Blueprint for #CitSciComm with and for Career Scientists

Deliverable Details

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Project Details

Acronym

NEWSERA

Title

Citizen Science as the new paradigm for Science Communication

Grant agreement

873125

Topic

SwafS-19-2018-2019-2020. Taking stock and re-examining the role of science communication

Duration

January 1st 2020 - March 31st 2023 (39 months)

Website

https://newsera2020.eu/

STATEMENT OF ORIGINALITY
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Foreword

Despite the exponential growth of citizen science projects in later years, it still remains a pursuit for a small number of aficionados, both in terms of citizens that do science and scientists that are willing to include citizens in their scientific activities. Good communication can help change that. On the part of scientists, there are still many misconceptions on the quality of work that citizens can do, on the effort needed to validate data collected by non-experts, on the value of combining experiential with scientific knowledge. Also, the scientific system continues to raise a lot of barriers to scientists interested in pursuing or collaborating in citizen science projects: lack of specific funding, an over-emphasis on narrow-minded metrics in career evaluation and progression, distrust from colleagues and employers. This blueprint plays a valuable role in highlighting these obstacles and proposing ways to overcome them. Based on an analysis of the communication strategies of several citizen science projects in three European countries, it underlines good practices and issues recommendations on how to enhance communication with academic scientists. This is mandatory reading for those interested in promoting a more effective and dialogic citizen science.

Ana Delicado, Specialist in Social Studies of Science
Researcher at the Institute of Social Sciences, University of Lisbon

This blueprint provides clear guidance about communication with academic scientists for organisers of citizen science projects. Most importantly, the blueprint shows how to move beyond a simple "dissemination" model to richer engagement with various academic stakeholders in ways that can shape and sustain citizen science projects. The blueprint recognizes that fundamental to communication is identifying specific audiences and their needs. There is no single "scientific community." Project organisers need to identify specific disciplinary groups, specific interest groups, specific communities where academic scientists work and engage. Project leaders then need to match their communication strategies with these specific groups, to engage academic scientists in ways that will achieve the overall project goals. The blueprint then provides detailed tools for how to analyse the needs and interests of different groups, how to match specific communication and engagement strategies to those needs and interests -- and, critical to long-term success, how to assess the achievements and effectiveness of the communication strategies. By including case studies and examples from the many citizen science projects where the blueprint was tested, the document gives substance to the analytical tools that the NEWSERA project developed.

Bruce Lewenstein, Specialist in Science Communication
Professor at the Cornell University

Although citizen science has been part of scientific practice since its early days, it is still not sufficiently known by a large part of the scientific community, or it is mostly considered as a science communication or education action rather than as scientific research. In addition, there is a lack of trust in data generated by non-experts, there is almost no specific funding to drive the implementation of citizen science activities as part of scientific practice, and there are few examples of training for academic scientists on how to deal with citizen science issues. As such, the #CitSciComm Labs dedicated to academic scientists that were developed under NEWSERA were an excellent opportunity and of utmost importance for citizen science projects to reflect on how to overcome these and other identified barriers. By working together with academic scientists (the potential target audience in this case), with the support of science communication experts, several citizen science projects generated a set of communication actions aimed at reaching and better engaging the scientific community in demonstrating the potential of their actions to generate high quality scientific knowledge. This resulted in a series of best practices and recommendations that are reflected in this blueprint which is a remarkable result of an innovative and challenging co-creation process that we hope will serve as inspiration for similar processes and be thoroughly used by all those willing to increasingly engage the scientific community in citizen science actions.

Cristina Luís, Researcher at the Faculty of Sciences, University of Lisbon FCiências.ID Partner, Career Scientists CitSciComm Lab Leader

*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:

- Citizen science researchers

- Citizen science projects communication managers

- Academy scientists interested in implementing CS initiatives

- Academy scientists who are willing to incorporate CS data in their research practices

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!

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 **career scientists 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.

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

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 fulfil 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. Another often neglected aspect is related to internal communication.

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 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

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

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 analysed 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:
Career Scientists

What do we want to achieve?
Increase the involvement of researchers and academics in citizen science by demonstrating its benefits and potential for improved research. Increase the confidence in citizen science data and results within the career scientists' community. Following the European Commission's recommendations to promote open science, show how information sharing through citizen science might benefit scientists and their research.

