA-USFS, and USDA-ARS. USA-NPN maintains partnerships with several hundred Non-Federal institutions (e.g., Arbor Day Foundation, Casey Trees, Chicago Park District, City of Roanoke, Great Basin Bird Observatory, Infinity Science Center, Jacksonville Zoo and Gardens, John D. MacArthur Beach State Park, Knoxville Zoo Classroom Pollinator Project, Monarch Watch, and others).

Advancement of Agency Mission: The USGS Ecosystems Mission Area provides scientific information and decision support to meet Department of Interior's shared responsibility for land and species management, to fulfill treaty obligations with Tribes and foreign governments, to develop energy and mineral resources on Interior lands and the Outer Continental Shelf, and to supply water for irrigation and other human needs. USGS science protects and conserves the Nation's fish and wildlife heritage by bridging the gap between science and management for at-risk species and species of management concern. Within the Ecosystems Mission Area, the Status and Trends Program – which funds the USA-NPN – provides (1) science, technology, and information that resource managers use to understand the current conditions and status of plants, animals, and habitats under management responsibility of Interior bureaus and other Federal, State, and Tribal partners, and (2) collects, analyzes, and delivers data and information about past and potential future changes to species and habitats.

Results: Nature's Notebook data for the USA-NPN are used by university or government scientists for research on topics ranging from understanding, detecting, and controlling plant invasions; predicting effects of frost on tree fruit crops; documenting drought impacts on corn and soybean production; and validating satellite-based assessments of foliage coloration in the autumn. About 60 peer-reviewed

articles have been published in high-quality ecological journals. All information products with USGS authors are compliant with "Fundamental Science Practice" review, approval, and release standards established by the Office of Science Quality and Integrity. Data are also used by Federal, Municipal, and Tribal natural resource managers for field-based decision-making. For example, managers have used the data to plan restoration of degraded habitats in flood-plains, to map invasive plant species to support detection and control activities, to prioritize habitat for migratory animals such as birds and monarch butterflies, to understand patterns of tree pollen production as a hazard to human health, and to plan street-sweeping activities designed to improve water quality in local municipalities.

Data Availability: The USA-NPN National Coordinating Office freely and readily delivers observational data on plant and animal phenology collected through Nature's Notebook in several formats, including minimally processed status and intensity datasets as well as derived phenometrics for individual plants, sites, and regions. These data can be downloaded from https://www.usanpn.org/data/observational and are also accessible via the Phenology Observation Portal (http://dx.doi.org/10.5066/F78S4N1V) and via an Application Programming Interface. The data are documented and described in the 2018 USA National Phenology Network Observational Data Documentation (https://doi.org/10.3133/ofr20181060).

D.5.10 The National Map Corps (TNMCorps)[27]

Lead Sponsoring Agency: USGS

Authority: Organic Act of 1879

Project Summary and Goals: The National Map Corps (TNMCorps) is a crowdsourcing program that is part of the U.S. Geological Survey (USGS) National Geospatial Program's The National Map, which collaboratively improves and delivers topographic information for the Nation. The National Map is free to the public and the government, and its uses range from disaster planning and emergency response to scientific analysis and recreation. The use of The National Map Corps, which encourages citizen participation in volunteer map data collection activities, will result in more complete, current, and accurate national datasets for The National Map.

Justification for Using Crowdsourcing and Citizen Science: The USGS National Geospatial Program (NGP) is currently pursuing a two-pronged approach for acquiring and maintaining structures data (e.g., data on schools, hospitals, post offices, fire stations, cemeteries, and other important public buildings). Where available the Program is seeking authoritative national sources. To fill the gaps and improve the completeness, currency, and accuracy of the structures data, NGP's strategy is to deploy The National Map Corps (TNMCorps) in using new technologies and Internet services to enable members of the public to produce volunteered geographic information (VGI) that will update and enhance the datasets.

The volunteer effort of TNMCorps to collect and improve structures data provides many benefits to the Program, its users, and the Nation. Volunteer participation improves government efficiency, public access to data, and data quality. Participation in The National Map Corps is easy and completely voluntary and raises geographic awareness and improves users' skills in using web-based tools. Developing more complete and current structures data in The National Map may improve emergency preparedness and response. Furthermore, The National Map Corps benefits the agency and the participants by providing opportunities for citizen participation in USGS science as well as creating opportunities for collaboration with other Federal agencies and partners.

[27] The website for the The National Map Corps (TNMCorps) is accessible at https://edits.nationalmap.gov/tnmcorps.

Status: The project started in March of 2012, and is ongoing.

Location: The project encompasses the entire United States, as well as Puerto Rico and the U.S. Virgin Islands. The project takes place online, so all volunteers with internet access can contribute.

Participation: The project targets the general public. The total number of individuals involved during this period was 1,266 participants, and the average number of active participants per month was 100 users. The total number of volunteer hours was 30,828 volunteer hours for FY17 and FY18.

Consent: All users provide consent through account creation.

Submissions: Participants update and verify locations, names, and addresses for geospatial structures data for The National Map.

Resources: N/A

Partnerships: No federal or non-federal partnerships associated with this project.

Advancement of Agency Mission: The mission of the USGS National Geospatial Program (NGP) is to organize, maintain, publish, and disseminate the geospatial baseline of the Nation's topography, natural landscape, and built environment through The National Map, which consists of basic geospatial information provided as a variety of mapping products and services. The use of The National Map Corps and Volunteered Geographic Information (VGI) will result in more complete national datasets in The National Map with improved positional and attribute accuracy.

Results: The use of The National Map Corps encourages citizen participation in volunteer map data collection activities and has resulted in more complete, current, and accurate (position and attributes) national datasets in The National Map.

Data Availability: The data collected by volunteers becomes part of the National Structures Dataset, which is one of the publicly available layers within The National Map and can be found at https://www.usgs.gov/core-science-systems/national-geospatial-program/national-map.

D.6 Environmental Protection Agency (EPA)

D.6.1 Building Capacity to Measure Air Pollution Mitigation Strategies at Schools

Lead Sponsoring Agency: EPA

Authority: Clean Water Act (Section 103)

Project Summary and Goals: Studies have shown that populations spending time near busy roads face elevated risks for many adverse health outcomes including asthma, developmental effects, and premature mortality. Research indicates that noise and vegetative barriers (separately or in combination) can reduce downwind air pollutant concentrations near busy roads. In 2016, EPA funded an intramural study on the effectiveness of roadside vegetation barriers to reduce exposure to vehicle emissions at sites in Oakland and Detroit. One of those locations, Brookfield Elementary School in Oakland, CA, is directly adjacent to a busy goods movement corridor (I-880). EPA assisted in the design of a vegetation barrier that was planted next to an existing noise barrier for air pollution mitigation. EPA also took initial air samples to establish baseline air quality conditions on the school site. Subsequent funding awarded in FY18 supplemented and expanded this work by: (1) acquiring low-cost sensors and designing innovative sensor housing units so that school/community members can monitor the effectiveness of the vegetation barrier as it grows over time; (2) training sensor operators and teachers on how to collect and evaluate sampled data; and (3) developing educational materials for Brookfield Elementary. While the focus of this project is to evaluate the progress and effectiveness of the

vegetative barrier, the methods and resources can also be used to promote and evaluate the implementation of other mitigation strategies to improve air quality at schools based on the recently released EPA report "Best Practices for Reducing Near-Road Air Pollution at Schools."

Justification for Using Crowdsourcing and Citizen Science: The initial phase of this project provided expert technical guidance to the School and the project partners on how best to design a vegetative barrier to mitigate near-road air pollution exposures. Guidelines were developed and applied for how to plant an effective barrier. Many juvenile trees and shrubs have been planted; however, it will take a few years before it will be possible to measure an air quality signal related to the barrier using sensors. In the meantime, resources have been devoted to the design and production of two user-friendly sensor packages; a Solar-Powered Air Quality Sampling System and a Portable Air Quality Sampler System. In May 2018, hands-on training of the equipment was piloted with school staff, though no data were collected. The long-term nature of this project is well-suited to citizen science since the vegetation barrier will need to mature and EPA staff cannot be on hand to regularly collect research data from year to year. Instead, the EPA is investing in building the capacity for the school and its staff to be able to measure air quality on their campus in the future.

Status: The project is ongoing.

Location: The project is located in Oakland, CA.

Participation: The project targeted students and staff of Brookfield Elementary School with possible broader community involvement in the future.

Consent: N/A

Submissions: N/A

Resources: Funding amounting to $40,000 in FY17 and $38,000 in FY18 was used for contractor support, air sensor acquisition, and development of training materials. A total of 0.3 FTEs were used in both fiscal years.

Partnerships: Non-Federal partners included the Bay Area Air Quality Management District, CALFIRE, Urban Releaf, Brookfield Elementary School, and Higher Ground Neighborhood Development Corp.

Advancement of Agency Mission: This project advances the agency's mission to protect human health and the environment by researching a potentially effective mitigation strategy to reduce children's exposure to near-road air pollution. The project is utilizing two innovative approaches: 1) advanced monitoring technologies: the project has funded the acquisition of advanced portable monitoring equipment that will eventually be provided to the school/community along with two innovative sensor housing units (for both fixed site and mobile data collection); and, 2) crowdsourcing and citizen science: the project will support the provision of educational materials and training to the school/community so that they will be able to collect, process, and interpret pollutant concentration data they collect downwind of the vegetation barrier as it matures over time.

Results: Data collection by school staff and students has not yet begun. Initial data collection could begin during the 2018-19 school year.

Data Availability: N/A

D.6.2 Crowdsourcing to Monitor Private Wells and Assess Contaminant Sources

Lead Sponsoring Agency: EPA

Authority: N/A

Project Summary and Goals: The goal of this project is to demonstrate how to use crowdsourcing to provide improved data to assess water quality in private water wells to protect private domestic well users. Private domestic wells (PDWs) are a source of drinking water for 15 percent of the U.S. population. Because private wells are an important drinking water source, it is incumbent upon homeowners to (1) understand potential sources of well contamination; (2) conduct testing of the appropriate parameters that may affect their well; and (3) take action on the results. This project addresses these steps, focusing on key parameters important to the water quality of private wells, including nitrate and *E. coli*. Nitrate is the most common anthropogenic contaminant found in private water wells that exceed human health standards. Assessing nitrate concentrations in private drinking water wells is especially critical in homes with young children (e.g., preparing infant formula using nitrate contaminated water is a known risk factor for methemoglobinemia or blue baby syndrome). *E. coli*, another parameter of key concern in private water wells, can emanate from human and animal fecal wastes. Wells can be contaminated from the surface where the wells are not adequately sealed or through the subsurface via contaminated ground water. In a national study of U.S. aquifers, nearly 30% of over 1100 private wells sampled tested positive for fecal-indicator bacteria.

Justification for Using Crowdsourcing and Citizen Science: Monitoring of private drinking water wells is ideally suited to crowdsourcing and citizen science. This project is being developed as a pilot to develop the training materials needed to conduct sampling, and how to understand the impacts of contamination in domestic wells and potential solutions. It is anticipated after this pilot work is completed that high school STEM classes nationally could independently carry out these efforts to protect this water supply.

Status: The project started in 2018 and is ongoing.

Location: Initially, the project took place in Arkansas high schools and is expanding to other schools.

Participation: The project targets high school STEM classes. The average number of individuals per class is approximately 15. Each class was engaged 1 to 2 times per month. The total number of volunteer hours was approximately 150 hours.

Consent: All individuals provided consent to participate in this activity.

Submissions: Water quality data.

Resources: A total of $50,000 has been allocated for the project, with $10,000 spent in FY18. These funds are being used to purchase equipment and supplies, identifying locations, coordinating with teachers and classes, develop training materials, and design the quality assurance project plan. The project requires less than one FTE per fiscal year.

Partnerships: Non-Federal partners included high school STEM classes.

Advancement of Agency Mission: This project will provide a better understanding of the extent of the fate and transport of key groundwater pollutants, temporally and spatially. It can provide important information to protect a key component of the U.S. domestic water supply.

Results: Data gathered will advance understanding of the quality of water in private domestic wells, to help ensure the safety of these water supplies.

Data Availability: These data will be made available to the public as confirmed by the owners of the wells.

D.6.3 Cyanoscope: EPA collaborative partnership on monitoring harmful algal blooms[28]

Lead Sponsoring Agency: EPA

Authority: N/A

Project Summary and Goals: This program started at the request of the New England State environmental agencies and their efforts to determine how best to monitor and manage harmful algal and cyanobacteria blooms. This initial project evolved into a three-tiered program to educate people on the problem, how to monitor and provide surveillance to better understand the dynamics of harmful algal blooms (HABs), and the collection of key data to assist in determining trends, hotspots, and other important data surrounding HABs.

Justification for Using Crowdsourcing and Citizen Science: Crowdsourcing and citizen science is the most cost-effective way to collect data on HABs. HABs can be very transitory in nature, and having a large collaborative of individuals from all geographic areas provides much better coverage and monitoring/surveillance opportunities. This program provides a large educational component to those who recreate and live near these waterbodies, and offers a real opportunity for data collection that would otherwise be unobtainable.

Status: The project started in March 2013 and is ongoing.

Location: The project takes place globally.

Participation: The project targeted all interested parties. Over 300 organizations participated. Ninety percent of the collaborative effort is accomplished through joint volunteering of time and expertise.

Consent: No consent was needed.

Submissions: Image based documentation of harmful algal blooms, microscopic images of individual organisms, and fluorometric data.

Resources: This project was initially funded in 2014 and overall development has been through the volunteer efforts of the program collaborators. Total FY18 support amounted to $1000 and less than one FTE. Primary expenses were tools and monitoring equipment for surveillance and assessment capabilities.

Partnerships: Federal partners included the U.S. Geological Survey. Non-Federal partners included over 300 collaborative partners ranging from State environmental agencies, academia, lake and watershed organizations, public water suppliers, concerned citizens, public K-9 schools, tribal nations, and private industry.

Advancement of Agency Mission: Protecting the Nation's water resources for ecological and human health reasons is a primary mission of the EPA. Algal toxins in water can cause fish kills, beach closures, and result in unsafe drinking water supplies that endanger human and animal health. Using citizen science advances the mission in two major ways: (1) bringing the importance of recognizing and understanding the causes of harmful algal blooms to the attention of citizens, and (2) add to EPA

[28] The website for Cyanoscope: EPA collaborative partnership on monitoring harmful algal blooms can be viewed at Cyanos.org.

research on improved ways to identify and predict harmful algal blooms by providing more data on bloom occurrence, duration, location, and toxicity.

Results: Much of the result of this program has been educational in nature, with training close to 100 individual public water supply staff, municipal employees, and hundreds of concerned citizens. Hard data collected in the program are used to identify trends, hot spots, areas of improvement from management practices, etc.

Data Availability: Data will be made available to the public using an existing cyanobacteria collaborative webpage where data visualization and data input is currently under development (cyanos.org). These data will be incorporated with other data and collected using the consistent quality assurance protocols and methods to ensure data compatibility. No numeric data from this project are available yet, but image data have been posted on two of our collaborative's webpages https://www.inaturalist.org/projects/cyanoscope and https://www.citsci.org/CWIS438/Browse/Project/Project_Info.php?ProjectID=822&WebSiteID=7 .

D.6.4 EPA/US Coast Guard Auxiliary Partnership for HAB Monitoring

Lead Sponsoring Agency: EPA

Authority: N/A

Project Summary and Goals: The goal of this project is to engage the Coast Guard Auxiliary in the Cyanoscope project. This will increase the volume of data on harmful algal blooms (HABs).

Justification for Using Crowdsourcing and Citizen Science: The United States Coast Guard Auxiliary (USCGA) is a volunteer organization that supports the U.S. Coast Guard whose mission includes such tasks as monitoring aids to navigation, surface vessel towing, providing assistance to boaters, and providing public education in boating and safety to the recreational boating community. The project presented an opportunity to form an EPA/USCGA partnership under the public education-marine safety program. The USCGA has numerous surface (boats) and air (helicopter and fixed wing air craft) assets that could be used to support EPA efforts to monitor and sample for conditions that lead to HABs and to provide sampling of water bodies to mitigate their effects. The number of Coast Guard Auxiliary members and the number of vessels that the USCGA increases the number of samples potentially collected and the area that can be studied, thereby increasing the number of individuals aware of HABs and their negative environmental consequences. Sampling efforts can be expanded to include tow net sampling for nutrients or selected organisms as needed given the availability of USCGA surface vessels.

Status: The project started in March 2017 and is ongoing.

Location: The project is based in the United States.

Participation: The project targeted members of the United States Coast Guard Auxiliary. The total number of individuals involved during this period was initially thirty.

Consent: No consent needed.

Submissions: Anticipated submissions are physical observations and data from CyanoScope HAB identification.

Resources: Funding ($17,000) was only used in FY17; less than one FTE was used in FY17 and FY18. Resources were used to hold interagency workgroup meetings and manage communications with USCG and USCGA contacts about training on the Cyanoscope program. A FY18 memorandum of understanding fostering EPA and USCGA cooperation will be used to conduct training on the Coast Guard Auxiliary in how to contribute observations to Cyanoscope.

Partnerships: Federal partners included the United States Coast Guard Auxiliary.

Advancement of Agency Mission: Harmful algal blooms and associated hypoxia events have devastating consequences for ecosystems, communities, and the health of humans, pets, livestock, and wildlife. Recent large scale HAB events in lakes and reservoirs across the country, as well as in large river systems (e.g., Ohio River), emphasize the need for further research to improve water quality and protect public health. HABs occur when physical, chemical, and biological conditions are optimal for bloom development. Previous research identified factors that influence the likelihood of bloom development, including physical drivers such as rainfall, extreme events, stratification, currents, wind, and mixing as well as temperature and light penetration. Protecting the Nation's water resources for ecological and human health reasons is a primary mission of the EPA. Algal toxins in water can cause fish kills, beach closures, and can cause unsafe drinking water supplies. Citizen science advances the EPA's mission in two major ways: (1) bringing to the attention of citizens the importance of recognizing and the causes behind harmful algal blooms, and (2) adding to the research on the identification and prediction of harmful algal blooms by providing more data on bloom occurrence, duration, and location.

