CS TRACK

Investigating Citizen Science

Broadening our knowledge about citizen science by investigating citizen science activities, disseminating good practices and formulating knowledge-based policy recommendations to maximise the potential benefit of citizen science activities for individual citizens, organisations, and society at large.

Consortium members during a project workshop at UPF Barcelona, March 2022

How to cite: CS Track consortium (2022). Broadening our knowledge about citizen science. Special collection of CS Track project outputs. DOI: 10.5281/zenodo.7003971

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872522.
The European Commission's support for this project does not constitute an endorsement of the contents, which reflect the views only of the partners, and the Commission cannot be held responsible for any use which may be made of the information contained.

Table of contents

Intro

CS Track, a research project funded by the European Commission, aims at broadening knowledge about citizen science by applying data analysis to publicly available information from the web and collecting complementary data through questionnaires and interviews with people who take part in CS activities. For this purpose, CS Track has collected publicly available data on more than 4500 projects from websites and online platforms and conducted a survey with more than 1000 participants from 30 European countries. Taking this approach, CS Track generated insights about citizen science and its impact in various areas during the past three years.

“Citizen science offers great potential for science and society, but this potential can only be fully realized if certain conditions are met. These conditions for success include, among others, strategies to ensure the active and long-term cooperation of citizen scientists. The aim must be to create an environment that motivates participants to get involved in the respective project - for example through educational offers, regular communication between volunteers and professional scientists in both directions, events, awards, certification and so forth. This aspect in particular is often very time-consuming and cost-intensive for the project initiators, but can be the deciding factor as to whether a project succeeds or fails.” Dr Raul Drachman, CS Track project coordinator.

This brochure provides a summary of the research work carried out by the project team in the first 30 months of CS Track’s lifetime.

Read more articles in the CS Track eMagazine: cstrack.eu

Discover our complete deliverables on Zenodo

Follow us on Twitter

Follow us on LinkedIn

Partners:

Knowledge building and roles in citizen science – findings from the CS Track survey 2021

By Aaron Peltoniemi, Heli Kauppinen, Raija Hämäläinen and Joni Lämsä

Talking and interacting with others, searching for information from the Internet and reflecting on previous knowledge and actions were the three types of activities in which learning was most often reported.

When looking at the adopted roles and activities, citizen scientists felt like they had learned the most while searching for information from the Internet. In turn, individuals who adopted leadership roles, such as being the leader of a CS project, felt like they had learned the most while talking and interacting with others.

CS provides the public and professionals with opportunities to have a variety of learning experiences as they engage in different social and scientific activities. Interestingly, of the 12 different activities identified in a recent CS Track survey in which CS participants reported learning experiences, interaction with others and the search for information online as well as personal reflection were the three reported activities that provided the most significant learning experiences.

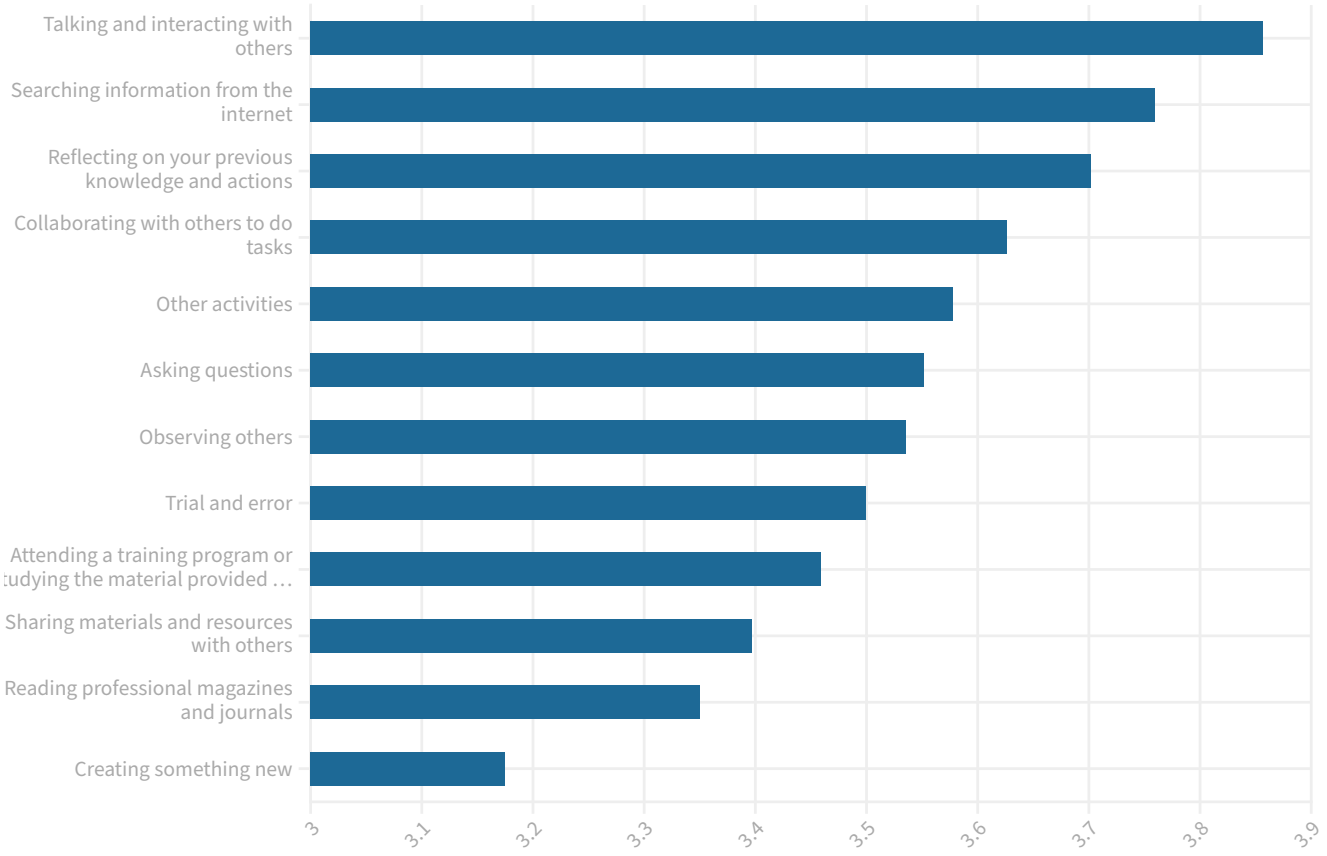


Figure 1. Activities reported to offer the most significant learning experience

How to interpret this data

CS activities also require participants to adopt different roles throughout a project, and these roles may shape their overall learning experience. This was also evident in the CS Track survey, which found that those who functioned as citizen scientists experienced the most learning through searching online for information. In contrast, those who served in managerial positions, such as managers and coordinators, experienced the most learning through interaction with others.
The slight difference in values between the tables is attributable to the fact that some respondents indicated adopting more than one role in CS projects.

Data Source

This article is based on the analysis collated in July of a survey conducted by the CS Track team from January until July 2021, in which adult citizen scientists (16 years or older) were asked to respond to a questionnaire regarding citizen science and CS activities. N = 1083 responses from 38 countries, 5 continents.

