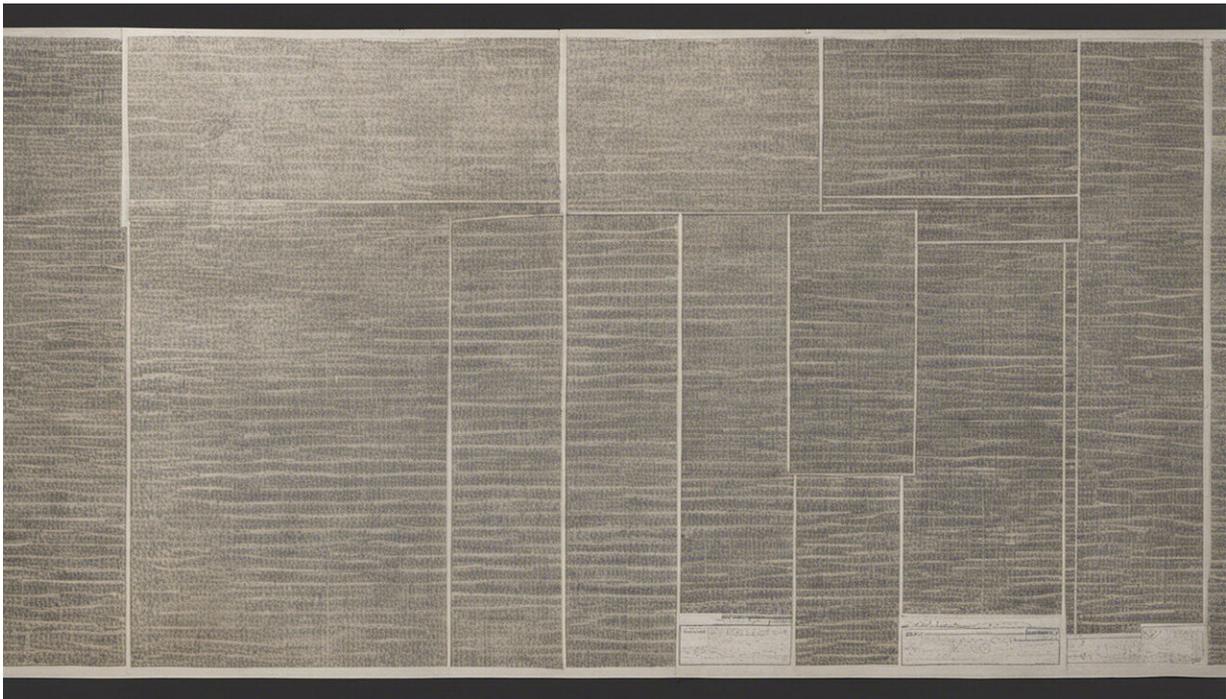


Expanding citizen science models to enhance open innovation

August 4 2016, by Kendra L. Smith



Credit: AI-generated image ([disclaimer](#))

Over the years, citizen scientists have provided vital data and contributed in invaluable ways to various scientific quests. But they're typically relegated to helping traditional scientists complete tasks the pros don't have the time or resources to deal with on their own. Citizens are asked to count wildlife, for instance, or classify photos that are of interest to

the lead researchers.

This type of top-down engagement has consigned citizen science to the fringes, where it fills a manpower gap but not much more. As a result, its full value has not been realized. Marginalizing the [citizen scientists](#) and their potential contribution is a grave mistake – it limits how far we can go in science and the speed and scope of discovery.

Instead, by harnessing globalization's increased interconnectivity, citizen science should become an integral part of open innovation. Science agendas can be set by citizens, data can be open, and open-source software and hardware can be shared to assist in the scientific process. And as the model proves itself, it can be expanded even further, into nonscience realms.

Some major citizen science successes

Citizen-powered science has been around for [over 100 years](#), utilizing the collective brainpower of regular, everyday people to collect, observe, input, identify and crossmatch data that contribute to and expand scientific discovery. And there have been some marked successes.

[eBird](#) allows scores of citizen scientists to record bird abundance via field observation; those data have contributed to over [90 peer-reviewed research articles](#). [Did You Feel It?](#) crowdsources information from people around that world who have experienced an earthquake. Snapshot Serengeti uses volunteers to identify, classify and catalog photos taken daily in this African ecosystem.

[FoldIt](#) is an online game where players are tasked with using the tools provided to virtually fold protein structures. The goal is to help scientists figure out if these structures can be used in medical applications. A set of users determined the [crystal structure](#) of an enzyme involved in the

monkey version of AIDS in just three weeks – a problem that had previously gone [unsolved for 15 years](#).



Since 1900 the Audubon Society has sponsored its annual Christmas Bird Count, which relies on amateur volunteers nationwide. Credit: USFWS Mountain-Prairie, CC BY

[Galaxy Zoo](#) is perhaps the most well-known online citizen science project. It uploads images from the Sloan Digital Sky Survey and allows users to assist with the morphological classification of galaxies. The citizen astronomers discovered an entirely new class of galaxy – ["green](#)

[pea" galaxies](#) – that have gone on to be the subject of over 20 academic articles.

These are all notable successes, with citizens contributing to the projects set out by professional scientists. But there's so much more potential in the model. What does the next generation of citizen science look like?

Open innovation could advance citizen science

The time is right for citizen science to join forces with open innovation. This is a concept that describes partnering with other people and sharing ideas to come up with something new. The assumption is that more can be achieved when boundaries are lowered and resources – including ideas, data, designs and software and hardware – are opened and made freely available.