Results: The data collected in this effort will augment data already being collected in Cyanoscope and other ongoing Nutrient/HAB research efforts at EPA.

Data Availability: Data will be made available to the public using an existing Cyanobacteria Monitoring Collaborative webpage where data visualization and data input is currently under development (cyanos.org). This data will be incorporated with other data and collected using the same protocols and methods to ensure data compatibility. No data from this project is available yet.

D.6.5 HiveScience: A Citizen Science Project for Beekeepers[29]

Lead Sponsoring Agency: EPA

Authority: N/A

Project Summary and Goals: HiveScience is a citizen science project designed for beekeepers that promotes EPA public engagement around collecting data on hive health, an important research issue at the local, national and international levels. For this project, beekeepers collect data on the health status of honey bee hives, submit a sample of honey for laboratory analysis for biomarkers of honey bee immune response, and provide data on the overwintering fate of sampled hives using an EPA-branded mobile application. Ultimately, these data will be used to determine if there is a correlation between biomarkers of honey bee colony health and actual colony overwintering performance.

Justification for Using Crowdsourcing and Citizen Science: The beekeeping community is acutely aware of the issues affecting honey bee colony health and is motivated to find solutions. Recognizing the limited capacity of State and Federal agencies to monitor and sample a sufficiently large sample of honey bee colonies, partnering with beekeepers is really the only viable solution. The network of engaged citizen scientists established through this project will increase the likelihood of identifying cost-effective tools capable of predicting honey bee hive health, reducing colony losses, and saving beekeepers both time and money.

Status: The project started in February 2017 and is ongoing.

Location: The project takes place on a National scale.

[29] The website for HiveScience: A Citizen Science Project for Beekeepers can be viewed at https://www.epa.gov/citizen-science/hivescience.

Participation: The project targeted beekeepers. The total number of individuals involved during this period was 100. The total number of volunteer hours was around 200 hours.

Consent: All participants consented to participation by actively downloading the project-specific smartphone mobile application and opting to request a honey sample kit.

Submissions: Volunteer beekeepers completed a hive health survey for one honey bee hive using an EPA-provided smartphone mobile application. The smartphone application also recorded the general location of the honey bee hive. In addition, beekeepers submitted a honey sample from the monitored hive.

Resources: Funding ($35,000 in FY17 and $30,500 in FY18) and agency personnel (less than one FTE in both years) were used to (1) create project-specific smartphone mobile applications (iOS and Android), (2) equip volunteer beekeepers for honey sample collection, (3) develop laboratory methodologies for measuring the production of hydrogen peroxide in honey samples submitted by volunteer beekeepers, and (4) provide student services contract support. The smartphone mobile applications were completed through collaboration with EPA's Office of Environmental Information.

Partnerships: Federal partners included the National Institute of Environmental Health Sciences and the U.S. Department of Agriculture's Agriculture Research Service. Non-Federal partners included the Eastern Missouri Beekeeper's Association.

Advancement of Agency Mission: HiveScience was developed in direct response to commitments made by the EPA in the National Strategy on Pollinator Health and its associated Pollinator Research Action Plan as well as the broader research needs identified in the Colony Collapse Disorder (CCD) and Honey Bee Health Action Plan.

Results: This project was launched less than two years ago and is still in the data collection phase. Some data (i.e., Varroa mite counts, mite mitigation, and general location) related to honey bee colony health assessments are readily accessible on a public webpage (i.e., Geoplatform). Beekeepers can use these data to learn about effective hive management strategies. As the project matures, data will be used to identify biomarkers that are predictive of honey bee colony health. Novel, cost-effective tools will be developed and made available to beekeepers. These tools will be useful for reducing colony losses thereby saving beekeepers time and money. It is anticipated that this project will phase-out in FY19.

Data Availability: Some data (i.e., Varroa mite counts, mite mitigation, and general location) related to honey bee colony health assessments are readily accessible on a public webpage (i.e., Geoplatform).

D.6.6 Kansas City Transportation and Local Scale Air Quality Study (KC TRAQS)

Lead Sponsoring Agency: EPA

Authority: N/A

Project Summary and Goals: KC TRAQS crowdsourcing and citizen science (CCS) was one component of a larger project that includes fixed sites with research grade monitors, research grade mobile monitoring, and modeling. The CCS part of the project had two goals: (1) to evaluate the ability of citizen scientists to collect valid air quality data with little training in collection methods using a custom sensor package, and (2) to evaluate the ability of the AirMappers, a low cost and portable air monitoring package, to collect valid data that can be used for Federal, State, and local air monitoring needs. The project also provided an opportunity for providing educational outreach. The project was being conducted by loaning AirMappers to participants in two ways. (1) Scheduled deployments to participating groups and library checkouts were conducted by giving a presentation to area middle and high school students and the loan of five AirMappers for one week to a class. The class conducted their

own experiments using the AirMappers, but were asked to keep notes and take measurements outdoors in the study area. Other groups in the study area scheduled a similar loan of the equipment, though only one group has participated. 2) AirMappers were also loaned to two libraries in the study area for check out to community members. Those who checked out the AirMappers were provided a manual and contact information for the study leads.

Justification for Using Crowdsourcing and Citizen Science: The only way to gather data on the effectiveness of CCS campaigns is to include citizen science in the study. The awarding of grants or other means to collect data are less effective for this type of study because the agency loses some control of the collection of data and decisions on how the study is conducted.

Status: The project started in October 2017 and concluded in October 2018.

Location: The project is located in Kansas City, KS.

Participation: The project targeted middle and high school classes, community volunteers, and organized group volunteers. There were two organized group volunteers, approximately seven community volunteers, and approximately 20 to 25 classrooms led by nine teachers that participated. Up to two class rooms per week were active during the school year. During the summer, there were two group volunteers and up to two community volunteers per week.

Consent: The libraries and community volunteers provided consent with sign out agreements. The classrooms provided consent through emails with the teachers who participated.

Submissions: Participants collected data using a custom air monitoring package, called the AirMapper. They turned in approximately 50 *Submissions:* 20 to 25 middle and high school classes, 22 library check out submissions (days of use), and one long term scheduled deployment.

Resources: FY17 funds ($50,000 and less than one FTE) were used to build the AirMappers and interact with participants.

Partnerships: N/A

Advancement of Agency Mission: The CCS part of the KC TRAQS project supports the EPA's mission to protect human health and the environment by investigating how air pollutants move in a valley with many transportation-related sources of pollution, determining the contributions of various sources of air pollutants, and by comparing different technologies' capabilities to collect this data. The CCS part of the project investigates the ability of low-cost monitors and citizen scientists to provide quality data, which could increase the ability of all interested parties and reduce costs of collecting environmental data. It also increases public awareness of environmental effects of transportation-related sources of air pollutants on human health by encouraging public participation in data collection.

Results: Science questions pertaining to the citizen science component of the larger KC-TRAQS project were: Can the effectiveness of a self-driven community measurement project be quantified? What is the suitability of a sensor instrument package (e.g., AirMapper) to support real-time mapping of particulate matter by citizens? What is the added value of citizen science in the research process and can this value added be quantified? The goal is to use data collected by the citizen science instrument package (i.e., AirMapper) in analyses that will also use data collected by more traditional methods (i.e., FEF/FRM instrumentation, lower-cost sensors, etc.). These results may be used to inform future citizen science projects (i.e., lessons learned) and also increase community environmental awareness.

Data Availability: All data from the KC TRAQS project will be made available to the public. A website will be created once the project is finished and all data have been collected, organized, and quality assured.

D.6.7 Marine/Water Contact Sanitary Survey Workshops in California[30]

Lead Sponsoring Agency: EPA

Authority: Beaches Environment Assessment and Coastal Health (BEACH) Act

Project Summary and Goals: EPA conducted three day-long workshops in California to educate and train local watershed managers, citizen scientists, environmental justice organizations, and tribal members on EPA's new Sanitary Survey App. The Marine Sanitary Survey App is based on the marine beach sanitary survey form and was developed to provide a technically sound and consistent approach to identify pollution sources and share information (e.g., water quality data, pollutant source data, and land use data) to improve water quality for swimming and other primary contact recreation activites. This was a collaborative outreach effort with the California State Water Resources Control Board's (SWRCB) Clean Water Teams within California Regional Water Quality Control Boards 4, 5, and 8 and onsite co-sponsorship with local and tribal organizations, including the Inland Empire WaterKeeper, Heal the Bay, and the Big Valley Rancheria of Pomo Indians. At each workshop, EPA and the California SWRCB demonstrated the utility of the app and hands-on training for participants.

Justification for Using Crowdsourcing and Citizen Science: Local citizens react positively to training that will help improve water quality. The direct hands-on contact that CCS provides for interested local watershed managers, citizen scientists, environmental justice organizations, and tribal members empowers them to learn how to better manage water bodies. After the training, citizen scientists are able to collect data to identify sources of pollution that cause beach closures or impairment of recreational uses of their waters. With this information they are empowered to identify solutions to improve the quality of local waterbodies.

Status: Workshops were held on September 21 (California RWQCB 5) in Riverside County – Inland Empire WaterKeeper; September 23 (RWQCB 4) in Los Angeles County – Heal the Bay; September 26 (RWQCB 8) in Clear Lake Watershed – Big Valley Rancheria of Pomo Ind. All scheduled events are complete.

Location: The project is located in California.

Participation: The project targeted local beach managers, citizen scientists, and tribal members. The total number of individuals involved during this period was 75, and the average number of active participants was 25+ per workshop. The total number of volunteer hours was 700.

Consent: A total of 75 individuals provided consent to participate in this project.

Submissions: N/A

Resources: There is no direct standing budget allocation in the Office of Science & Technology for this CCS project. However, EPA was able to work with partners to leverage resources to obtain space to hold the workshops and logistics for shipping materials. FY17 funds ($7,500) were used for workshop preparation and administrative support, travel, scheduling and selection of suitable training sites and related coordination, preparation of training materials, shipping materials, setting-up training rooms, and on-site coordination and support (0.25 FTE).

Partnerships: Federal partners included EPA Region 9. Non-Federal partners included the California State Water Resources Control Board and California Regional Water Quality Control Boards 4, 5, and 8 as well as onsite co-sponsorship with local and tribal organizations, including Inland Empire WaterKeeper, Heal the Bay, and the Big Valley Rancheria of Pomo Indians.

[30] The website for the Marine/Water Contact Sanitary Survey Workshops in California can be viewed at https://www.youtube.com/watch?v=w57F_nSV0a4&list=PLMSa5d-iIl6OsjuwK3Fh0tH6D4BOmFneV.

Advancement of Agency Mission: Under the Clean Water Act of 1987 (CWA), EPA reviews and approves water quality standards (WQS), which are established by states and authorized tribes. WQS reflect the management goals for water bodies, must be scientifically sound, and must protect the designated uses of the water body. Additionally, under the BEACH Act amendments to the CWA, EPA supports states, tribes, and local governments in protecting pubic health at beaches. EPA's Office of Science and Technology is responsible for overseeing the national WQS program and the national Beach Program. As a part of this responsibility, the Standards and Health Protection Division (SHPD) provides technology transfer, training, and outreach to water quality professionals and beach managers associated with Federal, State, tribal, and local agencies as well as those within the private sector. As a part of its outreach program, SHPD has been offering comprehensive training sessions since 1991.

Results: The science shared via the Sanitary Survey workshops has enabled participants to better understand their strategies for monitoring fecal indicator bacteria and placing data into context. Having the workshops at various venues throughout California generated interest in adopting water contact surveys by organizations that did not participate in the workshops. To further leverage the workshop's impact, and due to this interest, California produced a video series featuring presentations from the workshop, which can be accessed at www.youtube.com/watch?v=w57F_nSV0a4&list=PLMSa5d-iIl6OsjuwK3Fh0tH6D4BOmFneV. The EPA's collaboration with the State Water Resources Control Board and the Clean Water Team also led to the video An Introduction to Sanitary Surveys, which can be accessed at https://www.youtube.com/watch?v=e2aFg0dauVQ&index=3&list=PLvTjRb8VCkp5xsM7UgA6769YzPlYeiA0r. This video was recorded from a live webinar presentation hosted by two work groups from the California Water Quality Monitoring Council, Safe to Swim, and California Water Quality Monitoring Collaboration Network, as part of the Swimmable California Webinar Series 2017-2018. The training is bearing fruit. In 2018, several of the inland water quality monitoring programs in California are adopting/have adopted water contact sanitary surveys as part of their routine science programs to address fecal contamination in their recreational waters.

Data Availability: Making environmental data open and accessible is important to USEPA. Likewise, this was important to workshop participants. The current table-based app allows the user to collect and export sanitary survey data. However, EPA does not collect this information.

D.6.8 Measuring Coastal Acidification in New England Estuaries

Lead Sponsoring Agency: EPA

Authority: N/A

Project Summary and Goals: Four states in New England have established commissions or legislation to increase investment in research, monitoring, and mitigation strategies to address acidification of coastal areas. High resolution measurements of pH and total alkalinity (the ability of seawater to buffer against acidification) can help coastal water managers assess the health of local estuaries and better understand the threats to these ecosystems and shellfish species. This project will lend new, high quality, more affordable sensors to local volunteer water quality organizations and build capacity at the New England Regional Laboratory (NERL) to measure total alkalinity in seawater samples. These water quality citizen science volunteers will then be able to accurately measure pH and send water samples to the laboratory for total alkalinity analysis, providing valuable insight for coastal management decisions.

Justification for Using Crowdsourcing and Citizen Science: Volunteer water quality monitoring is a cost-effective way to collect data.

Status: The project started contacting potential partners in September 2018.

Location: The project is located in Maine, New Hampshire, and Massachusetts estuaries.

Participation: The project targeted watershed, estuary, and bay protection groups and national estuary programs.

Consent: N/A

Submissions: Water samples to be analyzed for total alkalinity; instrument readings of pH.

Resources: In FY18, $50,000 and less than 0.1 FTE were used to provide equipment, supplies, and contract support.

Partnerships: Federal partners included NOAA's Ocean Acidification Program and Sea Grant. Non-Federal partners included the Northeast Coastal Acidification Network (NECAN), and the states of Maine, New Hampshire, and Massachusetts.

Advancement of Agency Mission: One of EPA's missions of is to protect water quality. The Clean Water Act requires criteria and standards to protect aquatic life and other designated uses. Measurements of coastal acidification will assist the agency in better understanding the variability of calcium carbonate concentrations that specifically impact shellfish resources.

Results: This approach provides new monitoring technology to citizen scientists, which will provide a more regional perspective on the variability of coastal acidification in New England. This project leverages the network of established partners including the Northeast Coastal Acidification Network (NECAN), National Estuary Programs, State coastal managers, and the Integrated Sentinel Monitoring Network, which targets ocean and coastal acidification as an opportunity for development of a network of monitors. This project will educate the public and other stakeholders about the threats posed by coastal acidification and will supplement other data that evaluates threats to aquatic life, as required by the Clean Water Act.

Data Availability: Data will be made public, but the data management plan has not been established yet. EPA plans to utilize existing resources such as NECAN, Northeastern Regional Association of Coastal Ocean Observing Systems, and the Ocean Acidification Information Exchange.

D.6.9 Micro CSI-Urban Edition: A Microbial Citizen Science Initiative in Urban Watersheds

Lead Sponsoring Agency: EPA

Authority: Clean Water Act

Project Summary and Goals: Across the Nation, a number of citizen science efforts have been conducted to monitor water quality. Efforts have included monitoring of bacteriological parameters (*E. coli*, enterococci, and fecal coliforms) and/or physicochemical parameters (e.g., temperature, turbidity, pH, conductivity). Although these efforts are extremely useful to identify a problem area, they can be limited in scope due to insufficient resource availability, human manpower, or even sampling logistics. Likewise, monitoring efforts conducted by county, city, and State governments to identify water quality issues are often limited due to funding and/or lack of available personnel. The aim of our proposal is to build Urban MicroCSI, a program bringing together the efforts of citizen scientists from a variety of urban locations. Information gathered by citizen scientists on microbial water quality will be collected in a central location and used to adapt a statistical modeling tool (Virtual Beach) already used in recreational beaches to urban streams. Virtual Beach will facilitate identification of stream locations prone to impairment due to fecal bacteria and the environmental conditions that produce impairments. The effort will include source identification to better inform mitigation practices.

Justification for Using Crowdsourcing and Citizen Science: One of the main drivers of using this type of program is to facilitate water quality monitoring efforts by citizen scientists and encourage community participation in activities promoting environmental awareness. Sampling surface waters for water quality analysis can be an expensive activity for State and local governments. Monitoring by citizen scientists presents a cost-effective alternative, but it is imperative that the data abides to a QA/QC level acceptable under regulatory criteria. Using CCS allowed testing of the quality and usability of the data, sampling efficiency, and sampling coverage. The program provides an example of how other communities can develop similar monitoring programs using citizen scientists.

Status: The project started in December 2016 and is complete.

Location: The project is located in Proctor Creek and Oconee River Watersheds in Atlanta and Athens, GA, respectively.

Participation: The project targeted volunteers from the city of Atlanta for the Proctor Creek watershed, and University of Georgia (UGA) students in Athens for the Oconee River watershed. More than 30 individuals were involved during this period, and the average number of active participants per week was three.

Consent: Volunteers collecting samples in Proctor Creek Atlanta agreed to participate under a program called Neighborhood Water Watch, a community driven collaborative program between the Chattahoochee River Keeper and local neighborhood groups. In addition, the Chattahoochee River Keeper trains volunteers on sample collection and analysis under an EPA approved QAPP. Students from the University of Georgia agreed to perform sample collection and analysis as part of a class integrating experiential learning in the curriculum.

Submissions: The participants provided data, and shipped or delivered water samples to the EPA.

Resources: A Federal employee (1.0 FTE) designed and coordinated the overall project, managed the contract, and reviewed data for accuracy. Part of the funds ($56,000 in FY17 and $18,000 in FY18) were used to buy materials for sampling kits, materials used to quantify fecal indictors, and reagents to perform DNA extraction and analysis. Money was also used to buy a multiprobe meter to measure environmental parameters and pay volunteer coordinators in Atlanta and Athens. Other resources included efforts by a sustainability class at UGA focusing on experiential learning, which provided volunteers and data during the last sampling semester. Federal staff performed data management and reviewed data for presentation.