Learn more about the survey results here

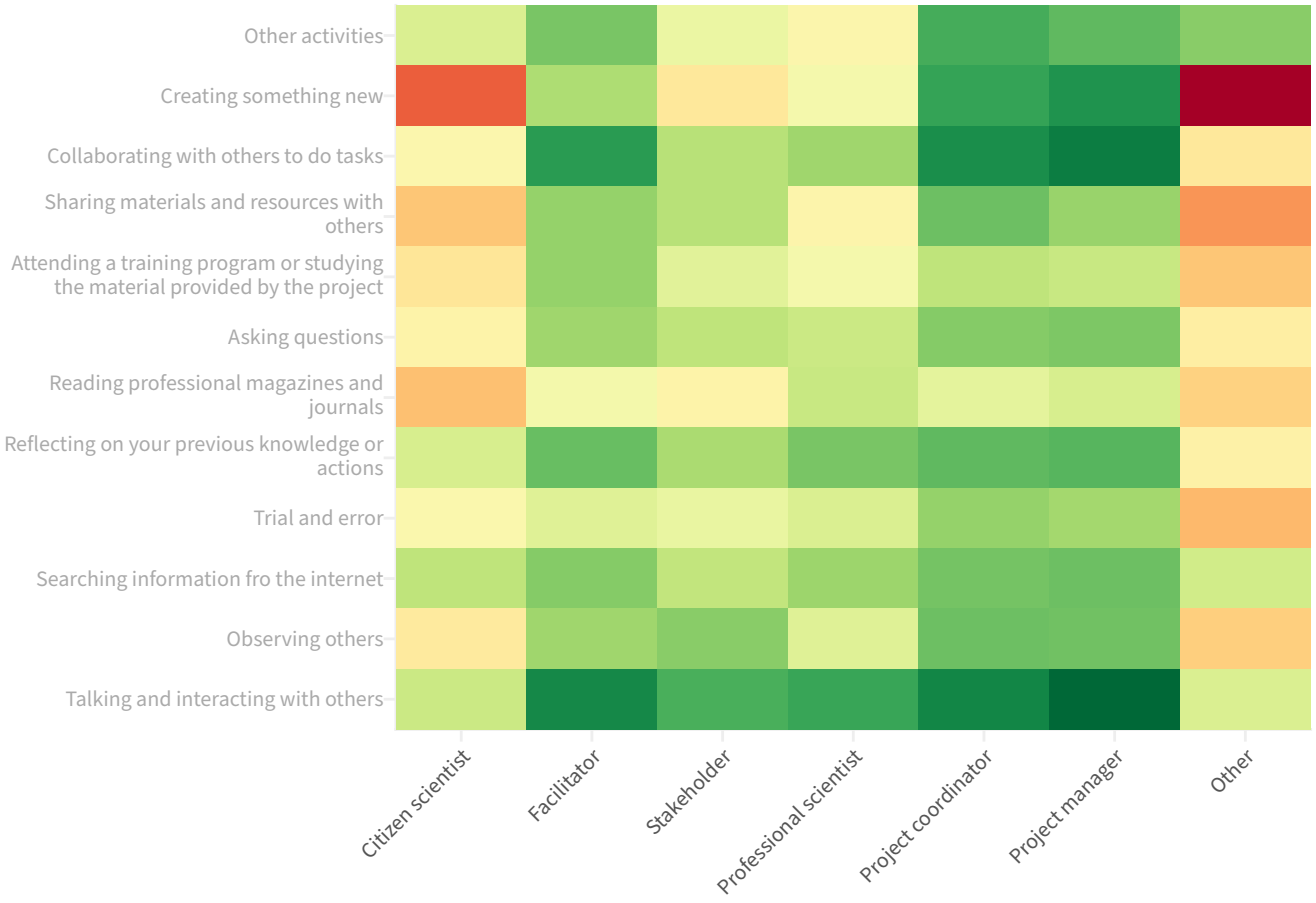


Figure 2. Heatmap

New models to help us understand patterns of participation in citizen science activities

By Ohto Sabel, Aaron Peltoniemi, Heli Kauppinen, Kari Nissinen, Joni Lämsä, Emilia Lampi, Raija Hämäläinen

In January 2022 the CS Track team released a new report entitled *Models to identify background factors associated with the CS activity*. It introduces how the CS Track team created 6 models with the aim of developing a deeper understanding of how different factors (e.g. gender, age, roles in CS) are associated with different forms of participation in CS activities. This report introduces the analysis of the CS Track survey (N=1083) carried out in 2021, summarises the characteristics of citizen scientists, discusses how learning and knowledge building occurs, and explains the structure of and the basis for the proposed models.

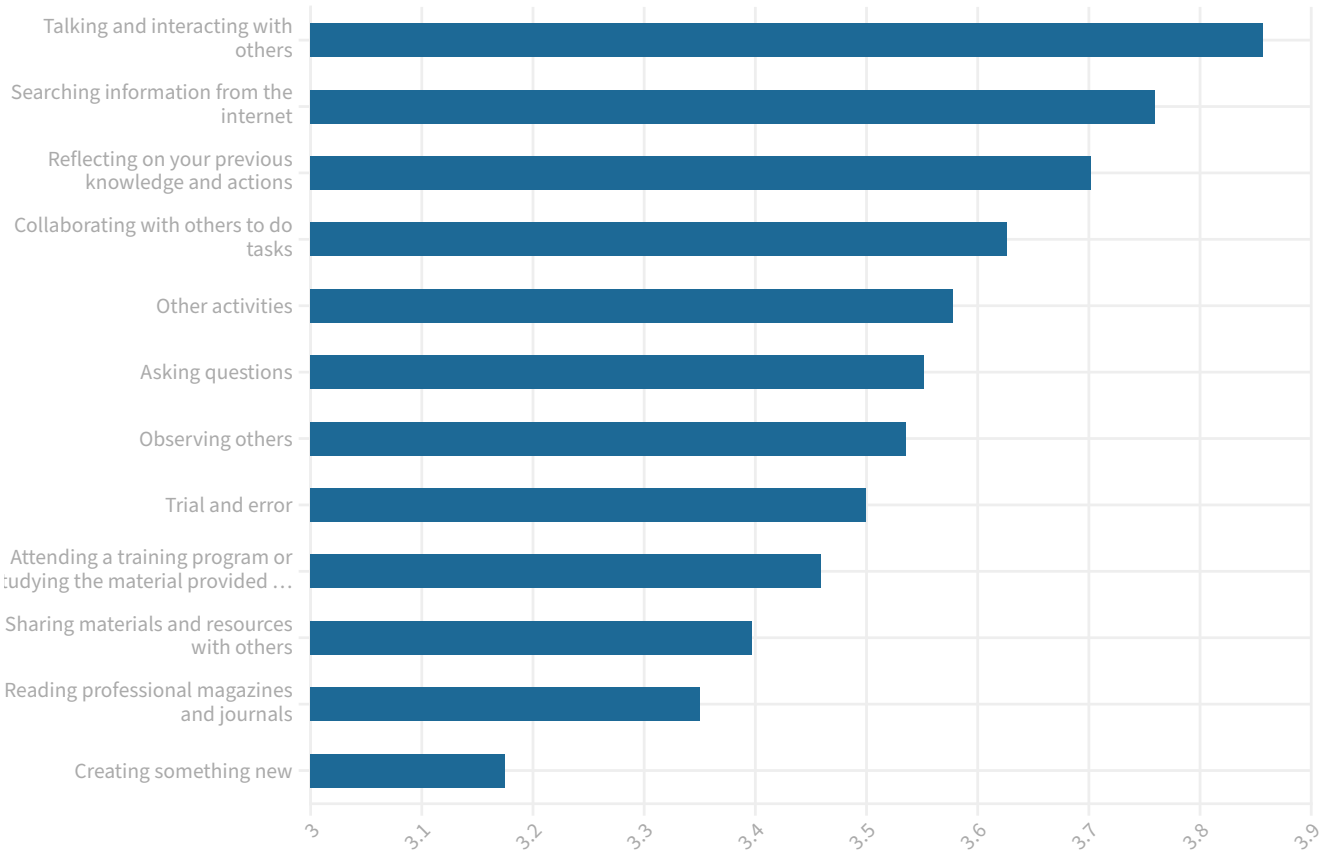


Figure 1. Activities reported to offer the most significant learning experience

Who are citizen scientists?

