Blueprint for #CitSciComm with and for Citizen scientists and society at large

NEWSERA
#CITSCI IS THE NEW #SCICOMM

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Foreword

Different fields of research need citizen science in order to enrich their results and impacts; citizen science needs citizens in order to develop projects that benefit the community. When focusing on citizens and society at large, the #CitSciComm Labs demonstrated the necessity to plan and adopt communication models targeted to their focal area, to their participants and the network of their stakeholders.
Thanks to the support offered by NEWSERA, individual CS projects were able to adapt their communication strategy and enlarge their publics, adapting tools and contents to their aims, local contexts and audiences. This meant to draw maps of beneficiaries with whom to form alliances, maintain the loyalty of citizen scientists and broaden the audience of possible new participants, from informal groups of citizens to local authorities, schools, and other CSOs. Once designed, maps including actors and activities should be periodically monitored and updated.
The way to share both qualitative and quantitative indicators demonstrated to be an effective way not just to enumerate activities but to evaluate and consequently improve them.

Federica Manzoli, Communication Expert,
Independent counselor

The #CitSciComm Labs organized in the framework of the NEWSERA project have provided the opportunity to advance communication strategies in Citizen Science (CS) improving methods for the engagement of different stakeholders. A participatory and co-creational approach, enabled the exchange of experience among experts and practitioners and the identification of concrete actions that can support CS project managers in preventing communication gaps and reaching out effectively to society at large. Communication is a key component of a CS project and as such has to be carefully planned and accounted for in project development and implementation. Projects like NEWSERA have a key role in developing knowledge and identifying best practices in CS, and we need to make sure that project results are made available to the wider community of practice. National networks can have a key role in communication and dissemination efforts and improved effectiveness and sustainability of tools and approaches. Thus, establishing a national network is an important step towards the integration of CS in science, society and policy. Doing It Together Science (DITOs, 2016-2019) is another example of a Horizon project that has contributed to the development of CS. The activities aimed at engaging policy makers at national level, led to the participatory development of a policy brief "Towards a shared national strategy: guidelines for the development of citizen science

in Italy" 1 involving over 50 CS experts across Italy. Thanks to DITO's support, the informal group of scientists and supporters was able to start the process of establishing a national coordination, needed in order to increase visibility of projects, disseminate best practices, tools, strategies and enhance engagement of stakeholders. As a result of this process, in February 2023, Citizen Science Italia (CSI) was founded to support the development of CS in Italy and sustain the community of practice. The Italian association aims to facilitate the sharing of best practices and experience among projects, develop inclusive and collaborative tools and solutions, in an open science perspective, and in close connection with the other international networks. The CSI network is a space for sharing and will benefit from the dissemination of the NEWSERA project results. Supporting CS project managers in framing communication approaches as inclusive and co-created is key to escalating the engagement in CS of the different stakeholders, thus, unleashing its potential.

Gaia Agnello, Citizen Science Italia Vice Chair

The #CitSciComm Lab for and for Citizen scientists and society at large has been a wonderful challenge to be tackled. Inviting Citizen Science projects leaders together with communication experts, spokespersons from associations, community champions and common people allowed for building upon a variety of experiences about engagement and participation in science and technology. For sure this Lab addressed the less unusual communication target for Citizen Science projects; as we learned both from our international investigation (Giardullo et al Forthcoming) and during the Labs, pilots tend to refer mainly to a general unspecified category of "audience"; most of their efforts were oriented to dissemination. Although in some cases, pilots showed to be proactive in communication channels (e.g. using social media) most of their strategy consisted in reproducing a knowledge transfer style with limited opportunities to have an effective interaction. The Lab unveiled this trend as a limit and allowed finding out potential solutions to overcome communication limits in a tailored way. It is possible, it is plausible and it has been done by our pilots. Furthermore, pilots developed a sensitivity to impact assessment about communication to make their outcomes even more visible and accountable. The most relevant contribution of this blueprint is then the approach and the method based on encounters between different social actors that may be engaged, or may profit from taking part in a Citizen Science project. Dialogue is necessary in times of global challenges and NEWSERA blueprints provide a useful framework to perform it effectively.

Paolo Giardullo, University of Padova (Italy), UNIPD Partner Leader for Citizen scientists and society at large CitSciComm Lab

*I always say that **doing Citizen Science is not an easy task**. You need knowledge, expertise, time and resources, and interdisciplinarity is key. As a Chemical Engineer expert in odour pollution, when I first had the idea of using citizen science for its monitoring I thought "I just need an App. Citizens have the best sensor, their own noses. I just need to provide them with a tool to collect their odour perceptions". And that's how OdourCollect was born. But I soon realised that the most important thing in a citizen science project is to achieve the engagement of communities. You can have the best App in the world, but without engaged citizens, you have nothing. In fact, a piece of paper is more than enough for data collection (and you better shall consider this as an alternative if you want to be inclusive).*

Then I started to realise more things. One of the main objectives of the D-NOSES Project was to advocate for a common policy framework to protect European citizens suffering odour pollution, since it is an under regulated issue and the second cause of environmental complaints after noise. But how can we researchers reach policy makers? Which is the right governance level? Our answer was the development of a multi-level governance model that allowed multi-level engagement of European, national and local decision makers. Not an easy task either.

*And what about industries? Would they be comfortable with an open data model which will point out the potential origin of odour emissions? Would they be willing to trust citizen generated data to identify the situations of maximum impact for their neighbours and act upon them? And what about fellow scientists? Would they rely on a new odour monitoring methodology? Would they trust the produced data sets? All **quadruple helix stakeholders** are part of the problem and also part of the solution, but they **have different interests, agendas, priorities and timings**, meaning that **communication is key** to engaging them all in the process. **And this was how NEWSERA was born**.*

*NEWSERA has been working with **39 Citizen Science projects in Spain, Italy and Portugal** for the last three years, co-creating innovative Science Communication strategies to effectively reach quadruple helix stakeholders through our **#CitSciComm Labs**, while developing a useful and replicable **impact evaluation framework**. We have identified a common lack of knowledge in science communication and a lack of resources (I was not alone, our pilots have not been alone anymore), and the NEWSERA team has been naturally evolving towards a mentoring role with the pilots. Specific training has also been offered within the Labs once the need for capacity building was made evident. We have been researching recognition of the practice as part of the solution, something that both Science Communication and Citizen Science share as scientific disciplines, and that we hope will eventually change in the years to come - specially because of the push that the European Commission is giving to public engagement and co-creation in all Clusters and Missions of Horizon Europe, and because we need an active and more informed society to deal with global crisis such as the COVID-19 pandemic or the climate emergency. In addition, we have been exploring two new concepts: **Citizen Science Communication** (including how*

citizen scientists become science communicators themselves using their own means and channels when actively involved in science) and ***Citizen Science Journalism*** *(as citizen generated data have a huge potential to produce newsable stories of societal relevance, and data journalism tools can help).*

