Universität Zürich[UZH] | ETH zürich

Citizen Science Center Zürich

PRACTICING CITIZEN SCIENCE IN ZURICH

HANDBOOK

Citizen Science Center Zurich

Practicing Citizen Science in Zurich

Handbook

This handbook is a practical guide on how to successfully design and run co-created Citizen Science projects, with some specific tips for practitioners in Zurich. The handbook is organized in parts that can be seen as a sequence of consecutive steps, or can be accessed at one's convenience for suggestions and recommendations on different aspects of designing, implementing, and running Citizen Science projects.

The handbook is a joint effort of the community of Citizen Science practitioners in Zurich, including researchers at the University of Zurich and ETH Zurich, and citizens.

The writing has been coordinated by the Citizen Science Center Zurich.

First edition: November 2021 (regular updates will follow)

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The handbook is structured according to the chapters as shown above.

User Guide

The structure of the handbook follows the typical steps of the scientific research process, as shown in the diagram below, outlining in particular the phases of ideation, planning and design, implementation, dissemination and evaluation. Within each phase, we consider aspects specific to the Citizen Science methodology, emphasizing the importance of co-creation and community management, and providing practical advice, links, and suggested literature.

As the goal of the handbook is to provide actionable information, planning and design of the research project make the most substantial chapter, as this phase can be better generalized to any research endeavours. It also reflects the importance of good planning for a successful Citizen Science project.

Note that we are not using direct referencing. However, in each chapter all the information we provide is based on the publications that are listed in the suggested literature ("Resources, links, and hints" box).

The handbook is structured according to the research process as shown above.


CITIZEN SCIENCE

Citizen Science

What is Citizen Science?

Citizen Science is defined in the Oxford English Dictionary as "scientific work undertaken by members of the general public, often in collaboration with or under the direction of professional scientists and scientific institutions". In fact, there are different definitions and interpretations of the term in the literature, which depend often on the context. Citizen Science can differ across research fields and in terms of design processes, participation levels, and engagement practices. It includes top-down, researchers-driven approaches and more bottom up, community-driven practices.

The European Citizen Science Association (ECSA) defines Citizen Science as "an 'umbrella' term that describes a variety of ways in which the public participates in science, with two main characteristics in common: (1) citizens are actively involved in research, in partnership or collaboration with scientists or professionals; and (2) there is a genuine outcome, such as new scientific knowledge, conservation action or policy change."

It may also be useful to examine the two key terms that describe the methodology, as they are still the subject of (sometimes heated) discussions because of their potential for misinterpretation. The term "citizens" has broad meaning in this context and refers to people with a varied range of knowledge and skills, who may or may not have a formal scientific education. It stands in contrast to "scientists", who have received a formal academic education in the specific field of research of the Citizen Science project, and work in academia or other research institutions.

To avoid any potential misunderstanding with the terms, in this document we will refer to two kinds of actors: "project organizers" and "project participants". Whereas the project organizers are the ones initiating the project, project participants are the collaborators. How that collaboration looks and what role the project participants take depends largely on the level of engagement built-in by design in the Citizen Science project.

Concerning the production of "scientific knowledge", this stands for the kind of knowledge that can be recognized by the (professional) scientific community as following established scientific methods. "Production of scientific knowledge" implies that participants are involved in the material and cognitive process of scientific research or inquiry.

Finally, Citizen Science projects may include a social component and may thus be seen as democratizing science and promoting social and/or environmental justice. Again different cases exist, including projects aimed at a pure investigation for research objectives, and/or projects aimed at collecting evidence to influence policy.

Typologies of Citizen Science

Citizen Science projects come in different forms, involving different degrees of collaboration between project organizers and project participants, and with different levels of quality for the produced scientific result. Several classifications exist in the literature, ladders that reflect the increasing level of involvement of participants in the different phases of the scientific research process. For the purpose of this document, we limit our considerations to the three types according to the most common typology:

- **Contributory projects** – designed by professional researchers, with members of the public primarily contributing data.

- **Collaborative projects** – designed by professional researchers, with members of the public contributing data as well as helping to refine project design, analyse data and/or disseminate findings.

- **Co-created projects** – designed by professional researchers together with members of the public. At least some members of the public are actively involved in most or all aspects of the research process.

Typologies of Citizen Science Projects

Co-Creation

With co-creation, participants are involved in various aspects of the project, including for example the development of the research question, the choice of data collection methods, the process of data analysis, and more. Co-created projects are seen as an excellent model of Citizen Science, as they foster a more significant public's participation, which brings the most to both communities – the citizens/public and the academic world.

For the **academic researchers**, they not only increase research capacity but they also produce socially robust knowledge. They also enjoy increased likelihood of serendipitous discoveries. With Citizen Science, researchers contribute to increasing scientific literacy in the general public by fostering understanding of the specific topic, insight into science, and development of new skills and abilities.

For the **citizens/public**, it is the opportunity to discover the entire scientific research cycle and gain a deeper understanding of the importance of science – also as a supporter of (social) decision making. Consequences include community development, empowerment, and change of attitudes, values and norms, action to improve the environment, and engagement in policy making. Furthermore, involving participants at an early stage of the process, as with co-creation, gives them the opportunity to express their unique interest in the project and its outcomes. This includes their potential concerns, and what they personally want to get out of participating. Creating common stakes and a shared sense of "ownership" will help engage an active community of volunteers.

Citizen Science «Zurich Style»

"Citizen Science Zurich Style" is the choice by the two universities supporting the Citizen Science Center in Zurich (University of Zurich (UZH) and ETH Zurich (ETHZ)) to qualify their joint effort as a unique endeavor to focus on co-created projects that feature academic-quality processes and results.

This means that the Citizen Science Center in Zurich is striving to support:

- activities and projects that maximize the collaboration between project organizers and project participants in all phases of the research process ("co-created");

- projects that apply established Citizen Science processes and standards to ensure the production of academic-quality data and results.

The Center believes that the next phase in the development of Citizen Science as a discipline is a better integration of the participants into the whole process of science: not just data collection and analysis, but also participating in the different phases of the research process, from ideation, planning and implementation all the way to analysis of data and publication of results.

If you want to know more about Citizen Science
We recommend you to explore the European Citizen Science Association (ECSA) platform, where you can find resources about the methodology in many different languages, a list of projects, and the (ongoing) research work on defining the 'Characteristics of Citizen Science'.

- **ECSA platform** https://ecsa.citizen-science.net/
- **ECSA resources** https://eu-citizen.science/resources
- **ECSA projects** https://eu-citizen.science/projects
- Research work on 'Characteristics of Citizen Science' https://zenodo.org/communities/citscicharacteristics

For terminology, see:

- ECSA Principles of Citizen Science https://osf.io/xpr2n/
- Eitzel, M. V. et Al. (2017). Citizen Science Terminology Matters: Exploring Key Terms. Citizen Science: Theory and Practice, 2(1): 1. http://doi.org/10.5334/cstp.96

Literature
Where is the term coming from? Here the historical papers, still relevant today, that defined the field:

- Bonney, R. (1996). Citizen Science: a lab tradition. Living Bird, 15(4): 7–15.

- Bonney, R. et Al. (2009). Public Participation in Scientific Research: Defining the Field and Assessing Its Potential for Informal Science Education (Report). Center for Advancement of Informal Science Education. https://www.informalscience.org/public-participation-scientific-research-defining-field-and-assessing-its-potential-informal-science.

- Irwin, A. (1995). Citizen Science: A Study of People, Expertise and Sustainable Development. Routledge.

- Shirk, J.L. et Al. (2012). Public Participation in Scientific Research: A Framework for Deliberate Design. Ecology And Society, 17(2): 29–48. https://www.ecologyandsociety.org/vol17/iss2/art29/.