The CS Track survey (N=1,083) provided more information on the current demographics of citizen scientists in Europe. Among the findings, the survey revealed that:

» 41% of citizen scientists have been active in CS for more than 10 years.

» Only 1 in 4 citizen scientists have children.

» Citizen scientists are likely to be married (55% of respondents)

» Most citizen scientists are well-educated (67% of respondents had a bachelor's degree or higher)

» Citizen scientists are likely to be older than 51 years old (53% of respondents)

» 1 in 4 citizen scientists live in a large town or a small city.

How do learning and knowledge building occur?

The CS Track survey helped identify 12 activities in CS projects that enable learning. Figure 1 highlights the activities in which learning was most often reported. Specifically, CS Track researchers found that citizen scientists were able to learn the most by interacting with others or with information online as well as by reflecting on prior knowledge.

CS Track researchers also investigated if and how the roles that were adopted (e.g. citizen scientist, facilitator, project coordinator, etc.) are associated with learning and knowledge building. They found that:

» Citizen scientists felt like they had learned the most while searching for information from the Internet and the least when creating something new.

Those who adopted leadership roles, such as being the leader of a CS project, felt like they had learned the most while talking and interacting with others but the least when reading professional magazines and journals.

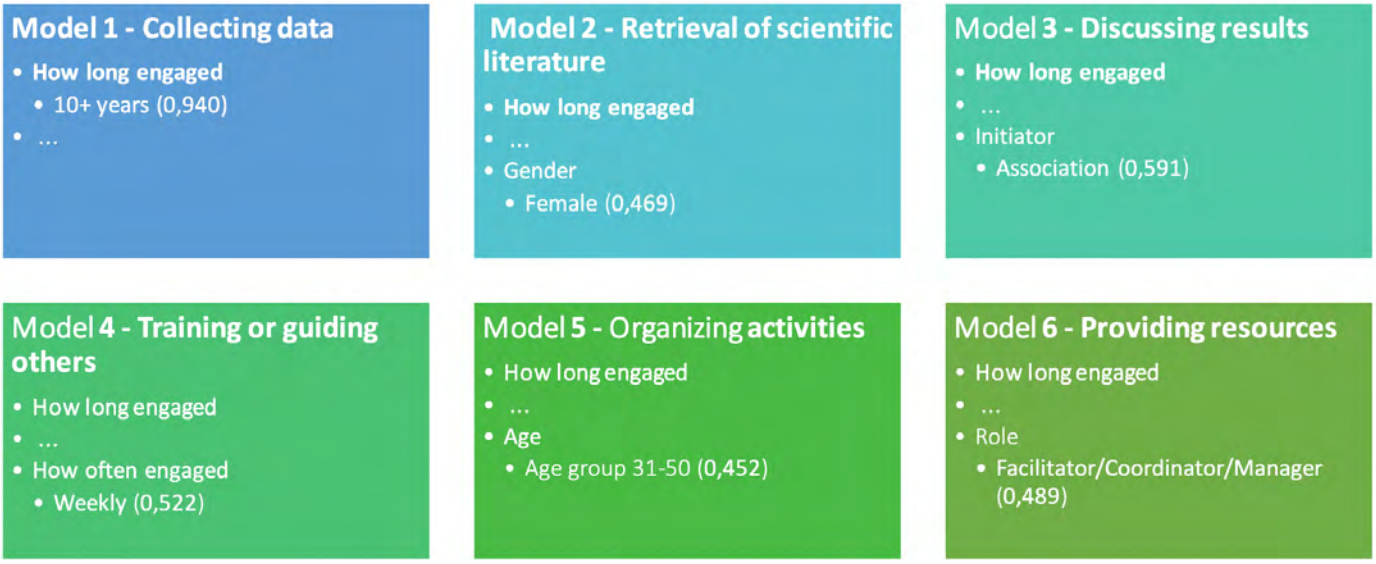


Figure 2. 6 models for analysing citizen science activities

6 models for analysing citizen science activities

CS Track researchers selected 6 different CS activities from the survey data (N=1,083), that illustrate the diversity of CS projects. Citizen scientists reported their participation in 1) collecting data, 2) retrieving scientific literature, 3) discussing results, 4) training or guiding others, 5) organising activities, or 6) providing resources to solve complex simulation problems.

For each of these 6 activities, an analysis of the survey data was conducted to examine which project-related and personal factors explain (as well as help us predict) the likelihood of participating in project activities. That is, if a significant score for a project-related and/or a personal factor was assigned to an activity by respondents, then that factor was added as a predictive factor for the activity. The goal of these 6 models is to help us understand and link different background factors together to create meaningful and relevant interpretations. In Figure 2, CS Track researchers illustrate how statistical modelling will construct an explanatory model of a particular phenomenon. For example, the factor "How long the respondent has been engaged in CS activities", was significant in all six models. In other words, it was significantly related to all six activities in question. Furthermore, if the respondent had been engaged in CS for 10 years or more, we can estimate that he/she had participated in data collection activities with probability of 0.940, according to Model 1. Figure 2 shows only a fragment of the results, but it highlights some of our final findings (which are to be published in a peer-reviewed journal). One such finding was that ‚how long engaged" was systematically associated with all six activities, while factors like ‚age" and ‚gender" did not appear significant in all six models.

The proposed models are used to deepen our understanding of citizen scientists' backgrounds and their involvement in citizen science activities. The acquired knowledge will be used together with other data collected by the CS Track team members to support the process of creating policy recommendations and thus determine accreditation practices.

Learn more about the models here

How do citizen science activities develop and work? Computational analysis techniques can help us find out

By Laia Albó, Miriam Calvera Isabal, Sven Manske, David Roldán Álvarez, Editor - H. Ulrich Hoppe

A cornerstone of the CS Track project's approach to investigating how citizen science (CS) activities develop and work is the use of computational analysis techniques applied to digital sources and traces to characterise and analyse these activities in terms of interactions within certain projects, the interplay with "official" science and their interaction with society. The recently published deliverable entitled "Specification of Web-based Analytics Methods and Tools" specifies the CS Track approach in terms of the selection and description of pertinent methods and their relevance in the citizen science context. This approach is also illustrated by a sample application of network analysis techniques to a Zooniverse case ("Chimp & See"). The final section of this deliverable explains the intended usage of the methodology.

