European Commission

Scaling up citizen science

Topic 5 Discussion paper

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Mutual Learning Exercise on Citizen Science Initiatives - Policy and Practice

Topic Five Discussion Paper: Scaling up citizen science

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Scaling up citizen science

Discussion Paper

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SCALING UP CITIZEN SCIENCE

"Complementing large questions (such as, the role of citizen science for governance, its contributions to human centred and explainable AI, and relationships with data altruism) and building on leading examples (such as, participatory mapping, bird watching or water quality monitoring) there is an eminent need to develop a better and more structured understanding of the context dependency and growing potential of citizen science approaches. This is both, in terms of scaling and spreading. Here, (up-)scaling can be considered as expanding a successful citizen science initiative in terms of both, the number of participants and the geographic extent. Spreading refers to portability and replication of existing solutions, without a change of the actual scale of the activity in itself. Once we understand the context dependency and pathways for expansion of single initiatives, we will be able to thrive for a systemic integration of citizen science approaches into larger governance structures. This will not only allow us to support digital transitions, but also to offer opportunities for engagement in policy making and implementation. In this way, citizen science will become one important piece of the larger puzzle that will help us all to get fit for the new digital age and to contribute to a vibrant democracy". [1]

Sven Schade, Joint Research Centre, European Commission

1. Introduction

An analysis of the European citizen science (CS) landscape shows an increasing number of projects, practices and initiatives developed across Europe in the past years: for instance, as of October 2022, the EU-Citizen.Science[2] – the European platform for sharing, initiating and learning citizen science - has 240 submissions of citizen science projects, out of which 194 are currently in progress, and 198 organisations engaged with the implementation of these projects across the academic, governmental, non-governmental, private and community-led realms. These promising figures suggest the mainstreaming of CS is certainly underway, although there is still a lot of work to be done towards mainstreaming CS as an accepted methodology and source of data e.g., for SDGs monitoring and reporting[3]. Further to this, it can be observed that the majority of CS projects run on empirical pilots, aimed at experimenting with novel tools and methods.

It is therefore time for the CS community to move from piloting to sustaining and upscaling successful CS projects starting from a reconsideration of CS projects' aims and business models for reasons that can be related to impact and ethics concerns[4]. If the "Scaling Ambition"[5] can be considered the bottom line of many CS projects and initiatives, there is little empirical evidence of success factors for scaling up CS projects and limited knowledge

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[1] Schade 2020
[2] https://eu-citizen.science/
[3] Mutual Learning Exercise on Citizen Science Initiatives – Policy and Practice Topic Three Discussion Paper: Maximising the relevance and excellence of citizen science chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://ec.europa.eu/research-and-innovation/sites/default/files/rio/report/psf-topic3-discussion_paper_v2.pdf
[4] Balestrini 2022
[5] Maturano 2020

about CS approaches and infrastructures developed across Europe in support of upscaling CS.

Against this backdrop, the Mutual Learning Exercise (MLE) 'Citizen Science Initiatives - Policy and Practice' (CSI-PP), initiated within the framework of the European Commission D-G R&I Horizon Policy Support Facility, operates with the aim of contributing to fill this gap of knowledge by sharing practices and experiences of eleven Member States (MS) participating in the MLE about the issue of scaling up citizen science.

1.1. Scope, Purpose and Structure of this Discussion Paper

According to the programme of the MLE CSI-PP, the overall goal of the fifth topic in the series "Scaling up citizen science" is specifically to draw on the shared experiences to discuss:

- challenges and success factors for scaling up CS projects on the basis of different approaches implemented in Member States (MS);

- means and willingness to contribute to the scaling up of transnational European CS campaigns.

Hence, the purpose of this Discussion Paper is to introduce Topic 5 to the participants in the MLE and provide inputs for discussion in advance of the Topic 5 meeting that will take place in Berlin (Germany) on 7-8 November 2022.