What are the challenges?
Academic scientists face strong pressure to publish, an intensive workload, and lack of time to engage in other activities outside their research work, mainly because there is no recognition of these activities in their scientific career, and CS activities are still mainly seen as a science communication or education actions, but not real science. Moreover, there is low trust in non-specialists-generated data as well as lack of specific funding to boost the implementation of CS activities and lack of training to academic scientists on how to deal with citizen science matters.

Who are the targets?
Academic scientists include researchers that work in universities, research centres, science and technology parks, learned societies, technology transfer offices, units of scientific cultures and other interface professionals. This diverse community includes both researchers who participate and create CS projects and those who do not know what CS is or are sceptical about it.

How did we do it?
The #CitSciComm Lab for and with Career Scientists explored and deployed these challenges with the following NEWSERA pilot CS projects: Biodiversidad virtual, Genigma, DENIS, MammalNet- from Spain; Biodiversity4All, Memória para Todos, Rios Potáveis - from Portugal; CSMON-Life, Easin, The School of Ants - from Italy and provides the basis for this blueprint.

Good practices for targeted communication plans directed to career scientists

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 forums 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 (S.M.A.R.T) indicators 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.

stakeholder

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

OPPORTUNITIES

FEASIBLE OPPORTUNITIES

COMMUNICATION ACTIONS & PRIORITIZATION

BENEFITS

PLAN FOR THE FIRST ACTION(S)

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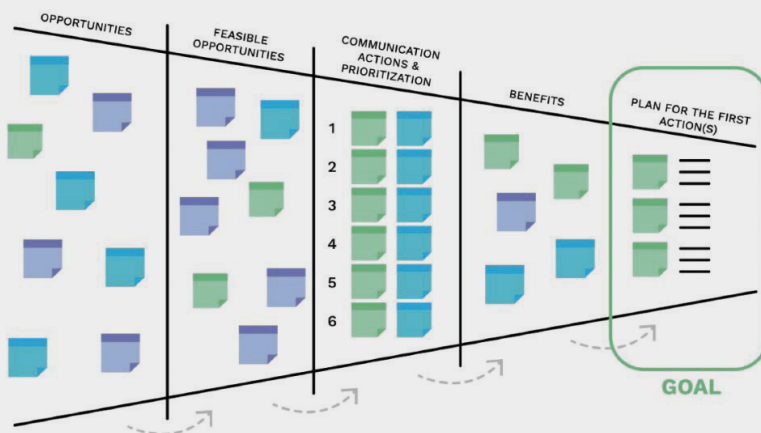
Chose the most feasible opportunities to involve your target stakeholder. Define possible communication actions, which benefit both the CS project and the stakeholder. Define a communication plan with prioritized and detailed actions and tasks.

Defining indicators

SCOPE
EFFECTIVENESS
SOCIAL PERCEPTION

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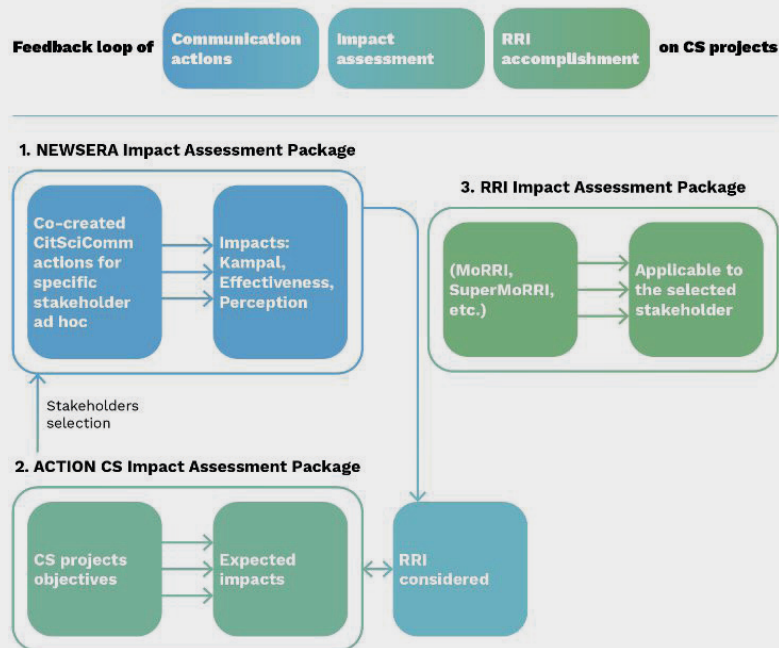
Figure 2. *NEWSERA Framework for impact assessment of communication strategies in CS projects*

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:** organise 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.