Partnerships: Non-Federal partners in Athens included the River Basin Center and Watershed UGA, both at the University of Georgia. In Atlanta, the Non-Federal partner was the Chatahoochee River Keeper.

Advancement of Agency Mission: One of EPA's needs identified in the review of the Beaches Environmental Assessment and Coastal Health Act is the need to provide alternative methodologies for rapid water quality assessments. The need is not only valid for coastal waters, but it is also highly needed for inland waters. The aim of this project was to develop a robust set of information suitable to test and implement the use of Virtual Beach for the rapid assessment of bacterial impairments in urban watersheds. Virtual Beach is a statistical tool developed for freshwater and marine beaches to rapidly identify fecal bacterial levels exceeding ambient water quality criteria using easy to measure environmental parameters. This project will provide information needed by the EPA to test the applicability of the model for urban watersheds. In addition, microbial source tracking information will be integrated to determine the prevalent sources of contamination impacting urban hotspots.

Results: The results from this project will be used to increase environmental education and awareness of citizen scientists on the impact of fecal contaminants in urban streams; develop easily transferable

protocols for the collection by citizen scientists of meaningful data usable for the development and testing of models; empower and encourage local NGOs to develop a consistent and sustainable sampling and analysis plan that provides a reliable source of information for the local government and fosters a healthy partnership in which citizen scientists are an essential part of the process; and finally, it will make Virtual Beach-Stream and River Module widely available to local governments, so that they can use it to better allocate resources when determining and implementing mitigation strategies.

Data Availability: The data collected will be available to the public in a variety of ways. The data from Proctor Creek in Atlanta has been posted in the Chattahoochee River Keeper website, under the neighborhood water watch (https://nww.chattahoochee.org/DataPage). The data collected in Athens, GA will be integrated with the monitoring performed by UGA students under the watershed UGA effort and which will reside in a variety of google documents available to students for a variety of analysis. In addition, some of the data can be found in the Upper Oconee Watershed Network site (http://uown.org/UOWN-Wordpress/monitoring-results). Finally, the data will be available to the scientific community in the form of manuscripts that are currently under preparation by both EPA and UGA.

D.6.10 Using Citizen Science to Analyze Underwater Videos in the Great Lakes[31]

Lead Sponsoring Agency: EPA

Authority: Clean Water Act § 104, 33 U.S.C. § 1254

Project Summary and Goals: The goal of this project is to evaluate a web-based citizen science approach to analyzing underwater videos in the Great Lakes to determine substrate type and presence of invasive species, such as round gobies or dreissenid mussels. Citizen scientists will be trained and tested for accuracy using a subset of underwater videos. The relative precision, accuracy, and cost-effectiveness of the citizen science approach will be compared to expert video interpretations. In addition to increasing our understanding of habitat characteristics and invasive species in the Great Lakes, this project aims to address the following questions: Can a citizen science approach to underwater video analysis meet the information needs of managers? How does the data produced by citizen scientists compare to the data produced by experts in terms of precision, accuracy, and relevancy to management needs? What effects, if any, does video quality and attribute selection have when comparing analysis of experts and citizen scientists?

Justification for Using Crowdsourcing and Citizen Science: A citizen science approach to underwater video analysis provides a cost-effective means for individual videos to be analyzed by multiple viewers. Multiple analysts increase precision and reduce bias but trained professional analysts are expensive. The cost to hire a single expert to review each video is $36,000. The CCS project also offers the opportunity to analyze and share results with the public in a more timely manner than would be possible having experts analyze the videos.

Status: A stakeholder input group was convene in Fall 2017. The project was designed in early 2018 and beta-tested in May – July 2018. Updates to the application are being made and tested, with a public launch planned for 2019. The project is ongoing.

Location: The project is located in the Great Lakes Region of the United States.

[31] The website for Using Citizen Science to Analyze Underwater Videos in the Great Lakes can be viewed at https://www.zooniverse.org/projects/USEPA/deep-lake-explorer.

Participation: The project targeted public and tribal, local, State, and Federal partners with 161 participants visiting the website in the beta-testing phase.

Consent: N/A

Submissions: In the beta-testing phase, 468 images were clipped from 52 videos representing 52 sites. Each image needed to be viewed 15 different times by different people. One hundreed and fifty video clips were pulled from 28 videos representing 28 sites, and each video need to be viewed 10 times each. When reviewing a video clip, three questions were answered and when viewing a image, two questions were answered. As a result, there were approximately 18,540 data submissions.

Resources: In FY17, EPA staff coordinated with stakeholders and designed and managed the project on the crowdsourcing website Zooniverse. A contractor provided technical support to run statistical analysis, modify videos to be used, and assist with programming. Total funding was $12,000 and required less than one FTE. In FY18, Federal staff upgraded the web-based project on the Zooniverse platform to include higher quality videos. External funding was used for video processing and contract support for the redesign and execution of the project. The FY18 budget was $25,000 and required less than one FTE.

Partnerships: Non-Federal partners included the Wisconsin Department of Natural Resources and Michigan Department of Natural Resources with a stakeholder team from 14 other non-Federal agencies. In addition, staff from different offices within EPA helped design the website

Advancement of Agency Mission: To effectively protect and restore water quality, EPA, states, and tribes need high quality data and information. Underwater videos are a tool being developed to help with assessing the overall condition of the Great Lakes as part of the National Coastal Condition Assessment, one of the surveys under the National Aquatic Resource Survey Program. The National Aquatic Resource Surveys (NARS) are collaborative programs between EPA, states, and tribes designed to assess the quality of the nation's coastal waters, lakes and reservoirs, rivers and streams, and wetlands using a statistical survey design. This work to improve our ability to process, analyze, and assess videos of underwater features and characteristics in a timely and cost-effective approach will increase the viability of using this technology as part of NARS and State/tribal water quality assessments.

Results: Although results from the beta-test are still being evaluated, preliminary results demonstrated that citizen scientists were able to identify substrate type, round gobies, and vegetation. The team also found that the use of crowdsourcing shows promise in being an acceptable and cost-effective means of interpreting/screening videos for experts to analyze in more depth. Additionally, the team learned that the agreement between citizen scientists and expert analysis would likely improve if the quality of the video was improved. Using the finding, the FY18 effort will focus on re-evaluating the tool with higher quality videos. Finally, the team will also be working on establishing a smooth and effective workflow so that when videos collected in 2020 as part of the National Coastal Condition Assessment are submitted, they will be processed and results can be shared in a timely manner that will be useful to resource managers in the Great Lakes.

Data Availability: Results from the beta-test are being reviewed. The preliminary results were shared with stakeholders in August 2018. Results of the beta-test from sites where there was agreement between experts and citizen scientist will be included on the Deep Lake Explorer website and in the 2015 NCCA reports. A report will be posted for the general public and participants at https://www.zooniverse.org/projects/USEPA/deep-lake-explorer.

D.6.11 Using Citizen Science to Improve Drinking Water Epidemiology Studies in Puerto Rico[32]

Lead Sponsoring Agency: EPA

Authority: N/A

Project Summary and Goals: The goal of this project is to showcase the simplicity of an innovative saliva test and improve the way epidemiology studies are designed using citizen science. Families with 3rd to 5th graders will report incidences of gastrointestinal disease to science teachers to facilitate follow-up stool and saliva tests in impacted school districts. The innovative saliva tests use salivary antibodies as a non-invasive indicator of waterborne infections. The project will prepare instructions for parents on how to report incidences of gastrointestinal illness that will be sent home with students at the start of the school year. The school districts in participating rural communities will collect health data when illnesses occur to maximize the effectiveness and improve the results of the epidemiology study. The incidence of illness will then be linked to specific community water systems using Safe Drinking Water Act sample results and violations. This project is important because it inspires citizens (i.e., non-experts) to actively participate in targeted studies to improve their health and understanding of water treatment. A secondary benefit will be the educational aspect for students. School science teachers will encourage students to participate, promote the scientific method behind this epidemiology study and provide information on waterborne illness, human health, and personal hygiene.

Justification for Using Crowdsourcing and Citizen Science: Citizens in Puerto Rico have a great interest in and can be positive contributors to environmental protection and the health of their communities. This citizen science project builds on a long history of working with citizens, community groups, students, and volunteers in rural communities in Puerto Rico. It allows community citizen scientists to become engaged in the process of linking their illnesses to pathogens in their drinking water systems. With the project-generated communication materials, citizens will understand the reason for the study, the trigger points/timing for collection of stool and saliva samples, and the results of the tests. School science teachers are assisting with the recruitment and retention of volunteers and will be able to provide answers to questions at a local level. Funding for this study is providing guidelines on quality assurance and quality control for dissemination to school science teachers and participants in the study.

Status: The project started in August 2017 and is ongoing.

Location: The project is located in Patillas, Adjuntas, and Yabucoa, Puerto Rico.

Participation: The project targeted 3rd to 5th grade school children. The total number of individuals involved during this period was 198 participants. Recruitment and training of school officials and science teachers required an estimated 100 hours, education and participation of 3rd -5th grade students required 600 hours, and survey completion by parents required 100 hours (a total of 800 volunteer hours).

Consent: Human Subject Research (HSR)-000997 approval, Information Collection Request (ICR) 2080-0083 approval, Puerto Rico Dept. of Education and private school approval.

Submissions: A total of 198 participants (33 3rd to 5th Graders from 6 private/public schools) will provide stool/saliva at the beginning of the Citizen Science Epidemiology Study and when gastrointestinal illness (GI) occurs for collection and analysis by Pegasus Technical Services, InterAmerican University in Puerto Rico, and EPA Office of Research and Development (ORD) in Cincinnati, Ohio. Surveys will also

[32] The website for Using Citizen Science to Improve Drinking Water Epidemiology Studies in Puerto Rico can be viewed at https://cfpub.epa.gov/si/si_public_record_report.cfm?dirEntryId=340734.

be filled out by parents and 3rd to 5th graders to document the impact of diet and drinking water sources on GI

Resources: One FTE and $3,000 were used in FY17 for supplies and equipment. One FTE and $53,000 were spent in FY18 on extramural support for preparation of Internal Review Board and Information Collection Request applications, the InterAmerican University Work Plan, Quality Assurance Project Plan and Health and Safety Plan to conduct the study in schools in rural Puerto Rico.

Partnerships: Non-Federal partners included Pegasus Technical Services, InterAmerican University, Department of Education, and Private Schools in Puerto Rico.

Advancement of Agency Mission: A majority of Safe Drinking Water Act violations occur in small rural communities that are economically challenged and cannot afford to provide basic filtration and disinfection treatment processes or pay operators to maintain their water systems. As a result, residents are vulnerable to acute illnesses caused by microbial and chemical contaminants. Often, episodes of diarrhea in isolated rural communities follow patterns that become a way of life. One way to identify risk factors for disease is to conduct epidemiology studies that document illness rates, and at the same time, involve and educate members of the community in the process.

Results: This citizen science project investigates the incidence and type of gastrointestinal illness using fecal and saliva tests in communities in Puerto Rico that do not have a municipal drinking water treatment plant. ORD will use saliva tests to look at the incidence of several bacterial and viral pathogens. Additionally, DNA extracted from stool samples will be used to determine the abundance of different bacterial groups, including fecal indicator bacteria, fecal source indicators, bacterial pathogens, and virulence factors. Overall, the information from this project is critical to identify the etiological agents and to evaluate the effectiveness of water treatment.

Data Availability: The data obtained during the study will be publicly available upon publication in a peer-reviewed journal article without personally identifiable information or sensitive personal information. Data will also be available in EPA Science Hub publication datasets.

D.6.12 Low Cost Sensors for Real-time Continuous Water Quality Monitoring in Georgia[33]

Lead Sponsoring Agency: EPA

Authority: Clean Water Act

Project Summary and Goals: The purpose of this study is to evaluate select low-cost water quality sensors in comparison to industry standard equipment as part of a regional innovations initiative supported by the U.S. EPA's Office of Research and Development (ORD). Non-point source monitoring programs, such as Georgia Environmental Protection Division's (GAEPD's) Georgia-Adopt-A-Stream (GA-AAS), that utilize citizen science data collected through volunteer monitoring efforts at the community level are vital to understanding base-line water quality conditions and the state of our nation's waters. In recent years a rapid expansion of open source resources and support have made the design and deployment of low-cost water quality sensors accessible to watershed monitoring organizations, researchers, students, and citizen scientists alike. The U.S. EPA currently maintains an Air Sensor Toolbox for citizen scientists but there is no analogous resource for low-cost water quality sensors. There is currently very limited information on the capabilities and quality of data collected by these emerging low-cost alternatives.

[33] The website for Low Cost Sensors for Real-time Continuous Water Quality Monitoring in Georgia can be viewed at https://github.com/CWQM/sensor-code.

Justification for Using Crowdsourcing and Citizen Science: Non-point source monitoring programs such as GA-AAS currently monitor a wide range of sites in different environments and conditions. This project took advantage of the pre-established network of active volunteers to assist in testing the ease of use and reliability of low cost water quality sensors. Citizen science eliminates the need to find installation locations and reduces travel and FTE on the part of EPA.

Status: The project started on January 23, 2018 in August 2017 and the sensor evaluation study with associated final report was completed in August 2018. . The use and testing of the sensors by volunteer monitoring organizations is ongoing.

Location: EPA Region 4 (Southeast U.S.)

Participation: The project targeted active members of Adopt-A-Stream. In total, 15 monitoring organizations participated in the sensor design workshop and subsequent field testing of the sensors. The total number of volunteer hours was estimated to be around 2,000 from all 15 groups.

Consent: Consent was obtained from 15 volunteering water quality monitoring groups.

Submissions: Observations on equipment, ease of use, durability, and technical issues.

Resources: In FY17, 0.25 FTE was dedicated to project proposal development and conceptual design of a sensor prototype and $27,000 was spent on equipment and supplies required to build and test the prototype sensor and build 20 replicate units during a public workshop and field study planned for FY18. In FY18, less than a $1,000 and 0.75 FTE was dedicated to designing and testing a sensor; pre-assembly of units prior to a public workshop; developing and presenting the workshop; installing, maintaining and troubleshooting equipment; providing support to adopt-a-stream; analyzing data; and writing the final report.

Partnerships: Non-Federal partners included GAEPD's GA-AAS and the University of Georgia.

Advancement of Agency Mission: Quantifying the cumulative water quality impacts on watersheds remains both a regional and national science priority and remains a top research priority for many of the states as summarized in a 2016 survey conducted by the Environmental Research Institute of the States. Collecting in-situ measurements of water quality via traditional instantaneous measurements is often inefficient and ineffective at observing natural patterns, trends, and assessing overall ecological health in extremely dynamic systems. Furthermore, collecting data during storm events can also be difficult and dangerous using traditional means. Advancements in monitoring technologies have made real-time continuous monitoring of water quality possible. This study will provide insight into emerging technologies and how they might be used by citizen scientist to assist in protecting human health and the environment.

Results: Data collected by the citizen science groups involved in this project is for their use. Feedback from the groups will be used in further development of equipment suggestions by EPA.

Data Availability: Data collected by the citizen science organizations involved in this project is shared at their discretion.

D.6.13 Smoke Sense[34]

Lead Sponsoring Agency: EPA

Authority: N/A

Project Summary and Goals: Smoke Sense is a citizen science, crowdsourcing initiative that leverages individual citizen's observations of wildland fire smoke and its health effects to broaden the knowledge base about smoke exposures and how they impact communities. Smoke Sense is facilitated through a mobile application that allows users to explore their current and forecasted daily air quality, maps of fire locations, and satellite images of smoke plumes. It also provides a means for users to learn about health consequences of exposure, record their own health effects, and explore smoke exposure and health in their local community. When combined with educational trivia games, these novel mobile health components promote preventive health behaviors. In total, Smoke Sense delivers an unprecedented degree of resources for wildfire smoke and air quality tracking and health effects management directly to citizen science users. EPA and other researchers will use the observations to determine the extent to which exposure to wildfire smoke affects health and productivity, and to help develop health risk communication strategies that improve public health on smoke days.

Justification for Using Crowdsourcing and Citizen Science: Citizen science and participatory research is the best way to reach individuals when and where hazardous conditions are likely to present as well as when and where individuals need the health risk information the most. The citizen science approach also facilitates democratization of knowledge and issue engagement in a way that other research approaches cannot. The cost of similar-size studies conducted in a traditional way would possibly reach into multiple millions of dollars.

Status: The project started on August 1, 2017 (Android) and October 1, 2017 (iOS) and has been extended beyond its initial completion date.

Location: The project is located in the United States.

Participation: The project targeted participants who are expected to be geographically located across the United States, particularly where wildfires and smoke events are likely to occur. The Smoke Sense mobile app was downloaded more than 5,000 times during the pilot data collection season. Because of the success of the app, EPA obtained permission to keep the app running on EPA servers but had to temporarily disable some functionality. By August, 2018, Smoke Sense had over 13,000 users.

Consent: Participants are not able to use the app without confirming willingness to participate.

Submissions: Participants report their smoke observations and symptoms.

Resources: Under the EPA's Strategic Plan FY2014-2018, the Office of Research and Development initiated research efforts to evaluate the abilities of environmental models to provide timely information on when and where hazardous conditions are likely to present a risk to public health, and on the effectiveness of public health communication strategies that rely on these models to reduce the public health burden. In FY17, a budget of $125,000 and one FTE were used to fund development of the app through an existing contract vehicle. Federal staff developed the project concept, study design, communication materials, and created a website. Smoke Sense also utilized resources at the National Computational Center to host the mobile application and data. In FY18, the budget was $104,000 and required 1.5 FTE.

Partnerships: As Federal partners, NOAA, USFS, and EPA provided data.

[34] The website for Smoke Sense can be viewed at http://www.epa.gov/air-research/smoke-sense.