This Discussion Paper is structured in **five sections and four appendices** that can be read independently. The Introduction (**section 1**) provides information about the materials and methods used to collect data about the topic of "scaling up Citizen Science" for writing this Paper, which include: feedback received from the MLE CSI-PP country representatives during the MLE CSI-PP kick-off meeting, a preliminary literature review, interviews with experts in CS and cognate disciplines and a survey distributed among the MLE CSI-PP country representatives. Then, in **section 2**, meaning(s) and dimensions of scalability are introduced to provide a basis for discussion at the Berlin meeting that could lead to a shared definition of scalability agreed among the MLE CSI-PP as an outcome of the MLE. Further to this, **section 3** discusses challenges and success factors for scaling up CS projects reported by the MLE CSI-PP country representatives, backed by evidence and examples from the upscaled CS projects shared by the MLE CSI-PP country participants (**section 4**). Finally, **section 5** outlines the scope of the working sessions included in the Berlin meeting's agenda and summarises the open questions – organised per topics – that will serve as a basis for discussion during the Berlin meeting. Additionally, **four Appendices** complement this Discussion Paper: **Appendix A** contains the protocol of the survey distributed among the MLE CSI-PP country participants, **Appendix B** reports the interview protocol and the list of scholars interviewed, **Appendix C** provides a 9-Driver Framework Check List of the up-scaled CS projects shared by the MLE CSI-PP country representatives, and **Appendix D** shows the responses to the questions included in the survey about the impact of the whole MLE CSI-PP that were submitted by the MLE CSI-PP country representatives.

This Discussion Paper can be found in the online repository of the EC Policy Support Facility[6].

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[6] PSF Challenge / MLE on Citizen Science Initiatives - Policy and Practice. https://ec.europa.eu/research-and-innovation/en/statistics/policy-support-facility/psf-challenge/mutual-learning-exercise-citizen-science-initiatives-policy-and-practice

1.2.   **Methods and Materials**

The content of this Discussion Paper stems from the application of a mixed methods approach which reflects and adheres to the mutual learning principles informing the MLE CSI-PP project. Thus, it integrates knowledge generated by a preliminary literature review with the results from a survey distributed among the MLE CSI-PP country representatives and the interviews with seven experts in CS and cognate disciplines. It should be noted that the content of this Paper uses data stemming from the European CS landscape and CS projects initiated by European institutions (research centres, universities) and funded via institutional funding programmes. If this is in line with the scope and purpose of the MLE CSI-PP initiative, it may underpin potential biases and limitations which are worth acknowledgment and possibly further discussion.

1.2.1.   Preliminary literature review

A preliminary literature review conducted in the field of CS showed that a few studies addressed the scalability/up-scaling of CS projects[7]. For the purpose of this Discussion Paper, we specifically draw upon a conceptual framework of nine drivers for up-scaling CS initiatives developed by Maccani and colleagues in 2020 as a theoretical reference and an assessment tool (see e.g., section 1.2.2., 3.1).

1.2.2.   Survey

A survey was distributed among the MLE CSI-PP country participants in September 2022. The survey was designed using: 1) the 9-Drivers Framework by Maccani et al. (2020) and 2) inputs received from the MLE CSI-PP country representatives during an online Jamboard session run at the MLE CSI-PP kick-off meeting in January 2022 in response to the question "What are the most important issues on which we should focus during the MLE?" (Fig. 1). As for the latter, the inputs revolved around specific topics, as follows:

- Challenges and barriers of scaling up CS projects: e.g., *technology, smartphone ownership, language, recruitment (hereby also mobilisation) for CS is a crucial phase (beyond voluntarism), the need to involve local and national actors, not only EU umbrella organisations, collaboration between federal institutes and grassroot CS communities (sometimes called activists) is very important but that gap can be big. How to bridge this?*

- Drivers of scalability: *schools as a good medium for upscaling across Europe, existing networks, a solid and broad platform of already existing and completed CS projects: these may create new (national-international) synergies, speed-dating between such actors, promotion of CS at EU level (e.g., researchers' night).*

- Best practices: *successful funding models, funding and advertising models, successful CS policy/programme (the relevant policies/actions for supporting the development of CS), accessibility to existing projects as examples.*

- Selection criteria: *develop a set of clear criteria for up-scaling national projects and initiatives, criteria for choosing EU wide campaigns.*