Figure 4. *Co-design frame to build indicators together with the stakeholder of interest*

Co-designing communication strategies targeting career scientists

In order to inspire on the co-design communication strategies, hereby are some of the actions and tasks defined and implemented by the NEWSERA Pilots involved in the Career Scientists CitSciComm Lab:

Biodiversidad Virtual
1. Define a mission, vision and objectives of the project (and to reach out to the scientific community)
2. Build a new narrative and a call to action on collaboration between institutions
3. Highlight the people/team that generated data (show at least who are the validators) for recognition
4. Create a strategy to welcome and mentor experts
5. Improve access to information and statistics on data generated through databases
6. Define an ambassadors plan
7. Design specific communication campaigns for a map of actors of the Spanish scientific public (social media, targeted mailing, create a challenge, or a slogan to advertise, etc.)

DENIS
1. Update the website
2. Disseminate promotional materials for the project (YouTube)
3. Define a strategy for social networks (Twitter)

BioDiversity4All
1. Develop a video to use in university classes, and scientific events or conferences
2. Design and develop practical classes, within university courses, showcasing the platform
3. Present the project in scientific seminars and congresses

Rios Potáveis
1. Adapt the website to have a component for researchers
2. Create dissemination materials for specialists
3. Prepare training actions directed to researchers and schools

Genigma
1. Identify different scientific profiles (hospitals, doctors, ICT, geneticists, others)
2. Co-create informative material for specialised audiences
3. Name Genigma scientific ambassadors
4. Create Scientific working groups/collaborative networks

MammalNet
1. Implement an institutional newsletter
2. Create a database for researchers and institutions
3. Establish contacts with the media
4. Develop training materials (courses, MOOCs, webinars)
5. Dedicate social media actions specific for professionals

Memória para Todos
1. Improve the platform in terms of usability for researchers
2. Disseminate the new platform among the research community

The School of Ants
1. Implement the project website
2. Search for ambassadors
3. Enhance partnerships
4. Train professors

Easin
1. Develop a MOOC on biodiversity
2. Develop an educational board game
3. Design a webpage on citizen science through the app "Invasive Alien Species in Europe"

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

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

Why? | CS is science | CS can be a co-creation process | CS is a data source | CS is a vehicle to connect science with society

CS promotes engagement and empowerment with specific scientific topics | Researchers participation is valuable

What for? | CS contributes to SDG goals and other societal values | CS data can be of quality and reliability | CS increases the quantity (spatio-temporal) of data | Recognizing the value of CS data

How? | Connecting societal issues with scientific issues | Considering ethical issues in the use of CS data | Clarifying the permission to use CS data | Having clear how to connect with society

CS promotes science communication and scientific culture | Having dedicated support and funding for CS

Who will do it? | Academia as user | Academia as co-creator

Innovative Tools and channels

Website and social media

Data quality metrics

Audiovisual and graphic resources using language adequate to the target audience

Apps

Social networks as communication channels (e.g. Twitter)

Actions

Scientific meetings on CS

Presentation of projects in classes, open days, congresses

Seminars, workshops on CS

Indicators of use in science (papers, theses, etc.)

