Harnessing the Ingenuity of the Public to Accelerate Science and Technology Innovation

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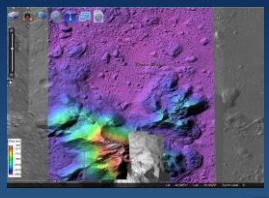
After analyzing 338 citizen science biodiversity projects around the world, researchers at the University of Washington estimated that the **in-kind contributions of 1.3–2.3 million citizen science volunteers** to biodiversity research have an **economic value of up to $2.5 billion per year**.

Source: Theobald, E.J., A.K. Ettinger, H.K. Burgess, L.B. DeBey, N.R. Schmidt, H.E. Froehlich, C. Wagner, J. HilleRisLambers, J. Tewksbury, M.A. Harsch, and J.K. Parrish. 2014. Global change and local solutions: Tapping the unrealized potential of citizen science for biodiversity research. Biological Conservation 181: 236-244. doi:10.1016/j.biocon.2014.10.021



Open Innovation (incentive prizes, crowdsourcing, and citizen science)

"**Government should be collaborative.** Collaboration actively engages Americans in the work of their government. Executive departments and agencies should use innovative tools, methods, and systems to cooperate among themselves, across all levels of government, and with nonprofit organizations, businesses, and individuals in the private sector."
President Obama, January 2009 [1]

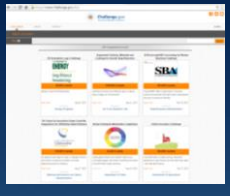
- Creates a more open government. Successfully addressing our nation's greatest challenges requires the active participation of an informed and active citizenry representing all sectors of society.
- Facilitates the participation of a broader range of stakeholders through new avenues, leveraging fresh perspectives and empowering communities to help solve problems.
- Harnesses the expertise, ingenuity, and creativity of Americans, engaging them as strategic partners in addressing some of the country's most pressing challenges.

Significant progress has been made during this Administration to incorporate collaborative approaches, like open innovation, into the work of the Federal government. [2]

Source [1]: Open Government Memorandum, January 2009.

Source [2]: Strategy for American Innovation, October 2015.

Prizes and Challenges in the Public Sector



Challenge.gov at-a-glance:
- 625+ competitions launched
- More than $220 million awarded in prizes
- 250,000+ solvers participated
- 3.5 million site visits
- Visitors from every country around the globe
- Participants from every state in the USA
- *Winner of the Harvard Ash Center "Innovations in American Government" Award*

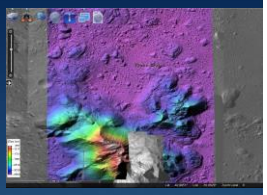
"Between 2010 and 2014 'incentive prizes have transformed from an exotic open innovation tool to a proven innovation strategy' with $64 million in total prize money being offered through Challenge.gov."
- "Craft of Prize Design..." Deloitte, 2015

Benefits of Prizes

1. Shine a spotlight on a problem or opportunity
2. Pay only for results
3. Target an ambitious goal without predicting which team or approach is most likely to succeed
4. Reach beyond usual suspects to tap top talent
5. Stimulate private sector investment many times greater than the prize purse
6. Bring out-of-discipline perspectives to bear
7. Inspire risk-taking by offering a level playing field
8. Establish clear target metrics and validation protocols

NASA's Lunar Mapping and Modelling Portal (LMMP) Image Processing Challenge

- Sought to develop a software application that performs image processing to transform the raw images taken by Lunar Reconnaissance Orbiter (LRO) into geo-referenced and "mosaicked" images that can be displayed on the LMMP
- 21 contests, 153 unique registrants, total of 35 submissions.
- The previous online service tool required 19 hours to process 29 images. **The new solution reduced the time to process the images to three hours.**
- This was accomplished with less than $13,000 in prize incentives and operational expenses of $55,000.



Northrop Grumman Lunar Lander X Challenge

- **Government-funded** prize purse; **Non-profit** administration; **Private sector** Sponsor
- Target: lift to a height of 50 meters, translate to a landing pad 100 meters away, land safely and then return, following the same path
- Two winning teams that have since received contracts with NASA
- $1,000,000 First Place Winner Masten Space Systems

What are Citizen Science and Crowdsourcing?