The Approach

The spectrum of methods includes social network analysis (SNA) as well as natural language processing and text mining. In the context of CS Track, these methods are employed on three different levels of granularity and scale with different outcomes:

» **Macro:** Here input is taken from open spaces in the web and particularly from the Twitter blogosphere, which allows for capturing projects and activities beyond the CS Track database. Possible outcomes include the identification of trends and the assessment of public outreach related to CS activities..

Level	Tools/Methods	Scope	Purpose (example)
Macro	Harvesting of Twitter data, network analyses, text mining	Open collections of projects or initiatives beyond the CS Track database	Identification of trends, "public outreach", "popularity",
Meso	Information extraction from homogeneously formatted datasets	Collections of projects in the CS Track database	Identification of research areas, relation to SDGs
Micro	Harvesting and analysis of project-specific web resources such as forum or wiki data	Small samples selected from the CS Track database using specific criteria	Participation profiles and distribution of roles

CS TRACK Investigating Citizen Science

Figure 1. Differences between the different levels and provides a specification of what kinds and combinations of methods and tools could be used to learn more about citizen science at each level.

» **Meso:** At this level, certain methods will be used on subsets of projects in the CS Track database in an automatic and uniform way. A typical example is the extraction of research areas from project descriptions, allowing assessing multi-disciplinarity and the interplay with standard scientific disciplines.

» **Micro:** Analyses at the smallest level of granularity are conducted with small sets of pre-selected projects, diving more deeply into specific information resources such as forums or wikis using combinations of social network analysis and text mining adapted to the specific case. This allows for identifying patterns of participation and exchange between different actors (e.g., comparing volunteers to professional scientists).

Example application of network analysis techniques at the micro level

The Chimp & See project was started in 2015 by the Max Planck Institute for Evolutionary Anthropology as one of the projects on the Zooniverse platform. Its goal is to gain a better understanding of chimp culture, population size and demographics in specific regions of Africa.
The forum data of the Chimp & See talk pages was processed to create a dataset for analysis. In total 3218 forum threads with 24531 individual posts were analysed by using Social Network Analysis. Sample findings include:

» The top 5% (in total 28) of users contribute around 87% of the forum posts.

» The roles are almost equally distributed between the top users (8 moderators, 9 scientists and 11 volunteers) and volunteers are highly motivated to contribute to the discussions.

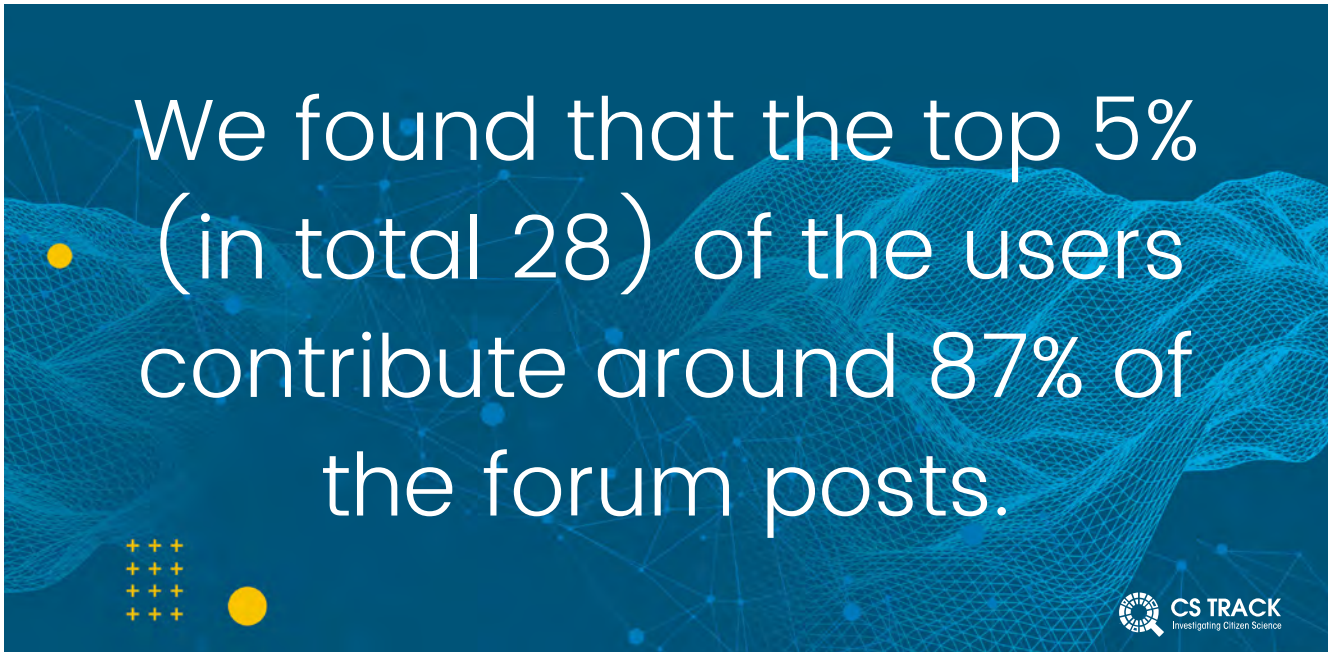


Figure 2. Users and posts

Intended usage of the methodology

Computational analytics together with the database-related activities form the core of technology-oriented elements of CS Track. Analytics results gained through different methods will be connected and integrated with empirical-interpretative approaches originating from social studies practices in a triangulation approach. The results will be used to provide strategic recommendations and evidence to support decision-making for stakeholders.
From a research perspective, analytics results as well as the experience gained through applying and adapting analytics methods to CS projects activities will be the source of scientific contributions in the context of research on electronic communities and collaboration with technologies with venues such as ACM Group or CollabTech (see recently accepted full paper: Amarasinghe et al., 2021).