To compile the main project findings, the NEWSERA team has produced ***five blueprints****, one addressed to each one of the stakeholders from the quadruple helix (citizens, academic scientists, the public sector, and industries and SMEs) and one addressed to data journalists, for any citizen science project that has the need (as we had) to reach any of their target audiences for a more effective engagement, and consequently, an increased impact. We hope that our results will be useful for building capacity in Science Communication within the Citizen Science community and beyond, to be able to engage more and more European citizens in science for a better future for all, to produce evidence-informed policies aligned with society, to increase academic recognition and trust of both disciplines, and to engage more industries and SMEs and produce new business models that will contribute to the sustainability and mainstreaming of the practice. You are not alone anymore. We are a community with a common need and we hope that this blueprint will help you shed light in your way.*

Rosa Arias
NEWSERA Project Coordinator

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Target Audience

This blueprint is addressed for the following target audiences:

- Ongoing CS projects
- Upcoming CS projects interested in NEWSERA's methodological approach, both to plan the communication strategy and to assess the impact
- Closed CS projects intending to evaluate ex-post the communication strategy
- Local associations and organizations engaged in sustainability or citizen empowerment issues
- Committees and groups of citizens interested in participating in decision making on issues that impact their daily lives
- Public sector that intends to raise public awareness of relevant issues or awareness surveys
- Educational or research institutions (schools, universities, research centers) interested in planning CS initiatives to involve students or young researchers

Summary

NEWSERA Blueprints for citizen science communication (#citscicomm) with and for quadruple helix stakeholders (citizens and society at large, academic scientists, public sector and policymakers, industry and SMES) and science and data journalists is an instrument that can serve a general audience, including those who are planning to start a citizen science (CS) project, those who want to improve and/or rethink their communication strategies in order to increase specific target audiences, or those who want to enlarge their scope of action by involving the different actors of the quadruple helix model and the media.

The road for CS projects establishment and sustainability is long and there are many barriers to be faced. But you are not alone!

The road for CS projects establishment and sustainability is long and there are many barriers to be faced. But you are not alone!

Together with 39 CS projects from Italy, Spain and Portugal, the NEWSERA Pilots, we have tested the NEWSERA methodology for the co-design, implementation, iterative assessment and validation of communication strategies directed to each of the quadruple helix stakeholders and science and data journalists. This was performed through our #CitSciComm Labs, dedicated to each individual stakeholder, consisting of three rounds of workshops, replicated in each of the participating countries, throughout three years.

In this series of five blueprints, NEWSERA brings the learnings of this co-created process together with our pilots, invited stakeholders and science communication experts (NEWSERA Sounding Board) that was complemented with mentoring, capacity building and networking sessions, generating knowledge, recommendations and useful resources.

In this blueprint, dedicated to **citizen scientists and society at large as target stakeholder**, you will find, more in depth, the importance to address this stakeholder, good practices on the co-design of targeted communication plans, elements of co-design, mutual benefits of CS project-stakeholder, and indicators. Furthermore, a description and details of messages, innovative tools, channels and specific case-studies from the NEWSERA Pilots are included.

Finally, we shared a series of recommendations to efficiently engage with quadruple helix stakeholders and science and data journalists for wider impact and ensure replicability of the NEWSERA findings and science communication strategies in citizen science projects and beyond.

Introduction

Citizen science (CS) initiatives are changing the paradigm of science communication. Not only the embedded bottom-up methodology considers people's questions and needs, aligning science and society interests, but also allows citizens and other key stakeholders to become data generators and, as such, to become themselves the source of scientific news. Non-experts participation in CS projects also implies the potential to strengthen science literacy and, for these reasons, opening science and innovation to society.

To fulfill these potentials and to achieve societal impact, CS initiatives may face different challenges. Effectiveness and long-term sustainability of a CS project requires the creation and maintenance of a complex ecosystem, in which the participation of quadruple helix stakeholders (citizens and society at large, academic scientists, public sector and policymakers, industry and SMES) (Carayannis *et al.,* 2009) is crucial. When we consider challenges in terms of science communication we can name: using a wide variety of specific communication tools and strategies for each target group, including digital, traditional and face to face activities to increase participation, providing the required continuous feedback to each stakeholder group to maintain engagement throughout project execution, and involving all stakeholders in every phase of the research.

this can increase trust among the whole range of stakeholders and open new opportunities to contribute to public knowledge

Interdisciplinarity, another intrinsic characteristic of CS projects, is also a challenge, and communication among the different disciplines involved can be a key asset for mutual understanding and collaboration. Science and data journalists also play a key role in mainstreaming CS processes and results and at the same time raising new questions that can shine a light on critical issues, gaps, and potential biases. Ultimately this can increase trust among the whole range of stakeholders and open new opportunities to contribute to public knowledge. All these challenges might be considered also on the other way round: CS can benefit from communication but CS can bring fresh new perspectives for improving science communication.

In NEWSERA, we conducted an analysis of the communication tools and strategies used by 157 CS initiatives, across the European Union (EU), United Kingdom (UK), and Switzerland (Giardullo *et al.*, 2023) portraying the state of the art of CS projects' communication strategies. We found out that most projects still see communication mainly as a dissemination activity, to serve educational purposes rather than exploring it as a tool to involve other potential target audiences, such as those from the quadruple helix model. Moreover, most CS projects, regardless of their stage, keep the potential level of engagement quite low, with citizen scientists' main contribution as data collectors. The lack of strategies with defined target audiences seem to present a repurposed top-down, one-to-many, unidirectional

and oriented to a knowledge transfer science communication style, which clearly undermines the very own potential of CS.

Through its #CitSciComm Labs methodology (Magalhães *et al.*, 2022), NEWSERA has analyzed and evaluated the complex and multidirectional communication strategies, addressed to each of the quadruple helix stakeholders, and science and data journalists. The activities involved 39 CS projects from three Southern European countries (Italy, Spain and Portugal), the NEWSERA Pilots, for elaborating a new paradigm for science communication. Using a bottom-up approach, innovative strategies have been co-designed, implemented and validated to overcome barriers identified for each stakeholder group, in order to improve the science communication strategies of NEWSERA pilots' and, in turn, the impact of the projects themselves, contributing to the mainstreaming of citizen science.

Through the five blueprints, NEWSERA will share the knowledge, resources and recommendations obtained in the #CitSciComm Labs targeting each of the quadruple helix stakeholders, and science and data journalists.