- Link to the EC: *role of ERA and link to it for the EU-wide campaigns.*

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[7] e.g., Maccani et al. 2020; Maturano 2020; Balestrini et al. 2021
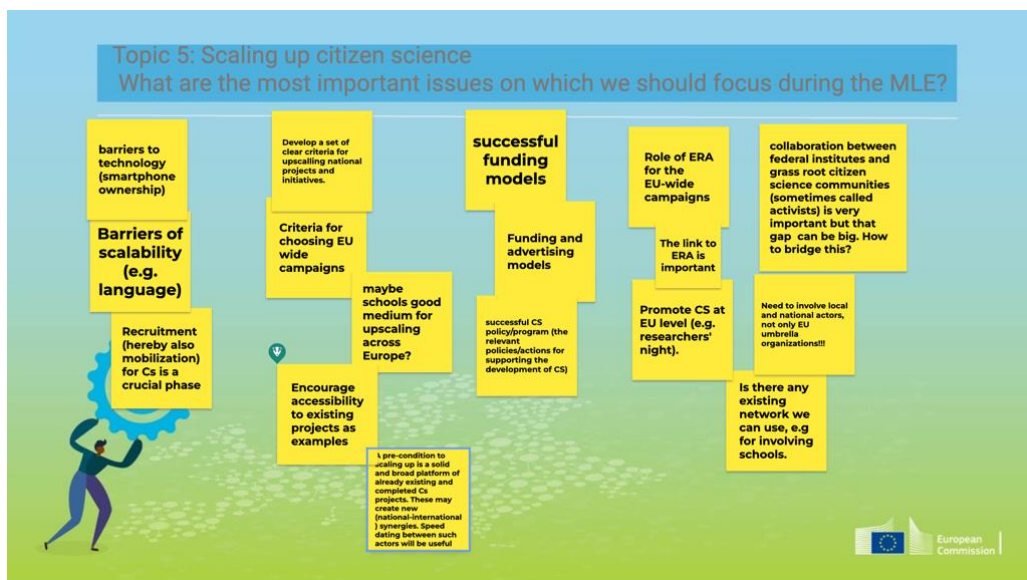
Figure 1. Screenshot of the Jamboard with the responses provided by the MLE CSI-PP country representatives during the the MLE CSI-PP kick-off meeting in January 2022.

The survey, distributed among the MLE CSI-PP country representatives, was composed of 35 questions divided in two Parts.

PART A of the survey was designed to collect knowledge on the definitions of scalability, barriers and success factors in scaling up CS projects, existence of policies/infrastructures/funding programmes in the MLE CSI-PP represented countries meant to support the scaling up of CS projects. Further to this, PART A also included an "impact section" dedicated to assess the impact of the whole MLE CSI-PP project on the MLE CSI-PP country representatives and their institutions.

PART B of the survey was meant to get information and experiences about exemplary up-scaled CS projects from the MLE CSI-PP country representatives.

The survey can be found in Appendix A of this Discussion Paper.

Out of the 11 MS representatives participating in the MLE CSI-PP project, four MSs completed the survey (PART A and B) and five MSs completed PART A of the survey. Overall, five exemplary up-scaled CS projects were shared by four MSs: The Plastic Pirates – Go Europe! citizen science initiative, Dugnad for Havet (in english: Marine Citizen Science), FotoQuest GO, The Star Spotting Experiment and the Tea Bag Index (section 4.1 and Appendix C)

1.2.3.   The interviews

In the summer of 2022, open-ended interviews were conducted via Zoom with seven experts in CS and cognate disciplines. A list of open-ended questions was shared with the interviewees as a prompt for the interview to discuss the topic of scaling up CS. The interview protocol and the list of the interviewees are available in the Appendix B.

2. Scaling-up citizen science

2.1. Definition(s) and dimensions of scalability

According to the findings from the survey distributed among the MLE CSI-PP country representatives, the interviews and the preliminary literature, there is no general consensus in the European CS community on the meaning of scalability, its dimensions and the approaches to foster the scaling up of CS projects[8].

Furthermore, as Maccani and colleagues (2020) point out, in the literature on CS and its cognate disciplines, the term scaling has been underexplored, or used inconsistently as a synonym of spreading or replicating. For example,

- in the "context of Social Innovation, Davies and Simon (2013), use the terms "scaling" and "spreading" interchangeably to generally describe geographical growth and replication of social innovation actions […]

- in the Business and Management literature, scaling is often associated with organisational growth in a market (DeSantola and Gulati, 2017) […]

- Clark and colleagues (2012) acknowledge how there is an increasing cross-disciplinary trend of shifting "away from the concept of scaling as organisational growth and towards the concept of scaling impact, or the outcomes the organisation has generated beyond just the organisation itself" (p.5)".[9]

Drawing on Innovation Society scholarship[10], Passani[11] highlights two problems with evaluation and scalability comparisons in the Innovation Society ideology/narrative which consist of:

1) the drivers and the metrics of scalability: economic value/profit is the target for entrepreneurial innovation, whereas for social innovation the targets are social value and impact on people's lives;

2) the problem of "scaling": scaling for entrepreneurial innovation can be accomplished using the profits generated by the projects, whereas scaling for social innovation is more challenging because social innovation projects are usually context-dependant (geographically and socially) and don't generate economic profit.