Learn more about web-based analytics methods and tools

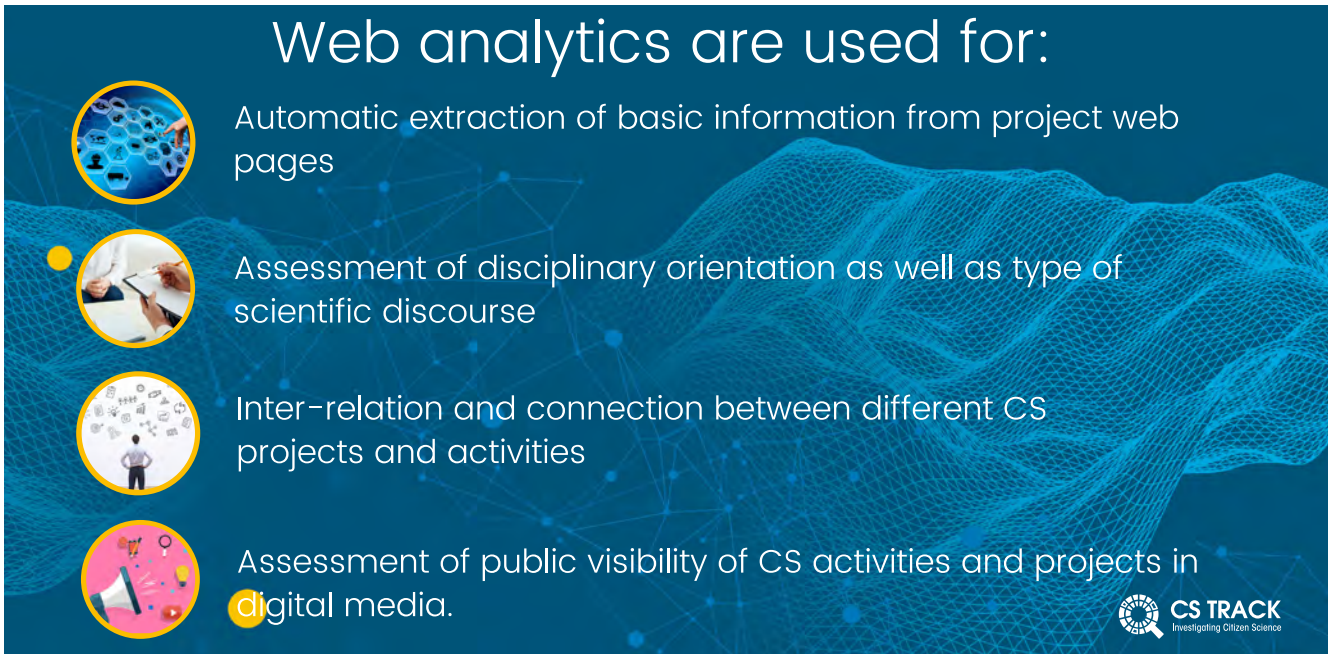


Figure 3. Uses of web analytics

A short introduction to the CS Track Analytics Workbench

By Cleo Schulten

Utilising analytic methods such as Named Entity Recognition (NER) and Explicit Semantic Analysis (ESA), the workbench generates results for individual projects based on textual project descriptions. We use ESA on extracted keywords to assign research areas and SDGs (Sustainable Development Goals) to projects. With NER, we extract named entities such as names of persons, institutions or organisations from the description.
The collected data from the analysed projects can then itself be viewed and analysed to find connections between projects.
Figure 1 shows the Workbench view of an e-health project from the SciStarter platform. Associated Research Areas, SDGs and Named Entities are extracted and also visualised. Figures 2 and 3 display summary information on a group of 105 projects in the form of a dashboard. The upper half of the dashboard (figure 2) shows the distributions of the predominant research areas,

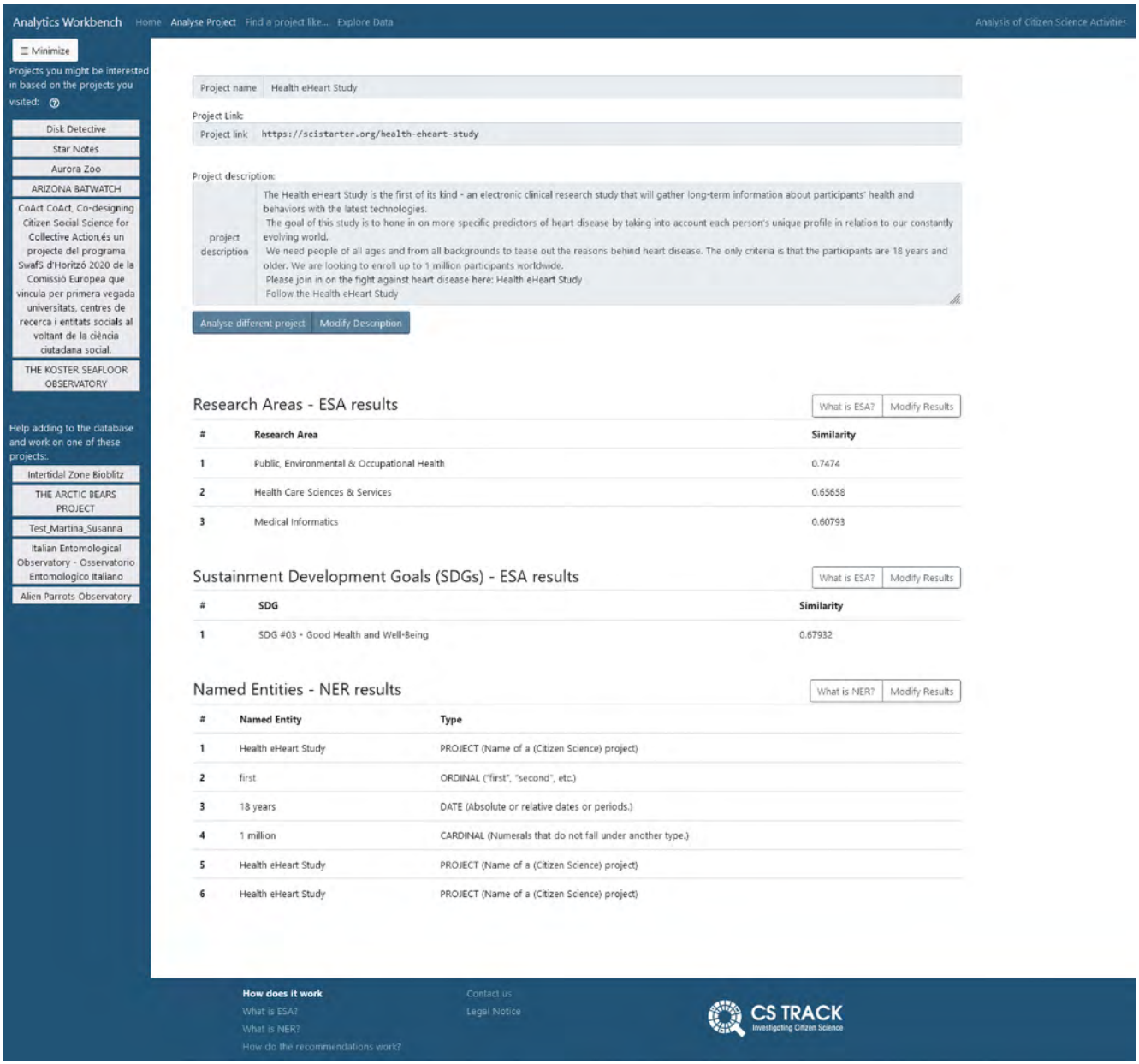


Figure 1. The Workbench view

SDGs and named entities. The lower half of the dashboard is illustrated in Figure 3 with a network view of projects, research areas and organisations. Similarly, this view also allows to display networks of projects connected via any combinations of research areas, SDGs or named entities.
If you want to know how the Analytics Workbench may be used to analyse your citizen science project, please contact cstrack@rias-institute.eu.

Graphic Figure 1

Legend

In this figure we see the analysis results for the citizen science project "Health eHeart Study". These are composed of research areas, SDGs and named entities. For research areas and SDGs we can also see the ESA-calculated similarities to the project description. All results can be manually modified where necessary.

Graphic Figure 2

Legend

Here we can see the top half of the dashboard. It gives an overview over the analysed projects, how many research areas, SDGs and named entities we have per project, as well as the distribution of research areas, SDGs and named entities in the data set.