TARGET STAKEHOLDER: Citizen scientists & Society at large

What do we want to achieve?
How to foster public engagement by intercepting potential stakeholders to be involved in CS project activities? Which communication tools and products should be adopted to broaden, reach and motivate citizens' participation? How to engage citizens to take part throughout the different stages of the scientific process, from the identification of the research question to the dissemination of results, taking into account their feedback? How to implement a co-creative approach to CS communication and assess its impact?

What are the challenges?
The need to enhance one's communication strategy in order to implement and diversify new engagement practices capable of intercepting new audiences, accessing under-represented targets, and retaining loyal citizens is one of the common needs of CS projects. Furthermore, although CS initiatives are now a widespread and legitimized research practice, it is still not easy to make an assessment of the impact of science communication on society. The setting up of a sustainable evaluation analysis, with the finding of suitable and measurable indicators, is one of the most urgent demands.

Who are the targets?
The stakeholders include both citizen scientists who already participate in CS projects, citizens interested in science or sustainability issues in general, but also the projects themselves (future or ongoing) willing to implement engagement activities by enhancing the communication strategy.

How did we do it?
The #CitSciComm Lab for citizen scientists and society at large explored and deployed these challenges with the following NEWSERA pilot CS projects: COMPASS, Urbamar, Plantees and Mosquito Alert- from Spain; FRISK, Vacaloura.pt, Grande Caça aos Ovos, Mosquito Web from Portugal; Roma UP, Innat, Gert - from Italy, and provides the basis for this blueprint.

Good practices for targeted communication plans directed to citizen scientists and society at large

1.

Co-designing communication plans, indicators and iterative assessment for impact

In order to excel in communication, it is fundamental to understand what processes may hinder, challenge, or drive any communication efforts. On this basis it is important to pave the way for effective communication strategies that reach wider as well as diversified audiences according to projects' needs. This requires considering different aspects, such as defining clear objectives, identifying stakeholders groups of potential interest, and selecting key communication channels, formats, messages and actions, as well as other variables, such as inclusivity and gender (Magalhães *et al.*, 2022).

Due to the complex nature of CS projects, an iterative approach and mutual exchange to communication strategies is essential, allowing flexibility and adjustments along the different phases of implementation (participants' recruitment, data collection, analysis, dissemination, etc.), depending on the level of engagement sought and the specific objectives, and during the projects' lifetime (and possibly beyond) (Roche *et al.*, 2020).

To support this process, NEWSERA has established the #CitSciComm Labs, as collaborative spaces, where the NEWSERA pilots worked together with stakeholders's representatives and science communication experts in the co-design, implementation and validation of communication strategies specifically addressed to each of the 4H stakeholders, as target audiences.

So, where to start?

1.A NEWSERA methodology to co-design communication strategies

Setting up the conditions: participants

In order to establish a new communication strategy from scratch or rethink an ongoing one, it is important to set up the conditions for mutual exchange between the CS project and potential stakeholder (or its representatives). This is a general recommendation based on NEWSERA #CitSciComm Labs. In order to design an effective communication strategy it is absolutely crucial to allocate time and resources for direct confrontation with potential stakeholders. Indeed, a first requirement for a CS science project is to gather participants for a mutual learning exercise: this allows to build a discussion forum for making mutually visible different perspectives to encounter. To this aim, as NEWSERA experience reported, it is essential to invite one or more representatives for stakeholders of interest. The aim is to work together for an approximately 3h session. A further condition to guarantee a proper mutual learning is to bring along science communicators experts, as mediators to help in making synthesis of encounters.

Starting the encounter

Mutual learning can develop through open dialogue about the aims of the CS projects both in terms of expectations about its scientific results and societal impact. Therefore, a CS project leader should be clear about expectations and benefits for all involved parties.

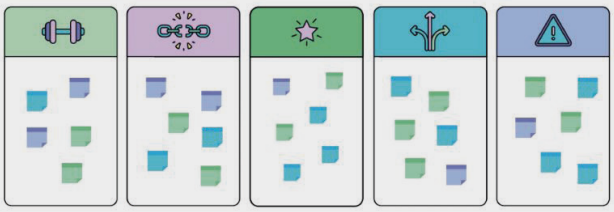
Discussion forum can start with CS project leaders presenting their project, as well as current communication practices, aims and challenges to the other participants. On this basis, NEWSERA recommends performing a dynamic analysis of the strengths, weaknesses, wishes, opportunities and threats, where each participant is encouraged to adopt different perspectives. Using these key areas means to either unpack the communication strategies and to make communication efforts more easy to be redesigned according to their strongholds and the opinions of both stakeholders representatives and communication experts.

At this point, the information necessary to further segment the target audience can be reached. The group works together to transform the opportunities previously detected into ad hoc communication actions and tasks. Concomitantly, the channels, communication tools and messages to be explored are defined. Afterwards a timeline should be established. Lastly, a first screening of specific, measurable, realistic and timely indicators (S.M.A.R.T.) to evaluate the communication actions could be undertaken or planned to be structured in another independent work session. The following sections will illustrate how to carry out activities, and the outcome obtained through NEWSERA pilots thanks to #CitSciComm Labs. The full methodology has been published elsewhere (Magalhães *et al.*, 2022).

Defining projects' and stakeholders' perspectives as well as objectives

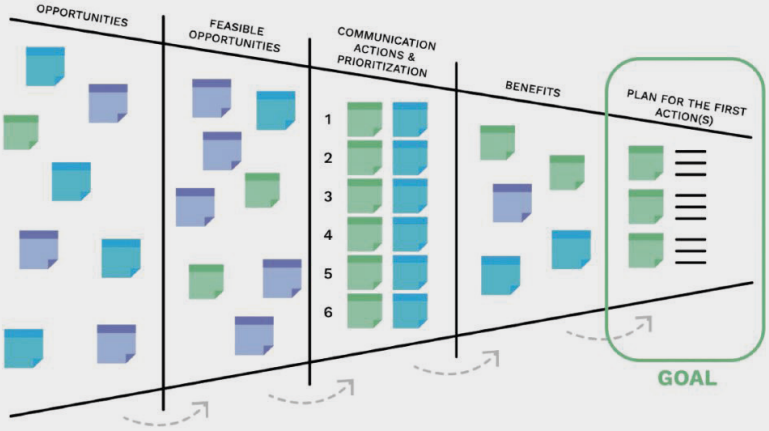
About your CS project: identify **S**trenghts ("what do you have"), **W**eaknesses ("what you don't have"), **W**ishes ("what you want to achieve"). Then brainstorm **O**pportunities that can help fulfill the Wishes and at the same time, detect possible **T**hreats.