Publications using CS data

Invited university classes

E-mail

Mailing-list

Newsletter

Personalized contacts

Partnerships

Partnerships with research centers

Partnerships with science communicators

CS Networks

Alliance with civil society collectives

CS Repositories

Involve communication offices in universities

Expected outcomes
and impacts

Engagement and recognition

Greater involvement of scientists

Increased participation of scientists in CS projects

Greater recognition and awareness of CS

CS become a source of recognition for scientists

For science

More articles and scientific papers using CS data

More openness to know the CS projects

Scientific collaborations

More scientific knowledge

Collaborations for funding

Theses and curricular projects

For society

Greater support from society to scientific activity

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
Distrust on data quality and validation	Involve scientists in validation processes. Create and stimulate data use licences. Communicate well how validation procedures are done. Stimulating the use of data processing and analysis tools.
Lack of knowledge about scientific tools, scientific topics and scientific language	Accessible language. Show how citizen science projects can be working tools. Synthesis of good practices on citizen science communication for academia.
Lack of dedicated funding (citizen science and science communication)	Increase funding dedicated to citizen science. Financing citizen science projects also increases communication. Consolidate national networks of citizen science to increase recognition for funding.
Lack of recognition in academic evaluation and institutional recognition of citizen science projects	To explicitly include citizen science in the scientific evaluation; Create multidisciplinary citizen science processes.
Reluctance to change (habits, methods, materials and structures); prejudice that it is not science generates resistance	Promote interaction among peers and others. Show the potential of citizen science for science communication. Involve scientists from the creation of the projects.
Lack of knowledge about CS projects	Disseminate citizen science in congresses, seminars of other scientific areas. Evidence-based communication of the usefulness of citizen science projects. Increase information and dissemination about citizen science and projects.

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

School of Ants (SOA)

What was this project about?
It is a scientific research project collecting data on the presence and distribution of the various species of ants living in the city. It is the result of a collaboration between researchers from the Laboratory of Myrmecology of the University of Parma and researchers from North Carolina State University and is financed by the Cariparma Foundation, the University of Parma and the IC Parmigianino.

www.schoolofants.unipr.it

Main Goal

SOA acts to address two main objectives: scientific, by conducting the first official census of ant species living in Italian cities in order to study phenomena such as the loss of biodiversity, climate change and the advance of invasive species with a view to sustainable development of cities; educational, by allowing anyone to actively participate in a scientific research project enabling them to increase their scientific knowledge through direct field experiences.

Good example for

Openness, Scientific Impact

Target audience

Teachers and students of all levels, researchers and academic scientists.

Best practices
SOA opened a **specific profile on their website** for academic scientists interested in collecting or sharing data on ants. Although **data sharing** is still difficult, SOA tried to seize the opportunity to discuss with other experts with the aim of **welcoming new data submissions from different synergies.** Along these lines, the attempt to initiate new collaborations with

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other universities (Unibo) and NGOs (LIPU) should be emphasised. In the meantime, SOA has been implementing an **online educational course** aimed at teachers operating in **geographical areas not yet covered** by the project. The numbers don't lie: SOA **increased** both the **scientific results** of the project and **the number of citizens involved in data collection.** The communication strategy is evolving and it is planned to open accounts on major social media in the coming months.


Number of teachers attending the SoA training course

Their feedback on NEWSERA participation:
"We were very satisfied with the experience because NEWSERA provided important communication skills to promote public engagement with a focus on potential new researchers to collaborate with. We also really enjoyed the Data Journalist Lab from which we learnt how to interface with science journalists."

MammalNet

What was this project about?
Pilot study (2019-2022) to engage citizen scientists in collecting data on geographic distribution and abundance of mammals in Europe using modern Information Technology systems, such as web-platforms, tablets, smartphones or other devices. MammalNet is connected with the European Network of Wildlife professionals (ENETWILD) and the European Observatory of Wildlife (EOW).

mammalnet.com
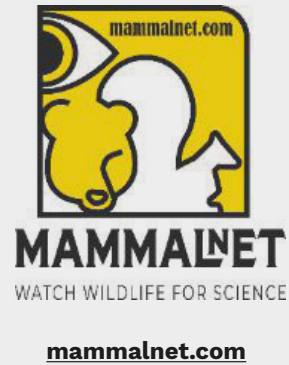
Main Goal

Explore different strategies and approaches to assess the potential of CS to improve knowledge of the distribution and abundance of European mammals.

Target audience

Professional profiles associated with wildlife management, composed by researchers, but also by wildlife managers associated with environmental NGOs, Game managers and Public sector.