Other handbooks resources
We are not the first ones producing a Citizen Science handbook! While this booklet is sometimes tailored to the specifics of Citizen Science in Zurich, you may find useful tips (especially for applying Citizen Science in specific fields) in the work done by other colleagues worldwide:

- Citizen Science for all. A guide for Citizen Science practitioners https://www.buergerschaffenwissen.de/sites/default/files/grid/2017/11/20/handreichunga5_engl_web.pdf (Germany, all fields)

- Open Science Training Handbook https://open-science-training-handbook.gitbook.io/book/open-science-basics/citizen-science

- The Citizen Science Manual https://citizenscienceguide.com/homepage (US, for Environmental Monitoring)

- Citizen Science Toolkit https://www.biodiversa.org/1770 (Europe, Biodiversity)

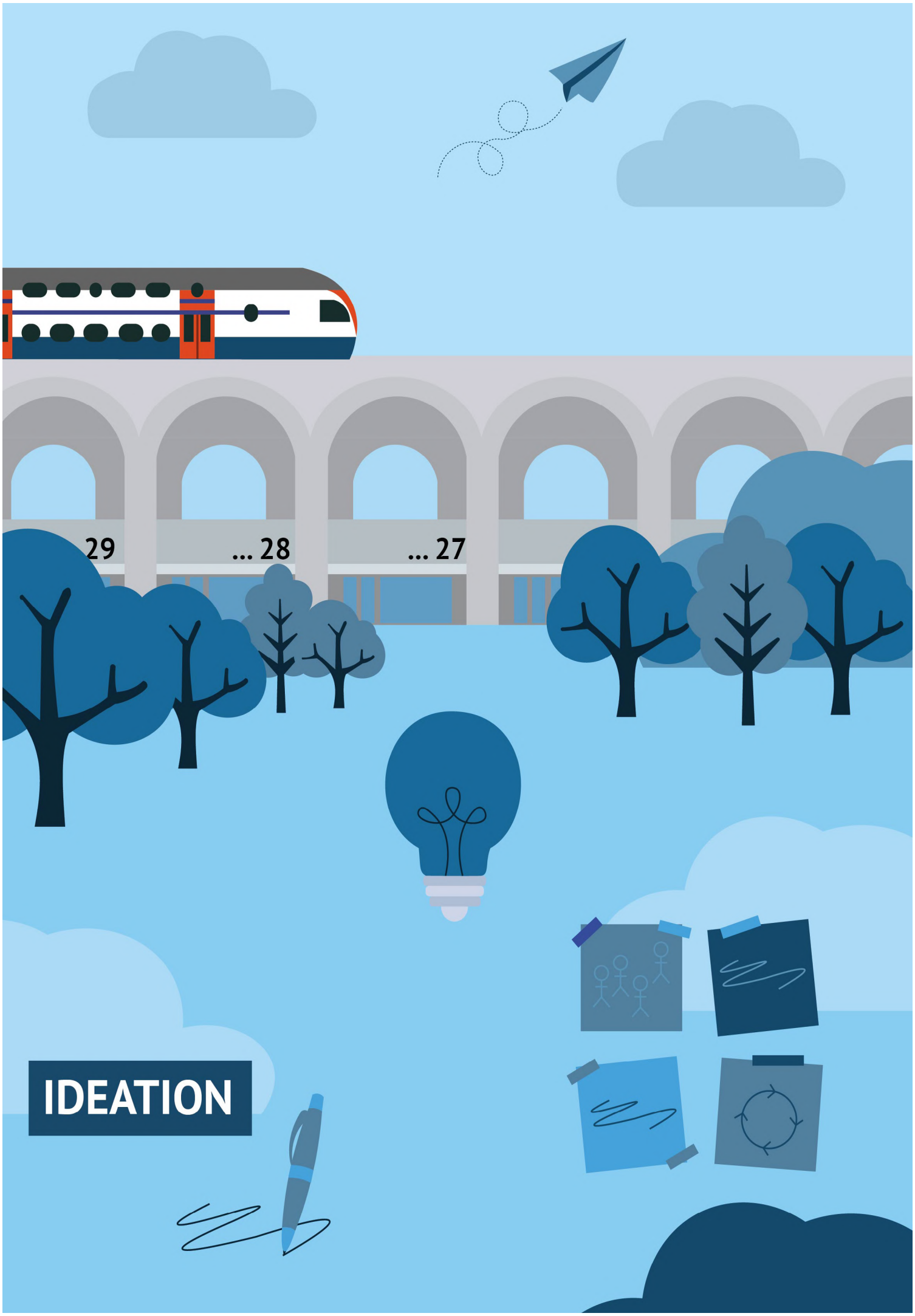
- Community Planning Toolkit https://www.communityplanningtoolkit.org/sites/default/files/Engagement.pdf (UK, Community Engagement)

- Federal Crowdsourcing and Citizen Science Toolkit https://www.citizenscience.gov/toolkit/howto/# (US, for Government)

- Communication in Citizen Science, A practical guide to communication and engagement in citizen science https://www.scivil.be/sites/default/files/paragraph/files/2020-01/Scivil%20Communication%20Guide.pdf (2019, Communication)

- Citizen Science jenseits von MINT https://www.hof.uni-halle.de/publikation/citizen-science-jenseits-von-mint/ (2020, Humanities)

- Kultur und Gesellschaft gemeinsam erforschen https://www.hof.uni-halle.de/publikation/kultur-und-gesellschaft-gemeinsam-erforschen (2020, Humanities)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IDEATION

Ideation

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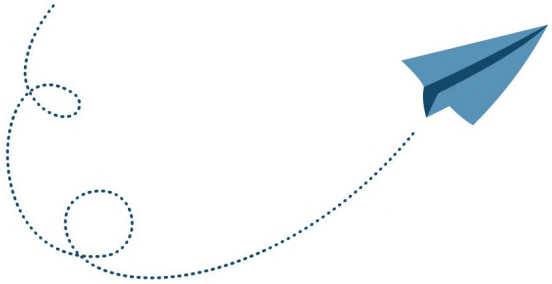


Step by step guide in this chapter.

Is Citizen Science the right methodology for your project?

At the origin of a Citizen Science project stands a question or possibly an issue (social, philosophical, ...) for which the solution requires a scientific research approach. Once the research question(s) have been identified and there is an initial idea of what the project could be about, the next step is to explore if Citizen Science is the right methodology to use.

When and why should Citizen Science be considered?
Project organizers should consider Citizen Science as a methodology from the very beginning of their research process, and regardless of the field of research, as successful Citizen Science projects exist in many domains of science, arts and humanities.

However, some of its characteristics make Citizen Science a particularly interesting research methodology when in presence of specific requirements. In particular:

- **The study would benefit from data collected across a large geographical area and/or for a long period of time** Certain studies require data from large areas to be scientifically meaningful and reliable. Similarly, data can be needed either continuously or periodically (for example every month or every year) over long periods of time. The contribution of project participants can make collecting such data cost-effective when compared to conventional methods.

- **The study requires analysis of large amounts of data** Despite the fast rise of Artificial Intelligence, humans still outperform computers in tasks such as sorting and analysing certain kinds of digitally-collected data (e.g. images, documents, audio/video files). For example, this may involve identifying and recording presence, behaviour, frequency, or duration of various phenomena in digital media, or geolocating images. When such tasks can be completed online via a web interface, participants with proper training and guidance can accurately perform most of them.

- **The study has potential for local and/or social impact** Citizen Science is well suited for interdisciplinary collaboration, particularly for projects that include both natural and social aspects, or focus on connections between humans and their environment. By connecting and engaging different stakeholders in local communities – scientists, regulators, decision-makers, volunteers, families, and others – Citizen Science can facilitate a shared understanding of research questions and make them more locally relevant, ultimately helping scientists, communities, and policy makers.

- **The study requires data about meaningful intellectual or social engagement in real life** The value of examining when, how, and with which consequences individuals engage in meaningful activities is becoming increasingly recognized, as important research and practical questions about individuals can be analysed and answered. Citizen Science projects and platform naturally provide such "additional" data.

Some examples: observation of physical and biological phenomena; seasonal events; air and water quality monitoring; monitoring of environmental changes and effectiveness of management practices; monitoring of personal/health related factors and behaviours. In the humanities, transcription and/or translation of hand-written documents, historical mapping, interpretation of documents, and more.

Level of Involvement

As already mentioned, there are different typologies of Citizen Science projects. The diagram below illustrates the key differences of the three most common groups, i.e. contributory, collaborative, and co-created projects. While in contributory projects participants may only contribute to the data collection or data analysis, complexity and engagement increase as we move to collaborative and then to co-created endeavours, where project participants are involved in some or all phases of the scientific research process and may also become project co-organizers.

Once decided that Citizen Science is the right approach, the next step is to think how much and at which points participants could and should be involved, as the typology that you choose will have an impact on the planning of your project. However, it is important to acknowledge that not all participants are interested in being involved in every stage of the research process. As early as possible – ideally already during project planning – they should have the possibility to decide how and when they wish to contribute in the different stages. This can generate "inner" and "outer" circles of participants, with those in the innermost circle being project co-owners and/or organizers and people in the outer circles that might want to participate only by collecting data.