Making a diagnosis of the communication strategies of each project



During SWOT + Wishes analysis, take into account the perspective of your target stakeholder. Also, consider adopting different points of view, have in mind neutral, emotional, optimistic, creative, organisational & judgemental opinions.

Co-designing communication actions



Chose the most feasible opportunities to involve your target stakeholder. Define possible communication actions, which benefit both the CS project and the stakeholder. Define a communication plan with prioritized and detailed actions and tasks.

Defining indicators

Define S.M.A.R.T. indicators (specific, measurable, realistic and timely) to measure the impact of your actions. Consider achieving societal, economical, political, scientific, educational and environmental impacts.

Figure 1. *NEWSERA Methodology in four steps*

1.B NEWSERA indicators and impact assessment methodology

NEWSERA established a new framework for the impact assessment of citizen science communication strategies (Giardullo *et al.*, 2021) taking into account different dimensions, such as communication, RRI (from the MoRRI and Super-MoRRI projects) and citizen science project' objectives (from the ACTION project).

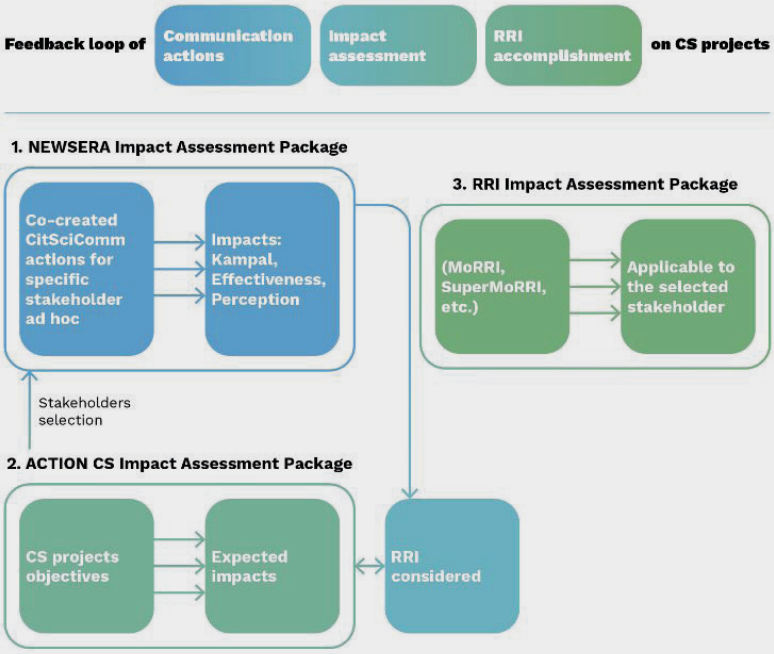


Figure 2. *NEWSERA Framework for impact assessment of communication strategies in CS projects*

Following on this framework model, NEWSERA suggests a set of indicators (NEWSERA Indicators Table), which correspond to three key macro-areas (Communication, Participation of quadruple helix stakeholders and Impact), each with three related sub-areas, as follows.

NEWSERA Indicators		
Communication	**Participation of 4H Stakeholders**	**Impact**
Channels (C)	Alignment with target audience (TAA)	Economic (E)
Actions (A)	Level of Engagement (LE)	Scientific (Sc)
Products (P)	Openness (O)	Political (P)
		Social (So)

Figure 3. *Macro-areas and corresponding sub-areas from the NEWSERA framework of indicators*

Furthermore, the comparison that emerged between the analyses of the NEWSERA pilots made it possible to create a flexible roadmap to monitor the effectiveness of the communication strategy used by a CS project, considering quadruple helix stakeholders and science and data journalists, in relation to outputs, outcomes and impact.

So, for any given CS project interested in carrying impact assessment (short, medium or long-term), NEWSERA suggests to plan another working session (approximately 2h) with the following steps:

1. **Co-create indicators:** organize a co-creation working session by inviting representatives of the stakeholder of interest in order to build indicators taking into account their experience, from which new needs or unforeseen outcomes can be identified;
2. **Analyze what exists**: look at the existing work plan, including objectives, actions, tasks and chronogram; choose which key macro-areas to submit to analysis and what data are or will be available;
3. **Select the most suitable indicators**: query the indicators on the NEWSERA Indicators Table, that comply with the SMART rule and which can be feasible for one's project, considering the available economic and human resources; consider including other indicators that are not on the table if these can be more useful.

Co-designing communication strategies targeting citizen scientists and society at large

In order to advance on your planning to co-design communication strategies, hereby are some of the actions and tasks defined and implemented by the NEWSERA Pilots involved in the Citizens and Society at large CitSciComm Lab:

COMPASS

1. Launch of digital presence (Instagram, website, LinkedIn, Twitter)
2. Promote CS actions in schools and universities also using the tools offered by e-learning (create a **MOOC**[1] and post videos on **YouTube**[2])
3. Create synergies with governmental actors and academic scientists

UrbamarBio

1. Plan the communication strategy including new communication channels by scheduling press releases
2. Look for synergies with local authorities in order to promote the co-creation of participative and transversal events
3. Enhance scientific data through a two-pronged strategy: promotion of new monitoring and collection events; sharing the results achieved through simple language that can be used by citizens

1. https://moodle.eu-citizen.science/
2. https://www.youtube.com/watch?v=WxtlZakHcxk

Plantees

1. Create different communities: a) affected people by plant allergies; b) hospitals and pharmacies networks; c) citizens
2. Map, select and contact patient associations; create and action plan together; and use their communication channels and networks to disseminate information about the project (for a and b)
3. Identify tech tools necessary to create a forum on the website; dinamize to articulate strategic actions (for c)

FRISK

1. Plan a video to be shared in YouTube
2. Organize workshops for citizens about invasive freshwater fish
3. Prepare a communication strategy in social media

Vacaloura.pt

1. Plan the online and offline media communication strategy
2. Implement an ambassadors plan with volunteers
3. Manage the change to iNaturalist platform

Mosquitoweb

1. Join social media platforms like Instagram, Facebook, Twitter
2. Measure interactions on media channels
3. Establish a communication planning through regular posts

InNat

1. Complete restyling of the project website in terms of content and new features
2. Create a new data collection app
3. Create and publish a new Newsletter, the “Bug Times”
4. Update report Cards, available online, with which to collect data
5. Open a Telegram channel to promptly update the most loyal citizens
6. Develop a communication strategy on Instagram