Advancement of Agency Mission: Protecting public health during smoke exposure is part of EPA's mission. Smoke from fires is a significant source of air pollution in the U.S. and globally. Among the pollutants found in smoke, fine particulate matter and ozone are strongly linked to cardiovascular and respiratory health effects. According to the 2011 National Emissions Inventory, 40% of fine particulate matter and 31% of volatile organic compounds that serve as pre-cursors to ozone formation are due to fires. Moreover, recent trends in factors contributing to the increased frequency and severity of these events, including growth of wildland urban interface, buildup of fuel, and weather patterns, are expected to continue. Additionally, as pollution from anthropogenic sources continues to decline, the relative contribution of smoke is expected to increase. Therefore, improving communication of health risks associated with this important source of two critical pollutants aligns with EPA's missions and goals to protect public health.

Results: Smoke Sense data and results will aim to bring about public health improvements by way of effectively supporting partner agencies who are more closely connected with their communities. The findings will provide insights about the experiences and challenges of our partners as well as their guidance as to how EPA can better support them.

Data Availability: Weekly aggregated summary statistics are shown in the Smoke Sense app under weekly statistics and posted online at https://www.epa.gov/air-research/smoke-sense. Individual level data will be published on EPA sites and used in K-12 curriculum about smoke as well as with community-level initiatives.

D.6.14 Air Sensor Toolbox[35]

Lead Sponsoring Agency: EPA

Authority: Clean Air Act

Project Summary and Goals: The primary goal of this project is to disseminate EPA information on emerging technologies like air quality sensors. The website provides the general public and other interested stakeholders access to technical information and useful tools developed by the EPA.

Justification for Using Crowdsourcing and Citizen Science: The Air Sensor Toolbox represents a key information source for citizen scientists. No performance certification requirements exist for low cost air quality sensors. Peer reviewed findings provided by the EPA on this topic often provide the only technical information available to citizen scientists, regulatory officials, and the general public. As such, information available through the site provides citizen scientists with critical information needed to make informed decisions about use of low cost air quality technology.

Status: The project started in June 2014 and is ongoing.

Location: N/A

Participation: The Air Sensor Toolbox is one of the most widely viewed websites in EPA's Office of Research and Development. Based upon contact inquiries, users include citizen scientists, community action groups, industry, sensor manufacturers, State and other regulatory officials. Thousands of visits and downloads often occur each month.

Consent: No consent is needed for those who access the information provided to all interested stakeholders.

[35] The website for the Air Sensor Toolbox can be viewed at https://www.epa.gov/air-sensor-toolbox.

Submissions: EPA based research findings and project information is provided on the Toolbox. Community air monitoring training materials, sensor use guidelines and host of other well-received tools are provided as the Office of Research and Development (ORD) completes research projects.

Resources: On an annual basis, less than 0.2 FTE in total are used to maintain the Air Sensor Toolbox website. The estimated annual funding (around $15,000) is used for contract support to update and maintain the website.

Partnerships: N/A

Advancement of Agency Mission: The Air Sensor Toolbox supports the Agency's mission by communicating EPA research findings to all interest parties. As such, the Toolbox represents a highly visible portal by which citizen scientists make contact with Agency staff members concerning specific project objectives and results. ORD's Tech Tracker database indicates that hundreds of contact inquiries were received since the database was established in October 2017. Each of these contacts represents acknowledgment of stakeholder awareness of EPA activities, many of which provide here-to-fore unavailable information, tools, or findings in an easy-to-access format.

Results: Citizen scientists and others often access the Air Sensor Toolbox to gain technical information unavailable from any other source (government or private). The tools provide citizens with critical information they need to make informed decisions about how to develop citizen science projects, air quality technologies, and related topics of interest. It is the primary venue by which the Air and Energy Research Program shares timely and topical findings with all interested parties.

Data Availability: The Air Sensor Toolbox website is located at https://www.epa.gov/air-sensor-toolbox.

D.6.15 Community-led Air Sensor Evaluation in North Carolina[36]

Lead Sponsoring Agency: EPA

Authority: Clean Air Act

Project Summary and Goals: EPA provided training to citizen scientists on how to successfully collocate low cost air quality sensors with regulatory monitors and then establish the ability of the sensor to provide purposeful air quality measurements. Low-cost sensors make it possible for citizens to collect air quality data in their own communities, but they still require instruction for optimal results. While low-cost sensors can measure many of the same air pollutants that costlier regulatory monitors measure, they are not required to meet the same rigorous standards of accuracy and reliability. Understanding how to collocate low-cost sensors with regulatory monitors and compare their results ensures that data from the low-cost monitors are collected in a purposeful manner.

Justification for Using Crowdsourcing and Citizen Science: It was paramount in the development of the sensor collocation tools to heavily draw on the perspective and account for the skill level of non-professional individuals. Air quality professionals typically possess skills and training to assess air quality instrumentation. Even so, many professionals have little or no experience operating low cost sensors. Therefore, even basic issues relative to using this type of technology cannot be assumed when EPA staff are working with its stakeholders. Teaming citizen scientists with no low-cost sensor experience and their highly variable skill levels with purposeful use of low cost sensors allowed EPA to gain insight on common questions others might encounter. The research ensured the concepts and

[36] The website for the Community-led Air Sensor Evaluation in North Carolina can be viewed at https://www.epa.gov/air-research/instruction-guide-and-macro-analysis-tool-community-led-air-monitoring.

topics described in tools produced by the EPA would be appropriate. Information gained from the research provided the means for EPA to develop a suite of tools widely transferrable to any low-cost air quality sensor stakeholder (citizen scientist, community group, industry, academia, regulatory officials). The partners in these efforts now have extensive knowledge on the strengths and weaknesses of low cost air quality sensors and how to best integrate this technology into their respective future efforts.

Status: The project ran from April 2017 through June 2017 and is complete.

Location: The project is located in Mecklenburg County, NC and Cherokee, NC.

Participation: The project targeted the Eastern Band of Cherokee Indians (EBCI), a federally recognized Native American tribe living in and around the Cherokee, NC area. Clean Air Carolina (CAC) is a community action group in Charlotte, NC involved in a wide range of environmental air quality initiatives. The total number of individuals involved during this period was 14; an estimated two individuals/week participated from the EBCI and a total of four individuals participated from CAC during the May-June 2017 time period. The EBCI and CAC are estimated to have contributed a total of 200 hours to this research.

Consent: Individual memorandums of understanding were signed by representatives of both the CAC and the EBCI. In like manner, representatives consented to quality assurance requirements of the research.

Submissions: The CAC and EBCI operated low cost air quality sensors for a one-month period using EPA-supplied operating procedures. They provided tabulated data documenting sensor measurements and technical feedback on tools useful in comparing sensor data with local regulatory measurements.

Resources: The funding for this project was $58,000 in FY17 and $22,000 in FY18. A total of 0.8 FTEs were allocated in both fiscal years. Extramural support contract resources were used to assist in the development of a sensor collocation guide document and an accompanying tool used to assist low cost sensor users in establishing the performance characteristics of collocated instrumentation.

Partnerships: Non-Federal partners included the EBCI, CAC, and the Mecklenburg County Department of Air Quality.

Advancement of Agency Mission: The EPA views emerging technologies as being of benefit to future air quality monitoring. Even so, use of low cost air quality sensors represents one of the most technically challenging efforts undertaken by citizen scientists. Many factors can influence air quality measurements (e.g., instrumentation design, environmental conditions). There currently exists no certification requirements for low cost sensors, resulting in a significant uncertainty by all parties as to the veracity of the measurements being obtained. States, regions, and program offices are sometimes confronted with low cost air quality data of unknown accuracy. The tools developed in this project provide the means for citizen scientists to establish the value of their measurements in advance of such discussions. The tools developed here are transferrable to any interested party including sensor manufacturers, who are expected to significantly advance the evolution of low cost sensors to the benefit of EPA and its full range of stakeholders.

Results: EPA has developed a guide and analysis tool for citizen scientists to evaluate the performance of low-cost sensors and interpret the data they collect to help citizen scientists interested in learning about local air quality. The first tool is an instruction guide on conducting a successful collocation evaluation of low-cost air sensors. Collocation refers to the process of operating a regulatory grade reference monitor (FRM/FEM) and non-reference monitor (low-cost sensor) side-by-side in real-world conditions for a defined evaluation period. Collocating low-cost sensors with regulatory monitors can

help citizen scientists evaluate their sensors' performances and the accuracy of their data. The instruction guide contains links to web-based supporting materials and introduces users to the second product––a macro analysis tool. EPA created the user-friendly, Excel-based macro analysis tool to help citizen scientists compare data from low-cost sensors to data from regulatory monitors, and interpret their results. The tool allows users to input data from low-cost and regulatory monitors for comparison, even if measurements were not recorded at precisely the same time, or were collected at different time intervals (e.g., 1-minute vs. 5- minute intervals). This tool addresses one of the major hurdles in citizen-led community air monitoring projects, which is working with and understanding the data. Both of the aforementioned tools are publicly available. The instruction guide and macro analysis tool are available at https://www.epa.gov/air-research/instruction-guide-and-macro-analysis-tool-community-led-air-monitoring.

Data Availability: No measurement data are currently available. The primary outputs of the project were the development of the collocation guide and the analysis tool. The day-to-day experience gained by the citizen scientists in operating low-cost sensors and their feedback on the resulting tools EPA developed to support such efforts were the primary data obtained during the research effort. The Office of Research and Development is currently reviewing the measurement data obtained during the study for any value as part of the Air Sensor Toolbox sensor performance reports provided to the public on individual sensor performance attributes. More information can be found at https://www.epa.gov/air-sensor-toolbox/evaluation-emerging-air-pollution-sensor-performance.

D.6.16 Regional Sensor Loan Program[37]

Lead Sponsoring Agency: EPA

Authority: Clean Air Act

Project Summary and Goals: This project gives EPA Regions the ability to investigate local and regional air quality using lower cost sensors through a sensor pod loan trial. EPA Regions and the communities they serve want to understand the pollutant concentrations in the air they breathe and want to be aware of potential pollution exposures in microenvironments where they live and work. Fixed regulatory monitoring networks might not be able to capture these local-scale conditions. Sensor pods are less expensive portable monitoring equipment that can provide finer spatial and temporal resolution than is possible with traditional monitoring. This trial loan program provides Regions with highly desired access to cutting edge sensor technology. Integration of the Regional need with the Office of Research and Development (ORD) success in sensor development relieves Regional partners of the technical burdens and maintenance aspects of having to develop a similar capability, while allowing ORD further opportunity to define the viability of low cost sensors to meet a wide range of stakeholder research needs.

Justification for Using Crowdsourcing and Citizen Science: ORD and each of the Regional partners have established citizen science efforts that this project builds upon. Previous programs have clearly shown the benefit of collaborative EPA-stakeholder research involving emerging low-cost sensor technologies. The lower cost of some sensor systems and relative ease of operation makes it possible for non-experts to use these technologies to gather air quality information. Some Regions are partnering with citizen scientists to build better relationships, address community concerns, and to teach them how to

[37] The website for the Regional Sensor Loan Program can be viewed at https://www.epa.gov/sites/production/files/2018-03/documents/final_em-3_master_slide_set.pdf

appropriately use sensor technologies. Each of the Regions has specific goals of their planned interactions with citizen scientists. Those goals will be fully established in FY19.

Status: The project started in Spring 2018 and is ongoing.

Location: Region 1 – Mountain Valleys in Vermont; Region 2 – New York/New Jersey; Region 3 – Philadelphia, PA; Region 5 – Saginaw, MI; Region 8 – Denver, CO

Participation: The project targeted collection of community-level data by university students (Regions 2 and 5), community groups (Region 8), and State (Region 1) and Regional (Region 3) staff.

Consent: Human subjects and other considerations are currently in review by each of the Regional partners. Each Regional project represents an independent research engagement with citizen scientists.

Submissions: Participants may be involved in one or more aspects of planning sensor collocation and deployment locations, agreeing to host a deployed sensor on their property, deploying and operating sensors using EPA-supplied operating procedures, weekly data retrievals, and/or data analysis and interpretation.

Resources: FY17 funding ($230,000 and 0.8 FTE) was used to investigate/develop/obtain multi-pollutant low cost sensor pods needed by each Region. Federal staff evaluated research sensor options, explored the cost of the sensor pod creation, and developed partnerships. FY18 funding resources ($230,000 and 3.1 FTE) were used extramurally to obtain ORD-supported multi-pollutant sensor pods. The sensor pod specifications were selected collectively by the Regional partners with ORD providing technical expertise in that effort. ORD support included technical investigation of possible commercial sensor units for meeting project goals, developing needed quality assurance documentation (operating procedures) as well as establishing technical procedures for data collection and recovery. Resources were used to establish the operational status of each sensor pod including comparisons with reference monitors. Resources were used to support the development of an easy-to-use tool to process raw sensor signal into ambient concentrations, track and ship sensor pods to Regional partners, and to support Regional partners with troubleshooting during their loan period.

Partnerships: Federal partners included EPA Regions 1, 2, 3, 5, and 8. Non-Federal partners included the Vermont Department of Environmental Conservation in Region 1; a Regional university (not yet selected) in Region 2; the City of Philadelphia in Region 3; Saginaw Valley State University in Region 5; and the City of Denver and two community groups in Region 8.

Advancement of Agency Mission: EPA's mission is advanced through the efforts of ORD, the Regions, and the many stakeholders engaged in the project (States, municipalities, citizen science groups) to collaborate on the potential use of emerging technologies to meet community-based air monitoring research interests. Emerging technologies can collect air quality data at finer spatial and temporal resolution and at a lower cost than traditional monitoring equipment. However, the accuracy of these measurements can vary considerably not only based on the sensors used but also on integration (e.g., sensor pod design) and environmental conditions (e.g., metrology, pollutant concentration, particle types). States, Regions, and program offices find these technologies potentially valuable but often lack the staff and resources to try technologies that are not well characterized. Additionally, these groups are often confronted with data from their stakeholders with little or no understanding of their accuracy. This project supports the Regions by helping them to access technology that ORD finds promising, supporting them with some technical support and documents (e.g., operating procedures), and introducing them to processes that help ensure data quality (e.g., collocation). The projects selected will help demonstrate potential uses for sensors and develop closer relationships between EPA and project partners.

Results: Each of the Regional partners are engaged in fully establishing all of their individual research efforts. Region 1's goal is to measure wintertime particulate matter concentrations in valley locations. Region 2's goal is to engage students in a community with environmental justice (EJ) concerns to measure air pollutants and better understand their local air pollution. Region 3's goal is to engage EJ communities and to investigate particulate matter concentrations in two such communities. Region 5's goal is to engage college students in air quality monitoring to address local air quality concerns. Region 8's goal is to engage community groups in air quality monitoring using sensors to further their environmental awareness activities.

Data Availability: No data are currently available due to the current status of the study. Citizen science data collections are scheduled to begin in FY19. ORD will be releasing quality assurance data collected while sensors are collocated with reference instruments both at the EPA facility in Research Triangle Park, NC and similar data while deployed within the Regions. These data and summarized findings will be made publicly available at the end of the project when researchers intend to publish a report on the performance of the multi- pollutant sensor pod (estimated to be in FY20). Regions and their project partners are currently establishing data handling and public data release policies for each of their individual research efforts.

D.6.17 Ironbound Neighborhood Air Monitoring [38]

Lead Sponsoring Agency: EPA

Authority: Clean Air Act

Project Summary and Goals: This collaboration provided for community-based participatory environmental monitoring of the particulate matter 2.5 micron size fraction (PM2.5) and gaseous nitrogen dioxide (NO_2), as pollutants chosen jointly by the EPA's Office of Research and Development (ORD), Region 2, and the Ironbound Community using an environmental sensor pod designed by ORD for the particular needs of the community. ORD provided technical commentary on the general research study plans developed by the Ironbound Community/Region 2 and provided data analysis expertise concerning data summarization options ultimately shared with the community. The primary objective of this effort was to develop the approach (Toolbox) needed to support such activities and ensure their success.

Justification for Using Crowdsourcing and Citizen Science: EPA aims to address environmental concerns of vulnerable populations in its research programs. Community-based citizen science efforts have the potential of providing Americans with new information sources useful for understanding local air quality. The Air Sensor Toolbox's technical resources developed for the Ironbound Community represent an example for use by other communities across the country in developing their own air monitoring programs in areas where pollution is a concern. As such, the pilot effort provided EPA an opportunity to work directly with a highly motived citizen science organization, develop a collaboratively agreed upon research plan, and introduce advanced technology to the citizen scientists to meet their needs. The pilot project provided useful lessons in how to improve coordination between EPA and communities, the types of tools and technologies needed to assist communities, and how the lessons learned from this pilot study might be applied to future efforts.

Status: The project started in June 2014 and was completed in June 2016.

Location: The project is located in Newark, New Jersey.

[38] The website for Ironbound Neighborhood Air Monitoring can be viewed at https://www.epa.gov/sciencematters/citizen-science-newark-new-jersey.

Participation: The project targeted the Ironbound Community Corporation. The total number of individuals involved was estimated to be around 20, and the average number of active participants per week was estimated to be 3-4 individuals. The total number of volunteer hours was in the range of 300 to 500.

Consent: No personal monitoring took place. Ironbound Community Corporation secured individual citizen scientists with their principal member providing consent for the effort and being a signatory on all major project documents.

Submissions: Participants were asked to recover air quality data weekly from a total of four sensor pods. Participants tabulated raw data and provided those electronic data files to EPA for validation and processing

Resources: No funds were specifically allocated for this project and less than 0.1 FTEs were used in FY17 and FY18. All primary work was completed in FY14-FY16. EPA activity centered around handling study inquiries and submitting a journal article that summarized the findings.

Partnerships: Non-Federal partners included the Ironbound Community Corporation and the New Jersey Department of the Environment.

Advancement of Agency Mission: EPA's mission is to protect human health and the environment. To move toward achieving this goal, EPA is facilitating identification of potential environmental concerns, particularly in vulnerable communities. This includes actively supporting citizen science projects and providing communities with the information and assistance they need to conduct their own air pollution monitoring efforts. The Air Sensor Toolbox for Citizen Scientists was developed as a resource to meet stakeholder needs. The Toolbox features resources developed by EPA researchers that can be used by citizens to effectively collect, analyze, interpret, and communicate air quality data. The resources include information about sampling methods, how to calibrate and validate monitors, options for measuring air quality, data interpretation guidelines, and low-cost sensor performance information. By testing emerging air sensor technologies, the EPA is evaluating new methods to support its core mission of protecting human health and the environment.