The important aspects distinguishing co-created Citizen Science projects from other projects are that 1) participants are able to decide for every step of the process if and how they wish to be involved and 2) participants are peers and partners, and they do have equal rights when it comes to decision-making.

Community Management

As Citizen Science projects depend largely on project participants, one of the major tasks is to build and sustain a community around them. A community is defined by the Cambridge Dictionary as a group of people who have similar interests or who want to achieve something together. However, motivations, backgrounds and skill-sets of volunteers may vary considerably.

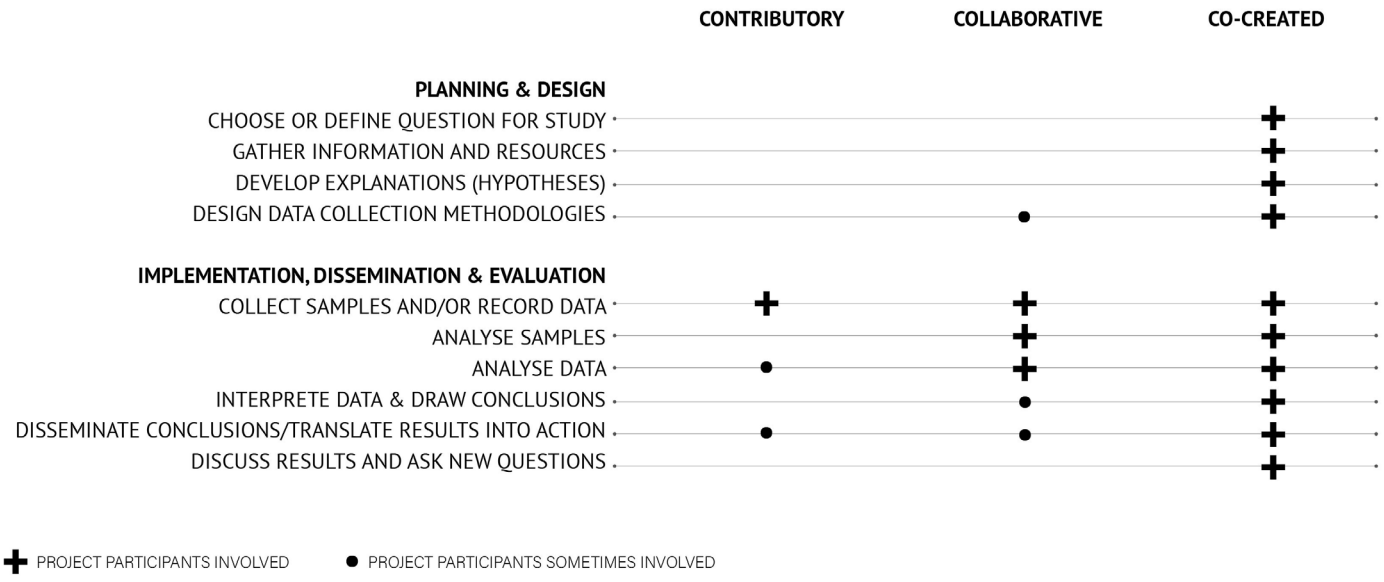
One of the first milestones to build a community is to develop a community management strategy (see Planning and Design phase), which will be based on questions such as: who are the people most likely to be interested in the topic? What would their motivation be to participate? What type and level of involvement would they want and which would be adequate for the project?

You should also evaluate which kind of audience you need to address. Some projects are better suited for very specific groups (e.g. amateur herpetologist, German dialects lovers, etc.), while others are general enough to be potentially interesting for the larger public. This choice influences the ways to reach out and promote the project, including channels, formats, and level of the content.

Why do people participate?
Understanding their motivations is essential to enhance recruitment, ensure good retention rates and ultimately make the Citizen Science project a success. Researchers have investigated reasons for participating in a variety of projects, and these research studies suggest that volunteers are motivated by a combination of many different factors, including:

- Interest in the research topic (first motive overall for joining a project!)
- Learning new information
- Contributing to original research
- Enjoying the research task
- Sharing the same goals and values as the project
- Helping others and feeling part of a team
- Recognition of contribution and feedback on contribution

Motivations can change over time, so constant monitoring (i.e. communication and feedback loops) are essential to make participants feel appreciated, to make sure they enjoy participating, and to promote any activities surrounding the project (forums, chats, etc.). Stronger motivation can also be achieved by clearly highlighting the benefits of participating. In general terms, the main benefits include increased scientific literacy (increased knowledge of the topic studied, but also insight into science in general and acquisition of new skills and abilities), understanding of the scientific process and method (especially in co-created



The level of involvment has effects on when and how you include project participants.

projects, it includes the ability to formulate a problem based on observation, develop hypotheses, design a study, and interpret findings), facilitated access to science information (e.g. one-on-one interaction with scientists), facilitated access to a network of peers with similar interests, and increased ability to interpret scientific information and data. Benefits may also include learning something and generating information about oneself, or creating valuable information/data with the potential for multiple uses.

Additional benefits, that come from seeing science as a tool to increase social learning and trust among diverse groups, can motivate the more socially engaged participants. These include increases in community-building, social capital, but also changes in attitudes, norms and values (e.g. about the environment, about science, about institutions), and the possibility for Citizen Scientists to take action to influence policy and/or improve their living environment.

When does community building take place?
This depends on your decision on the involvement of contributors. If you choose co-creation, then you should involve contributors as early as possible in the process, i.e. already in the formulation of the research questions. In the case of contributory or collaborative projects you can start building your community later – shortly before the implementation phase.

RESOURCES, LINKS, AND HINTS

Definitions

- **Community**: a group of people who have similar interests or who want to achieve something together (Cambridge Dictionary).

- **Community Building**: describes the development of communities. In order to attract a group of participants (through content, common goals or incentives), each project organizer needs a solid concept.

- **Community Management**: follows the community building and refers to the active moderation and organization of the community. It involves taking care of the members, responding to their needs and ensuring interaction.

Blogs

- **ETH Library** https://blogs.ethz.ch/crowdsourcing/
- **Citizen Science Center** https://citizensciencezurich.blog/
- ***Österreich forscht*** https://www.citizen-science.at/blog

Literature

- Aristeidou, M. et Al. (2017). Profiles of engagement in online communities of citizen science participation. Computers in Human Behavior, 74: 246–256. https://doi.org/10.1016/j.chb.2017.04.044.

- Bonney, R. et Al. (2009). Citizen Science: a developing tool for expanding science knowledge and scientific literacy. BioScience, 59(11): 977–984. http://dx.doi.org/10.1525/bio.2009.59.11.9.

- Citizenscience.gov. Step – 3 Build a Community. https://www.citizenscience.gov/toolkit/howto/step3/#

- Dickinson, J. et Al. (2010). Citizen Science as an Ecological Research Tool: Challenges and Benefits. Annual Review of Ecology, Evolution, and Systematics, 41(1): 149–172. https://www.annualreviews.org/doi/10.1146/annurev-ecolsys-102209-144636.

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- Rüfenacht, S. et Al. (2021). Communication and Dissemination in Citizen Science. In: Vohland, K. et Al. (eds) the Science of Citizen Science: 475–494. Springer. https://link.springer.com/chapter/10.1007/978-3-030-58278-4_24.

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- Veeckman, C. et Al. (2019). Communication in Citizen Science. A practical guide to communication and engagement in citizen Science. SCIVIL. https://www.scivil.be/sites/default/files/paragraph/files/2020-01/Scivil%20Communication%20Guide.pdf.


PLANNING & DESIGN

Planning and Design

Scoping

Developing a successful Citizen Science project is an iterative process. It includes finding the research question, defining project objectives, exploring effective methodologies, evaluating data requirements for meaningful results, estimating the potential interest for the project participants, verifying compliance with existing Citizen Science criteria and principles, and iterating this process until full optimization of each component is reached.

In addition, this process needs to be approached – from the very beginning – with the perspective of all involved players.

For all project organizers it is useful to start by thinking of the reasons why participants' contribution is needed for the desidered study and outcome, and why Citizen Science may be the best approach, exploring the specific strengths and challenges of the methodology for the given application. For instance, it may be that similar studies based on traditional research methods have revealed data gaps that only a more inclusive and participative approach can fill.

The choice of Citizen Science over more traditional methods may need to be understood and accepted by key institutional and organizational stakeholders who may not be fully aware of the methodology. This requires having considered, weighted, and articulated how Citizen Science will best achieve the desired outcomes of the project. Also, it is worth including additional benefits specific to Citizen Science, such as effects on learning and education, increased social awareness, or engagement in environmental problems.