Mosquito Alert

1. Humanize Mosquito Alert by posting team members on the website with photos and a short biography
2. Develop an internal communication system to convey continuous information and updates to the team
3. Develop users forums: offer in-depth content or invite users to share concerns and experiences by opening a blog on the website
4. Plan the publication strategy for the newsletter and other narrative products such as videos and comics

A Grande Caça aos Ovos

1. Establish a communication strategy for social media (association to Shark Attract Facebook page)
2. Plan using other social media platforms
3. Establish protocols for communication partnerships
4. Organize species identification workshops for entities
5. Contact public event managers and offer projet activities

Roma UP

1. Promote civic monitoring walks conducted on the Tiber
2. Organized higher education accredited training and environmental education courses for both university students and secondary school teachers
3. Co-organize **events**[3] by strengthening networking between realities dealing with the river
4. Publish and disseminate via web of a dossier containing a report on the methodology, results and prospects from the project
5. Organize advocacy activities through formal and informal meetings with local administrators and technicians

Gert

1. Plan a communication strategy directed at the target audience by diversifying products and activities
2. Include in the team a communication expert capable of taking care of engagement and information strategies
3. Diversify the target reached through the promotion of sensorial activities to discover the forest aimed at the very young
4. Before NEWSERA, CS was the main driving force of the project, and members became to realize it as an element to be valorised in order to promote **educational pathways of citizenship empowerment**[4]

3. https://asud.net/un-patto-per-i-beni-pubblici-ambientali-evento-pubblico

4. https://www.quarrylifeaward.it/notizia/2022-10-20-il-progetto-italiano-cuore-vince-uno-dei-premi-internazionali-quarry-life-award

We hereby also include the selection of indicators used (N= number of projects that have selected the indicator to monitor) by the NEWSERA Pilots, but as aforementioned, the NEWSERA Indicators Table can be used ad hoc according to your own needs and stakeholder of interest.

Table 1. *Overview of the indicators used by the NEWSERA Pilots, according to their work plan and target stakeholder.*

Macro-Area	Sub-Area	Co-created indicator	N
Communication	Action	Does the project have a targeted outreach and communication strategy?	3
		Are citizen scientists involved in communicating, spreading, sharing results?	4
		Number of public meetings/events per year	8
		Does the project use informal and formal communication tools to get connection, upgrade and inform the citizens?	11
	Channels	Does the project have a presence on TV, radio, newspapers or magazines?	7
		Does the project have a presence on digital social networks?	4
		Does the project include innovative means of science communication and popular media (e.g. art)?	3
	Products	Increase in community reach on social media (twitter, fb, etc)	13
		Increase number of followers on social media	7

Table 1. *Overview of the indicators used by the NEWSERA Pilots, according to their work plan and target stakeholder.*

Macro-Area	Sub-Area	Co-created indicator	N
Impact	ECO	Does the project have any cooperation for exploitation, e.g. with social entrepreneurs?	1
		Does the project generate any economic impact, e.g. cost reduction, new job creation, new business model, etc.?	2
	POL	Number of activities/reports related to policies	1
		Does the project have any impact on political decisions?	6
	SCI	Does any cross-fertilization of projects take place?	4
		Does the project link to experts from other disciplines?	3
		Does the project collaborate with other initiatives at national or international level to enhance mutual learning and adaptation?	5
	SO	Number of scientific contributions	4
		Number of schools (number of teachers, number of students)	5
		Have you had any educational materials and resources derived from the project (e.g. MOOCs) being applied?	1
		Does the project collaborate with local organizations (e.g. in environmental or social fields)?	5

Table 1. *Overview of the indicators used by the NEWSERA Pilots, according to their work plan and target stakeholder.*

Macro-Area	Sub-Area	Co-created indicator	N
Stakeholder engagement	Level of partecipation	Are the participation options and the degree of involvement diversified? Which levels can people participate in?	1
		Are citizen scientists participating in publications or is their engagement recognized?	3
		Ratio of registered users and active users	3
		General level of engagement	10
	Openness	Are the project objectives and results clearly and transparently communicated?	1
		Does the project have a data management plan, IPR strategy and ethical guidelines?	1
		Is the data handling process transparent? (E.g. do citizens know what the data is used for, where the data is stored and shared?)	2
		Is the generated data shared publicly and under which conditions, e.g. anonymized, metadata, ownership, consent, etc.?	1
	Alignment with target audience	Diversity in project's public meetings composition in terms of Age range	5
		Diversity in project's public meetings composition in terms of Level of education	2
		Diversity in project's public meetings composition in terms of Gender	1
		Diversity in project's public meetings composition in terms of quadruple-helix representatives	4
		Does the project stimulate political and public sector participation (e.g. through participatory meetings, interviews, other means)?	9
		Does the project stimulate academic research participation (e.g. through data/methodology validation, participatory meetings, interviews, other means)?	1
		Does the project seek collaboration with science communication professionals?	3
		Has the project elaborated policy briefs or formats (infographics, etc.) directed to policy makers?	4

As in most communication strategies today, especially in CS, projects target citizens both online and offline. Planning a communication strategy that can broaden engagement, promote the recruitment of new citizens and retain those already active is crucial. A CS project that has a multilevel communication strategy, implemented through social media on the one hand and traditional media on the other, is more likely to reach and expand its target audience. Moreover, the diversification of communication tools allows CS projects to address multiple audiences through simple language when referring to lay-people, specialist language when referring to experts. Using innovative storytelling and rewarding techniques such as using ambassadors or gamification, thus stimulating participants' motivation, is one of the evidences shared by the projects that participated in the #CitSciComm Labs.

Citizen scientists, as an integral part of the project, play an active role in both the data collection and dissemination phases and need to be included in the communication and feedback process by giving them a leading role and/or rewarding them. For example, mentions in publications, participation in the writing of reports or scientific articles up to the sharing of monitoring days, data collection and direct experience in project activities.

Planning a systematic communication strategy allows, among other things, to reflect on one's own potential by choosing how to allocate the economic and professional resources available to the project and to measure its impact. A CS project interested in multilevel planning to broaden, retain, include and influence the building of an aware citizenry can follow the path shown in Figure 4.

Understanding specific contexts in which CS projects operate is a key point to identify general barriers and opportunities for CS communication: the sharing of different experiences and backgrounds is basic to define a focused communication strategy. Building on this, it is possible to go through a more general conception of certain issues about strengthening communication strategies and designing joint practical actions for 4-H stakeholders engagement in CS, and how to overcome common challenges (Magalhães *et al.*, 2022).

