**Crowdsourcing & Citizen Science**

**Quote:**

[N/A: surely we can find one from Jenn Gustetic]

**Intro**:

By enabling and scaling the use of open innovation methods such as citizen science and crowdsourcing, the Federal government is increasingly harnessing the ingenuity of the public to accelerate science and technology innovation, and improve the efficiency and effectiveness of government. Crowdsourcing and citizen science are tools that educate, engage, and empower the public to apply their curiosity and contribute their talents to a wide range of real-world problems. Crowdsourcing is an online, distributed problem-solving and production model whereby organizations submit an open call for voluntary assistance from a large group of individuals. Through citizen science, members of the public participate 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. Members of the public can contribute to a wide range of scientific and societal problems, including public health, disaster response, biodiversity research, and astronomy. *Sourced directly from:* [Holdren, J., “[Addressing Societal and Scientific Challenges through Citizen Science and Crowdsourcing](https://www.whitehouse.gov/sites/default/files/microsites/ostp/holdren_citizen_science_memo_092915_0.pdf),” Office of Science and Technology Policy, September 30th, 2015.]

**Why:**

Citizen science and crowdsourcing are important for a number of reasons. First, citizen science and crowdsourcing help enhance and accelerate scientific research through group discovery and co-creation of knowledge. For instance, volunteers can collect data over large areas and long periods of time—and sometimes increase the frequency of observations—in ways that Federal agencies may not be able to do, given geographic and resource constraints. Second, citizen science and crowdsourcing projects not only augment and enhance the scientific process, but also address other societal needs while drawing on a vast reservoir of untapped resources—the skills, dedication, and ingenuity of the American people. Diverse participation by all parts of society helps bring in new ideas and insights to contribute to solutions. Citizen science and crowdsourcing can address a range of societal needs and Federal agency goals, ranging from enhancing the accuracy of prediction markets to tagging and transcribing National Archive records. Finally, whether as youth or as adults, participants in crowdsourcing and citizen science projects have the opportunity to acquire a lifelong enthusiasm for science, along with valuable skills in science, technology, engineering, and mathematics (STEM). *Sourced directly from:* [“[A Strategy for American Innovation](https://www.whitehouse.gov/sites/default/files/strategy_for_american_innovation_october_2015.pdf),” Economic Council and Office of Science and Technology Policy, October 2015.]

Citizen science and crowdsourcing are powerful tools that can help Federal agencies:

* Advance and accelerate scientific research through group discovery and co-creation of knowledge. For instance, engaging the public in data collection can provide information at resolutions that would be difficult for Federal agencies to obtain due to time, geographic, or resource constraints.
* Increase science literacy and provide students with skills needed to excel in science, technology, engineering, and math (STEM). Volunteers in citizen science or crowdsourcing projects gain hands-on experience doing real science, and take that learning outside of the classroom setting.
* Improve delivery of government services with significantly lower resource investments.
* Connect citizens to the missions of Federal agencies by promoting a spirit of open government and volunteerism. S*ourced directly from:* [Marcoullier, T., “[Crowdsourcing Month: An Overview](https://www.digitalgov.gov/2014/12/08/crowdsourcing-month-an-overview/),” DigitalGov, December 8th, 2014.]

**How:**

In December 2016, Congress passed the [American Innovation and Competitiveness Act](https://www.congress.gov/bill/114th-congress/senate-bill/3084/text), which adds explicit new authority for agencies to undertake crowdsourcing and citizen science projects. While citizen science has long been conducted by Federal agencies, this new law explicitly recognizes the value of this approach and gives agencies the capacity to carry out the projects. [Nelson, C., personal communication with Policy Design Lab, January 10, 2017.]