Results: A primary purpose of this effort was the development of needed citizen science tools. These included quality assurance documentation and similar documentation that would be transferable to other communities interested in conducting citizen science air quality research. These tools were publicly released as part of ORD's Citizen Science Toolbox, which can be accessed at https://www.epa.gov/air-sensor-toolbox. In addition, the Ironbound Community received valuable training in how to conduct complex air quality monitoring and its validation. Study results were jointly presented by EPA and the citizen science team to the full community. The community received in-depth air quality information collected by their own citizens highlighting the observed environmental concentrations and how their measurements related to the national air quality standards and other similar communities. This effort provided EPA with invaluable lessons learned on how to plan and execute complex air quality citizen science research efforts.

Data Availability: Data have been publicly available since the publication of the primary peer review journal article summarizing key findings. The data can be accessed at https://edg.epa.gov/metadata/catalog/search/resource/details.page?uuid=%7BDFEDA959-0DBB-434C-B736-0249DD083473%7D and the paper can be accessed at https://doi.org/10.23719/1407516.

D.6.18 The Efficacy of Citizen Science Air Monitoring for Building Public Awareness of Exposures in a US Caribbean Urban Neighborhood Impacted by Heavy Industrial Contamination[39]

Lead Sponsoring Agency: EPA

Authority: Clean Air Act

Project Summary and Goals: A research partnership with a Puerto Rico-based regional consortium, Desarrollo Integral del Sur, Inc. (DISUR), was developed to determine the challenges and benefits of low-cost air quality (AQ) sensors for citizen science. EPA developed a unique low-cost multi-pollutant sensor pod that was provided to the community group and the training/tools needed for its operation. The citizens self-organized a community effort to conduct approximately five months of intensive AQ monitoring in residential areas of Guayanilla and Peñuelas, Puerto Rico, which had little historical data on spatial variability. The citizens successfully completed the intensive data collections, summary of quality assurance checks, and database development. The study provided environmental justice communities in Peñuelas and Guayanilla, as well as surrounding communities, an awareness of local air quality conditions and opportunities for citizen scientists to gain extensive experience in use of emerging sensor technologies. The collaboration provided EPA an opportunity to evaluate low-cost sensor performance under harsh environmental conditions (high relative humidity in a coastal environment).

Justification for Using Crowdsourcing and Citizen Science: Citizens in the study area had an established interest in environmental air quality issues in southern Puerto Rico. In particular, they had concerns about air pollutants from a variety of potential sources including abandoned industrial sites that they did not feel were being fully characterized. Establishing a citizen science project allowed the local communities to be directly involved in not only selected monitoring sites of interest but also providing them with extensive training and experience on the use of emerging air quality technologies (low cost sensors). This project provided the EPA the ability to gain seminal knowledge on the ability of low cost air quality sensors to operate in the harsh Caribbean climate (high temperatures, high relative humidity, and abundant rainfall) for extended periods of time (about six months). The reliability of low cost sensors (environmental impacts as well as lifetime of performance) has not been established and there currently exists no manufacturer's certification of performance. Therefore, the information gained by the project involving non-professional operation and collection of environmental data was highly valuable in establishing "lessons learned" under such conditions. The citizen science project provided direct feedback to local citizens using a credible source (e.g., other community members), therefore providing enhanced understanding about the local air quality conditions from data collection that was not government based.

Status: The project started in October 2016 and is complete.

Location: The project took place in Peñuelas and Guayanilla, Puerto Rico.

Participation: The project targeted community members in Peñuelas and Guayanilla, Puerto Rico. The total number of individuals involved over the full course of the study (October 2016 through February 2018) was 23 participants. Citizen scientists and community group members contributed an estimated 500 total hours.

[39] The website for the Efficacy of Citizen Science Air Monitoring for Building Public Awareness of Exposures in a US Caribbean Urban Neighborhood Impacted by Heavy Industrial Contamination can be viewed at https://www.epa.gov/air-research/citizen-science-air-monitoring-puerto-rico-fact-sheet.

Consent: Consent was received from 20 community members and 3 DISUR staff members. DISUR, as the primary community leader, was a signatory on all key project documents (e.g., QA documentation, community recruitment/training activities).

Submissions: Participants deployed a number of EPA-developed low cost air quality sensor pods and weather monitors at sites community members selected. Data were harvested on a weekly basis. Tabulated data were then provided to EPA.

Resources: FY17 funding ($100,000 and 1 FTE) was used for an extramural support contract that provided the means to develop the low cost sensor pods, establish and conduct a training program for the Puerto Rico-based citizen scientists, and ultimately establish the community-based leadership support with DISUR needed to facilitate citizen science activities, and air quality data collection. Extramural funding was also used for technical support needed to conduct quality assurance review of raw tabulated data provided by the citizen scientists. FY18 funding ($100,000 and 1 FTE) was used for an extramural support contract provided for DISUR to conduct data quality assurance validation efforts and refinement of the tabulated database they had established.

Partnerships: Non-Federal partners included DISUR Community group and the Puerto Rico Environmental Quality Board.

Advancement of Agency Mission: EPA is involved in the discovery, evaluation, and application of low-cost air quality sensors to meet a wide variety of stakeholder needs. One key feature of this effort is the determination of low-cost sensor performance under real-world conditions. The EPA is recognized as one of the premier research organizations in the world investigating the value and potential of emerging air quality sensor technology for evaluating air quality. EPA is also actively supporting citizen scientists by transferring knowledge gained from its own research and directly engaging with them in the pursuit of community-based interests.

Results: Air quality information obtained during the study was directly shared with local citizens by a joint Office of Research and Development/EPA Region 2/DISUR team in February 2018 to mark the completion of the study. At this meeting, air quality information collected during the study was related to historical regulatory monitoring. In particular, validated data from the citizen science study indicated environmental concentrations of the select air pollutants monitored were well below ambient air quality values during the study period. While the study was not long-term and used non-regulatory monitors, citizens received unprecedented information on their local air quality. The maritime climate encountered during the study provided EPA a great deal of performance data on low cost sensors. Data findings revealed that extensive data validation and processing was needed to overcome interference with high relative humidity for many of the low-cost sensors. Data validation techniques developed during that portion of the study are directly transferrable to future EPA field efforts involving this same type of technology. Sensor performance characteristics are not typically known because of the lack of a required manufacturer's certification requirement. Data findings from this study will be published in the peer reviewed literature summarizing the viability of low cost technology to meet air quality monitoring needs under harsh operating conditions.

Data Availability: The data obtained during the study will be publically available upon publication of a submitted peer reviewed journal article. Data will be obtainable at the EPA environmental dataset gateway, accessible at https://edg.epa.gov. The dataset can be retrieved by searching for The Peñuelas Project-SCID:A-K99b or by the name of the senior EPA author, Ron Williams.

D.7 National Aeronautics and Space Administration (NASA)

D.7.1 GLOBE Program[40]

Lead Sponsoring Agency: NASA

Authority: National Aeronautics and Space Act (as amended)

Project Summary and Goals: The Global Learning and Observations to Benefit the Environment (GLOBE) Program is an international hands-on environmental science and education program. GLOBE's Strategic Priorities are to improve student understanding of environmental and Earth system science across the curriculum; contribute to scientific understanding of Earth as a system; build and sustain a global community of students, teachers, scientists and citizens; and engage the next generation of scientists and global citizens in activities to benefit the environment. GLOBE encourages and supports students, teachers and scientists to collaborate on inquiry-based investigations of their local environment, sharing results in person and virtually through local, regional and international science symposia.

Justification for Using Crowdsourcing and Citizen Science: Citizen science and crowdsourcing provide a practical and efficient means to collect local observations of the Earth system globally and over long time periods. GLOBE also engages students and teachers as a way for them to learn more about their own environment (local, regional, and global).

Status: The project started in April 1995 and is ongoing.

Location: Participation is possible in 121 countries and all U.S. states and territories.

Participation: The project targets teachers with K-12 students, as well as the general public. The total number of teachers involved during this reporting period as of August 26, 2018 was 3,163, and with an average of 237 active participants per day, 385 active participants per week, and 596 active participants per month.

Consent: All data submissions and teacher participations are voluntary.

Submissions: GLOBE participants can report measurements in over 70 protocol areas across four Earth spheres: atmosphere, biosphere, hydrosphere, and pedosphere. Approximately 16,489,000 data points were recorded over the FY17 and FY18 timeframe as of August 26, 2018.

Resources: GLOBE has a dedicated budget within NASA's Science Mission Directorate/Earth Science Division. Funding for the citizen science component of GLOBE cannot be pulled out from the overall budget of GLOBE, which includes a wide array of additional science and education activities.

Partnerships: Federal partners included the National Oceanic and Atmospheric Administration, the National Science Foundation, and the Department of State. Non-Federal partners included implementation by the University Corporation for Atmospheric Research.

Advancement of Agency Mission: GLOBE students and teachers contribute to a knowledge base about the Earth system, in support of the NASA strategic goal to "expand human knowledge through new scientific discoveries." GLOBE also serves to meet NASA's strategic objective to "inspire and engage the Public in aeronautics, space, and science."

Results: GLOBE data have been used extensively. Students use the data to conduct research projects for Student Research Symposia (https://www.globe.gov/web/united-states-of-america/home/student-

[40] The website for the Globe Program can be viewed at https://www.globe.gov.

research-symposia) and for the International Virtual Science Symposium (https://www.globe.gov/news-events/globe-events/virtual-conferences/2018-international-virtual-science-symposium). GLOBE data have also been used in hundreds of science and education publications. An example list can be seen at https://www.globe.gov/do-globe/research-resources/publications.

Data Availability: GLOBE provides visualizations, maps, and graphs presenting reported data. Raw data can also be downloaded to compare and contrast local and global environments. The GLOBE visualization website also provides tutorials on how to access data.[41]

D.7.2 Students' Cloud Observations on-Line (S'COOL)[42]

Lead Sponsoring Agency: NASA

Authority: National Aeronautics and Space Act (as amended)

Project Summary and Goals: The S'COOL Project involves participants ages 5-20+ in real science, making and reporting ground truth observations of clouds to assist in the validation of NASA's Clouds and the Earth's Radiant Energy System (CERES) satellite instrument. Clouds are an important part of the atmosphere, and scientists are studying how they affect weather and climate. S'COOL observations provide one more piece of the puzzle.

Justification for Using Crowdsourcing and Citizen Science: CERES observes the entire Earth every day. Citizen science is the only way to get ground truth reports from many geographic areas over the mission lifetime. In 2018, nearly all of the program was ported over to the GLOBE Program, though S'COOL will continue into 2019 to support participants from countries that are not part of the GLOBE Program.

Status: The project started in January 1997 and is ongoing.

Location: Observations for S'COOL are made on a global scale.

Participation: The total number of individuals involved during this period was 159. The project initially targeted K-12 students but eventually included a public citizen science component open to all. Numbers are low in this reporting period because many participants already migrated to the GLOBE Program (teachers and students).

Consent: No specific consent is requested. Consent is assumed when data are reported.

Submissions: A total of 4,034 submission have been received during this reporting period.

Resources: Support was provided through the NASA Science Mission Directorate's Science Activation funding. A total of $267,000 funded 2 WYEs in FY17 who maintained the website and database, responded to participant questions, and worked on porting the project into the GLOBE Program framework. A total of $173,000 funded 1.5 WYEs in FY18 who supported finalizing porting of the project into the GLOBE framework, connecting databases and making sure functions continue to work, and helping participants through the transition

Partnerships: N/A.

Advancement of Agency Mission: S'COOL provides ground truth for the NASA CERES satellite instrument, multiple copies of which are in orbit observing the Earth.

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[41] The website can be accessed at https://www.globe.gov/globe-data/visualize-and-retrieve-data.

[42] The website for the Students' Cloud Observations on-Line (S'COOL) can be viewed at https://scool.larc.nasa.gov.

Results: S'COOL observations are compared to satellite data whenever reports are made within 15 minutes of an overpass. Statistical analyses are performed to understand what types of clouds are missed by the satellite and how often those clouds are missed. The project's utility has been cited in a couple of scientific publications.

Data Availability: The S'COOL project maintains an open database at https://scool.larc.nasa.gov/database.html, which shows cloud observations with corresponding satellite cloud retrievals when available.

D.7.3 Aurorasaurus[43]

Lead Sponsoring Agency: NASA

Authority: N/A

Project Summary and Goals: In 2013, NSF funded a research team to build the first citizen science project around observing the aurora. The Aurorasaurus.org project was funded for its innovative interdisciplinary goals around geospace, informal science education, and human-centered computing. This project had two fundamental objectives which have been successfully achieved: (1) collect real-time, ground-based aurora data from citizen scientists (soft sensors) and (2) incorporate this new type of data into scientific investigations pertaining to aurora. In 2016, NASA provided funding as part of the Space Science Education Consortium and its nation-wide education goals.

Justification for Using Crowdsourcing and Citizen Science: Crowdsourcing and citizen science are the only way to provide these newly available data, enabled by smart phones, digital cameras, and social media sources like Twitter. There are no other real-time verified sources of data indicating accurately where the dynamic aurora are visible (e.g. no imaging satellites, and no cameras that extract the actual locations). This is a unique service for the public who are interested in this information and the scientists who use these data to supplement and ground-truth traditional sources of data about the aurora. There are dedicated communities world-wide who can contribute and benefit by increasing their scientific literacy. In addition, the larger and more rare the auroral event, the less traditional data sources (e.g., ground-based scientific cameras) exist to document the rarer phenomena (e.g., the newly recognized STEVE aurora-like phenomena), and the more citizen scientists can contribute.

Status: The project started in 2012, and is ongoing.

Location: The whole globe, primarily in polar regions.

Participation: The project targeted (1) citizen scientists who see the aurora and want to submit an observation about it; and (2) anyone who is interested to help verify crowdsourced data about the aurora, accomplished through the verify tweets feature. NASA estimates 5,000 to 10,000 participants in FY17 and FY18. The total number of volunteer hours was approximately 14,000 hours for type 1 observations and approximately 4,000 hours for Type 2 observations.

Consent: Per the project's IRB reviews, formal consent is not required to participate. All citizen scientists must agree to the privacy and terms of use statement when submitting data (http://aurorasaurus.org/privacy).

Submissions: Citizen scientist participants fill out a simple form about whether they have or have not seen aurora (including the time/date/location at a minimum). They have the option to include a photo. There have been 7,000 submissions so far. Crowdsourcing participants simply submit a vote (yes or no)

[43] The website for Aurorasaurus can be viewed at www.aurorasaurus.org.

on a tweet that is a potential real-time sighting of the aurora. There have been 500,000 votes or user actions on tweets.

Budget and Resources: NASA provided support for this project (~0.5 FTE) as part of the NASA Space Science Education Consortium Cooperative Agreement. This competitive opportunity was open to both NASA and external entities. The Aurorasaurus team includes NASA FTE as well as external partners. NSF provided support (including postdoc funding, ~1.2 FTE plus additional funds for operations) under the INSPIRE grant. More information at: https://www.nsf.gov/awardsearch/showAward?AWD_ID=1344296&HistoricalAwards=false.

Partnerships: Federal partners included NSF. Non-Federal partners included the New Mexico Consortium.

Advancement of Agency Mission: Aurorasaurus advances the science of heliophysics and serves as a model for other projects within NASA. In addition, it advances the agency's education, outreach, science engagement, partnership, and scientific literacy goals. Citizen scientists are tangibly contributing to NASA scientific discoveries around one of the most beautiful, accessible, and inspiring phenomena in the near-Earth space weather environment. Their contributions have energized the public and personnel throughout NASA in a multitude of ways.

Results: In terms of broader impacts, this work has been featured in a variety of media including Science Friday, Space.com, the New York Times, the Weather Network, and Discovery News. Scientifically, this work has led to publications across multiple fields featuring innovative methods to harness citizen science to verify and improve space weather models. This project has demonstrated that people can robustly detect and document previously unknown auroral features and can impact multiple fields within heliophysics and the larger citizen science community.

Data Availability: The Aurorasaurus team has a paper submitted for publication and have posted the data on Zenodo. Data can be accessed at https://zenodo.org/record/1255196#.W79tlxNKjs0.

D.7.4 Disk Detective[44,45]

Lead Sponsoring Agency: NASA

Authority: National Aeronautics and Space Act (as amended)

Project Summary and Goals: NASA's Wide Field Infrared Explorer (WISE) mission is a discovery tool sensitive enough to detect several thousand debris disks out to 300 parsecs and Young Stellar Objects to 1 kiloparsecs. These circumstellar disks are signposts of planets and serve as roadmaps to guide exoplanet searches and increase understanding of planet formation. However, the confusion noise inherent in the WISE mission data has limited the usefulness of this resource as a tool for disk and planet hunters. The Disk Detective project uses the power of citizen science to remedy this confusion noise problem in the WISE data. Disk Detective engages volunteers to compare images from WISE, NASA's Two-Micron All Sky Survey (2MASS), and optical surveys to search for new circumstellar disk candidates via the website DiskDetective.org. This project is the largest survey for debris disks with WISE and has already uncovered approximately 4,000 disk candidates worthy of follow-up, including 24 late type dwarfs too red for Hipparcos. By the project's completion in 2019, NASA estimates the project will have

[44] The website for the Disk Detective can be viewed at Diskdetective.org.

[45] The Disk Detective project was conducted under the Crowdsourcing and Citizen Science Act as well as 51 USC § 20112(a).

found around 3,200 disk candidates closer than 100 parsecs. These discoveries will guide searches for new groups of young stars and yield new targets for the upcoming James Webb Space Telescope.

Justification for Using Crowdsourcing and Citizen Science: Professional astronomers have been scouring the WISE data archive for years prior to this work, and through trial and error, the community realized that each disk candidate needed to be checked by eye, even when advanced machine learning techniques were applied to the data. Thus, large numbers of individuals are needed to accelerate this task.