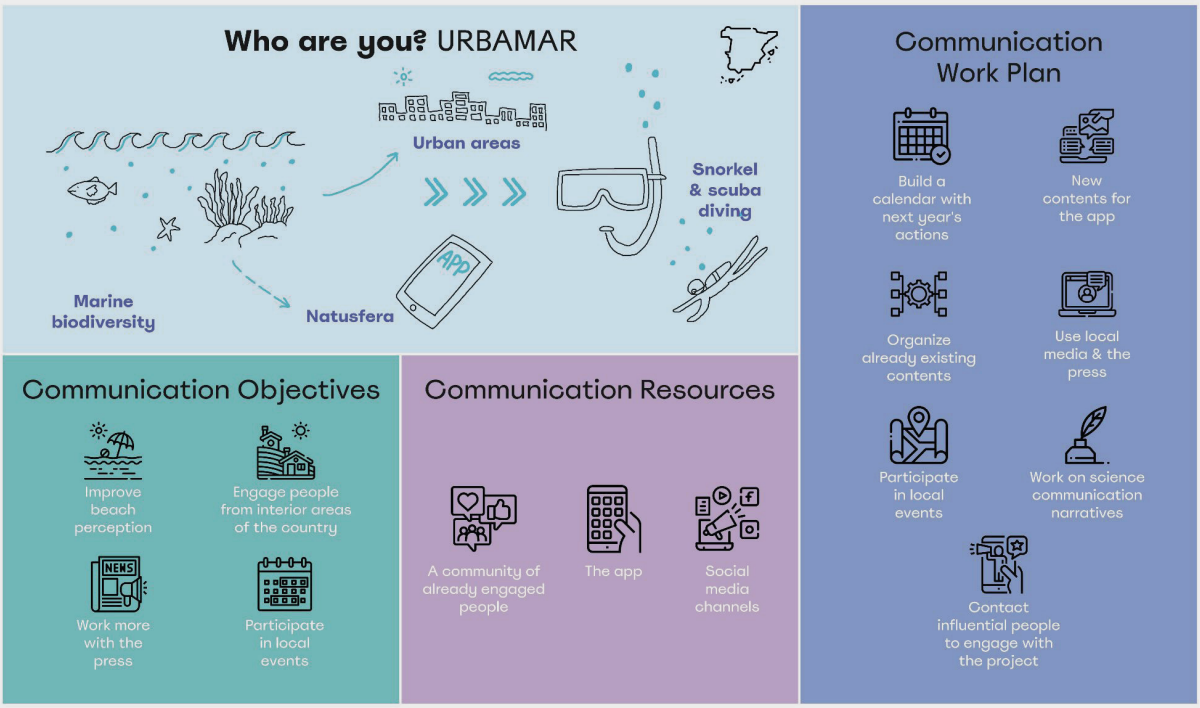


Figure 4. *Example of URBAMAR, one of the NEWSERA pilots graphic recording, including: CS project description, communication objectives, resources and work plan. From Magalhães et al., 2022*

2. Messages, innovative tools and channels

Hereby we gather a compilation of the description and details of messages, innovative tools and channels NEWSERA pilots have used. Moreover, we included expected outcomes and impacts that communicative actions can have to sustain long term collaborations between CS projects and their specific target stakeholder.

Messages

Innovative Tools and channels

Expected outcomes and impacts

3. Barriers and Mitigation Strategies

When addressing each of the 4H-stakeholders, we have found common barriers faced by the NEWSERA Pilots. Hereby we propose several mitigation strategies that can be planned in order to avoid or overcome these.

Barriers	Mitigation strategies
Marginality challenge; meaning socio-cultural and ethnic fragility (linguistic minorities, population groups such as migrants or those at risk of exclusion) but also represented by people with sensory, motor, intellectual and mental disabilities	Active Listening & Synergies. A CS project, through active listening practices, can gather the demands of the citizenry, attempting to implement an inclusive design through which to prepare tools to enable each citizen - taking into account his or her characteristics and frailty - to participate in data collection and monitoring activities. Activating synergies with other institutions or projects that have already developed inclusive designs from which to draw inspiration is one suggestion.
Target audience profiling	Comprehensive stakeholder mapping (interested, potential, affectionate) with which to know not only the socio-descriptive variables but also the interests, opinions, habits and value system with which the various social, environmental and biodiversity phenomena are perceived. Use the typical tools of applied science such as questionnaires, interviews and focus groups to carry out an inclusive project and act on any improvements to be made.
Planning and monitoring the self-evaluation gap	Impact and self-evaluation analysis represents a complex challenge for CS projects that often relate to research outputs but not outcomes. Equipping professionalism or getting skills to use qualitative indicator monitoring tools is a common need.
Diverse backgrounds and skills of citizen scientists	A planning that provides for diversified activities in relation to both the levels of access to information related to the issue addressed and its complexity by borrowing from other sectors the differentiation between entry level, expert and professional profile.

4.

Lessons learnt: NEWSERA Pilot Case studies

In this section we illustrate NEWSERA pilots as case studies, including a brief description, aim, more concrete target audience within their stakeholder group, indicators and best practices. Each case study further develops on their successes and achievements towards their specific stakeholder within the CitSciComm Labs, and overall in the project itself.

During NEWSERA synergies between the different CS projects also occurred and themselves served as inspiration between each other, cultivating an active community of practice that expanded to other local, national and international networks (for example, ECS platform, National associations of CS, the SwafS-19 sister projects, the Spanish Observatory of CS, etc.) and that will surely hold after NEWSERA ends, either independently and/or connected via new initiatives. In each of the blueprints we share some "seed" examples that emerged during the project.

Project

InNat

What was this project about?
CS project promoted by Crea, started in 2017. It has MiTE and Carabinieri Biodiversity Regiment as partners. InNat aims to monitor, through a dedicated App, data on 34 selected species of insects, a freshwater crustacean (crayfish), 3 species of plants and 2 habitats, in accordance with the Habitats Directive, reported by citizens throughout the country and validated by a team of researchers.

www.innat.unimol.it

Main Goal

Enable citizens to collect and provide reports on 34 insect species, 1 crustacean, 3 plant species and 2 habitats.

Target audience

Citizens, nature walkers, scientific research professionals in various capacities, employees of partner institutions.

Good example for

Communication and stakeholder engagement plan.

Best practices
Increased citizen scientists' engagement and inclusion activities by planning **both offline and online communication strategy**. To make the website more accessible, they carried out a complete restyling by including an in-depth column on **monitored species**, a constant **update** on the number of **validated reports**, and planned an **award ranking** for the most active reporters and a **weekly newsletter**. InNat also devised a **comic strip**, the "Bug Times" where insects spread and research information on protected species. InNat also took action on social media by revitalizing the **Instagram account**, which, thanks to a **biweekly scheduling of posts and an**

upgrade of stories, has increased its number of followers by threefold, since 2020. To interact in a well-timed way with the **most loyal reporters**, they opened a **Telegram account**. In order to get to **know the target audience and assess the impact** that participation in the project has had on **scientific learning and awareness**, InNat conducted a **sociological survey** that enabled it to obtain a **sketch of their citizen scientists and an initial assessment of the project's activities**. Lastly, InNat **began to report their own data with an eye towards data journalism methods**, due to the **collaboration with journalists**, through NEWSERA.