For executing a crowdsourcing or citizen science project, there are five basic process steps for planning, designing, and implementing:

1. scope out your problem

2. design a project

3. build a community

4. manage your data

5. sustain and improve

In order to use citizen science and crowdsourcing appropriately and effectively, agencies should apply the following principles, where relevant, in project design:

* **Data quality**. Information collected and/or used by volunteers should be credible and usable. Recognizing that a “one-size-fits-all” quality-assurance approach will not work for all projects, Federal agencies should apply the principle of “fitness for use,” ensuring that data have the appropriate level of quality for the purposes of a particular project. In addition, citizen science projects should incorporate the same practices generally followed by all science projects, including data-quality assurance, data management, and ongoing project evaluation; relevant Federal and agency policies for scientific integrity and ethics; and other applicable agency principles, policies, and practices.
* **Openness**. Information is a valuable national resource and a strategic asset to the Federal Government, its partners, and the public. Data worth collecting and using also are worth preserving and sharing. Federal agencies should design projects that generate datasets, code, applications, and technologies that are transparent, open, and available to the public, consistent with applicable intellectual property, security, and privacy protections. Agencies should use machine-readable formats to share data, metadata, and results with project volunteers and the general public.
* **Public participation.** Public engagement enhances the government’s effectiveness and improves the quality of its decisions. Americans’ collective expertise and information are valuable assets. Participation in projects should be fully voluntary, and volunteers should be acknowledged for their contributions. Further, volunteers should know how their contributions are meaningful to the project and how they, as volunteers, will benefit from participating. Where appropriate, agencies should consider engaging other countries or regions with relevant experience, programs, or citizenry to provide useful scientific data on issues that span national borders and build international understanding of shared scientific challenges. *Sourced directly from:* [Holdren, J., “[Addressing Societal and Scientific Challenges through Citizen Science and Crowdsourcing](https://www.whitehouse.gov/sites/default/files/microsites/ostp/holdren_citizen_science_memo_092915_0.pdf),” Office of Science and Technology Policy, September 30th, 2015.]

**Case Study:**

**The Aggregative Contingent Estimation Program: Predicting Global Events Through Crowdsourcing**

*Sourced directly from:* [“[The Aggregative Contingent Estimation Program: Predicting Global Events Through Crowdsourcing](https://www.citizenscience.gov/2015/08/25/ace-forecasting/),” citizenscience.gov, August 25th, 2015.]

**Summary**

The goal of the *Aggregative Contingent Estimation* Program, sponsored by the Intelligence Advanced Research Projects Activity, is to enhance the accuracy, precision and timeliness of forecasts for a broad range of global events. The program develops advanced techniques to gather, weight, and combine the judgments of people from many backgrounds and fields and in many different locations. *ACE* is powered by human judgment, which makes it flexible enough to provide forecasts on just about any type of intelligence-forecasting question. Launched in 2010, *ACE* is based on the idea that combining forecasts made by an informed and diverse group of people often produces more accurate predictions of future events than those made by a single expert.

**How they did it**

*ACE* started with a “forecasting tournament.” Five teams of leading scholars from industry and academia competed to forecast events. They recruited thousands of research participants; each year, the participants answered about 100 questions related to social, economic and political events. Every day, the teams sent forecasts to an independent evaluator, who scored them based on actual outcomes. Each research team tried to produce the most accurate forecasts, competing against each other and against a benchmark group that used the unweighted average judgment of a group of forecasters.

After two years, one research team — the Good Judgment Project–substantially outperformed the others. In fact, Good Judgment’s improvement in accuracy was greater than the improvement of the other four research teams combined — about 70 percent over the benchmark. Forecast improvement was measured using Brier scoring, a method originally developed to evaluate weather forecasts.

**Key accomplishments:**

The team that won the *ACE* tournament (the Good Judgment Project) made substantial advances in all three areas:

* *Collecting judgments*: Given the advanced algorithms generated in *ACE*, opinion surveys surpassed prediction market platforms as the best way to elicit probabilistic judgments from forecasters.
* *Combining judgments*: Promising new algorithms weighted individual survey responses based on past accuracy, then pushed up some probability judgments (for example, an average prediction of 70 percent might be pushed to 90 percent if the beliefs of previously accurate forecasters warranted it). This dramatically increased the accuracy of the combined judgments.
* *Training forecasters*: The team created a one-hour online class that improved individual forecaster accuracy by about 10 percent.