Good example for

Communication - channels, Stakeholder engagement - Openness, Scientific Impact

Best practices

MammalNet developed its communication strategy in parallel with the already existing one for ENETWILD, considering this as a **bridge to the scientific community** but at the same time **clearly distinguishing between scientific community-oriented and citizen-oriented communication targets.** Their participation in EOW also allowed them to **enlarge their network** by establishing common objectives using a collaborative approach. **Digital tools were prioritised**, such as newsletters, frequent posts on the website, mailing and social media (mainly Twitter), targeting segmented audiences, as aforementioned. Moreover, they established **segmented training and didactic actions**, such as **MOOCs** for citizens, **courses** for professionals, **webinars and meetings** for professionals and governmental staff. MammalNet also has a **strong ethics on open data**; they registered the publication of 16 open documents from March 2021 to November 2022, including the recognition of citizen scientists. Overall, the above stimulates the acquisition of new knowledge, competences and science literacy. They promoted a **survey to understand personal motivation and engagement**, and **found gender and age differences**, this is, with increasing age, men showed higher motivation than women to participate in their activities, which should be taken into account in planning future communication and engagement strategies. As future impacts, the project expects to: increase trust by promoting international collaboration; revalue the potential of wildlife monitoring in a harmonised way, to encourage scientifically based decision-making and, finally, to promote and encourage CS as an alternative and complementary way of collecting useful information and involving society with nature and science.

Their feedback on NEWSERA participation:
"Communication plays an important role in the active participation of the different actors. A flexible approach to projects based on active listening to the actors allows for an adaptation of the project. The academic and professional world associated with research and management of natural resources needs to improve its communication skills, beyond the fact that professionals are involved in these tasks."

Project

BioDiversity4All

What was this project about?
BioDiversity4All is an online and open access database, where every citizen can contribute with observations of living beings from any group (e.g., plants, animals, mushrooms) and can develop citizen science projects in biodiversity. It is connected to the worldwide iNaturalist platform.

www.biodiversity4all.org

Main Goal

Connect with the largest number of people so that by photographing and recording observations in the platform there is an increased knowledge about Portuguese biodiversity. Having an open space where anyone can create their own citizen science project directly related to biodiversity recording. Increase the use of collected data for scientific purposes.

Target audience

Researchers and academic scientists, teachers and students of all levels, public sector, industry and SMEs, society in general.

Good example for

Scientific impact, Openness

Best practices:
BioDiversity4All developed a series of actions to improve the connection with academic scientists. Several videos were produced to showcase the project within the academic and research community. This **opened the door for the development of Bioblitzes in academic institutions**, which are a great tool to involve the scientific community in CS activities. The **communication strategies directed to show how CS data, collected in the platform, is open for the development of academic work**, including university classes, **led to the development of several master theses in different research areas**. The promotion of the platform in scientific meetings has led to more **academic professors now using the platform in the context of classes** and to more researchers developing projects on the platform. As a **joint effect of the actions** directed specifically to academic scientists, but also of those to other audiences, there was an **enormous increase in the number of records in the platform**, between 2020 and 2023, reaching more than 1,000,000 records by the end of February 2023. Moreover, the number of users also increased as well as the **number of validators that now include many more researchers**. The number of projects also increased (more than 200 projects running in Portugal), and many of them were initiated by academic institutions.

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Observações

Criar Conta | Explorar

Their feedback on NEWSERA participation:

"NEWSERA participation allowed us to learn from other projects and with the project promoters to improve connection with the academic community. It also made us realise that the contact with data journalists should be improved, enabling citizen science projects to become more interesting to these journalists."

Other successful stories from NEWSERA Pilots

Formal Training in Citizen Science

Members of MammalNet organised and coordinated the first edition of the "**Summer Course Citizen Science Applied to Teaching in Natural and Cultural Patrimony**", at the University of Castilla la Mancha, that gave credits for undergraduate degrees at this university. This two-day course addressed, through case studies, **the didactic potential of citizen science to improve the learning motivation of students, interrelating different disciplines, bringing science and critical thinking to the classroom and improving the knowledge of rural, natural and cultural heritage**. It counted with the participation of NEWSERA's team members, with the opening lecture on "Citizen Science - Who, how and when", as well as other NEWSERA pilots, such as D-NOSES/OdourCollect and Cities at Night.