Innat, Bug Times The origin, 1st Number.

Their feedback on NEWSERA participation:
"Participating in NEWSERA really opened up a world to us that we hadn't considered before. The importance of communicating, updating volunteers and being present on social media were aspects that the project and the team itself, regarded as marginal. Thanks to NEWSERA, instead, we understood that involvement passes through a communication accessible to everyone, where the citizen is the protagonist"

Project

UrbamarBio

What was this project about?
UrbamarBio, consists of the long-term high-resolution spatio-temporal participatory monitoring of coastal biodiversity in 20 urban beaches in three cities (Barcelona, Badalona and Sant Adrià del Besòs). From 2016 to 2021, volunteers reported observations (photographs) of coastal and marine living organisms on the CO Natusfera platform, now designated MINKA.

anellides.com/es/blog/portfolio-items/urbamar/

Main Goal

engage participants to monitor and understand the factors affecting biodiversity in beaches around the Barcelona Metropolitan Area.

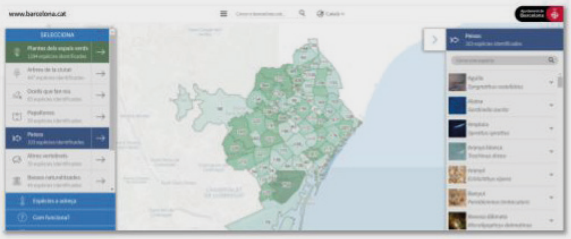
Target audience

People over 12 years old with basic swimming and/or diving skills within 5 kilometers or the area of study.

Good example for

Communication - products; stakeholder engagement - alignment with target audience; social impact.

Best practices
UrbamarBio has created a **multi-temporal model** (Janus Model of Engagement) that connects both **short-term and long-term actions and rewards**, considering bor each, citizens as volunteers/participants and policymakers, as stakeholders, respectively. In order to implement their strategy towards citizens, ICM-CSIC (Academic leader) established a **collaboration with an Industry Enabler** (a local SME - Anèllides, focused on marine environmental education and communication with strong connections with local NGOs, schools and councils). The project has been promoted particularly through the **social channels** of the Anèllides, **exploiting the guided scientific snorkeling tours as a market opportunity** (Fraisl et al., 2022). **For each barrier** they detected for citizen's engagement they created a **matrix of solutions,** connected with specific **KPIs**. Some of which were: to offer training both in the platform and the monitoring by organizing BioBlitzs and "**Identification Parties**" (+ 600 identified species; + 8000 observations; + 400 participants); to maintain a regular connection with



participants by targeted mailing and social media; to **show the contribution** of each volunteer on the MINKA platform and consider their **acknowledgement in future scientific publications; create collaborative products** (example of this were the "Participatory Guide of the Marine Species in the Barcelona Metropolitan Area" and the **Atlas of Barcelona Biodiversity**).

UrbamarBio received an award for best practices in sustainability "Premi Bona pràctica per canviar el món 2022 – Barcelona + Sostenible".

Project

Vacaloura.pt

What was this project about?
VacaLoura.pt is a citizen science project, founded in 2016, to map and preserve the beetles of the Lucanidae family in Portugal, but also the remaining large beetles in the country and also other species of invertebrates that share habitat with the Vaca-Loura.

www.vacaloura.pt

Main Goal

Compile and organize information sent by citizens on the distribution and status of the Vaca-Loura populations and other beetles of the Lucanidae family in Portugal, in order to collaborate with the Vaca-Loura European Monitoring Network, which in turn aims to assess the conservation status of this species in its distribution area. The project has also a strong environmental education component, intending to disseminate and raise awareness about the importance of dead wood in forest ecosystems, the biodiversity associated with these habitats, and how all together can help in the conservation of these ecosystems.

Target audience

Society at large.

Good example for

Citizens-generated data projects; environmental impact; policy impact.

Best practices
Implementation of a Network of Ambassadors that includes not only individual participants but institutions as well, which replicates the existing actions, motivates the communities to have an active participation and creates synergies among all to improve the work developed.

Their feedback on NEWSERA participation: *After participating in NEWSERA, VacaLoura.pt has now a more "strategic communication planning for society at large" and knows more about the "importance of communicating appropriately to other types of audiences (municipalities, private companies) enabling them to increase the reach of the project".*

Other successful stories from NEWSERA Pilots

Creation of the National Association of CS in Italy

On 17 February 2023, at the Botanical Garden in Rome, the **national association Citizen Science Italia ETS was founded**. It is the result of a national network of Italian initiatives, experts, universities, research centers, science museums, associations and public bodies, whose **aim is to build inclusive and collaborative tools and solutions, in an open science perspective, in close contact with other international networks**.
The promoting core is composed of scientists and supporters of CS who have been working in Italy over the last decade to disseminate and develop projects and coordination initiatives at a local, national and European level.

The association, based at the Natural History Museum of the Maremma (Grosseto, Italy), **aims at promoting the full development of CS in Italy, creating a community that, through the exchange of experiences and networking, is able to give unambiguous answers to policy makers**. The overall ambition is to represent the Italian community at national and international level, facilitating the communication and dissemination of projects, through the promotion of networking and exchange of experiences.

The association is the result of an ongoing effort that resulted in 2017 in the drafting of the '**Guidelines for the development of a national citizen science strategy**' (**https://discovery.ucl.ac.uk/id/eprint/10073924/**).

Among others, the **founding committee includes the project leaders of two CS projects involved in NEWSERA** (Alessandro Campanaro for InNat and Cristina Castracani for School of Ants) and the vice-president is the CS expert involved in the #CitSciCommLabs, Gaia Agnello.

The way to go: recommendations to efficiently engage with citizen scientists and society at large for wider impact

- **Identify citizen's groups for your CS project.** It is worth starting at the beginning of any CS project the analysis of the needs, expectations and motivations of the citizens in order to better engage and communicate with them.

- **Foster public engagement.** This will make the process of knowledge creation more open towards society. Co-creating the research project with citizens makes you more aligned with societal needs and concerns.

- **Team up with other existing groups.** Intercepting potential volunteers through initiatives on the territory. Creating exchange meetings where every citizen can intervene brings more social robustness to your project.