*ACE* shows that meaningful geopolitical forecasts can be produced quickly and accurately on topics ranging from violent international confrontations to how long international leaders will stay in power. By better measuring exact levels of uncertainty, the project can also increase the rigor of intelligence analysis more generally. For the first time, we have a quantitative system flexible enough for rapid analysis of almost any subject. Where traditional analysis can take days or weeks, *ACE* forecasts can be obtained in a matter of hours. Consumers of *ACE* forecasts can be confident in their accuracy because the technologies have been validated in a real-world forecasting tournament.

**Lessons Learned**

Four of the five teams had difficulty recruiting and retaining the number of people they needed, because continuous forecasting was somewhat time-consuming (taking about one hour per week). Teams also had to decide how best to use project resources —  and whether to focus most of their effort on finding the best ways to efficiently collect probability judgments; on determining how best to combine and weight those judgments; or on developing training methods for forecasters.

* Collecting judgments involved finding the best way to gather the needed range and number of probabilistic beliefs from a crowd of individuals — whether by surveys, by prediction markets, or by some other technique — and then producing the most intuitive and user-friendly interfaces for these platforms.
* Combining judgments involved developing new algorithms to create the most accurate aggregated forecasts.
* Training involved teaching forecasters the skills that would help them become more accurate and less susceptible to judgmental biases or poor decision-making.

In addition, the project’s initial concept faced resistance from potential participants and customers. Analysts are not often trained to think in quantitative terms and may be reluctant to provide numerical forecasts that can be scored for accuracy. However, letting forecasters be anonymous made it easier for them to take the risk and to take the time to develop the skills needed.

**Key learning insights:**

The *ACE*case study illustrates the following steps for designing a crowdsourcing project:

* **Know Your Objectives***.*  The objective in this case was to improve forecasting by more than 50 percent over the state-of-the-art forecasts. Choosing a clear, measurable target and having a state-of-the-art control group as a benchmark enabled progress to be clearly gauged. By the program’s end, the Good Judgment Project beat the state-of-the-art forecasts by more than 70 percent. Setting specific quantitative performance benchmarks is a hallmark of all IARPA programs, and *ACE* was no different.
* **Engage Your Community.** The Good Judgment Project recruited and retained an impressive pool of high-quality participants. Participants were highly credentialed (some 60 percent had graduate degrees) and tenacious. Many spent dozens of hours per week forecasting, even though they were paid only a couple hundred dollars per year in Amazon gift cards. The Good Judgment Project understood its pool of participants, providing ongoing feedback on individual accuracy to encourage participation and ongoing effort. The project recognized and rewarded exceptional forecasters as “superforecasters.” The result was a uniquely engaged and loyal group of participants.

**Read more:**

* Website: [*ACE*](http://www.iarpa.gov/index.php/research-programs/ace)
* [Principles of Community Engagement, NIH (2011)](http://www.atsdr.cdc.gov/communityengagement/pdf/PCE_Report_508_FINAL.pdf)
* [Using Crowdsourcing in Government, IBM Center for The Business of Government (2013)](http://www.businessofgovernment.org/sites/default/files/Using%20Crowdsourcing%20In%20Government.pdf)
* [Community Engagement Techniques: Best Practices (2014)](https://www.herefordshire.gov.uk/media/6312587/12_best_practice_community_engagement_techniques.pdf)
* [Crowdsourcing: A Geographic Approach to Public Engagement, SSRN (2014)](http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2518233)

For more information, contact Dr. Steve Rieber at [steven.rieber@iarpa.gov](mailto:steven.rieber@iarpa.gov)

[“[The Aggregative Contingent Estimation Program: Predicting Global Events Through Crowdsourcing](https://www.citizenscience.gov/2015/08/25/ace-forecasting/),” citizenscience.gov, August 25th, 2015.]

**Next Steps/Checklist:**

**Relevant Policies:**

**Additional Resources:**