Trying to identify additional stakeholders who may need, or care for, the data and results of a given research study can be very useful to assess its potential uptake at acceptance at the contributors' level. Additional stakeholders may be scientists in related scientific domains or similar research fields, but also organizations and communities that could use and/or be impacted by the data and knowledge that the project generates.

Being able to express and communicate the overall scientific scope and methodological steps in a clear way, that is understandable by all people involved (i.e. avoiding domain jargon that can make it hard to understand for people outside the specific field) is essential to capture people's interest and build a core community of volunteer contributors.

Citizen Science Zurich support to scoping and co-creation
The Citizen Science Center Zurich and Participatory Science Academy (PWA) teams are available to investigate with you on all aspects of your idea to help assess if Citizen Science is an appropriate solution. To make our initial interactions more efficient, we suggest that before contacting us you get familiar with the Center's "Criteria for project support" https://citizenscience.ch/en/start/criteria.

Ready? Get in touch with us:
e-mail: info@citizenscience.ch & pwa@citizenscience.ch
phone: +41 44 634 21 97
in person: Kurvenstrasse 17, 8006 Zurich

Finding early stage contributors (stakeholders/ participants/ volunteers)
The Citizen Science Center Zurich is very happy to support you in the building of your communities as well as to connect you with the communities that we already have established at the center (see also "Partnerships" in chapter "Resources").

Additionaly, here are a few ideas for where to look to find potential stakeholders and project participants.

- Social media groups, channels, lists
- Local communities
- Global organizations
- Centers of expertise
- Facebook groups, hobby associations
- Swiss Guides and Scouts
- Established networks of interest (i.e. nature organizations)
- Advocacy groups
- Senior associations
- Specialized associations (dialects, etc.)

Resources
- Bonney, R. et Al. (2009). Public Participation in Scientific Research: Defining the Field and Assessing Its Potential

for Informal Science Education (Report). Center for Advancement of Informal Science Education. https://www.informalscience.org/public-participation-scientific-research-defining-field-and-assessing-its-potential-informal-science.

• Den Broeder, L. et Al. (2016). Citizen Science for public health. Health Promotion International, 33(3): 1–10. https://doi.org/10.1093/heapro/daw086.

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• Knack, A. et Al. (2017). Open science. The citizen's role in and contribution to research. RAND Coperation. https://www.rand.org/pubs/conf_proceedings/CF375.html.

• Nowotny, H. (2003). Democratising Expertise and Socially Robust Knowledge. Science and Public Policy, 30(3): 151–156. https://doi.org/10.3152/147154303781780461.

• Pohl, C. (2011). What is progress in transdisciplinary research? Futures, 43(6): 618–626. https://doi.org/10.1016/j.futures.2011.03.001.

Project Design / Protocol

In Citizen Science, "project protocol" (or workflow) refers to the sequence of tasks that need to be performed by project participants, and their associated rules. Depending on the project's objectives, the research protocol may cover tasks for data collection, for data analysis, or for a combination of both in different forms. Ultimately, all the steps and tasks should fit in a workflow that makes it easy and engaging for participants to contribute while ensuring the overall quality of data and results.

Example: your project aims at classifying biodiversity images. The protocol would detail where the images will be made available (i.e. web interface), if contributors will need to register or not, which questions will be associated with each image, how many times the same image will need to be classified, etc.

For each protocol's step, some of the more general aspects to examine include:

• whether the task's format and requirements would be best performed in a virtual (online) or physical environment;

• whether the necessary information/data would be best collected digitally (i.e. website, smartphone app, wearable gadgets, digital sensors, etc.), or in other forms (i.e. paper form, low-cost or "Do it yourself" (DIY) kits);

• whether volunteers will need training and/or supervision to be able to perform the tasks;

• whether the time and commitment required of a contributor are reasonable. If a task is too time demanding, further splitting it into smaller (shorter) tasks may be considered. Make sure you assess the overall feasibility and tailor the protocol depending on the kind of contributors you are targeting (consider attention span, available free time, etc.);

• whether data gathering should be organized as a short event (i.e. challenge) or for a longer period of time. Assess if you need information monthly, seasonally, or annually;

• at which points in the process the data collected by contributors needs to be validated.

Overall, make it easy and fun to participate in your project while ensuring the highest possible quality standards!

Gamification

As mentioned above, the use of methods and technologies inspired by online gaming can be effective to boost the fun-based motivation of some participants and achieve sustained engagement by providing instant-gratification. A growing number of projects includes for instance a reward system where individuals can gain status (points) and compete to reach the leader board. Gamification techniques include virtual recognition badges, friending, map challenges, and can use a mixture of traditional and social media interactions.

The use of gamification allows to establish personal connections and a gentle competition among participants that has shown to stimulate them to engage repeatedly over time. However, the competition element should be introduced with care. Participants must feel that the competition is fair, less competitive individuals should not be discouraged from participating, and above all it should not reduce in any way data quality or accuracy for the project.

Iterations

It is quite common for projects and processes to require modifications and adjustments after their initial implementation. It's therefore a good and more efficient practice to start small, with a pilot, as optimization is an iterative process that requires testing, flexibility, and being prepared to adjust the project design as needed as conditions could change, for instance depending on the interpretation of early results.

In Citizen Science projects it is a common practice to start by testing procedures with colleagues and with friends who may not be experts in the topic; their feedback often carries invaluable hints on aspects such as clarity, level of difficulty, level of engagement, which help you improve your project by making the necessary adaptations.

Some practical ways to collect feedback and exchange with contributors include interactive tools such as feedback forms, forums, chats, and social media channels, most of which have the benefit to allow you to respond and keep your contributors up to date with changes and improvements. It is essential that participants provide their feedback throughout the life of the project.

Pre-existing projects

As you may be aware, there are plenty of Citizen Science projects out there and chances are high that somebody, somewhere, is already doing something similar in scope and/or method to your own idea. To find out if best practices or protocols exist that can be applied or easily modified to fit your aims, searching existing project databases can be a practical solution. For scholarly as well as generic web searches though, it may be useful to be aware of the many different ways such projects are called in both official and grey literature, including community science, participatory science, participatory sensing, volunteered geographic information, volunteer monitoring, and more.

Of course, all other scientific projects – beyond Citizen Science – may be equally relevant and inspiring.

Platforms with existing projects

- **citizenscience.ch** The Zurich Center's platform hosts a number of data analysis Citizen Science projects for you to join! https://citizenscience.ch/en/

- **Citizen Science at Zentralbibliothek** featuring the projects offered by the Library https://www.zb.uzh.ch/de/ueber-uns/citizen-science

- **Schweiz Forscht** is an initiative of the Foundation Science et Cité and of the Swiss Academies of Science and Arts. The platform features an ample choice of national Citizen Science projects. https://www.schweizforscht.ch/projekte

- **Bürger schaffen Wissen** The German Citizen Science Platform https://www.buergerschaffenwissen.de/citizen-science

- **Österreich forscht** The Austrian Citizen Science Platform https://www.citizen-science.at/en/

- **The Zooniverse** is the world's largest and most popular platform for data-analysis Citizen Science projects, or "people-powered research". More than a million people around the world contributed to Zooniverse research projects. https://www.zooniverse.org/projects

- **EU-Citizen.Science** is an online platform developed by the homonymous EC Horizon 2020 project, designed to serve as a Knowledge Hub, in aid of the mainstreaming of Citizen Science. https://eu-citizen.science/projects

- **SciStarter** is a popular US-based Citizen Science portal with more than 3,000 projects, searchable by location, topic, age level, etc. SciStarter hosts an active community of close to 100,000 registered citizen scientists and millions of additional site visitors. https://scistarter.org

Resources

- Eitzel, M. V. et Al. (2017). Citizen Science Terminology Matters: Exploring Key Terms. Citizen Science: Theory and Practice, 2(1): 1. http://doi.org/10.5334/cstp.96.

- Bowser, A. et Al. (2013). Using gamification to inspire new citizen science volunteers. Gamification '13: Proceedings of the First International Conference on Gameful Design, Research, and Applications: 18–25. https://dl.acm.org/doi/pdf/10.1145/2583008.2583011.

Tools and Methods

Making technological choices (i.e. selecting tools and infrastructure that will enable and support the research process) is a challenging part of designing a research project, as the choice has numerous and long lasting repercussions on resources (personnel, skills, timeline, budget) and on the sustainability of processes and data.