Another good example of **formal training on CS organised by participants in NEWSERA is the PhD course "Open Science and citizen participation in scientific research projects"**, developed by the

Citizen Observatory of Drought (OCS) coordinator. This course took place online at the University of Pablo Olavide, in Seville and was open to Latin America students. The course was divided into two theoretical sessions and one practical. NEWSERA's team members participated has invited lecturers, who approached several themes tackled within NEWSERA such as **(re)thinking research projects that include the participation of citizens and other agents** (public sector, private sector, journalists), the scientific, social, economic and political **impact and evaluation mechanisms and CS as a tool for science communication**. The second theoretical session included **basic notions of participatory methodologies and co-design** and how co-design can be applied to citizen science. Finally, for the practical session, participants could experience the **co-design methodology developed under NEWSERA applied to their PhD thesis work plan** and how to interact with 4H-stakeholders and science and data journalists throughout their research projects.

Applications in Research

BioDiversity4All was used as a **case study for a master's thesis in Computer Science** entitled **"Bias in Citizen Science: an application to the BioDiversity4All project"**, to study possible **CS-generated data bias derived from the users' preferences, skill, and effort.**

Results suggest that accessibility to observation sites is one of the most important factors for users. This information can be highly informative for projects dealing with the same type of data collection as this one.
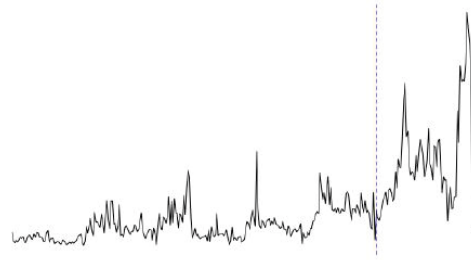
Bias in Citizen Science: an application to the BioDiversity4All project

Rethinking Citizen Science

Rios Potáveis, besides having been in the creation of the Iberian group on CS of Freshwater Ecosystems (see the blueprint dedicated to Industry and SMEs), is an example of **rethinking CS in action**. At the beginning of the NEWSERA follow-ups, the project started analysing more in detail its scientific objectives and began to contact several researchers and institutions to find out how data collected by citizens could be effectively used in research. During the NEWSERA project, Rios Potáveis **completely reworked its goals to become more clearly a CS project and not just a science awareness and education project.** While the science education component is still an important part of the project, allowing it to have the **local community highly involved, there is now a clear link to the academic community**, through the Universidade da Beira Interior (UBI), so that the **CS-generated data can be used in research with a subsequent return to society**.

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

- **Involve researchers and academics:** present citizen science projects in academic fora (conferences, journals, etc.) beyond the citizen science "bubble".

- **Contact science broadcasters and research centres:** collaborate and identify champions within the scientific community. Co-creating a CS project with scientists can take part in any phase of the research, from ideation and proposal planning to co-creating validation processes.

- **Foster networking with scientists from other disciplines:** only through means of collaboration can the transdisciplinary character of CS projects be strengthened.

- **Pay special attention to communication materials:** do your desk research about quality audiovisual and graphic resources, and learn from other disciplines (e.g. sociocultural animation).

- **Make sure to communicate the science within the project:** communicate the scientific features of citizen science projects to academic scientists. This way the scientific community will understand that citizen science is real science, and can create a positive spill-over effect in the community.

- **Advocate for higher investment in science dissemination:** not only high quality materials require investment (such as guides, videos or infographics), but also learning new skills require time and resources (e.g. how to undertake presentations). Additionally, inclusive audiovisual materials are costly and require high investments.

- **Show the value of CS projects for greater social impact than a traditional research project:** make sure to leave room for disseminating CS-generated data and promote dissemination workshops.

- **Lobby for greater sustainability of CS projects:** The CS ecosystem can be strengthened by many means, from professional networkings, reusing existing experiences and resources, involving citizens from the beginning and in all phases of the research, to advocating to include the CS methodology in traditional research fields.

- **Promote Open Science:** CS can contribute to embrace open science and improve the quality, efficiency, and responsiveness of any research.

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/**

Acknowledgements

The NEWSERA consortium acknowledges all the representatives of the quadruple helix (citizens and society at large, academic scientists, public sector and policymakers, industry and SMES), sounding board (science communicators and journalists), science and data journalists and other invited experts that were involved in the #CitSciComm Labs, and very specially, the team members from the citizen science projects that participated as the NEWSERA pilots, as described in the NEWSERA website **https://newsera2020.eu/labs/**