Open innovation is collaborative, distributed, cumulative and it develops over time. Citizen science can be a critical element here because its [professional-amateurs](#) can become another significant source of data, standards and best practices that could further the work of scientific and lay communities.

Globalization has spurred on this trend through the ubiquity of internet and wireless connections, affordable devices to collect data (such as cameras, smartphones, smart sensors, wearable technologies), and the ability to easily connect with others. Increased access to people, information and ideas points the way to unlock new synergies, new relationships and new forms of collaboration that transcend boundaries. And individuals can focus their attention and spend their time on anything they want.

We are seeing this emerge in what has been termed the "solution economy" – where citizens find fixes to challenges that are traditionally

managed by government.



People can contribute to crowdsourced projects from just about anywhere.
Credit: Nazareth College, CC BY

Consider the issue of accessibility. Passage of the 1990 Americans with Disabilities Act aimed to improve accessibility issues in the U.S. But more than two decades later, individuals with disabilities are still dealing with substantial mobility issues in public spaces – due to street conditions, cracked or nonexistent sidewalks, missing curb cuts, obstructions or only portions of a building being accessible. These all can create physical and emotional challenges for the disabled.

To help deal with this issue, several individual solution seekers have merged citizen science, open innovation and open sourcing to create mobile and web applications that provide information about navigating city streets. For instance, [Jason DaSilva](#), a filmmaker with multiple sclerosis, developed [AXS Map](#) – a free online and mobile app powered by Google Places API. It crowdsources information from people across the country about wheelchair accessibility in cities nationwide.

Broadening the model

There's no reason the diffuse resources and open process of the citizen scientist model need be applied only to science questions.

For instance, [Science Gossip](#) is a [Zooniverse citizen science project](#). It's rooted in Victorian-era [natural history](#) – the period considered to be the [dawn of modern science](#) – but it crosses disciplinary boundaries. At the time, scientific information was produced everywhere and recorded in letters, books, newspapers and periodicals (it was also the beginning of mass printing). Science Gossip allows citizen scientists to pore through pages of Victorian natural history periodicals. The site prompts them with questions meant to ensure continuity with other user entries.

The final product is digitized data based on the 140,000 pages of 19th-century periodicals. Anyone can access it on [Biodiversity Heritage Library](#) easily and for free. This work has obvious benefits for natural history researchers but it also can be used by art enthusiasts, ethnographers, biographers, historians, rhetoricians, or authors of historical fiction or filmmakers of period pieces who seek to create accurate settings. The collection possesses value that goes beyond scientific data and becomes critical to understanding the period in which data was collected.

It's also possible to imagine flipping the citizen science script, with the

citizens themselves calling the shots about what they want to see investigated. Implementing this version of citizen science in disenfranchised communities could be a means of access and empowerment. Imagine Flint, Michigan residents directing expert researchers on studies of their drinking water.



Crowds can't reliably rate typhoon damage like this without adequate training.
Credit: Bronze Yu, CC BY-NC-ND

Or consider the aim of many localities to become so-called [smart cities](#) – connected cities that integrate information and communication technologies to improve the quality of life for residents as well as manage the city's assets. Citizen science could have a direct impact on

community engagement and urban planning via data consumption and analysis, feedback loops and project testing. Or residents can even [collect data on topics important to local government](#). With technology and open innovation, much of this is practical and possible.

What stands in the way?

Perhaps the most pressing limitation of scaling up the citizen science model is issues with reliability. While many of these projects have been proven reliable, others have fallen short.

For instance, [crowdsourced damage assessments](#) from satellite images following 2013's Typhoon Haiyan in the Philippines faced challenges. [But according to aid agencies](#), remote damage assessments by citizen scientists had a devastatingly low accuracy of 36 percent. They overrepresented "destroyed" structures by 134 percent.

Reliability problems often stem from a lack of training, coordination and standardization in platforms and data collection. It turned out in the case of Typhoon Haiyan the satellite imagery did not provide enough detail or high enough resolution for contributors to accurately classify buildings. Further, volunteers weren't given proper guidance on making accurate assessments. There also were no standardized validation review procedures for contributor data.

Another challenge for open source innovation is organizing and standardizing data in a way that would be useful to others.

Understandably, we collect data to fit our own needs – there isn't anything wrong with that. However, those in charge of databases need to commit to data collection and curation standards so anyone may use the data with complete understanding of why, by whom and when they were collected.

Finally, deciding to open data – making it freely available for anyone to use and republish – is critical. There's been a strong, popular push for government to open data of late but it isn't [done widely](#) or [well enough](#) to have widespread impact. Further, the opening of of nonproprietary data from nongovernment entities – nonprofits, universities, businesses – is lacking. If they are in a position to, organizations and individuals should seek to open their data to spur innovation ecosystems in the future.

Citizen science has proven itself in some fields and has the potential to expand to others as organizers leverage the effects of globalization to enhance innovation. To do so, we must keep an eye on [citizen science](#) reliability, open [data](#) whenever possible, and constantly seek to expand the model to new disciplines and communities.

This article was originally published on [The Conversation](#). Read the [original article](#).

Source: The Conversation

Citation: Expanding citizen science models to enhance open innovation (2016, August 4) retrieved 17 April 2024 from <https://phys.org/news/2016-08-citizen-science.html>

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