- "In **citizen science**, the public participates **voluntarily** in the scientific process, addressing real-world problems in ways that may include formulating research questions, conducting scientific experiments, collecting and analyzing data, interpreting results, making new discoveries, developing technologies and applications, and solving complex problems." [1]
- "In **crowdsourcing**, organizations submit an open call for **voluntary** assistance from a large group of individuals for online, distributed problem solving." [1]

[2]

Note, often, citizen science and crowdsourcing approaches are more collaborative, volunteer-based, and data focused than prizes and challenges.

Source [1]:
Memorandum from Dr Holdren to the Agencies: Addressing Societal and Scientific Challenges through Citizen Science and Crowdsourcing

Source [2]:
Notes from Citizen Cyber Science and Crowdsourcing Metadata Workshop Summary, July 2015

Other Related Terms

- Science 2.0
- Collaborative mapping
- Wikinomics
- Extreme citizen science
- Geographic citizen science
- Geocollaboration
- Map Hacking or Map Hacks
- Neogeography
- Participatory sensing
- Ubiquitous cartography
- Mashup
- Citizen science
- Collaboratively contributed geographic information
- Crowdsourcing
- Geographic World Wide Web
- GeoWeb or GeoSpatialWeb
- Involuntary geographic information
- Volunteered Geographic Information
- Public participation in scientific research
- Ambient geographic information
- User-generated content
- Contributed Geographic Information

Huerta, Schade, Granell (Eds). Semantic analysis of Citizen Sensing, Crowdsourcing and VGI. Connecting a Digital Europe through Location and Place. Proceedings of the AGILE'2014 International Conference on Geographic Information Science, Castellón, June, 3-6, 2014. ISBN: 978-90-816960-4-3

Policy: Holdren Memo

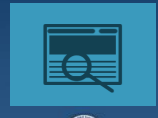
- *Addressing Societal and Scientific Challenges through Citizen Science and Crowdsourcing* was released on September 30, 2015.
- This memorandum:
  - Outlines principles that agencies should apply in order to ensure future use of citizen science and crowdsourcing in a way that is appropriate and leads to greatest value and impact:
    - Data quality
    - Openness
    - Public Participation
  - Articulates the benefits of CCS approaches:
    - Enhance scientific research
    - Address societal need
    - Provide hands-on STEM learning and increase STEM literacy
  - Recommends agency actions to build capacity for citizen science and crowdsourcing.
  - Provides, in the Appendix, examples of successful completed and ongoing applications of citizen science and crowdsourcing at Federal agencies.

Practices: Federal Crowdsourcing and Citizen Science Toolkit

The purpose of the Federal Crowdsourcing and Citizen Science Toolkit, as one of the tools in the Innovation Toolkit, is to "help further the culture of innovation, learning, sharing, and doing in the federal citizen science and crowdsourcing community."

The primary content in support of this purpose are:

- How To – Process Steps
- Case Studies
- Resource Library
- Legal and Policy


citizenscience.gov

Monitoring Sudden Oak Death in California

- "Sudden oak death is the Ebola of the plant world, the most serious threat to non-agricultural plants"
- Starting in 2008, University of California (UC), Berkeley, researchers expanded their sudden oak death monitoring efforts exponentially, thanks to observations from 1,600 trained volunteers who collected leaf samples from trees in metropolitan and urban wildland areas.
- Those data were used to develop accurate computer models for the disease's spread, showing that properly trained and educated citizen scientists can collect data that's just as reliable as that of professionals.
- Follow-up evaluation showed that trained citizen scientists were as effective as experts in identifying and collecting diseased tree leaves, whether or not they reported having a professional background in science.

NOAA's mPING Project

- This project has collected more than 860,000 weather reports containing information on a variety of weather-related events, including rain, snow, ice, wind, tornadoes, and more.
- These reports from volunteers are used to improve weather computer models, forecast ground icing that could affect road maintenance and aviation operations, and predict the potential for in-flight icing.
- Using the free mPING app, anyone can submit a weather observation anonymously.
- mPING was deployed in 2012 and developed through a partnership between NOAA/NSSL, the University of Oklahoma, and the Cooperative Institute for Mesoscale Meteorological Studies.