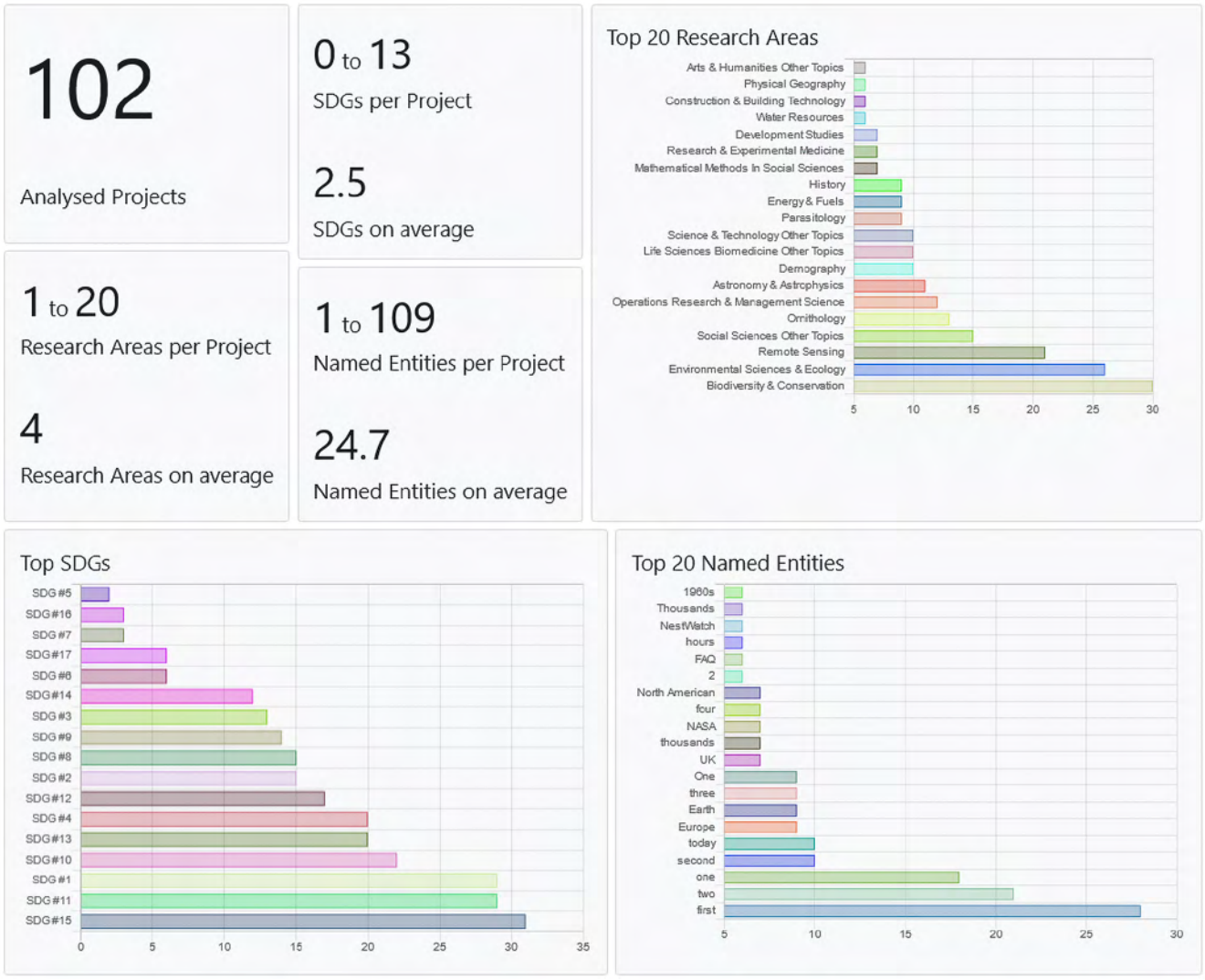


Figure 2. Dashboard

Graphic Figure 3

Legend

In this figure we see the second half of the dashboard which contains a network view of projects (blue), research Areas (yellow) and organisations (red). With the input fields the users are able to manipulate the network view by choosing the connecting elements between projects they want to see (e.g. research areas, SDGs, organisations, places, etc.), picking a project to centre the view on or filtering by node-degree. Additionally the last field can be used to search for a project or a connecting element in the network.

Data Source

The data was originally taken from the CS Track project database.

Explore the landscape of online citizen science projects with our Analytics Workbench