In the case of Citizen Science projects, one of the first assessments is whether the project needs new technology or it can use existing solutions.

When possible, it's desirable for new projects to consider leveraging existing infrastructures. For many volunteer activities in fact, open (and free) solutions exist that have been developed with the specific needs of Citizen Science initiatives in mind. They have been used by multiple projects, and have been perfected over time thanks to the feedback of researchers and volunteer contributors. They include platforms where anybody can build a data analysis project quickly and without need for any coding skills, and smartphone app generators that allow the design of apps for data collection tailored to each project's specific needs.

Existing solutions may not be perfectly fitting the final requirements, but they are often useful in different ways and at different stages of the project. In the initial testing of protocol design for example, they can facilitate co-creation by allowing quick prototyping and multiple iterations with teammates and early collaborators. Sometimes, existing solutions are all you need for the full implementation of your research project, with significant savings in terms of time and resources. One extra advantage of existing platforms is that they often come with an established community of active users that may be attracted to joining your project as well.

If existing solutions do not fit your needs, and you have to build your own platform (web or mobile) you may want to consider leveraging existing open software or open-source content management systems. This choice, in line with the Open Science (OS) principles (and part of the OS UZH policy) is possible even if the development is contracted to a private company. Similarly, if you need specialized sensors and gadgets, consider using open hardware and low tech, DIY solutions to minimize costs of production, especially if you are not planning to provide the devices to your contributors.

Beside using tools, there are large practical advantages in sharing also certain elements of the co-creation research process, instead of having to develop each step from scratch. To help this process, the Citizen Science Center in Zurich is collaborating with Swiss and European projects in developing best practices to mainstream co-created Citizen Science.

Citizen Science Project Builder (PB)

The Citizen Science Project Builder (PB) is a web-based tool that allows researchers, students, and all members of the public to create and run data-analysis Citizen Science projects. Such projects may take many different forms, from classifying images of snakes to transcribing handwritten Swiss German dialect, from collecting samples of water to taking pictures of insects and plants. Typically, project participants are asked to perform complex data classification tasks (i.e. classify, tag, describe, or geo-localize) that are still best performed by human minds and skills. In particular, the PB supports projects based on existing digital data that can be in the form of images, text, PDF documents, social media posts (tweets), audio recordings and video clips.

The PB provides an interface that requires limited technical knowledge, and ideally little or no coding skills. Its aim is to facilitate the co-creation of Citizen Science projects between the two communities of academic researchers and volunteer contributors, by starting with the implementation of simple pilots. Any idea for a data classification project can be implemented with little effort, the basic requirement being that the project responds to some simple criteria available in the platform. By building around it an initial community of contributors (colleagues, friends, family, and more!) the research question, process, and data quality can be tested and iterated.

An important feature of the PB concerns data and metadata generated through each project. Users have full ownership and control of all their own contributions, which they can easily manage from their profile dashboard. This data includes information on their contribution history and results, and they are free to use it as they prefer, including donating it for additional studies. The potential of such behavioural data for researchers is huge, as we explain in the "data valorisation" section below.

The PB has been developed by the Citizen Science Center in Zurich in collaboration with the Citizen Cyberlab at University of Geneva. Its implementation is based on the open source crowdsourcing framework PyBossa and its code is publicly available under the 'CitizenScienceCenter' organisation on Github.

Step-by-Step Project Creation: Setting up a project involves a few simple steps. All you need are the digital data that you want to analyse, that can be text, images, video and audio files, tweets, and PDF documents.

- **STEP 0: Login or create your Project Builder account**
- **STEP 1: Create your project's home page**
- **STEP 2: Select the type of source file**
- **STEP 3: Select the type of task for contributors (i.e. survey style questionnaire or survey style questionnaire with geolocation)**
- **STEP 4: Design your task protocol**
- **STEP 5: Select the location of your source files (Import tasks)**
- **STEP 6: Project Overview page – test and adjust your project**
- **STEP 7: Submit for publication**

Find out more, and start building your project here: https://lab.citizenscience.ch.

RESOURCES, LINKS, AND HINTS

Here is a list of additional open and free tools that you may want to check-out before developing your own technical solution:

Project co-creation

- **td-net toolbox** Methods and tools for co-producing knowledge https://naturalsciences.ch/co-producing-knowledge-explained/methods/td-net_toolbox

Web platform (data analysis)

- **Zooniverse Builder** The Zooniverse Project Builder provides a powerful interface for creating data analysis projects. https://www.zooniverse.org/lab

- **iNaturalist** is a social network of naturalists, citizen scientists, and biologists where contributors share, classify, and map observations of biodiversity across the globe. A joint initiative by the California Academy of Sciences and the National Geographic Society, it offers the option to start your own biodiversity collection project. iNaturalist also includes an App for data collection. https://www.inaturalist.org

- **Label Studio** is an open source data labeling tool for labeling and exploring multiple types of data. You can perform many different types of labeling for many different data formats, and also use it with machine learning models. https://labelstud.io/

Smartphone App (data collection)

- **Epicollect5** is a mobile and web application for free and easy generation of forms (questionnaires), and freely hosted project websites for data collection.Projects are created by using the web application and then downloaded to the device, both Android (5+) and iOS (8+), to perform the data collection. https://five.epicollect.net/

- **KoBoToolbox** is a free and open source suite of tools for field data collection for use in challenging environments. Most users are people working in humanitarian crises, as well as aid professionals and researchers working in developing countries. https://www.kobotoolbox.org/

- **ExCiteS** Software Researchers at University College London (UCL) ExCiteS have created several bespoke technologies, including an open source mobile data collection platform for non-literate and illiterate users (Sapelli) and web platforms for participatory mapping. https://www.geog.ucl.ac.uk/research/research-centres/excites/software

Other platforms with specific tools

- **sMapshot** – the participative time machine https://smapshot.heig-vd.ch/

- **Pybossa** – open framework for Citizen Science projects https://pybossa.com/

Resources

As any other research effort, Citizen Science projects need a careful estimation of the resources needed to carry out the project with the desired timeline and outcomes, and full awareness of limitations in terms of funding, staffing, equipment, etc.

Team Members
In addition to the skills and responsibilities common to traditional research projects, successfully launching and running a Citizen Science project requires a variety of roles aimed at facilitating the collaboration among players with different kinds of knowledge, goals, and ultimate motivations. With this specific "facilitation" role in mind, it may be helpful to complement traditional research profiles and skills with competencies in public communication, community engagement, visual design, data management, and project management and evaluation. Luckily, such roles can be taken up by the different players involved, including researchers, volunteers, partner organizations, and participants.

Project Timeline
All major project activities that will be performed during the course of the project should be inserted in a timeline agreed with all stakeholders. These should include communication and recruitment of volunteers, production of briefing materials, training, etc. – practically all major steps up to the publication of results. Particular attention should be paid to scheduling regular interactions to update the volunteers' community, which can be in the form of regular events and accessible channels to share progresses, solicit feedback, and network among participants.

Very relevant (and often forgotten) is the need to identify when the project is expected to end, or under what circumstances it may be terminated or held off to different players. This is a big part of managing expectations and needs to be communicated from the very beginning to everybody involved. Plans should include the creation of a persistent public-facing presentation of the results to replace the no-longer active project website. Potential partners for ensuring long-term sustainability might be university libraries.

Budget
The costs entailed in Citizen Science projects should be clearly identified and assigned to the different partners in the project plan. These may be related to the development of tools (tailored web platform, smartphone apps, or data collection kits) or to the engagement of the contributors (i.e. training material, events, prizes in case of challenges or gamification of the project). Partner organizations can be key in providing goods and services through direct investment or in-kind contributions. Especially in co-created projects, some stakeholders (such as teachers, young workers, or similar) may find it economically difficult to invest significant personal time in the project. Also, sometimes salaries can be precarious (i.e. in NGO or NPO) and project budgets should include, whenever possible, not only the salary of the academic scientists but also the one of non-academic partners. There are funding institutions, such as foundations, that will accept those costs as part of the proposed budget. Overall, the topic of payment in Citizen Science remains difficult and it is often discussed without a solution that fits all cases. However, from offering vouchers, to inviting for free-meal gathering, to offering childcare, there are many other ways to make sure that participants' contributions and needs are valued and accounted for.

Partnerships
Vital to many Citizen Science endeavours, partner organizations may include research groups with similar interests, libraries, existing projects, Citizen Science centers/labs in other universities, network of practitioners, civil society organizations with similar interests, and more. There are many benefits to establishing partnerships, such as:

- strengthening requests for financial support via joint applications to public and private grants;
- providing missing expertise and experience;
- widening the reach or the project by joining networks;
- increasing the project team's size, also helping ensure long-term sustainability.