- **Involve citizens in doing science.** Engage citizens as sensors, data interpreters, up to active collaborators in identifying the research problem, setting up research questions and analyse data.

- **Take into account the analysis, project planning and dissemination.** Use co-design methodologies to carry out preliminary project analysis by involving citizens to participate in both educational and informational events. Encourage co-production of scientific content, data collection and dissemination tools together with the citizen scientists.

- **Plan the communication strategy beforehand.** Use innovative co-produced narrative styles and registers (ironic/emotional communication), sharing updated information and data with defined time frames. It takes time and requires specific dedication, however, it assures that the citizens' voices are heard.

- **Be flexible in times of crisis.** Social media can be useful to maintain regular communication, use gamification to ensure a high rate of participation.

- **Practice active listening.** Willingness to adopt an approach that gathers input from several citizens addressing marginality and fragility through the use of synergies and virtuous alliances.

- **Address fake news.** Citizens can become an evidence-informed network to tackle fake scientific information; society only needs training.

General resources

NEWSERA Policy Briefs

NEWSERA Policy Brief 1
https://doi.org/10.5281/zenodo.4837244

NEWSERA Policy Brief 2
https://doi.org/10.5281/zenodo.7752561

Guides and online training

Guide of science communication for citizen science projects and citizen science journalism
https://doi.org/10.5281/zenodo.7752525

How do you transform citizen science data into a news story?
YouTube link:
https://youtu.be/Y_lAo321_V4
Invited talks from science and data journalists - only available in Spanish

Data4CitSciNews conference
YouTube link: **https://www.youtube.com/live/EwDdfJ7yFoY**
Invited talks from scientists, journalists and designers to debate on the state of the art in data journalism, fake news and the concept of citizen science journalism

Online workshop on common challenges for citizen science: communication. Organised by Scivil – Citizen Science Vlaanderen YouTube link: **https://youtu.be/9a700xeWTeQ**

Relevant Publications from the NEWSERA Consortium in Open Access

Magalhães, J., Guasch, B., Arias, R., Giardullo, P., Elorza, A., Navalhas, I., Marín-González, E., Mazzonetto, M. and Luís, C. (2022). 'A methodological approach to co-design citizen science communication strategies directed to quadruple-helix stakeholders'. JCOM 21 (04), A05.
https://doi.org/10.22323/2.21040205
Here you will find our methodology to co-design a CS project communication strategy together with the stakeholder of interest. You can adapt to your own specific case.

Luís, C., Navalhas, I., Marín-González, E., Magalhães, J., Arias, R., Giardullo, P., Leguina, L. Keeping participants engaged in citizen science projects: the role of science communication strategies. PoS (CitSci2002) 017.
https://pos.sissa.it/418/017/pdf
Here you will find a methodology to discuss with CS project managers, participants, and other stakeholders, the challenges faced in maintaining long-term engagement, specifically focusing on citizens as the main stakeholder target group.

Giardullo, P., Neresini, F., Magalhães, J., Luís, C., Marín-González, E. and Arias, R. (2023). Citizen science and participatory science communication: an empirically informed discussion connecting research and theory. JCOM 22(2), A01.
https://doi.org/10.22323/2.22020201
Our exploration consisted in a survey involving 157 CS projects around the EU. We found that CS projects tend to communicate through social media mainly reproducing a knowledge transfer mode. This may hinder effective encounters with both participants and potential target audiences.

Giardullo, P., Arias, R., Leguina, L., Magalhães, J. (2021) Responsible and inclusive citizen science: comparing initiatives and assessing impacts. Tecnoscienza 24, 12, 2
http://www.tecnoscienza.net/index.php/tsj/article/view/480/294.
This paper resumes the variety of notions of participation, citizenship, and democratization of science in CS as they emerged during a panel carried out during the XIII STS Italia Conference "Dis/entangling Technoscience" held in June 2021.

Relevant public deliverables from the NEWSERA Consortium

Giardullo P, Citarella MA, Neresini F, Magalhães J, Arias R, Guasch B, Pelacho M, Luís C (2021) NEWSERA - Report on indicators for impact assessment of science communication in Citizen Science Projects (Deliverable 2.2) (1.1). Zenodo.
https://doi.org/10.5281/zenodo.5139999

Leguina, Magalhães J, Tola E, Guasch B, Elorza A, Lacunza I, Arias R. (2023). Citizen Science as a communication tool in the Post-Factual Era. (Deliverable 3.7) (v1.2). Deliverable report of project H2020 NEWSERA (grant agreement No 873125). Zenodo.
https://doi.org/10.5281/zenodo.7689045

Relevant Publications from our Pilots

Liñán S, *et al.* (2022) A new theoretical engagement framework for citizen science projects: using a multi-temporal approach to address long-term public engagement challenges. Environ. Res. Lett. 17 105006
https://doi.org/10.1088/1748-9326/ac939d

Garrison H, Agostinho M, *et al.* (2021) Reflections on meaningful and impactful stakeholder engagement in fundamental research. EMBO Reports (2021)22:e54000
https://doi.org/10.15252/embr.202154000

Others

Frontiers Research Topic "Bridging Citizen Science and Science Communication", with Yaela Golumbic, Alice Motion, Joseph Roche and Joana Magalhães as co-editors.
https://www.frontiersin.org/research-topics/48185/bridging-citizen-science-and-science-communication

Carayannis EG and Campbell DFJ (2009) 'Mode 3' and 'Quadruple Helix': toward a 21st century fractal innovation ecosystem. Inter J Tech Manag, 46:3-4, 201-234.
https://doi.org/10.1504/IJTM.2009.023374

A 10-step guide to writing citizen science project descriptions that spark interest and attracts volunteers - CS Track Project
https://cstrack.eu/format/news/how-to-write-an-engaging-citizen-science-project-description/

SwafS-19 sister Projects

"Science communication: Empowering citizens in the public discussion of science"- CORDIS RESULTS PACK
https://cordis.europa.eu/article/id/442429-science-communication-empowering-citizens-in-the-public-discussion-of-science

Roche J, Arias R, Bell L, Boscolo M, Fornetti A, Knutas A, Kupper F, Magalhães J, Mannino I, Mendoza I, Moreno-Castro C, Murphy K, Pridmore J, Smyth F, Tola E, Tulin M, Weitkamp E and Wolff A (2021) Taking Stock and Re-Examining the Role of Science Communication. Front. Environ. Sci. 9:734081.
https://www.frontiersin.org/articles/10.3389/fenvs.2021.734081/full

EU Funding Opportunities

EU Prize for Citizen Science and Accelerator Open Call - **https://impetus4cs.eu/**

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