Check out the Analytics Workbench

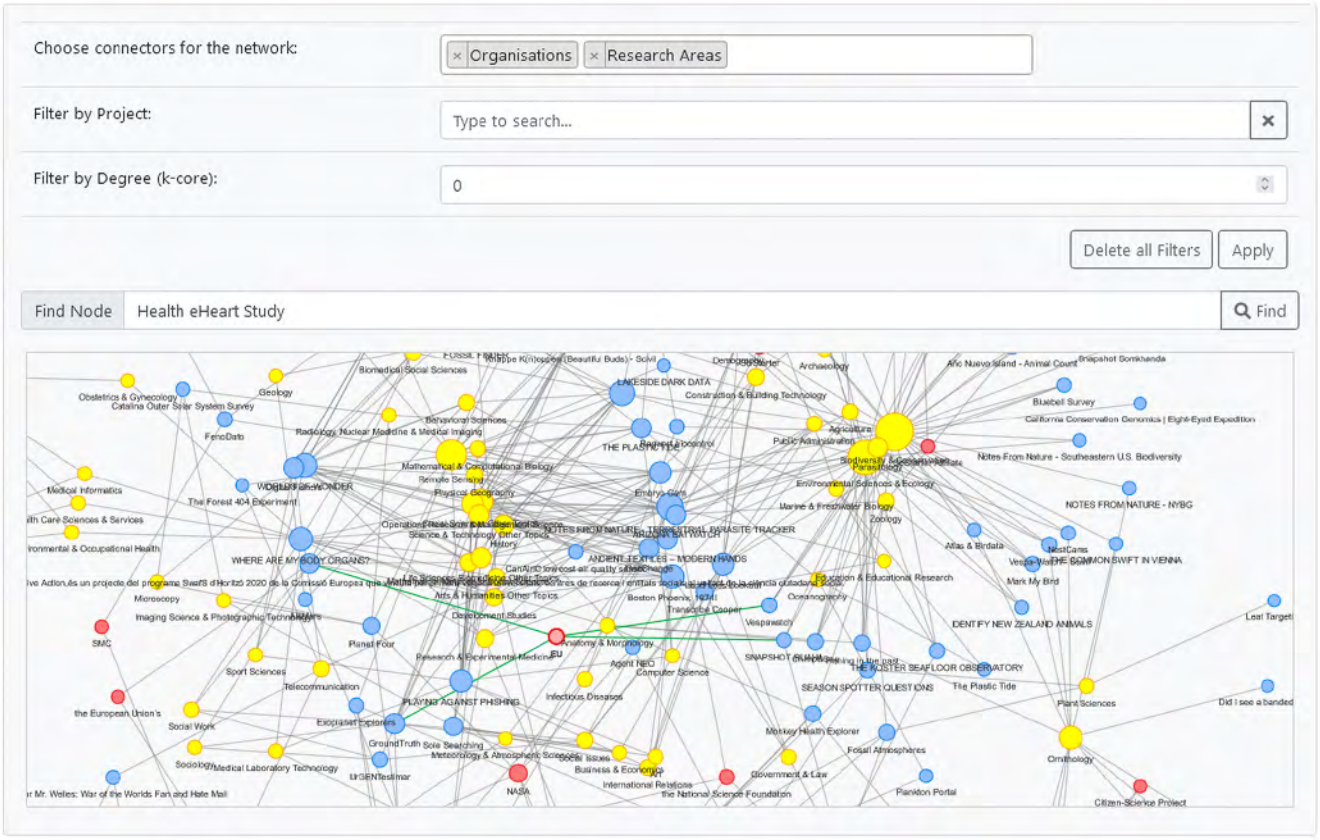


Figure 3. Network view of projects, research areas and organisations

12 recommendations for addressing future challenges through citizen science

By Anne Turbe, Yaela Golumbic, Tslil Farchi, Reuma De-Groot

The COVID-19 pandemic exposed an opportunity to improve the outcomes of citizen science in response to emerging challenges. Such unforeseen events can have a transformative power of their own, as we could all witness in recent years. Entire populations were suddenly locked down and their behaviour modified in various ways – for instance through travel restrictions and social distancing, or by being forced to pause work or studies. This process was often accompanied by feelings of anxiety, but it also meant that some people suddenly had more free time at their disposal. Participation in many citizen science programs skyrocketed in this period, demonstrating the unique potential citizen science offers to tap into people's willingness to contribute to a greater good.

The CS Track team of researchers led by Dr. Anne Turbe (Ecoscope) and Dr. Yaela Golumbic have recently published a study that investigates the potential of citizen science to respond to emerging challenges. This report presents an analysis of Covid-19 citizen science projects based on a two-phase research approach consisting of a website content analysis and detailed case studies of seven citizen science initiatives. It also includes a set of recommendations for tackling future challenges.

Website content analysis

In total, 25 citizen science projects focused on Covid-19 were identified and subjected to website content analysis. Most projects were entirely new (72%), but 7 projects consisted in extending previous activities of existing citizen science projects, in particular influenza monitoring projects. The content analysis findings include:

- All projects stated their aims clearly.
- Most projects were initiated either in Europe (44%) or in Northern America (36%), with only three projects originating from other parts of the world (Australia, Singapore, Israel).
- Almost all projects were widely accessible, targeting a broad audience and requiring no special skills (92%).
- The projects were usually interdisciplinary and covered engineering, social sciences, natural sciences and medical sciences.
- Citizens were mostly involved in data collection, and over three fourths of projects were contributory (76%, n=19).
- The vast majority of projects were participatory crowd-sourced projects (92%), with only two projects relying on distributed intelligence.
- Most projects required participants to answer a questionnaire (64%), often also including the location (tracked or from zip code, n=8 projects, 32%), or more rarely a picture (n=2, 8%).

- Overall, the projects provided limited opportunities for the participants to interact with the data.

- Mobile technology offered unprecedented opportunities for supporting data collection relying on images, movement patterns and basic physiological variables.One of the biggest challenges in the current COVID-19 pandemic has been the difficulty to effectively track the virus, predict public health outcomes and recommend quick public health interventions. Through web or mobile apps, citizen-driven efforts can effectively fill those gaps, whether volunteers regularly log details about their location (CovidWatcher), their symptoms (sQuantified Flu, Outbreaks Near Me), their well-being (Covid Open Survey), or the material resources available in their community (CovidWatcher, Safcast Covid-19 map).

Detailed case studies of Covid-19 citizen science projects were used to provide additional in-depth information on how citizen science can help respond to emergencies. They also allowed the CS Track researchers to assess alignment with the overview analysis of projects based solely on their online content.

12 recommendations to ensure impact and adaptability

Building on the good practices observed in these case studies, the CS Track researchers were furthermore able to identify some key elements that were shared by all case studies and seem to enable responsiveness and impact delivery during a crisis.

- When building your project, cooperate with projects and/or people that are already involved in the subject of research.
- Invest in the citizen science infrastructure early-on, before the next emergency arrives. From a technical point of view, a nimble, adjustable infrastructure is needed that can easily be leveraged and deployed at scale. OpenPandemics, Covid Phym, Outbreaks Near Me and Safecast Covid 19 map were all able to build on an existing volunteer community and big data infrastructure.
- Plan for success: Think big. When you have a project with a high potential, it is worth investing in it from the start and planning for success. This may also require thinking about the funding model to ensure project sustainability. The Flu Near You platform could not be extended to include Covid-19 symptoms because its technology was too obsolete. This led to the creation of the Covid Near Me Platform, then fully redesigned and replaced by Outbreaks Near Me, when funding was available to develop a more expandable platform.
- Make sure that your citizen science activity has a clear, explicit, and straightforward goal.
- Keep it simple, this will help make the project more accessible and allow you to attract more participants, rather than scaring them off through complex or overly long surveys.
- Be realistic and manage expectations. Agree on what your project goal is and frame your project accordingly.
- Design openness into the system from the beginning by making data easily accessible. Most of the case studies analysed will make their data available upon request while, presently, only aggregated results are directly accessible.
- Keep your contributors happy, update them regularly and thank them for their efforts.
- Make sure the project is accessible to diverse audiences.
- Understand and listen to people's concerns.
- Give back to your participants to secure trust and engagement.
- Partner with NGOs. Partnerships with non-scientific organisations can improve communication between researchers and citizen scientists, encourage social accountability, and help with outreach and dissemination of results.

Learn more about the study here

Expert interviews highlight benefits, pitfalls and ethical issues of citizen science

By Michael Strähle, Christine Urban, Marinos Anastasakis, Smaragda Lymperopoulou, Kathy Kikis-Papadakis, Patricia Santos, Miriam Calvera-Isabal, Ishari Amarasinghe, Ohto Sabel, Aaron Peltoniemi, Emilia Lampi, Joni Lämsä, Raija Hämäläinen, Julia Lorke, Florence Mühlenbein, Marius Oesterheld, Reuma De-Groot, Yaela Golumbic, Raul Drachman, Ulrich Hoppe, Nils Malzahn, Cleo Schulten

The CS Track research team, led by partners Christine Urban and Michael Strähle from the Wissenschaftsladen Wien – Science Shop Vienna, has published a report called Conceptual Framework for Analytics Tools. This document builds on the preceding report Framework Conceptual Model and lays the conceptual foundation for the project. It maps citizen science landscapes in the European Union and beyond, funding programmes, policies, advocacy and working groups, and opportunities for participating in citizen science activities. Moreover, the report presents an overview of educational citizen science activities in schools that complements the previously published literature review on citizen science activities in education. Last but not least, it also includes interviews with African, Asian, European and American experts on Open Science, research ethics and research integrity, which supplement the literature review included in the Framework Conceptual Model report and are the focus of this article.

The CS Track researchers interviewed experts who live or work on different continents or have carried out projects which fall under the European Commission's definition of citizen science in different parts of the world. When selecting experts, the interviewers considered several dimensions: geography, professional status and background, sufficient visibility in their field, no close affiliation to those who are often cited in research on citizen science, and scientific expertise in respect to the topic of the interview, and gender. 55 experts were approached and 12 of them were interviewed.

Benefits, pitfalls and caveats

Experts shared their thoughts on some potential benefits, pitfalls and caveats of citizen science. Here are some of their observations:

» Lyn Horn (University of Cape Town, South Africa) believes that grassroot citizen science can provide counter expertise and open access to data powerful people with hidden agendas try to hide. However, activists and scientists should be careful not to overstep their field of expertise.

