

# Working Paper: Citizen Science

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## Motivation for the research

Citizen science (also known as crowd science, crowd-sourced science, or networked science) is scientific research conducted, in whole or in part, by amateur or nonprofessional scientists (Wikipedia<sup>1</sup>). According to Muki Haklay, the phenomenon of Citizen Science is attracting increased attention in academic forums, on social networks and on national print and broadcast media<sup>2</sup>. This interest is primarily driven by the rise of electronically mediated forms of Citizen Science which are enabling fundamentally new modes of interaction between university, organizational, individual and governmental stakeholders.

This report examines the emergence of citizen science within the broader context of academic research and its relevance to practice. The report focuses specifically on identifying the opportunities afforded by citizen science and the key obstacles that need to be overcome if citizen science initiatives are to benefit governmental, organizational and individual stakeholders. The report begins by reviewing the existing literature on citizen science. This review focuses on defining the phenomenon of interest, sketching the historical context of it. The review then presents an analysis of the main opportunities and challenges associated with it. Using this analysis, a set of research questions are identified and an initial research plan is presented. The report concludes by considering the potential contributions of this research project to existing knowledge on citizen science.

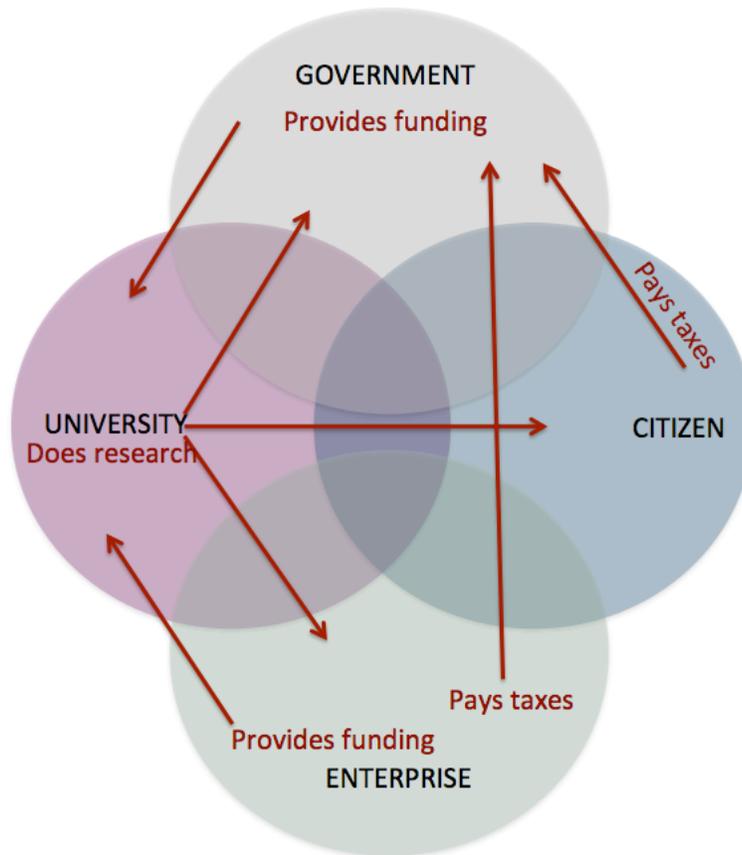
## Theoretical background

The scientific method is a body of techniques for investigating phenomena, acquiring new knowledge, or correcting and integrating previous knowledge (Goldhaber and Nieto, 2010). It has, since the 17th century, been one of the primary modes for scholarly investigation. It is primarily as a result of the scientific method and advances in technology that the pace of innovation and discovery has increased so significantly in the past 150 years (Arbesman, 2009). This, in turn, has led to economic growth at a national level (Rosenberg, 1974), increased innovation in firms (Rae-Dupree, 2013), and improvements in things like health and well-being at the individual level (Digital Agenda for Europe, 2013). Recognizing the benefits associated with both basic and applied forms of research, governmental and organizational stakeholders have traditionally been responsible for funding scientific research in academic institutions (see Figure 1). Indeed, as a result of the emergence of crowdfunding websites like Kickstarter, citizens are increasingly involved in directly funding scientific and technological research and innovation (O Riordan, 2013).

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<sup>1</sup> [http://en.wikipedia.org/wiki/Citizen\\_science](http://en.wikipedia.org/wiki/Citizen_science) Accessed October 23rd 2013

<sup>2</sup> <http://povesham.wordpress.com/2013/07/08/gartners-hype-cycle-and-citizen-science/> Accessed October 23rd 2013



**Figure 1.** Visualizing the roles of governmental, organizational, university and individual stakeholders in the conduct of scientific research.

It is because scientific research is effectively sponsored by governments, organizations and individuals, that researchers are increasingly asked to scrutinize the (immediate) impact of their work in practice. With the emergence of citizen science, researchers are beginning to understand that one of the most effective ways of ensuring that their work has an immediate impact is to directly involve stakeholders in the process of doing research.