"In the Innovation Society ideology, the success or failure of an innovation – that is, whether or not it will "scale"– depends on just one thing: the profit it will generate in the marketplace. From this point of view, projects that the innovating entrepreneur   undertakes and the ways he goes about implementing them, must be primarily driven by economic value. In contrast, the social innovator's projects are primarily driven by social values, which take into account the different ways in which the projects affect the lives of the members of the population they seek to impact. [...].

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[8] Maccani et al. 2020, Balestrini et al. 2021
[9] Maccani et al. 2020, p. 9
[10] Addario and Lane 2014
[11] Passani 2022, 2014

There is another problem that social innovators have to solve in a different way from the innovating entrepreneur in the Innovation Society's dominant narrative: the problem of "scaling." In the Innovation Society's narrative, innovation projects scale with the profits they generate, which can be used to produce and market more of the new product, or can be invested to start up new innovation projects. Scaling for social innovation projects is much more problematic. First, many social innovation projects are site-specific, geographically and socially: after all, most aspects of most people's well-being, the quality of their personal lives and social interactions are determined in large part by factors specific to the environments in which they live".[12]

In the field of CS, Maccani and colleagues[13] provide a definition of scalability distinctive from the concept of spreading, where:

- "Scaling refers to the extension of existing approaches from a smaller geographical area to a larger one - for example from a neighbourhood to an entire city, and then to a region", whereas

- "Spreading […] is understood as the ability to successfully replicate and carry over CS approaches from one location to another at the same geographic scale - for example from one neighbourhood, city or region to another".

Although the distinction between the two terms is an important one, it should be noted that some extent of overlap between the two terms exists, for example when the project scales up only geographically[14].

Passani[15] also agrees on the importance of making a distinction between scaling up and replicating, suggesting to consider replicability as a more sustainable dimension of scalability. Further to this, Passani discusses the potential adaptability of the replicated/upscaled CS projects or methodologies according to the new places, cultures, people, etc.

Lehner[16] also points to adaptability but from a different angle through which it is seen as a characteristic of scalability that occurs when part of a project, e.g., the methodology, is scaled up by other stakeholders and applied to different contexts/fields (as in the case of the VILLAGE project[17]). Conversely, scalability can be interpreted as "the qualities of any given CS project that enable it to be scaled up or down in different contexts […] without much adaptation, so that the results can feed into a larger whole" (Norway, Table 1).

For the MLE CSI-PP country representatives who responded to the survey (Table 1), scalability can be generally associated with a growth in size, and occurs according to several dimensions, such as the geographic spread, the temporal spread, the research scope, the communities engaged, the amount of data collected, and the technology / methodology deployed.

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[12] Loretta & Passani 2014, pp. 11-12
[13] Maccani et al. 2020
[14] Schade 2022
[15] Passani 2022
[16] Lehner 2022
[17] https://village.lbg.ac.at/

Table 1. Verbatim responses of the MLE CSI-PP country representatives to the survey's questions 4: *How would you define scalability in citizen science?* and 5. *What are the key dimensions of scalability in your opinion?* (Annex A)

Member State	Definition	Dimensions
Austria	*Scalability is the potential of a CS campaign/project to enlarge its reach - geographically its area of study, i.e., its reach to citizen scientists and sampling sites/data etc. and/or socially its coverage of social groups, i.e. addressing marginalised or hard to reach groups.*	*Key dimensions of scalability are:* *a) Topic of CS campaign (e.g., if it deals with a local language, versus if it deals with climate change mitigation)* *b) Methodology of CS campaign (e.g., is it using expensive equipment, or does it require specific conditions?)* *c) Project/campaign management capacities (i.e., can the people behind the campaign cope with the increased numbers of citizen scientists or samples?)* *d) Added value potential of going large.* *e) Ethical considerations.*
Belgium	*The possibility to move from very specialised stakeholders' involvement to the involvement of the general public*	*Communication, empowerment*
Germany	*In our understanding scaling refers to the extension of existing approaches from a smaller geographical area to a larger one. Scalability in citizen science enables knowledge transfer and community building at the same time. Gained best practice experiences can be shared among scientists and citizens.*	*Geographical dimension: from local to global knowledge dimension: research scope, impact/ relevance, Communication dimension: partner network, communication channels Technology use and accessibility dimension: application of platform technologies*
Norway	*Scaled, citizen-led research is a way of conducting research or innovation by involving large numbers of non-professional researchers in researching an important issue, and, through this, improving scientific knowledge and empowering non-professional researchers. We interpret scalability as the qualities of any given citizen science project that enable it to be scaled up or down in different contexts, so that it can*	*Interest and involvement, ethics in conducting research work, data collection and ethical involvement in the evaluation process, culturally sensitive, ability to be communicated in diverse cultural settings*

