FUTURE DIRECTIONS FOR CITIZEN SCIENCE AND PUBLIC POLICY

Edited by Katie Cohen and Robert Doubleday
Centre for Science and Policy
Why is it so difficult to integrate citizen science into practice?

Muki Haklay

The term ‘citizen science’ includes many forms of public participation in research. These range from participating in a search for a cure for cancer by allowing scientists to utilise unused computing resources with little ongoing attention by the participant, to participation in all stages of the scientific process including shaping the research question. It is, therefore, unsurprising that a wide range of issues emerge regarding the integration of citizen science into decision-making processes or policy implementation.

Even if we focus solely on one of the most often acknowledged outputs of citizen science – the production of data at scale – we can see difficulties in its uptake and integration by governmental bodies, and marked differences in the use of citizen science compared to other approaches for information gathering. By and large, there is an expectation that government data gathered by traditional means is of high quality. Questions over the quality of data for decision making emerge occasionally (e.g. the missing million men in the 2001 UK census,¹ or the discussion on how to count deaths as a result of the COVID-19 pandemic²), but these are rare exceptions given how much data is routinely used by local and national governments.

However, it is much more common to encounter concerns over data quality when citizen science or crowdsourcing are involved.³ (We will use the term ‘crowdsourcing’ in addition to ‘citizen science’ since the two overlap, and, especially in the context of data creation, are often used interchangeably.⁴) This questioning of data quality is somewhat puzzling when we consider
that the use of citizen-science data as part of government practice is not new. Every day for at least 150 years, meteorological services across the world have received weather observations from far and wide that are contributed by volunteers. The same is true for research institutions – from William Whewell’s great tide experiment of 1835, which included thousands of observers, to the history of biological recording of different species by amateurs, which also goes back hundreds of years.

Why, then, do we need to advocate the integration of citizen-science data in government and research institutions? Why is it that in the third decade of the 21st century, we need to create special incentives and plans to encourage such bodies to open up to the public, and for scientists to integrate the capacity of public observers in their work?

**Understanding the institutional challenges**

To understand the institutional resistance and consider how to overcome it, we need to look at several issues that are central to the utilisation of citizen-science data within governmental bodies.

Firstly, consider the maxim ‘organisations do not use crowdsourcing because they want to, but because they have to’. In the cases of weather and biological recording, it is prohibitively expensive to locate observers with the necessary geographical distribution; even the location and maintenance of automated sensors will be too costly. In other cases, too, it is budget constraints that push organisations towards such methods of data collection. Compare the relatively well-funded US Census Bureau to the less-well-funded US Geological Survey (USGS). When the Census Bureau updated its maps, it used its employees for comparing its maps to recent satellite images – a task that can be done well with volunteers, and is the basis of projects such as OpenStreetMap. In contrast, USGS uses a volunteer programme, the well-established National Map Corps, to update its maps – because in some cases, due to budget limitations, these were not updated for 20 years or more.

In these situations, an organisation may consider that a task should be managed internally if it can be, even if this will entail missing out on
benefits from citizen science (such as the utilisation of local knowledge), and prefer to rely on existing resources and practices. This is unless an external force – such as a regulatory requirement, or a decision by someone who is in charge of the organisation's activities (e.g., a minister) – pushes the organisation to adopt citizen science.

Secondly, many governmental practices of data collection evolved from command-and-control structures, and therefore the in-built messiness in citizen science, and other activities that rely on open calls, are conceptually challenging. Many government organisations have created industrial processes for data collection, as a standardised and routinised process can be automated to better use limited resources.

Endorsing citizen science processes, by contrast, requires a change in mindset about the production and use of data. For example, the quality of the interface for a publicly open system needs to be much better than for an equivalent intra-organisation one. We are all familiar with intra-organisation computer systems with hard-to-use interfaces; such difficult interfaces persist because an organisation can compel its employees to use these systems to fulfil their jobs, and because the number of employees using the system might be relatively small, so that the organisation can rely on tacit knowledge and peer support to make the system operational and produce good-quality information. In contrast, a public-facing system needs to support a short learning curve, by a large group of people with a range of skills and backgrounds. The system and its interface must also be designed to support the process of entering high-quality data – and that might require careful design and testing of the workflow process.

Quality-assurance processes also require a different approach in citizen-science projects; encouraging wider use of citizen-science practices may require both awareness-raising and implementation support. Concerns about data quality, for example, may be alleviated through the inclusion of an 'expert in the loop.' We can see the role of the UK’s Biological Records Centre (BRC) as exactly that. The BRC is an interface between the scientific and governmental system (which needs the data from many recording schemes that are carried out across the country) and the needs and
interests of the volunteers and the organisations that support them. With a very small team, the BRC provides the scientific interface which facilitates the integration and use of citizen-science data for policy.

Thirdly, governmental organisations operate within a legal and regulatory environment that has evolved over time. Data collection and use are frequently linked to obligations for monitoring a condition or delivering an agreed policy, as in the case of environmental monitoring against acceptable levels of pollutants. Another example is the agreed service standards of mapping agencies, such as the commitment of the Ordnance Survey to update a major change to the landscape within a given period of time. Moreover, many governmental data-collection activities are impacted indirectly by laws in other domains of government activity. For example, in the US, the 1995 Paperwork Reduction Act stipulates a need for approval
for requesting information from the public; this is done by a single cross-
government committee in a complex and lengthy process, representing
a barrier to the use of citizen science by the federal government. The
2016 Crowdsourcing and Citizen Science Act, a specific law enacted to
alleviate such barriers, stands as an example of legislative action to address
regulatory and legal limitations on the use of citizen science in government.