## Identifying the current gaps in our understanding

Formally, citizen science has been defined as "the systematic collection and analysis of data; development of technology; testing of natural phenomena; and the dissemination of these activities by researchers on a primarily a vocational basis" (Open Scientist, 2013). More informally, citizen science is scientific research conducted, in whole or in part, by amateur or nonprofessional scientists, often by crowdsourcing and crowdfunding<sup>3</sup>. Citizen scientists can adopt a variety of roles in citizen science projects. These include: gathering or analyzing data that will be analyzed by professional researchers, volunteering at a research center or joining a research expedition, competing in science competitions and even building their own instructions or laboratories to gather data for their own experiments or as part of a larger project (ibid.).

Research on citizen science to date have investigated citizens' motivations and experiences of participation (Raddick et al, 2010; Trumbull et al., 2000), the challenges and benefits of citizen science

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<sup>3</sup> [http://en.wikipedia.org/wiki/Citizen\\_science](http://en.wikipedia.org/wiki/Citizen_science) Accessed October 23rd 2013

(e.g. Dickinson et al., 2010), and the evaluation of citizen science research projects (e.g. Cohn, 2008; Brossard et al., 2005).

In an effort to generate a typology of citizen science projects, Wiggins et al (2011) identify a number of different types of research project that are amenable to citizen science approaches. These include:

- (1) Action oriented citizen science projects which encourage participant intervention in local concerns and the use of scientific research as a tool to support civic agendas
- (2) Conservation projects which support stewardship and natural resource management goals
- (3) Educational projects which are designed to make education and outreach the primary goal of the project

Wiggins et al (2011), identify a fourth category of citizen science project, the virtual citizen science project. The authors define virtual citizen science projects as those that are fully mediated by ICTs and a well known example of a virtual citizen science project is Galaxy Zoo, a interactive project that allows the user to participate in a large-scale project of galaxy research<sup>4</sup>.

According to Wiggins et al (2011), virtual citizen science projects are unlike other kinds of citizen science projects and as such, have not been fully examined in prior research on citizen science. Nevertheless, these kinds of projects have strong potential. This can best be appreciated by considering the success of first generation open science projects like the Human Genome Project where research objectives far beyond the capabilities of a single institution or research group were achieved using crowds of research scientists. For the remainder of this review, we therefore focus specifically on virtual citizen science projects (VCSPs).

The research to date indicates that virtual citizen science projects are a highly efficient use of resources, which is particularly important in a time of economic recession when resources are scarce. At the same time, these projects have the capacity to allow researchers to conduct projects on a scale that would not otherwise be viable through traditional institutional and funding structures. Just as open source software benefits from the principle that “with enough eyeballs, all bugs are shallow” (Raymond, 2000), virtual citizen science projects allow researchers to tackle problems that might otherwise be beyond the scope of their capabilities.

Nevertheless, there are some key challenges that must be overcome if the opportunities afforded by virtual citizen science projects are to be fully realized.

- There are serious question marks about the intellectual property rights issues associated with citizen science. In a large virtual citizen science project (VCSP), dozens or even hundreds of individuals may make a contribution to a new discovery. In that scenario, authorship (the traditional vehicle for attributing intellectual property rights) is inapplicable. This has serious implications for publishers of academic journals as well and there is very little clarity on how it might be overcome.
- Scientists, for generations, have used the peer review process as a collaborative mechanism for ensuring and evaluating the quality of research (ibid). The difficulty with opening up access to scientific publications and scientific data to the public is that poorly qualified individuals may be in a position to review scientific work. This could have significant negative implications for scientific progress.

## **Specifying the research questions**

Based on this analysis, we have identified three main areas where we feel there is a pressing need for research.

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<sup>4</sup> See <http://www.galaxyzoo.org/>, accessed October 23rd 2013

The first area concerns the existing **data infrastructures** that are used to support citizen science initiatives. It is clear that the requirements of a citizen science project in terms of data protection differ quite substantially from existing collaborative science projects and research is needed to investigate the design, development and implementation of new and effective platforms for creating, storing and transferring the data that is analysed in citizen science projects.

The second main area relates to concerns about the **validity** or **trustworthiness** of scientific results generated by citizen science projects. In the first instance, there is a need to develop new ways of both *measuring* and *improving* the scientific quality of citizen science research. In the second instance, there is a need to develop new ways of sharing or publishing the results of citizen science projects together with these assessments of quality. In this regard, we feel that a key enabler of citizen science will be the establishment of more open and transparent ways of accessing existing research – which has, in the end, been bought and paid for by the citizen - are developed. Without this, our citizen scientists are effectively working in the dark.

The third area relates to concerns about **possible ethical issues** in citizen science research contexts. In traditional scientific laboratories, researchers are expected to submit their proposals to institutional ethical review committees whose job it is to ensure that the research is ethically sound. Citizen scientists do not have access to the same protections. Research is needed to investigate the current approach to ethical review in citizen science projects and to propose and evaluate possible new ethical review mechanisms for citizen science.

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