Status: The project started in January 2014 and is ongoing.

Location: Participation in the project is available globally through internet access.

Participation: The project targeted the general public. The total number of individuals involved during this period was approximately 40,000, and the average number of active participants per week was between 20 and 40. The total number of volunteer hours was 48,000 hours for the classification work on the Zooniverse site alone, plus approximately the same amount of effort contributed by the advanced user group on various side projects.

Consent: All participants consented to participate. Approximately 13,800 participants have registered with Zooniverse. However, registration is not required for participation.

Submissions: Approximately 2.9 million classifications of movie images have been performed.

Resources: The project has been supported by the NASA Science Mission Directorate. The Space Telescope Science Institute Director's Discretionary Fund funded the development of the data archive. Extramural funding for FY17 and FY18 totaled $80,000 each, and 0.5 internal FTEs supported the project each year. The principal investigator is a NASA civil servant. Most of the funding is used to support the work of one graduate student on the project. Approximately $10,000 was spent each year on publication costs, travel to meetings, and travel to observatories for follow-up observations. The Space Telescope Science Institute spent $30,000 for their developers to build the archive. NASA provided funding in prior fiscal years to Zooniverse (zooniverse.org) to develop and use the Zooniverse platform for this project.

Partnerships: Non-Federal partners include Zooniverse, Carnegie Institute Department of Terrestrial Magnetism, University of Oklahoma, Harvard-Smithsonian Center for Astrophysics, University of Hawaii, Observatorio Astronomico de Cordoba, and the Space Telescope Science Institute.

Advancement of Agency Mission: The project addresses NASA's mission to understand the solar system and the universe by finding nearby circumstellar disks where planets like Earth form.

Results: This project is used to advance scientific understanding and has been cited by several scientific journal publications.

Data Availability: The data will be shared with the public through the Space Telescope Science Institute's Mikulski Science Archive. A beta version of our archive is online at https://mast.stsci.edu.

D.7.5 Globe Observer[46,47]

Lead Sponsoring Agency: NASA

Authority: National Aeronautics and Space Act (as amended)

Project Summary and Goals: The Global Learning and Observations to Benefit the Environment (GLOBE) Observer (GO) is an international network of citizen scientists and scientists working together to learn more about the shared environment and changing climate. GO is built on the GLOBE Program (www.globe.gov) and is intended to make citizen science activities available to GLOBE students more widely accessible to anyone who wants to participate through a smart phone app. The goals in implementing GO were two-fold. First, the program was designed to collect more environmental data in support of scientific research and GLOBE student research. Second, the program is educational and should increase participants' sense of belonging to a scientific community and their scientific literacy.

Justification for Using Crowdsourcing and Citizen Science: GO collects distributed environmental data on an ongoing basis, making citizen science an effective means for accomplishing its goals. It would be cost-prohibitive to collect the same volume and distribution of data through a contract or grant or other funded mechanism. A challenge, by its nature, has an end date, so that format would not work for ongoing data collection. Finally, the education and communication aspect of citizen science allows GO to function as both an educational and scientific program.

Status: The project started in September 2016 and is ongoing.

Location: Data are accepted from participants in the U.S. and in countries participating in the GLOBE Program. GLOBE is implemented through bilateral agreements between the U.S. Government and governments of partner nations.

Participation: The project targeted adults with access to a smart phone or tablet who are located in the U.S. and in countries participating in the GLOBE Program. The total number of individuals involved during this period was 26,460, and the average number of active participants per month was 1,525. The total number of volunteer hours was estimated to total 22,500 hours over two years. The estimate was based on the 270,000 observations in the database and the assumption of a five minute completion rate per observation.

Consent: All participants consent to NASA's knowledge of their location, the participants ownership of all photos submitted, that the photos include no identifiable people, and that NASA and GLOBE may post the pictures.

Submissions: Submissions include observations, location, and photographs.

Resources: FY17 and FY18 funds for GO were provided through a cooperative agreement to NASA Goddard Space Flight Center from the NASA Science Mission Directorate. Funds were dispersed from NASA Goddard to contractor staff for labor and IT support. FY17 funding totaled $825,891, including 2.55 work year equivalents (WYE), and 0.3 FTEs supported the project. FY18 funding totaled $1,126,983, including 2.55 WYE, and 0.3 FTEs supported the project. FTE labor included oversight. WYE labor included protocol development, website development and maintenance, program implementation, evaluation and audience needs assessments, development of material to support informal educators, and direct communication/support of citizen scientists. Non-labor dollars were spent on an IT support

[46] The website for the Globe Observer can be viewed at https://observer.globe.gov/.

[47] The Globe Observer project was conducted under the Crowdsourcing and Citizen Science Act as well as 51 USC § 20111, et seq.

contract (app and website development), printed material and videos to recruit participants, shipping, computers and software, and WYE travel. GO is built on the GLOBE Program, referenced in this report as a separate citizen science project, and all data are stored in the GLOBE database. Database support and management, as well as the management of the overall GLOBE Program, are not included in the FTE or funding estimates. NASA Office of Communication also helped promote the project through web features and social media.

Partnerships: Federal partners included U.S. Department of State.

Advancement of Agency Mission: NASA's vision is to discover and expand knowledge for the benefit of humanity. GO collects citizen science observations of clouds and mosquito habitats. Both types of observations support NASA satellite-based science. The GO team includes educators and scientists connected to relevant fields and missions in NASA's Science Mission Directorate. Furthermore, GO expands scientific knowledge by providing access to authentic scientific data collection to everyone.

Results: Cloud data are being analyzed by scientists at NASA Langley Research Center to compare against satellite-collected cloud data. Initial results show citizen reports identify some clouds that satellites tend to miss. These initial analyses show that as the project matures and collects more data, it can become a useful source of verification data. Mosquito Habitat Mapper data has only been collected for one year. When enough data has been collected, NASA will look to integrate the data into satellite-based models that predict outbreaks of vector-borne disease.

Data Availability: All data collected through GO are screened and then made public in the GLOBE database. Photos and classification information can be previewed at https://vis.globe.gov/GLOBE/. Complete data records may be accessed at https://datasearch.globe.gov/.

D.7.6 Image Detective[48,49]

Lead Sponsoring Agency: NASA

Authority: National Aeronautics and Space Act (as amended)

Project Summary and Goals: Image Detective was developed in direct response to decreases in funding from the International Space Station Program for astronaut photography cataloging (geolocation by image geographic centerpoint and addition of descriptive geographic metadata) at Johnson Space Center. Since members of the public continued to submit data from their own image cataloging and provided positive feedback regarding the usefulness of cataloged imagery, development of a crowdsourcing interface to allow for official public cataloging was the logical next step. The geographical knowledge and other STEM educational benefits to the public are self-evident—participants must examine features in an astronaut photograph and locate those same features in other georeferenced data (e.g. Google Earth) in order to derive a geographic centerpoint. By doing this, participants are gaining better knowledge of Earth's physiographic diversity as well as the current geopolitical landscape.

Justification for Using Crowdsourcing and Citizen Science: While astronaut photography of Earth holds many potential benefits for long-term change studies, the limitations of the dataset (3-band visible wavelength data; high variability in terms of look angle and sun illumination; variable ground sample distance; no native georeferencing data) have acted to limit its application and recognition among the

[48] The website for the Image Detective can be viewed at https://eol.jsc.nasa.gov/BeyondThePhotography/ImageDetective/.

[49] The Image Detective project was conducted under the Crowdsourcing and Citizen Science Act as well as 51 USC § 20112(a).

remote sensing community. As a result, requests for proposals amenable to astronaut photography as a primary science dataset have been few and far between. Grant funding did not represent a viable approach for development or long-term support of the NASA-managed Image Detective. Rather, the International Space Station Program provides stable funding for ongoing mission support of new astronaut photography of Earth, as well as curation of the online database of historical imagery at Johnson Space Center. As many of the components of Image Detective were already in place as part of existing cataloging, database, and website tools, and NASA's team held software and web design skillsets, crowdsourcing and citizen science could be incorporated into ongoing funded activities. As mentioned previously, allied education/outreach efforts and public feedback on NASA's online database indicated a strong public interest in astronaut photography and willingness to participate in cataloging of astronaut images of Earth. A crowsourcing and citizen science interface was both feasible with existing resources and the appropriate mechanism for public engagement.

Status: The project started in 2013 and is ongoing.

Location: The photographs cover all regions of Earth's surface between approximately 52 degrees North and South latitudes, however the dataset is spatially and temporally discontinuous for some regions.

Participation: The project targets the general public. The total number of individuals involved between October 1, 2016 and August 19, 2018 was 670, and the average number of active participants per week was 14. Assuming a cataloging time of 20 minutes per image by a citizen scientist, the total number of volunteer hours was estimated to be 1,036 hours.

Consent: No formal consent was required.

Submissions: Participants are asked to provide three types of information: (1) the geographic coordinates for the centerpoint of a given astronaut photograph of Earth; (2) an estimation of the cloud cover percentage in the image; and (3) the geographic metadata for features visible in the image (e.g., New York City, Mt. St. Helens, Mississippi River, etc.). A total of 3,108 images were added to the public database through Image Detective between October 1, 2016 and August 19, 2018.

Resources: There is no dedicated budget or account to support the NASA Image Detective. Funding for maintenance of the software, interface, and quality assurance/quality control (QA/QC) activities are considered part of our International Space Station mission operations and online database curation activities. In both FY17 and FY18, 0.1 FTE and 0.02 WYE (equivalent to $9,000) supported the project. Resources were used to maintain Image Detective software and image database functions and to perform QA/QC of submitted data prior to incorporation into our public database.

Partnerships: N/A

Advancement of Agency Mission: The Image Detective project furthers the NASA mission by making more of the astronaut photography dataset accessible (i.e., searchable) by scientists, educators, and the general public, improving knowledge of the Earth and forging direct and personal connections with NASA science and human spaceflight. Astronaut photography of the Earth has been collected by every crewed NASA mission since the Mercury Program and thus represents the longest continuously-collected orbital image record of changes to the Earth surface supporting a wide range of geologic, oceanographic, and climatic research. As the images are acquired by human beings using visible-wavelength (true color) cameras rather than robotic sensors, the public has an intuitive connection to the images that strengthens interest and aids in image interpretation, making the dataset powerful for educational applications.

Results: The primary use of the Image Detective results is for reducing the backlog of uncatalogued astronaut photography of Earth. In addition, the crowdsourcing and citizen science cataloged data are

used to add images to specific collections available through NASA's online astronaut photography database website (e.g., volcanos, cities) and for allied education and outreach programs. As the data cataloged through Image Detective are added to the publicly available online database, the data become more useful for downstream scientific and educational applications by other users of the database.

Data Availability: Once data submitted through the NASA Image Detective have been passed through a QA/QC review, the location, cloud cover, and feature metadata are added to the specific image records in the publicly accessible online database, the Gateway to Astronaut Photography of Earth (https://eol.jsc.nasa.gov/). An image with metadata obtained from an Image Detective participant is identified as "Public Inputs (from public image detectives, not NASA)" in the image details section of the image data record.

D.8 Smithsonian Institution (SI)

D.8.1 City Nature Challenge DC 2018[50]

Lead Sponsoring Agency: Smithsonian Institution

Authority: N/A

Project Summary and Goals: The City Nature Challenge 2018 is an international effort for people to find and document plants and wildlife in cities across the globe. It is a competition to see which city can make the most observations of nature, find the most species, and engage the most people. The Smithsonian's goal was to increase participation, raise awareness, and become more competitive as a city. Washington, DC placed fourth overall in number of participants, fifth in observations, and eigth in species.

Justification for Using Crowdsourcing and Citizen Science: Nearly 23,000 observations were made in just four days, which mapped species diversity and locations in the DC metropolitan area. The project was designed as a public engagement event, which incidentally contributes data of scientific quality. Other alternatives for documenting biodiversity would not have had the same public impact.

Status: The project ran between April 27 and April 30, 2018, and is complete.

Location: The project took place in the Washington, DC metropolitan region.

Participation: The project targeted District of Columbia metropolitan area residents. The total number of individuals involved during this period was 904, and the average number of active participants was 904 over the four day event.

Consent: Participation was conducted through the iNaturalist app and the agreement to share data was voluntary.

Submissions: Submissions were in the form of images and sound files, both are considered 'observations.' A total of 22,931 observations were submitted on 1,808 identified species.

Resources: The event only required organization and promotional materials, including printing flyers and signs, with a cost of around $100.

[50] The website for the City Nature Challenge DC 2018 can be viewed at https://www.inaturalist.org/projects/city-nature-challenge-2018-washington-dc-metro-area.

Partnerships: Non-Federal partners included the American Association for the Advancement of Science, National Geographic, Biophilic DC, U.S. Green Building Council, and Arlington Regional Master Naturalists.

Advancement of Agency Mission: The Smithsonian Institution's mission is to increase and diffuse knowledge; the National Museum of Natural History (NMNH) focuses that knowledge on the natural world and our place in it. Public engagement is used to increase public understanding of science and the natural world. For the challenge, NMNH used its unique assets, biodiversity collections, and taxonomic expertise to educate the public, and it used its social media channels to recruite people to participate in the project. Moreover, citizen scientists observations that rose to a state of validation became part of the scientific database at the Global Biodiversity Information Facility.

Results: Results that have been validated and are considered research grade were incorporated into the Global Biodiversity Information Facility database. This event contributed 10,828 research-grade observations with images, time, and locality information. The database is used by researchers around the world to study patterns of biodiversity.

Data Availability: All data are available to the public through the iNaturalist City Nature Challenge DC 2018 website. All research-grade data are available on iNaturalist and the Global Biodiversity Information Facility website for download.

D.8.2 Chesapeake Bay Parasite Project[51]

Lead Sponsoring Agency: Smithsonian Institution

Authority: N/A

Project Summary and Goals: White-fingered mud Crabs (*Rhithropanopeus harrissi*) are small scavengers native to the Chesapeake Bay that live in oyster reefs and woody debris in the water where they play a key role in the food web structure of this ecosystem. They may also be an indicator species, which means that the health of their population is a direct reflection of the health of their habitat. Mud crabs typically live less than two years, which means they do not have a long time to reproduce. The parasitic barnacle *Loxothylacus panopaei* (Loxo, for short) is an invasive species that castrates these mud crabs when it infects them. Though this project, Smithsonian scientists seek to understand how Loxo affects the mud crab population. Specifically, are mud crab populations steady or are they declining because Loxo hinders their reproduction?

Justification for Using Crowdsourcing and Citizen Science: Engaging citizen scientists enables collection of large amounts of data in a very short period of time. The number of sites sampled has tripled since this project became a citizen science project, which ensures that the environmental conditions impacting crabs at different sites are similar. Volunteers also help process samples in the lab.

Status: The project started in June 2013 and is ongoing.

Location: This project is conducted in the Chesapeake Bay.

Participation: The total number of individuals involved during FY18 was 130. The total number of volunteer hours was 801.

Consent: Participation by the 130 individuals involved during FY18 was voluntary.

[51] The website for the Chesapeake Bay Parasite Project can be viewed at https://serc.si.edu/citizen-science/projects/chesapeake-bay-parasite-project.

Submissions: Submissions are received in the form of data and observations.

Resources: N/A

Partnerships: N/A

Advancement of Agency Mission: This is an initiative of the Smithsonian Environmental Research Center SERC), which leads the nation in discovering the links between land and water ecosystems in the coastal zone. SERC researchers investigate questions related to fisheries, climate change, invasive species, mercury pollution, water quality, ozone depletion, and more.

Results: Results have been presented at professional conferences.

Data Availability: All data are available upon request.

D.8.3 Environmental Archaeology at the Smithsonian Environmental Research Center[52]

Lead Sponsoring Agency: Smithsonian Institution

Authority: N/A

Project Summary and Goals: The projects at the Sellman Plantation all fall within the field of environmental archaeology: the study of the relationship between the land and the people who lived on it over time. They seek to understand how people's interactions with the land shaped their cultures and how their cultures shaped the land. Environmental archaeology provides insights into how human-induced environmental changes have affected our surroundings in the past, providing a basis for better decisions about land use today.

Justification for Using Crowdsourcing and Citizen Science: This project is an entirely volunteer effort. There is not an archaeologist on staff at the Smithsonian Environmental Research Center (SERC), but there is a large piece of property that is rich in archaeological sites. By engaging research associates and volunteers, the Smithsonian is able to conduct research that would otherwise never be done.

Status: The project started in April 2014 and is ongoing.

Location: This project is located in Edgewater, Maryland.

Participation: The total number of individuals involved in FY18 was 185. The total number of volunteer hours was 4286.

Consent: Participation by the 185 individuals involved during FY18 was voluntary.

Submissions: Submissions are received in the form of data and observations.

Resources: N/A

Partnerships: N/A

Advancement of Agency Mission: The Smithsonian Environmental Research Center leads the nation in discovering the links between land and water ecosystems in the coastal zone. Environmental archaeology provides insights into how human-induced environmental changes have affected our surroundings in the past, providing a basis for better decisions about land use today.

Results: Results have been presented at professional conferences and in peer reviewed publications.

[52] The website for Environmental Archaeology at the Smithsonian Environmental Research Center can be viewed at https://serc.si.edu/citizen-science/projects/environmental-archaeology-serc.

Data Availability: All data are available upon request.

D.8.4 eMammal[53]

Lead Sponsoring Agency: Smithsonian Institution

Authority: N/A

Project Summary and Goals: eMammal is a wildlife image repository that relies on citizen scientists to join projects which place cameras in natural areas and detect wildlife. Data and images are used to determine the distribution of mammals across the project areas.

Justification for Using Crowdsourcing and Citizen Science: The projects relies on data being collected across broad landscapes – beyond the capacity of individual staff to collect.

Status: The project started in 2012 and is ongoing.

Location: The project collects information worldwide.

Participation: The project targeted adults and youth living near natural areas. The total number of individuals involved during FY17 and FY18 was 1750, and the average number of active participants was 1200. The total number of volunteer hours was approximately 18,000.