Overall, it's useful to ask yourself: who else might have a stake in your project's data and results? How could they support you in promoting the project and disseminating the results? And what might get them interested in sharing resources or ideas? It is important to talk with the potential partners you identify and learn what would motivate them, including scientific curiosity, hobbies, health-related concerns and more.

The Citizen Science Center Zurich has already established partnerships and collaborations with several institutions and organizations in Zurich and Switzerland, representing both researchers and citizens. Such network constitute an invaluable asset for our community of practitioners, as it offers both a pool of potential project's participants and a spectrum on expertise to tap in. Also, partners have explicitly expressed their interest in collaborating with local and Swiss initiatives. Do not hesitate to contact us if you identify

among our partners suitable collaborators for your project, we would be happy to build the necessary connections.

PWA Seed Grants (specific to Zurich)
The Participatory Science Academy (Partizipative Wissenschaftsakademie, PWA) – together with Mercator Foundation Switzerland – awards Seed Grants for the development and implementation of participatory Citizen Science projects. Teams of academic researchers from UZH and/or ETHZ and citizens are given the opportunity to develop and/or carry out a participatory research project. Priority is given to projects which, in addition to the prospect of excellent research, show a high degree of participation in as many phases of the research process as possible. One Seed Grant per year is reserved for research on participatory research.

Key criteria for the grant assignment include:
- **Excellence and innovation**
- **Degree and structure of participation**
- **Added value of participatory approaches in the field of research**
- **Desired impact of the project**
- **Quality and appropriateness of the methods chosen to address the research question**
- **Feasibility of the project**
- **Prospect of follow-up project(s)**

Make sure you check the PWA website (www.pwa.uzh.ch) for more information, news, application deadlines, etc.

RESOURCES, LINKS, AND HINTS

Public and Private Grants
Here some useful links for an overview of institutions and organizations that (could) provide resources for projects that include Citizen Science:

- **SNSF, swissuniversities** SNSF funding programmes could be used for supporting projects including Citizen Science. Also, as an integral component of Open Science, Citizen Science could potentially be integrated in "Programme Open Science II" (2025-2028) of Swissuniversities, along with Open Innovation and Open Education. https://www.swissuniversities.ch/en/topics/digitalisation/open-science; http://www.snf.ch/en/funding/Pages/default.aspx

- **European Commision** Citizen Science is expected to play a more prominent role in European Research and Innovation (R&I) in the years to come: it will be mainstreamed across Horizon Europe, and featured as part of the European Commission Communication: "A new European Research Area for R&I". https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/home

- **Swiss Private Foundations** Some Swiss foundations are known for supporting participatory research efforts in different domains, and also specific Citizen Science projects. The majority of the "big" foundations are part of swissfoundations, whose website can be searched by name or by funding area (e.g. Science & Research) https://www.swissfoundations.ch/fr/a-propos/nos-membres/

It is still recommended to look at each foundation's website for updated guidelines (information elsewhere can be outdated). One additional tip: make sure you visit the website of projects similar to yours (same research area/ same target groups) to check out the logos of foundations/ institutions who support them!

Crowdfunding platforms
- **wemakeit** (founded in Switzerland in 2012 and featuring the Science Booster) https://wemakeit.com/pages/science?locale=en
- **Crowd.science** https://crowd.science/
- **Experiment.com** https://experiment.com/
- **Consano** https://consano.org/

If you are not convinced by crowd funding science, here a Nature's interesting article "Crowdfunding research flips science's traditional reward model" https://www.nature.com/articles/d41586-019-00104-1.

Existing Citizen Science networks
Citizen Science practitioners exist all over the world. Here are some established national networks that may be contacted for further information on potential collaborations:

- **European CS Association (ECSA)** https://ecsa.citizen-science.net/
- **CS Association (US CSA)** https://citizenscience.org/
- **Australian CS Association (ACSA)** https://citizenscience.org.au/
- **CitSci Africa** https://www.usiu.ac.ke/citsci-africa-association
- **CitSciAsia** https://www.facebook.com/CitSciAsia/

Data

The generation of different forms of data by volunteers is the common denominator of most Citizen Science projects. National and international Citizen Science associations have been working for years on the principles and values behind such data, and on the elaboration of data and metadata standards. ECSA, for instance, emphases the principle of data sharing, as summarized in "Citizen Science project data and metadata are made publicly available and where possible, results are published in an open access format." (ECSA "10 Principles of Citizen Science").

More generally, only data properly managed and of high quality have the potential to fulfil two of the main ambitions of Citizen Science data: generate new scientific knowledge and serve evidence-based decision and policy making.

Wide-ranging advice for data and data life-cycle management plans in research is available for UZH and ETHZ researchers at the data units of the two institutions:

- **Data Services & Open Access at UZH** https://www.hbz.uzh.ch/en/open-access-und-open-science.html
- **Research Data at ETH Zurich** https://ethz.ch/services/en/service/a-to-z/research-data.html

Citizen Science data management

As for any other research project, Citizen Science data management includes aspects of data storage, infrastructures, access, governance, standards, and documentation. Citizen Science practices generally aim at fulfilling the (rapidly evolving) standards of open and FAIR data, while acknowledging that the re-use of existing datasets by researchers is only possible when provenance, methods, constraints, and treatments of datasets are clear and well documented.

While each project is unique in its requirements and it is hard to generalize solutions, several peer reviewed papers present a number of recommendations and practices for Citizen Science practitioners that aim at ensuring inter-operability through data standards (see resources).

Together with practical data solutions, project organizers should not overlook legal and ethical aspects of the collection, storage, and use of data (for instance protecting private and location-based information), including compliance to national Data Protection Regulation (for Switzerland, see the Swiss Federal Act on Data Protection and the EU General Data Protection Regulation).

An obvious advice is to seek guidance by institutional legal and ethical bodies, as it is impossible to generalize recommendations and best practices across institutions (research institutions have their own regulations) and across projects (each project has its own requirements, for instance specific reasons for balancing openness vs privacy).

In all cases, data ownership and use, terms, and conditions needs to be easily available in a publically accessible location (typically the website of the project).

Data quality

The perceived quality of Citizen Science data is a major concern in the scientific community and it is often raised as an issue for the uptake of the methodology. However, there is an emerging body of research showing that citizens are able to make contributions that meet the standards of professional scientists and that the methodology, when appropriately applied, has the same level of accuracy as traditional methods.

To achieve optimal quality though, any potential issue needs to be considered in advance and addressed through the application of adequate quality control measures. More than 10 different strategies have been identified in the literature (see box) that can be applied, usually in combination, during planning, training, data collection, data analysis, or program evaluation. They include requesting task redundancy (i.e. having the same tasks performed by multiple participants, a feature which is usually provided automatically by most Citizen Science platforms), providing training, including standardized samples, cross-checking data and results with expert evaluation or existing literature, simplifying the tasks, and more. Whenever possible, it's good practice to perform testing and prototyping with contributors to get first-hand feedback on the process while monitoring the quality of resulting test data.

Note: as the literature highlights, often the issue with Citizen Science data quality is not in actual practices, but in the lack of documentation on the action taken during data acquisition and/or analysis by contributors. Especially for projects that seek to promote the re-use of their data, standardized ways exist (meta-data) to detail as comprehensively as possible all factors related to data management, including origin, treatment, constraints, and biases.

"Fitness for use"

"Fitness for use" is an interesting concept being increasingly used for Citizen Science practices and data. It refers to a new construct of data quality in research projects, where the actual quality of data has significance only in the context of usage, i.e. it must match the research question. For example, in some studies lower resolution may be balanced by a far wider scope and coverage of data. This concept acknowledges the difficulty to establish a unique standard and universal criteria for quality in scientific data.

Example: "In air-quality monitoring, low-cost sensors cannot currently compete with professional instruments for achieving precision and accuracy at the levels necessary for regulation. Therefore, one goal of Citizen Science air-quality projects may be to get regulators to take notice when systematically collected data indicates a potential problem meriting further investigation. Low-cost (including commercial or open-source/do-it-yourself) sensors are of suitable quality to be fit for this, and often other, purposes." (Browser, A. et Al. 2020)

Ethical considerations

For general consideration and recommendations concerning compliance to legal requirements and the ethical aspects of Citizen Science projects, including some specific information for practitioners in Zurich and Switzerland, we recommend reading "Ethics guidelines in Citizen Science", a report which is the result of a collaboration between the Citizen Science Center Zurich and the Health Ethics & Policy Lab at ETHZ. The document provides an overview of existing ethics guidelines in Citizen Science as promoted by the Citizen Science Association (CSA), the European Citizen Science Association (ECSA) and similar organizations.