» Glenn Hampson (Science Communication Institute and Open Scholarship Initiative, USA) warns of "potential misappropriate use of findings to support other agendas".

» "It does not work for all kinds of research." Sara Decoster (KU Leuven, Belgium)

» "Successful citizen science is very time consuming." Aleta Quinn (University of Idaho, USA)

» "I think citizen science sells well. In the museum community, if you're trying to get a job as a curator or even a collections manager these days, they want you to have some component of interacting with the community and they want the phrase citizen science to be on your resume. There seems to be a push in a way that it might take resources away from other activities. It might oversell the concepts of citizen science." Aleta Quinn

- Rebecca Lave pointed out that scientists might miss out on something by partially outsourcing data collection to volunteers. For perhaps scientists would notice something in data collection that citizens would not. The opportunities for unplanned fortunate discoveries might be reduced.

- "Science needs to remain science, quality assurance is necessary (but easier said than done)." Sara Decoster

- "Citizen science is just a building block in Open Science. It is a problem if anything can be called citizen science." Alexander Refsum Jensenius

- "I think people need to realise that an important aspect of science is about doubt and uncertainty, which are in fact essential components of science, as demonstrated by epistemologists like Popper & Kuhn. The idea that something is true only until the contrary has been proven. But now citizens are asking scientists to give clear answers, to tell them the truth and are not always aware that the truth might not exist. Or that the truth of today is not the truth of tomorrow." Sara Decoster

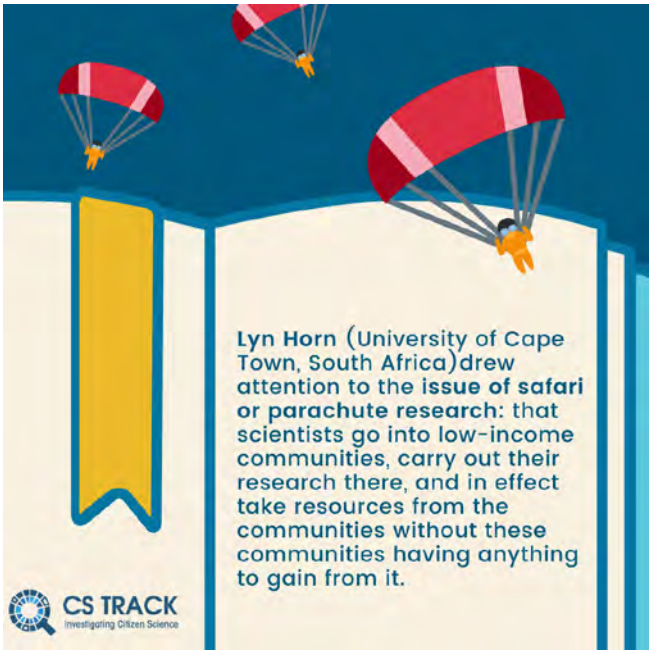
Ethical issues

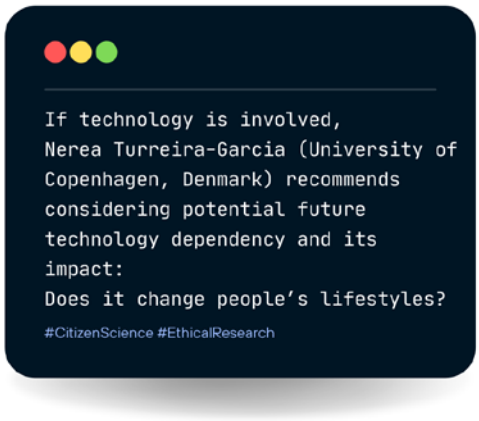
The experts on research ethics and research integrity mentioned several ethical issues, including well-known ones such as privacy, and inclusion barriers and some that are not widely discussed in citizen science communities.

Ethical issues may also depend on project design. "Who decides project objectives, methods, data validation, and data use, in short: the project agenda?" asks Nerea Turreira-Garcia, as "such decisions decide about ethical issues, too, especially in participatory research activities such as participatory environmental monitoring."

Recognition of the citizens involved and of citizen science itself also remains an issue. For example, scientific journals make it difficult to adequately name citizen scientists.

Without payment, people with few financial resources can be excluded from participation, especially when it comes to more time-consuming contributions.





CS TRACK
Investigating Citizen Science

How to mitigate ethical issues?

Interviewed experts shared their suggestions of how some of the ethical issues can be mitigated, including:

» Aleta Quinn suggested that closer cooperation between scientists and citizen scientists cannot only prevent ethical issues, but can also reveal ethical issues scientists are not aware of.

» Nerea Turreira-Garcia recommends making data collection as low-tech as possible and to give data collectors full ownership of their data.

» Rebecca Lave (Indiana University Bloomington, USA) believes that data and results must be made available to volunteers in an understandable way.

Read the full deliverable "Conceptual Framework for Analytics Tools"

Read the full deliverable "Framework Conceptual Model"

Highlights from the CS Track eMagazine series of interviews

Looking for inspiration? Make sure to read these interviews with citizen science experts!

“Citizen science is likely to lead to greater relevance of research and innovation for citizens and society, and hence facilitate uptake and behavioural changes in support of action”

Linden Farrer (European Commission)

Read the full article to learn more

ZENTRUM FÜR SOZIALE INNOVATION
CENTRE FOR SOCIAL INNOVATION

PROJECT RESULT

“Defining project goals with participants may also lead to more ownership and identification with a project, as well as empower potentially marginalised populations in the process.”

ZSI Team

Read the full article to learn more

"Having contact points for citizen science in public institutions, and the time and resources to engage in such dialogues does not come for free, but can lead to great benefits for everyone involved."

Sven Schade (JRC)

Read the full article to learn more

"And if you think CS data is problematic, then you are part of the problem!"

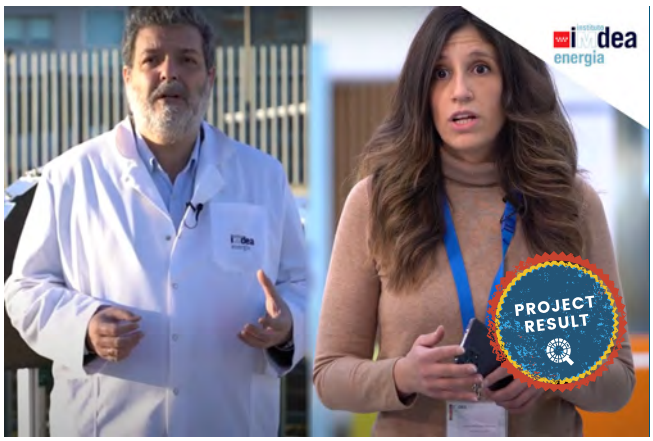
Romain Julliard (MOSAIC)

Read the full article to learn more

"It is important to realise that, when we share our data we might also be sharing data about others such as members of our family, friends, colleagues, including children, without necessarily their permission or knowledge."

Huma Shah (CSI-COP)

Read the full article to learn more



"Research cannot turn its back on society. It is essential to respond to society's needs, especially on the part of those of us who work in the public sector."

Javier Dufour (IMDEA)

Read the full article to learn more

Read more articles in the CS Track eMagazine: cstrack.eu

Discover our full deliverables on Zenodo

Follow us on Twitter

Follow us on LinkedIn

CS TRACK
Investigating Citizen Science