Consent: Participation by the 1750 individuals involved during FY17 and FY18 was voluntary.

Submissions: Images and associated metadata are collected. To date, nine million images have been submitted.

Resources: The Office of the Chief Information Officer has provided servers and storage. The eMammal team also uses Smithsonian computers and vehicles. The project required 1.5 FTEs in both FY17 and FY18. Grants from the National Science Foundation and the North Carolina Museum of Natural History. In FY18, $10,000 was received from the Smithsonian Conservation Biology Institute in addition to support from existing resources (used in both FY17 and FY18).

Partnerships: Federal partners include the National Park Service. Non-Federal partners include the North Carolina Musuem of Natural History and Conservation International.

Advancement of Agency Mission: eMammal advances the Smithsonian's commitment to exploration and discovery of biological diversity and to sustaining the Earth's wildlife.

Results: Since FY17, publications in peer-reviewed scientific journals include (1) "Do occupancy or detection rates from camera traps reflect deer density?" in the Journal of Mammalogy; (2) "A community effort to document wildlife: eMammal project expands the impact of citizen scientists" in the The Wildlife Professional; (3) Does hunting or hiking affect wildlife communities in protected areas?" in the Journal of Applied Ecology; and (4) "Deer on the lookout: how hunting, hiking and coyotes affect white-tailed deer vigilance" in the Journal of Zoology.

Data Availability: All data, except for some sensitive information like locations of endangered species, are available at eMammal website.

[53] The website for eMammal can be viewed at https://emammal.si.edu/look-pictures.

D.8.5 Fossil Atmospheres[54]

Lead Sponsoring Agency: Smithsonian Institution

Authority: N/A

Project Summary and Goals: This project aims to refine proxy estimates of atmospheric carbon dioxide that are based on an understanding of how the properties of stomatal pores in the leaves of *Ginkgo* trees respond to elevated carbon dioxide concentration. This proxy relationship, established using controlled experiments on cultivated *Ginkgo* leaves, will be applied to the ancient record of atmospheric carbon dioxide using fossil *Ginkgo* leaves that are common in sediments deposited during periods when Earth's atmospheric carbon dioxide concentration and climate varied substantially from the present. The project will also educate students and citizen scientists about the scientific method and insights from this research by involving them in collecting specimens, making measurements and analyzing data.

Justification for Using Crowdsourcing and Citizen Science: Crowdsourcing and Citizen Science fits into the Smithsonian's mission to increase the public's understanding of science. An individual cannot classify sufficient leaf cells in a day, week, or month, but thousands of people can classify enough cells for analysis in a reasonable amount of time. The cost benefit makes it virtually the only way this project can be accomplished.

Status: The project started in October, 2017 and is ongoing.

Location: The project is located in Washington, D.C., Edgewater, MD, and the Rocky Mountain Region, USA.

Participation: The project has engaged Citizen Scientists both onsite and online. At the National Museum of Natural History (NMNH), 90 visitors participated in special Fossil Atmospheres programs, contributing a total of 270 hours, and 3 behind-the-scenes volunteers worked for 770 hours. At the Smithsonian Environmental Research Center, 17 volunteers contributed 750 hours. On the Zooniverse website 4855 individuals dedicated approximately 6200 hours.

Consent: Participation from all participants was voluntary.

Submissions: The research studies ginkgo trees grown in controlled environments with manipulated CO_2 concentrations. Magnified images of leaf cells uploaded to Zooniverse, a public platform for citizen science, are downloaded by citizen scientists to classify.

Resources: The project, P2C2: Collaborative Research: New Estimates of Atmospheric pCO2 for the Paleocene-Eocene, is supported by the National Science Foundation (Federal award ID number 1805228) through the Program in Geobioloby & Low Temperature Geochemistry. The award is $671,160 and supports salary, supplies, travel, and broader impact, including the citizen science component. Zooniverse is a free platform with no costs associated other than setting up the project and supplying the images. A Smithsonian funded postdoc with 25% commitment to outreach used the Zooniverse site to set up the project for public participation using 25 hours of their time. Two, three-hour citizen science events were run by two staff members. No Smithsonian funding was directly used to support these events, although miscellaneous office supplies such as a display monitor, paper, and pens were used. The NMNH office of Education & Outreach supported the onsite programs by promoting them through their media channels and facilitating logistics. NMNH volunteers managed the crowd.

[54] The website for Fossil Atmospheres can be viewed at https://www.zooniverse.org/projects/laurasoul/fossil-atmospheres.

Partnerships: N/A

Advancement of Agency Mission: The Smithsonian's mission is to increase and diffuse knowledge, whereas NMNH focuses on the natural world and our place in it. This research project fits squarely within the mission as it will advance our knowledge of the relationships between CO_2 concentrations, atmospheric temperature, ice volume, sea levels, and climate. Understanding the past to project the future is a strength of NMNH research and collections.

Results: The data collected by citizen scientists will be used to refine proxy estimates of atmospheric carbon dioxide that are based on an understanding of how the properties of stomatal pores in the leaves of ginkgo trees respond to elevated carbon dioxide concentration. Leaves from trees grown in enclosures with different concentrations of CO_2 will have stomatal pore counts associated with different CO_2 concentrations. Citizen Scientist classifications will be used to compare modern Ginkgo leaves with known CO_2 concentrations with fossil Ginkgo leaves from the Paleocene and Early Eocene (a period of warm climate).

Data Availability: Results will be shared online at Zooniverse where the public made the classifications and through peer-reviewed scientific journals.

D.8.6 Global Change Research Wetland Plant Census[55]

Lead Sponsoring Agency: Smithsonian Institution

Authority: N/A

Project Summary and Goals: Salt marshes are unique ecosystems that serve as nurseries and habitat for wildlife and protect coastal communities from flooding and storms. Scientists are looking at the effect of multiple different types of global change on the growth of the salt marsh. Climate change effects can be simulated by placing plants into different depths of water (sea level rise), pumping predicted amounts of gases into chambers (increase in carbon dioxide), or heating the marsh (global warming).

Justification for Using Crowdsourcing and Citizen Science: By engaging citizen scientists, the Smithsonian is able to collect large amounts of data, related to all of the projects happening at the marsh, in a very short period of time. This ensures that all of the plants are the same age and at the same stage of seasonal development when samples are taken, allowing us to compare across projects and through time. As the number of projects grows, it would not be possible to collect the data in the same small window of time without volunteers.

Status: The project started in July 2014 and is ongoing.

Location: This project is located in the Chesapeake Bay.

Participation: The total number of individuals involved during FY18 was 57. The total number of volunteer hours was 955.

Consent: Participation by the 57 individuals involved during FY18 was voluntary.

Submissions: Submissions are received in the form of data and observations.

Resources: Support for project staff (post doctoral fellows, technicians, principal investigators), maintenance of field site, purchase of supplies were all covered as normal operating expenses for the Global Change Research Wetland Plant Census.

[55] The website for the Global Change Research Wetland Plant Census can be viewed at https://serc.si.edu/citizen-science-research/projects/salt-marsh-census.

Partnerships: Federal partners include the National Science Foundation, Department of Energy, U.S. Geological Survey, and the National Aeronautics and Space Adminsitration, each of which are either currently or previously have provided funding for the project. Non-Federal partners include Maryland Sea Grant and Bryn Mawr College.

Advancement of Agency Mission: The Smithsonian Environmental Research Center provides science-based knowledge to meet the environmental challenges of the 21st century. The Center leads research on coastal ecosystems, such as the Global Change Research Wetland Plant Census, to inform real-world decisions for wise policies, best business practices, and a sustainable planet.

Results: Results are used in numerous peer-reviewed pubications, professional presentations, and graduate student dissertations.

Data Availability: All data are made available on the project website.

D.8.7 Invader ID[56]

Lead Sponsoring Agency: Smithsonian Institution

Authority: N/A

Project Summary and Goals: This project focuses on how introducing new organisms to an area can change the numbers and types of other organisms in the marine fouling community. By doing surveys of bays through time, it is possible see how the types and abundances of the organisms change, and how different species interact with one another. It also allows detection of new invasive species before they become problematic. Researchers use the data collected through the fouling community surveys to look at how fouling communities change through time and between one location and another. They combine this information with other data, such as weather data, to try to understand the patterns that they observe. By understanding these patterns, scientists can better predict which species are likely to invade nearby areas and what kinds of impacts they could have.

Justification for Using Crowdsourcing and Citizen Science: Fouling community patterns are most effective when data from lots of places over several years are available. Currently, scientists do all of the identifications, but this is a time consuming process and limits the number of bays that can be surveyed. Involving citizen scientists should increase the rate of data acquisition and the total amount of data available.

Status: The project started in March 2018 and is ongoing.

Location: Online only at this time.

Participation: The total number of individuals involved during FY18 was 1372.

Consent: Participation by the 1372 individuals involved during FY18 was voluntary.

Submissions: 48,542 classifications

Resources: N/A

Partnerships: N/A.

Advancement of Agency Mission: The Smithsonian Environmental Research Center provides science-based knowledge to meet the environmental challenges of the 21st century. The Center leads research

[56] The website for the Invader ID can be viewed at https://www.zooniverse.org/projects/serc/invader-id.

on coastal ecosystems, such as this pilot project, to inform real-world decisions for wise policies, best business practices, and a sustainable planet.

Results: This is a pilot project. No results have been published yet.

Data Availability: This is a pilot project but preliminary data can be shared upon request.

D.8.8 Leafsnap[57]

Lead Sponsoring Agency: Smithsonian Institution

Authority: N/A

Project Summary and Goals: Leafsnap is an electronic field guide that helps users learn about tree species and contribute to biodiversity research. Developed by researchers at Columbia University, the University of Maryland, and the Smithsonian, the free mobile app uses visual recognition software to identify tree species from high-resolution photographs of leaves. Leafsnap users automatically share images, species identifications, and geo-coded stamps of species locations with a community of scientists who use the data to map and monitor the ebb and flow of flora.

Justification for Using Crowdsourcing and Citizen Science: N/A

Status: The project started in 2011 and is ongoing.

Location: Northeastern United States and Canada, with plans to expand to full Continental U.S.

Participation: N/A

Consent: N/A

Submissions: N/A

Resources: N/A

Partnerships: Non-Federal partners include Columbia University and University of Maryland.

Advancement of Agency Mission: Leafsnap advances the Smithsonian's commitment to exploration and discovery of biological diversity and to sustaining the Earth's plant life.

Results: N/A

Data Availability: N/A

D.8.9 Neighbor Nestwatch[58]

Lead Sponsoring Agency: Smithsonian Institution

Authority: N/A

Project Summary and Goals: Neighborhood Nestwatch provides an outdoor educational experience for backyard wildlife enthusiasts and underserved youth. Participants contribute to important scientific research by re-sighting banded birds and monitoring nests. The Neighborhood Nestwatch approach features face-to-face interaction on an annual basis between Smithsonian scientists, participants, and neighborhood birds. Taking place in metro-area backyards in a growing number of metropolitan regions, Nestwatch seeks to determine how well backyard birds are coping amid rapid land use change

[57] The website for Leafsnap can be viewed at http://leafsnap.com/.

[58] The website for the Neighbor Nestwatch can be viewed at https://nationalzoo.si.edu/migratory-birds/neighborhood-nestwatch.

and simultaneously educate the public about threats and habitat enhancements that affect bird survival.

Justification for Using Crowdsourcing and Citizen Science: Members of the public give direct access to properties and offer first-hand observations of banded birds and nests.

Status: The project started in 2000 and is ongoing.

Location: The project is currently located in the Eastern seaboard and Colorado, and is Expanding to other U.S. metro regions.

Participation: The project targeted homeowners in metro regions. The total number of individuals involved during FY17 and FY18 was 500.

Consent: Participation by the 500 individuals involved during FY17 and FY18 was voluntary.

Submissions: Data observations on bird nests and color-banded birds in their backyards

Resources: Less that one FTE was used for the program, Resources for program management, seasonal field technicians, transportation, and equipment were provided by a Smithsonian "Youth Acess" grant. Additional resources were provided by a Cullman Foundation grant.

Partnerships: Federal partners include the Department of Agriculture. Non-Federal partners include the National Aviary (Pittsburgh), the Fernbank Museum of Natural History (Atlanta), and the Bird Conservancy of the Rockies (Denver).

Advancement of Agency Mission: The citizen science project has brought greater attention to Neighborhood Nestwatch thereby promoting an understanding of the conservation of backyard birds as well as educating the public about local bird survival.

Results: Overall, more than twenty articles have been published directly from Nestwatch data since project inception. Scientific publications in recent fiscal years include "Characterizing avian survival along a rural-to-urban land use gradient" in the journal Ecology, and "Native plants improve breeding and foraging habitat for an insectivorous bird" in the journal Biological Conservation.

Data Availability: Through the program website, Nestwatch participants can view birds banded and nests found at other locations within the Nestwatch participant base. Technical data are not made available until such data are analyzed, published, and disseminated online.

D.8.10 Smithsonian Transcription Center[59]

Lead Sponsoring Agency: Smithsonian Institution

Authority: N/A

Project Summary and Goals: The Smithsonian Transcription Center was created to increase and improve the access and use of Smithsonian digital collections, enhance the the quality of public engagement and participation, create new pathways of learning and knowledge, and maintain and build trust with communities of interest. In short, it was designed as an easy-to-use, free, online platform where the public – from anywhere in the world – could interact with digitized collections from around the Smithsonian and help enhance those materials through crowdsourced transcription and review. This

[59] The website for the Smithsonian Transcription Center can be viewed at https://transcription.si.edu/.

process allows public participants to engage with Smithsonian materials and increase the accessibility and discoverability of these collections by creating readable, text-searchable transcriptions.

Justification for Using Crowdsourcing and Citizen Science: The Smithsonian Transcription Center was designed as a crowdsourcing project because there was a defined need across the institution to increase and improve the accessibility of collections that could not be achieved by staff due to limited time and financial resources. Previous transcription projects were done by staff members, contractors, or interns, on a project-by-project basis, when time and resources permitted. Through crowdsourcing with digital volunteers, the stories and information locked within digitized collections is made accessible on a level far beyond the abilities of Smithsonian staff. On average, digital volunteers transcribe and review over seventy-five pages of material per day. The choice to enlist the public in this project for crowdsourcing transcriptions additionally fits into the Smithsonian Institution's mission of engaging the public in the increase and diffusion of knowledge.

Status: The project started in June 2013 and is ongoing.

Location: Materials that are posted for transcription pertain to areas across the United States and around the world.

Participation: The project targeted any member of the public interested in helping transcribe Smithsonian library, archival, and museum collections. By the end of FY18, the Transcription Center had 11,889 participants (registered digital volunteers). Of these, 4,551 were newly registered during FY17 and FY18. Of the new volunteers, 2,927 were active transcribers.

Consent: Participation by the 4,551 volunteers involved during FY17 and FY18 was voluntary.

Submissions: Volunteer participants are asked to transcribe and review digitized Smithsonian archival, library, and museum collections. During FY17 and FY18, volunteers completed 194,827 pages.

Resources: The Smithsonian Transcription Center crowdsourcing platform is supported by the Smithsonian's Office of the Chief Information Officer (OCIO). OCIO staff oversee operations and continued development of the platform, working in close coordination with colleagues in the Smithsonian museums and research centers that contribute collections for transcription. A full-time project coordinator sponsored by OCIO supports unit staff in utilizing the system and fosters the Center's vibrant community of Digital Volunteers. Two to three FTEs were used to execute this project in FY17 and FY18.

Partnerships: N/A

Advancement of Agency Mission: The Smithsonian Transcription Center advances the Institution's historic mission to "increase and diffuse knowledge" by providing a digital platform where the public can take part in making treasures now held in Smithsonian museums, libraries, and archives accessible to the world. The program, which presents materials for transcription spanning the fields of science, history, art, and culture, supports the goals of the current Strategic Plan of engaging and inspiring millions more people – locally and around the globe – through audience-focused pan-Institutional initiatives.

Results: The transcribed pages completed by digital volunteers in the Smithsonian Transcription Center are used in a variety of research projects and exhibits both within and outside the Smtihsonian. Because all of the transcriptions are made publically available on multiple platforms, Smithsonian staff and researchers, along with the public, can find and use the information transcribed for their own research purposes. For example, completed transcription projects have been used by Smithsonian curators to more easily locate information within collection materials to include in museum exhibits; data gathered from transcriptions has been used to map and reveal new information on the growth of different

vegetables around the country, the populations of insect species over time, and the flora and fauna present in various countries throughout different centuries; and transcriptions of correspondence, diaries, field notes, and government and organizational records have been used by both academic researchers and the public to locate genealogical information. Some of the major projects launched and completed in the Transcription Center during FY17 and FY18 include: (1) Records of the Bureau of Refugees, Freedmen, and Abandoned Lands (collaborative project between the National Museum of African American History and Culture and the National Archives, https://s.si.edu/2LlYpkg); (2) Field Book Project (including field notes from around the Smithsonian, https://s.si.edu/2npArut); (3) The Jacques Seligmann & Co. Records from the Archives of American Art (https://s.si.edu/2QqdmV1); (4) Projects related to Frederick Douglass for the Bicentennial of his birth (https://s.si.edu/2Nd4ssF); and (5) Phyllis Diller Gag File from the National Museum of American History (https://s.si.edu/2P6IEQf).

Data Availability: All completed (i.e., transcribed and reviewed) pages are made available to the public online. Transcribed content is always available on the Smithsonian Transcription Center website (transcription.si.edu) on both the project pages themselves and through downloadable pdfs (as individual pages or fully completed projects). The original digitized images of the material being transcribed remain next to the completed transcription for reference. Transcription Center completed pages and projects are also linked internally with the Smithsonian's online, public-facing databases: Collections Search Center (http://collections.si.edu/search/) and the Smithsonian's Online Virtual Archive (https://sova.si.edu/). Within minutes of a page being transcribed, the transcribed content automatically appears alongside the digitized collection page in these online databases and is text searchable.