RESOURCES, LINKS, AND HINTS

The papers listed here provide an overview of the current status and recommendations for Citizen Science data management.

- Bowser, A. et Al. (2020). Still in Need of Norms: The State of the Data in Citizen Science. Citizen Science: Theory and Practice, 5(1): 18. https://doi.org/10.5334/cstp.303

- Freitag, A. et Al. (2016). Strategies Employed by Citizen Science Programs to Increase the Credibility of Their Data. Citizen Science: Theory and Practice, 1(1): 2. http://dx.doi.org/10.5334/cstp.6.

- Kosmala, M. et Al. (2016). Assessing data quality in Citizen Science. Frontiers in Ecology and the Environment, 14(10): 551–560. https://doi.org/10.1002/fee.1436.

- Weigelhofer, G., Pölz, E. (2016). Data Quality in Citizen Science Projects: Challenges and Solutions. Frontiers in Environmental Science 4. https://www.frontiersin.org/10.3389/conf.FENVS.2016.01.00011/event_abstract.

- Wiggins, A. et Al. (2011). Mechanisms for Data Quality and Validation in Citizen Science. Proceedings of the IEEE 7th International Conference on E-Science. IEEE. https://ieeexplore.ieee.org/document/6130725.

Specific work on metadata

- Wagenknecht, K, et Al. (2021). EU-Citizen.Science: A Platform for Mainstreaming Citizen Science and Open Science in Europe. Data Intelligence, 3(1): 136–149. https://www.mitpressjournals.org/doi/full/10.1162/dint_a_00085.

- PPSR-Core information: https://core.citizenscience.org/

On the concept of fitness for use

- Castell, N. et Al. (2017). Can commercial low-cost sensor platforms contribute to air quality monitoring and exposure estimates? Environment International, 99: 293–302. https://www.sciencedirect.com/science/article/pii/S0160412016309989

- Chapman, A. D. (2005). Principles of Data Quality. Global Biodiversity Information Facility. https://doi.org/10.15468/doc.jrgg-a190.

On ethics in Citizen Science

- Jobin, A. et Al. (2020). Ethics guidelines in Citizen Science. ETH Zurich / Citizen Science Center Zurich. https://doi.org/10.3929/ethz-b-000428502.

- Rasmussen, L.M., Cooper, C. (2019). Citizen Science Ethics. Citizen Science: Theory and Practice, 4(1): 5. http://doi.org/10.5334/cstp.235.

- Resnik, D.B. et Al. (2015). A framework for addressing ethical issues in citizen science. Environmental Science & Policy, 54: 475–481. https://doi.org/10.1016/j.envsci.2015.05.008.

Community Management

Once you have defined the project's ambitions and the desired level of engagement for the participants, it's time to plan your concrete ways to reach out to them. In a co-created approach, this step could already be done collaboratively with (some) of them. One way to do this is to hold a workshop in which everyone expresses their view to come out with a common vision, which can then be written down as a concept and agreed by all involved. As a matter of fact, community management is to a large extent communication, and effective communication is important to increase your project's visibility, reach potential participants, and later keep them actively engaged.

Note: Community engagement is iterative and it is important to start the conversation early, constantly elicit feedback, and build trust by implementing easy feedback channels and loops!

Map stakeholders and define your target groups

In order to set up a good basis for communication, outreach and interaction, it is important to map out your target group, i.e. determine the individuals, organisations, and groups that have an interest in your project and/or are impacted by its outcomes. This includes much more than identifying them! It means understanding their perspectives and interests, knowing their motivation, visualizing their relationships among each other, and finally prioritizing the stakeholders with the highest relevance. Once stakeholders are identified, you may ask yourself: how can you reach out and make your project visible and interesting to them? Once engaged, how can you best exchange with them? What platforms and communication channels are the most appropriate and effective to this goal?

HINT: You do not need to reinvent the wheel. Benefit and build upon already existing communities and networks that you might have identified during your stakeholder analysis.

Plan the tools and channels to interact with your community

To reach out and interact with your community you can choose different tools and several communication channels and media. In a very general way, one can differentiate between online and offline activities.

- Thanks to modern technologies, large numbers of people can be reached and engaged in Citizen Science with online channels and tools. These include communication channels such as websites, blogs, apps, newsletters, social media, online networking platforms, forums, chat apps (e.g. Citizen Science group in WhatsApp, Telegram), etc. While evaluating which one(s) to choose, it is worth considering to take advantage of the ones that your organization is already using and build on existing formats and audiences.

  In the case of online communication and reach out, potential contributors will be geographically dispersed and contribute at a time and with frequency that is convenient to them. Depending on the project, a way to partially control the geographic distribution of participants may be provided by the choice of the language for communication. German, for instance, would probably increase local participation, while English would provide a more global audience.

- In-person, on-site activities such as face-to-face meetings and events have the big advantage of providing chances for social interaction and networking opportunities. Project organizers and project participants in-person exchanges provide more immediate and useful feedback, often obtained simply by observing participants acting on the project (e.g. provide their contributors or answer the required questions). Sometimes more structured interactions are needed, for instance in workshops organized for designing/planning aspects of the project, or for sessions of training.

Depending on the project, the best solution can be purely online, offline, or a mix of the two formats. In any case, content should be tailored to the specifics of the media and target public (language, level of details, use of visuals, etc.). Overall, make sure to create a clear message that conveys what the project is about and what volunteers benefit from when participating.

HINT: Projects gain much more visibility and attention by the general public when they are mentioned in traditional media such as newspapers, radio or television. If possible, use corporate communication offices (or your network!) to get your project featured there.

COMMUNITY MANAGEMENT STEP BY STEP

1 **Start elaborating a Community Management Strategy.**
What is the ambition of your project, what the desired level of engagement of participants, and what are the benefits they get etc.?
page 12

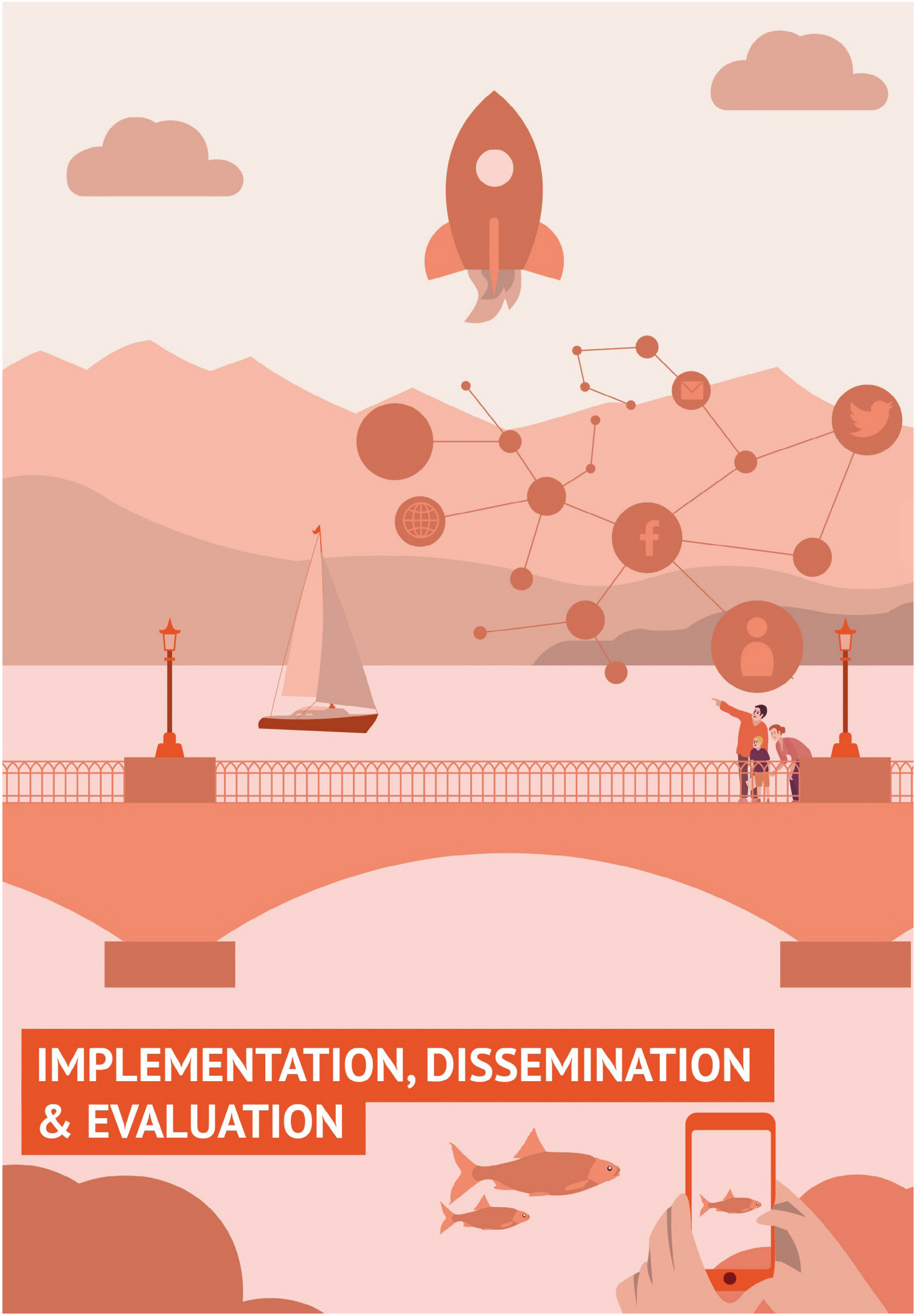
2 **Specify your community.**
Create a stakeholder mapping and define who the people and organizations are that might be interested in participating.
page 24