A number of other factors have been identified as contributors to
the acceptance of citizen science and crowdsourced information in
government. For example:

- The role of ‘champions’ inside governmental organisations – individuals
  willing to encourage their colleagues and managers to integrate citizen-
  science data in the work of the organisation
- The value of working with intermediary organisations with experience in
  running and utilising such methodologies, and using their experience in
  training staff in how to develop such activities
- ‘Trigger events’, frequently linked to some sort of emergency, which
  open up both the need and the willingness to utilise alternative sources
  of data; natural and human-made disasters, as well as major outbreaks
  such as COVID-19, are such events, as the example of Safecast in Japan
  demonstrates.

Finally, however, we also need to recognise a major cultural obstacle within
scientific practice itself, one which is based on perceptions and anxieties
about the special role of scientists and experts in policy making and
implementation – that is, the view that opening up decision-making and
monitoring processes risks letting in the ‘barbarians at the gate’.

Since the end of the Second World War, scientists have established
themselves in relation to wider society as an autonomous and exclusive
group of knowledge producers especially when it comes to decision
making processes. They might be issue advocates, honest brokers, or
communicators of the latest science – but in all these variations, it is the
scientific community that is in charge of creating scientific knowledge.
Research shows that only a small group of researchers communicate their
research to the public. Moreover, when asked about it, scientists often do not see citizen science as an appropriate methodology, and if given a choice and funding, would prefer to carry out their studies without public involvement.

The cultural objection for opening up to public participation in the scientific process is also linked to concerns about status and acceptance of expertise, and respect towards scientists. These concerns may be linked to the data-quality issue (“only a qualified scientist can collect the data properly”), suspicions about motivation (“only a practising scientist can understand the principles of objective and disinterested research”), or concerns about social standing, secured streams of funding for vital scientific work, and job security. Despite cultural changes that are aimed at internal scientific practices, such as the move towards open access publications, the resistance runs deep, and persistent push from research funders is required if behaviour is to change. Citizen science represents the opening up of practices that are mature and comfortable to those who are involved in them, and it is therefore not surprising to encounter significant resistance. This issue can be addressed both by encouragement from research funders and science policy makers, as well as through the provision of appropriate guidelines and support to champions who are changing the practice from within.

Overcoming the challenges

In summary, the acceptance of citizen-science data is linked to individual perceptions, organisational practices, skills, legal framework, and cultural factors. Many of these challenges apply beyond our focus on data collection and are relevant to other forms of citizen science; they can also explain why more comprehensive forms of participation – where the public is also influencing the research question, the analysis, or the use of the resulting information – can present more challenges and face strong resistance. All these are changing, but it is not surprising that the pace of change is slow.

The UK is fortunate to have a long and distinguished history of citizen science, a strong sense of public interest and trust in science, and a history
of innovation in this area. Witness this history of achievements (some of them touched on above), all of which have policy implications: Whewell’s tides experiment in 1835; the Met Office’s observations since the 1850s that culminate in 13 million records on Weather Observation Website today, providing the UK with excellent weather forecasting with high economic value; the sustained effort of the BRC over the past 50 years, with over 80 recording schemes and the sharing of data with government; the creation in 2004 of OpenStreetMap, which is now used by the likes of Facebook and Microsoft; the engagement of over one million students through the Open Air Laboratories (OPAL) project from 2007 to 2019; and the establishment of the Zooniverse platform in 2007 with its one-million-plus volunteers. The UK is also the home of Big Garden Birdwatch, which has engaged millions of people in observing birds since 1979 and is now the largest wildlife survey in the world. All these initiatives demonstrate the UK’s existing expertise, knowledge, and infrastructure in citizen science.

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At a time when many countries and international organisations are engaging with citizen science, there is an opportunity to capitalise on this social, professional, and physical infrastructure, and integrate it into practices that are required for sustainable living in a highly educated society. By putting the necessary regulations, incentives, and support in place, many opportunities can be opened up. These might include:

- Transforming education and increasing public knowledge of science, which is now critical to making sense of the world and acting as active citizens in society
- Addressing health challenges through the participation of patients and community in collecting information as well as agreeing on courses of action to address issues such as obesity or child health
- Providing the data needed to understand environmental change, and to engage people in climate adaptation and actions to address its challenges.

None of the barriers outlined in this paper is insurmountable; all can be addressed with carefully designed interventions that will resonate in other forms of participatory governance.

**Muki Haklay** is Professor of Geographic Information Science in the Department of Geography at University College London (m.haklay@ucl.ac.uk).

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Endnotes

Future directions for citizen science and public policy

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The past decade has seen a growing imperative in government to find new ways to involve citizens as partners in the development and delivery of policy. At the same time, we have seen a flourishing of citizen science experiments and the increasing embrace of these approaches by scientific communities. But to date there have been surprisingly few experiments with citizen science by government itself.

Citizen science has made vital contributions during the COVID-19 pandemic. As the UK government continues to navigate a way through the challenges posed by the pandemic, it is important to consider how citizens’ knowledge can continue to make a more active contribution to science and government.

To support these efforts, this collection brings together new essays by policy makers, scientists, practitioners and scholars, with a foreword by UK Government Chief Scientific Adviser Sir Patrick Vallance. Authors draw on a wide range of insights including from Zooniverse, Citizen Sense, THIS Institute, Sortition Foundation, Food Standards Agency and Copenhagen Business School.

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“I am very grateful to CSaP for bringing together this diverse group of authors to share their experience of citizen science, enabling us all to better understand the potential it has to contribute to public policy.”

Sir Patrick Vallance