D.8.11 Smithsonian Transcription Center - Biodiversity Collection Records and Specimen Labels[60]

Lead Sponsoring Agency: Smithsonian Institution

Authority: N/A

Project Summary and Goals: Since 2013, one of the primary goals of the Smithsonian Transcription Center has been to increase and improve the access and use of Smithsonian scientific related collections, enhance the quality of public engagement with these materials, and create new pathways of learning and knowledge related to scientific and biodiversity data. By enlisting the public's help in transcribing and reviewing scientific specimen records and collections, the Transcription Center promotes and sustains the discoverability of scientific data.

Justification for Using Crowdsourcing and Citizen Science: The Smithsonian Transcription Center was designed as a crowdsourcing project because there was a defined need across the institution to increase and improve the accessibility of our collections that could not be achieved by staff due to limited time and financial resources. Previous transcription projects were done by staff members, contractors, or interns, on a project-by-project basis, when time and resources permitted. Through crowdsourcing with digital volunteers, the stories and information locked within our digitized collections is made accessible on a level far beyond the abilities of Smithsonian staff. On average, digital volunteers transcribe and review over seventy-five pages of material per day. The choice to enlist the public in this project for crowdsourcing transcriptions additionally fits into the Smithsonian

[60] The website for the Smithsonian Transcription Center - Biodiversity Collection Records and Specimen Labels can be viewed at https://transcription.si.edu/; Paleobiology catalog cards: https://s.si.edu/2NhAuTn; Pollen Cards: https://s.si.edu/2P4U4nM; Botanical Specimen Sheets: https://s.si.edu/2P1nao8; Entomology Bumblee Specimen Sheets: https://s.si.edu/2xRHOQL.

Institution's mission of engaging the public in the increase and diffusion of knowledge. Scientific field books and other archival materials were seen as particularly relevant and important for inclusion into the Transcription Center, as transcriptions of this content would help further unlock hidden data for researchers around the world.

Status: The project started in June 2013 and is complete.

Location: Collection records pertained to locations throughout the U.S., Panama, and other countries.

Participation: The project targeted any member of the public with internet access interested in helping to transcribe and review Smithsonian archival collections related to the history of science and biodiversity. From launch of the Smithsonian Transcription Center in 2013 through the end of FY18, a total of 11,889 individuals have registered on the platform. In FY17-18 alone, the community grew by 4,551 registered users, 2,927 of whom actively transcribed.

Consent: All individuals who registered on the platform provided consent.

Submissions: Participants were asked to transcribe and review digitized specimen labels and collection information for a number of different scientific specimens from the National Museum of Natural History's Department of Botany, Entomology, and Paleobiology, and from the Smithsonian Tropical Research Institute. This transcribed data was used to create catalog records for these materials, increasing accessibility to this scientific research material.

Resources: N/A

Partnerships: N/A

Advancement of Agency Mission: The Smithsonian Transcription Center's projects from the Institution's various biodiversity collections and specimen records advance the mission and strategic objectives of the Smithsonian Institution. By providing a pan-institutional digital platform where the public can not only access digitized science-related collections, but also participate in improving them, the Transcription Center plays a prominent role in the increase and diffusion of knowledge. With over 11,800 active digital volunteers from over fifty different countries, the Transcription Center also advances the goals of the Smithsonian's strategic plan to engage and inspire more people by 2022 through new digital initiatives, interdisciplinary projects, and improve and increase access to our scientific collections.

Results: The transcribed pages completed by digital volunteers in the Smithsonian Transcription Center are used in a variety of research projects and exhibits both within and outside the Smithsonian. Because all of the data (transcriptions) are made publically available on multiple platforms, Smithsonian staff and researchers, along with the public, can find and use the information transcribed for their own research purposes. For example, completed transcription projects from biodiversity specimen collections have been used to enhance and improve data in a variety of scientific research projects. Not only did this work create catalog records for this material that did not exist before, but transcriptions of this data also increased the accessibility and readability of the information related to these various scientific specimens on a level that could not be achieved by department staff. Smithsonian researchers and the public have been able to use this information to more easily study the geographic and chronological population changes of bumblebees, botanical specimens, pollen, and the prehistoric marine invertebrates, and discover, from anywhere in the world, new scientific information about these collections and species.

Data Availability: All completed (i.e., transcribed and reviewed) pages are made available to the public online. Transcribed content is always available on the Smithsonian Transcription Center website (transcription.si.edu) on both the project pages themselves and through downloadable pdfs (as

individual pages or fully completed projects). The original digitized images of the material being transcribed remain next to the completed transcription for reference.

D.8.12 Smithsonian Transcription Center - Project PHaEDRA: Preserving Harvard's Early Data and Research in Astronomy[61]

Lead Sponsoring Agency: Smithsonian Institution

Authority: N/A

Project Summary and Goals: Since 2013, one of the primary goals of the Smithsonian Transcription Center has been to increase and improve the access and use of Smithsonian scientific collections, enhance the quality of public engagement with these materials, and create new pathways of learning and knowledge related to scientific and biodiversity data. By enlisting the public's help in transcribing and reviewing research data from the Harvard-Smithsonian Center for Astrophysics, the Transcription Center promotes and sustains the discoverability of scientific research and data for researchers around the world, and makes available primary sources on the evolution of observation methods and astronomy.

Justification for Using Crowdsourcing and Citizen Science: The Smithsonian Transcription Center was designed as a crowdsourcing project because there was a defined need across the institution to increase and improve the accessibility of our collections that could not be achieved by staff due to limited time and financial resources. Previous transcription projects were done by staff members, contractors, or interns, on a project-by-project basis, when time and resources permitted. Through crowdsourcing with online volunteers, the stories and information locked within our digitized collections is made accessible far beyond the abilities of Smithsonian staff. On average, digital volunteers transcribe and review over seventy-five pages of material per day. The choice to enlist the public in this project for crowdsourcing transcriptions additionally fits into the Smithsonian Institution's mission of engaging the public in the increase and diffusion of knowledge. Scientific field books and other archival materials were seen as particularly relevant and important for inclusion into the Transcripiton Center, as transcriptions of this content would help further unlock hidden data for researchers around the world.

Status: The project started in June 2013 and is ongoing.

Location: N/A

Participation: The project targets any member of the public with internet access and access to a computer interested in helping to transcribe and review Smithsonian archival collections related to the history of science and astronomy. From launch of the Smithsonian Transcription Center in 2013 through the end of FY18, a total of 11,889 individuals have registered on the platform. In FY17-18 alone, the community grew by 4551 registered users, 2927 of whom actively transcribed material.

Consent: Participation was voluntary.

Submissions: Participants, or "digital volunteers", were asked to transcribe and review digitized log books and notes created by "human computers" at the Harvard College Observatory in the 19th and 20th centuries. Now held in the Wolbach Library of the Harvard-Smithsonian Center for Astrophysics, these logbooks – and their transcriptions – provide an invaluable resource on the history of astronomy.

[61] The website for the Smithsonian Transcription Center -- Project PHaEDRA: Preserving Harvard's Early Data and Research in Astronomy can be viewed at https://s.si.edu/2xRukol.

Resources: The Smithsonian Transcription Center crowdsourcing platform is supported by the Smithsonian's Office of the Chief Information Officer (OCIO). OCIO staff oversee operations and continued development of the platform, working in close coordination with colleagues in the Smithsonian museums and research centers that contribute collections for transcription. A full-time project coordinator sponsored by OCIO supports unit staff (equivalent to 2-3 FTEs) in utilizing the system and fosters the Center's vibrant community of Digital Volunteers.

Partnerships: Non-Federal partners include Harvard University.

Advancement of Agency Mission: The Smithsonian Transcription Center's projects on astronomy and astrophysics research data from the Harvard-Smithsonian Center for Astrophysics advance the mission and strategic objectives of the Smithsonian Institution. The Transcription Center plays a prominent role in the increase and diffusion of knowledge. With over 11,800 active digital volunteers from over fifty different countries, the Transcription Center also advances the goals of the Smithsonian's strategic plan to engage and inspire more people by 2022 through new digitial initiatives, interdisciplinary projects, and improve and increase access to scientific collections.

Results: All of the transcribed projects from the Harvard-Smithsonian Center for Astrophysics will be available digitally in both Harvard University's databases as well as remaining permanently available in the Transcription Center. The availability of these transcription projects in these online systems allows researchers around the world to more easily discover and study the history of astronomy as a science, the development and evolution of observation methods, changes over time in the night sky, and the role of women in this research during the nineteenth and twentieth centuries. Harvard-Smithsonian Center for Astrophysics' Wolbach Library Staff are already using transcribed data to contextualize and inform related materials in their collections and create outreach and engagement tools, including educational resources related to the history of astronomy.

Data Availability: All of the transcribed projects from the Harvard-Smithsonian Center for Astrophysics are permanently available in the Transcription Center and can be downloaded and searched by anyone interested. The transcriptions will also become full-text searchable in the NASA Astrophysics Data System through Harvard University (https://ui.adsabs.harvard.edu/), and will be linked to the original source material: 500,000 glass plate photographs representing the first picture of the visible universe. These plates are currently being digitized through the DASCH Project at Harvard University (https://platestacks.cfa.harvard.edu/dasch-project). The availability of these transcription projects in the Transcription Center and through Harvard University's online systems allows researchers around the world to more easily discover and study the history of astronomy as a science, the development and evolution of observation methods, changes over time in the night sky, and the role of women in this research during the nineteenth and twentieth centuries. The Project PHaEDRA projects are downloadable and viewable in the Transcription Center at https://s.si.edu/2xRukol.

D.8.13 Smithsonian Transcription Center - Transcription of Science-related Archival Documents[62]

Lead Sponsoring Agency: Smithsonian Institution

Authority: N/A

Project Summary and Goals: Since it was created in 2013, the Smithsonian Transcription Center has expanded access to Smithsonian science-related collections, enhanced the quality of public

[62] The website for the Smithsonian Transcription Center, Transcription of Science-related Archival Documents can be viewed at https://s.si.edu/2OYqhx6.

engagement with these materials, and created new pathways of learning and knowledge related to scientific and biodiversity data. By enlisting the public's help in transcribing and reviewing scientific field notes, annual reports, correspondence, and more, the Transcription Center promotes the discoverability and use of scientific data by professional researchers and laypeople.

Justification for Using Crowdsourcing and Citizen Science: The Smithsonian Transcription Center was designed as a crowdsourcing project because there was a defined need across the institution to increase and improve the accessibility of collections that could not be achieved by staff due to limited time and financial resources. Previous transcription projects were done by staff members, contractors, or interns, on a project-by-project basis, when time and resources permitted. Through crowdsourcing with digital volunteers, the stories and information locked within the Smithsonian's digitized collections is made accessible on a level far beyond the abilities of Smithsonian staff. On average, digital volunteers transcribe and review over seventy-five pages of material per day. The choice to enlist the public in this project for crowdsourcing transcriptions additionally fits into the Smithsonian Institution's mission of engaging the public in the increase and diffusion of knowledge. Scientific field books and other archival materials were seen as particularly relevant and important for inclusion into the Transcripiton Center, as transcriptions of this content would help further unlock hidden data for researchers around the world.

Status: The project started in June 2013 and is ongoing.

Location: Archival documents pertaining to locations throughout the United States and beyond.

Participation: The project targets any member of the public interested in helping transcribe Smithsonian archival collections related to science and biodiversity. From launch of the Smithsonian Transcription Center in 2013 through the end of FY18, a total of 11,889 individuals have registered on the platform. In FY17-18 alone, the community grew by 4551 registered users, 2927 of whom actively transcribed material.

Consent: Participation by all individuals is voluntary.

Submissions: Participants, or "digital volunteers", are asked to transcribe and review digitized Smithsonian archival materials related to science and biodiversity, including field notes from scientific expeditions, annual reports of Smithsonian scientific departments, and correspondence from Smithsonian scientific curators. Their efforts make the data within the archival materials more accessible (more readable and keyword searchable) for the scientists and the general public.

Resources: The Smithsonian Transcription Center crowdsourcing platform is supported by the Smithsonian's Office of the Chief Information Officer (OCIO). OCIO staff oversee operations and continued development of the platform, working in close coordination with colleagues in the Smithsonian museums and research centers that contribute collections for transcription. A full-time project coordinator sponsored by OCIO supports unit staff (equivalent to 2-3 FTEs) in utilizing the system and fosters the Center's vibrant community of Digital Volunteers.

Partnerships: N/A

Advancement of Agency Mission: The Smithsonian Transcription Center advances the Institution's historic mission to "increase and diffuse knowledge" by providing a pan-institutional digital platform where the public can take part in making treasures now held in Smithsonian museums, libraries, and archives accessible to the world. The program, which presents materials for transcription spanning the fields of science, history, art, and culture, supports the goals of the current Strategic Plan of engaging and inspiring millions more people—locally and around the globe—through audience-focused pan-Institutional initiatives.

Results: N/A

Data Availability: All completed (i.e., transcribed and reviewed) pages are made available to the public online. Transcribed content is always available on the Smithsonian Transcription Center website (transcription.si.edu) on both the project pages themselves and through downloadable pdfs (as individual pages or fully completed projects). The original digitized images of the material being transcribed remain next to the completed transcription for reference. Transcription Center completed pages and projects are also linked internally with the Smithsonian's online, public-facing databases: Collections Search Center (http://collections.si.edu/search/) and the Smithsonian's Online Virtual Archive (https://sova.si.edu/). Within minutes of a page being transcribed, the transcribed content automatically appears alongside the digitized collection page in these online databases and is text searchable.

D.8.14 Virginia Working Landscapes: Grasslands Biodiversity Survey[63]

Lead Sponsoring Agency: Smithsonian Institution

Authority: N/A

Project Summary and Goals: Virginia Working Landscapes (VWL) is a program of the Smithsonian Conservation Biology Institute (SCBI) that promotes the conservation of native biodiversity and sustainable land-use through research, education, and community engagement. Its goals are to: (1) Create a community network to promote dissemination of information from neighbor to neighbor; (2) Network landowners with State and Federal agencies that can provide them with specific technical and financial assistance; (3) Establish and highlight demonstration sites on working farms that showcase best practices for different land uses, agricultural production, and biodiversity management; and (4) Advance the science of land management and develop best practices relevant both to working farmers and conservationists.

Justification for Using Crowdsourcing and Citizen Science: Citizen science allows VWL to gather data over a large geographic area (incorporating 16 counties) from private landholdings. VWL's focus is on engagement with the community of concerned citizens over a multi-county region of central and northern Virginia, over the broad topic of biological conservation. Citizen science is a means to recruit, train, and continuously provide outreach and education materials to the community. In turn, citizen scientists become ambassadors for the program and the Smithsonian Institution. The program convenes a large audience of citizen scientists, landowners, researchers, other non-profit organizations, and natural resource industry service providers through Smithsonian's field work, frequent training, and enrichment opportunities. The citizen scientists make a direct contribution to research, increase their scientific understanding, and are allowed to immerse themselves in the field of conservation. This all results in highly impactful, personally transformative experiences for the citizen scientist volunteers. The project encourages not only good conservation, but also good community-based, person-to-person networking around a good cause.

Status: The project started in January 2010 and is ongoing.

Location: The project is located in Northern and Central Virginia, Northern Blue Ridge and Northern Piedmont ecoregions.

[63] The website for the Virginia Working Landscapes: Grasslands Biodiversity Survey can be viewed at http://www.vaworkinglandscapes.org/conservation-science/priority-areas/220-grassland-biodiversity-surveys.

Participation: The project targets landowners, research professionals, naturalist volunteers, government and non-government natural resource organizations, conservation land trusts, and for-profit land management businesses. The project involved 83 citizen scientists in 2017 and 64 in 2018. The total number of volunteer hours was 1.19 FTEs.

Consent: Participation by the 131 individuals involved in FY17 and FY18 was voluntary.

Submissions: Participants submitted ecological monitoring data, photographs, and plant and animal specimens collected from the field.

Resources: The program required 0.54 FTEs in FY18.

Partnerships: Non-Federal partners include Blandy Experimental Farm and State Arboretum; Piedmont Environmental Council; Blue Ridge PRISM; Smithsonian-Mason School of Conservation; National Bobwhite Conservation Initiative; Virginia Master Naturalists; Virginia Department of Game and Inland Fisheries.

Advancement of Agency Mission: The Smithsonian's mission is to increase and diffuse knowledge. Virginia Working Landscapes is a program of the Smithsonian Conservation Biology Institute that promotes the conservation of native biodiversity and sustainable land-use through research, education, and community engagement.

Results: Through the development of consistent survey protocols and rigorous volunteer training, the data from VWL surveys has begun to yield results that can be applied to local land management. For example, it is now known that native warm-season grass meadows, such as those established through bobwhite quail conservation programs, support higher densities of declining shrubland birds and overwintering birds. Similarly, citizen scientists study how human activities influence movement patterns of the region's carnivores, explore how urban development impacts bumblebee populations, and identify relationships between native plants, land management, and wildlife. These studies can help delineate areas of conservation priority while engaging landowners and educating them regarding best practices for biodiversity. The results of the analyses derived from data collected through our citizen science project are disseminated to regional planning entities, policy makers, the scientific community, VWL's partner organizations, and landowners. Results appear in peer-reviewed journals and publications as well as through SI media channels and other popular print and online publications. On average, outreach effort includes over twenty formal presentations a year and include hosting or attending at least ten other public outreach events in our region. An additional 5000+ people are reached through social media and website visits each year. Analyses are useful to natural resource agency regulators and partners for identifying population trends among a host of plant and wildlife species, some of which are currently federally endangered or considered at-risk, and many of which are considered in decline. This knowledge will contribute to a growing body of knowledge around grasslands ecology, particularly in the area of grassland breeding birds, native pollinators, the impacts of invasive or introduced plant species on the biodiversity, overall health, and stability of grass-dominated ecosystems in the eastern United States. In addition, each landowner on whose property a survey is conducted is provided an annual report summarizing all the data collected in a given year. Results provide an important input for landowners and land managers, and form a foundation for making good land management decisions.

Data Availability: Data collected by VWL citizen scientists has in the past been made publically available through the website, but due to the sensitive, proprietary nature of private property, and the need to protect the identities of landowners and other private citizens, the practice of publically releasing this information has been ended. VWL intends to explore ways to make the data available in the future through the publication of results.