3 **Define tools and communication channels.**
How do you reach out to your community, how do you communicate within the community etc.?
page 24

4 **Manage and motivate your community.**
How can you keep your community motivated and engaged?
page 27

5 **Measure success and evaluate.**
Have you achieved your goals? What did work well, what didn't?
page 28

Step by step guide for the Community Management.



IMPLEMENTATION, DISSEMINATION & EVALUATION

Impementation, Dissemination and Evaluation

It's finally time to implement and run your project! Once at this stage, project organizers should know how to deal with the implementation and running of the project, including the different phases of data acquisition, analysis, dissemination of results, and overall project evaluation. As such aspects depend on the specificities of each project, it is hard to provide generalized directives. Except, also in this phase community management stays central to the success of the Citizen Science endeavour.

As a last recommandation, do not neglect to perform a final evaluation of your experience and results. This is useful to learn from your own experience and improve your own project and approach, but such knowledge is also sought after by the extended community to advance the knowledge on Citizen Science as a research methodology.

Community Management

After all the work done to attract participants and build a community around the project, the priority now moves to keeping participants motivated and engaged throughout the project's lifetime and during the final research phases. Alas, depending on several factors, many participants risk to visit the project the moment they hear about it, contribute once, and then never come back. You want to avoid this by providing motivation and incentives to stay actively involved and connected. One aspect becomes central: regular communication and interactions between project organizers and participants.

Everything that you have learned about them, all the tips and tricks that have been used while (co-)designing and developing the project and building its initial community, are all essential now as they provide invaluable knowledge to tap into to interact with participants in the most effective way. If the overall engagement seems to be going down, additional offerings may include fun experiences and opportunities to connect and network. Impromptu in-person and virtual activities can be arranged to satisfy social motivations such as getting to know people, having a good time and feeling part of a community. If the kind of project allows, good examples include social events such as competitions, common activities, family games afternoons, group walks, meet & greets between citizens and scientists, movie nights, debates etc.

In the field of physical and mental health, especially when the project has been fully co-created, constant and open communication with all stakeholders invovled in the process is paramount. Be aware that facilitating these interactions takes time; depending on the research topic and/or the vulnerability of the participants, it might be advised to get support from an external facilitator to moderate workshops or sensitive discussions (resources that go into the role of the facilitator should be carefully planned and budgeted for). A good example of such practices, developed in the context of co-created participatory research in aging, can be found at the Gerontology Center of UZH (see resources).

Above all, project organizers should keep the community updated on all interesting aspects and decision-making milestones, and whenever possible seek their unique contribution. Involving the community gives them the opportunity to ask questions, express their opinion and communicate their ideas, needs, and wishes. A constant show of respect and appreciation goes a long way in gaining participants' loyalty and reliability.

Disseminate research findings

Project participants have always the right to know what happens with their contributions, and ultimately what the results of the project are. This needs to be communicated in a form and with a language that is suitable for all participants, and can be understood by all stakeholders involved. You can also ask them directly what findings are important to them and what ways would be used to disseminate.

If the academics among the project organizers plan a scientific paper, they should consider including some (or all … it has happened!) of the project participants, depending on their level of involvement in the overall process.

If the project's topic tackles a societal issue, results and data can be used, also by civil society organizations, to contact policy or decision makers. In this case, the production of policy briefs or the invitation to public presentation of the result can be effective to support social change.

Data Valorization

Data valorisation is a practice that consists in identifying the potential of data to create value in addition to the primary purpose for which they were collected and determining how this can be achieved.

In the case of Citizen Science, the primary purpose of data collection is most often some specific research and innovation (to advance knowledge in a certain field, for instance astronomy) and broad temporal/spatial decision-making (to inform policy decisions, for instance for conservation). Can this data be used for other purposes? What is their value? What is the value of sharing them with others?

One of the great advantages of digital data is that they are infinitely shareable (i.e. anybody can use the same data at the same time) and, from a very general point of view, the more they are shared, the greater their value. Data can be combined with other data, and data collected for one purpose can be re-used and valued for other scopes to produce new information and insights.

For instance, who would have anticipated that data on water evaporation – originally collected to help farmers optimize crop irrigation – could be used by lawyers to assess road friction coefficients in automobile accidents?

However, all data are not created equal. Higher quality data are more valuable as they have the potential to create better information. Note that higher quality data does not mean "more data", as redundant, duplicated data have no value, and in general value decreases once the amount exceeds the capacity to handle. Similarly, quality itself needs not to exceed the need for the specific purpose (see "fitness for use" above).

Privacy and ownership aspects must be considered before sharing, including ownership of researchers and contributors. In general, data re-use is hindered if people do not know data exist, cannot discover data easily, do not have access, or do not have the information (metadata) or knowledge to put the data to appropriate use (FAIR and Open principles).

A huge potential for Citizen Science data

When data are collected in a Citizen Science project on any topic, the collection contains two different types of information. One type refers to the project topic itself, the other type is about the use of intellectual abilities to engage in a meaningful activity. One can assume that citizens contributing to a Citizen Science project are performing an activity that they consider to be meaningful and that this activity requires the use of intellectual abilities. So in most Citizen Science projects, additional value comes from using the data about the generation of project data, i.e. data on when, where, how and with which outcome contributors engaged in the project.

Such data on meaningful intellectual activity or social engagement in real life are of huge value for researchers interested in examining the longterm relations between intellectual engagement in real life contexts and wellbeing or abilities. The diverse approaches of Citizen Science projects provide natural real world experiments.

Extra benefit arises when such data are controlled by individuals, as it is the case for the Citizen Science Project Builder (see page 18). In this case contributors have full control of their own data and may individually decide if, with whom, and for what they want to share, allowing the tackling of important research and practical questions. Citizens' data ownership makes them equal partners of academic researchers. It also creates added value to researchers and citizens because such individual data accounts allow to apply completely new types of person- and context-specific analyses.

Evaluation

In most scientific projects evaluation is a core management instrument increasingly required by project initiatives, by policy-makers, and by institutions providing grants – also to improve funding schemes.

Evaluation of Citizen Science is a relatively new area of research and it is still ongoing, reflecting the evolution of the field itself and its diversity.

There are currently no established indicators for evaluating Citizen Science. The challenge is left to individual projects that need to define the most appropriate way to assess their own impact, and continually learn from this assessment. The reward however is that your evaluation criteria and results may be themselves the subject for a publication and may be used to advocate for such evaluations to be relevant for funding decisions.

While working on an integrated and agreed framework, Citizen Science programmes are typically evaluated at various stages of the process (in the beginning, during, and in the end) and often along three dimensions:

- scientific impact (including project process and scientific outcomes);
- learning and empowerment of participants;
- impact for wider society and socio-ecological relevance.

RESOURCES, LINKS, AND HINTS

Literature

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Participatory Aging Research

- **Gerontology Center UZH** https://www.zfg.uzh.ch/de/Partizipative-Altersforschung.html

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