	be conducted in local, regional, national and international contexts without much adaptation, so that the results can feed into a larger whole. This requires the implementation of scientific methods and data collection, for example that can easily be used in different settings.	
Portugal	*The threefold capacity to impact & change RFPOs at the levels of policy, rules, etc., to change cultural relationships, values, beliefs, expectations and needs, and to increase the number of people & communities engaged and impacted.*	*Impacting RFPOs; impacting cultural expectations; increasing reach.*
Romania	*-*	*-*
Slovenia	*As an extension of existing approaches from small community/projects to larger ones*	*Improving, adjusting, sharing (knowledge)*
Sweden	*Enable the inclusion of small and large groups of participants. Can include small to increased amounts of users, data or transactions without tension.* *New - The possibility to adapt a project or citizen science initiative to new target groups and stakeholders.*	*Flexible, robustness* *Collaborations, translation, communication.*

2.2.   Discussion points and open questions

In Section 2.1 we provided an overview of the different meanings associated with the term scaling and its use as a synonym of concepts like spreading, replicating, adapting in CS and neighbourhood disciplines. Following Maccani and colleagues, we believe that a lack of common agreement on the definition of scalability and its dimensions can represent "a substantial gap […] with respect to a commonly understood theoretical and pragmatic framework to first understand and subsequently guide scaling and spreading of practices and outcomes (also) in the Citizen Science field"[18].

The Berlin meeting therefore represents an opportunity for the MLE CSI-PP country representatives to reflect on the meaning of the term and its constitutive dimensions in CS and on the implications of a common definition of scalability for policymakers.

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[18] Maccani et al. 2020

Below we report a list of open questions which can be used as a basis for discussion during the Berlin meeting's working sessions.

- What does scalability in CS mean for the MLE CSI-PP country representatives?

- Is scalability in CS a quantitative and/or qualitative construct?

- Should scalability and its dimensions in CS be 'responsible'[19]?

- What are the dimensions that should define scalability in CS?

- What are the differences (if any) between the term scalability, replicability and adaptability for the MLE CSI-PP country representatives?

- Can a common definition of scalability in CS be relevant for policymakers?

- How do the scalability's dimensions interrelate and affect the scalability of CS projects?

- How can scalability and its dimensions be measured by policymakers?

- The seven Questions of the Scaling Ambition Framework[20]

    1. What do we want to scale?
    2. For whom? Who is our target group?
    3. Where? What is/are our target intervention area/s?
    4. How many? What is the size of the target group aimed for?
    5. By whom the scaling process is led?
    6. By when will we reach the desired scale?
    7. Why? What is the system change we contribute to?

3. Drivers, success factors and challenges of scaling up Citizen Science

Knowledge of drivers, challenges and related mitigation strategies are key to the successful scaling up of CS projects. However, the literature on CS offers limited insights into the factors that influence the processes of scaling up CS projects and initiatives[21].

A valuable exception is represented by the 9-Drivers Framework, a conceptual framework developed by Maccani and colleagues[22] to support the scaling up of CS projects by design. For this Discussion Paper, we firstly introduce this framework in section 3.1., and then in section 3.2 we use it as a qualitative tool for analysing the success factors and challenges of

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[19] The term refers to the EC RRI framework: https://rri-tools.eu/about-rri
[20] Adapted from Maturano 2020
[21] Balestrini et al. 2020
[22] Maccani and colleagues 2020

scaling up CS reported by the MLECSI-PP country representatives by answering questions 6 and 7 of the survey (Table 2).

3.1.   Scaling up Citizen Science by design: the 9-Drivers Framework

Maccani and colleagues developed a conceptual framework for scaling up CS projects by design, drawing on theories of diffusion of innovation, technology adoption and infrastructure[23]. This theoretically grounded framework encompasses nine enablers for scaling up CS projects, that belong to three overarching categories:

• **Intrinsic elements of a given CS initiative to be scaled or spread** (proof of value, ease of use and understanding, openness)

• **Elements supporting the spreading and up-scaling process** (communication and dissemination strategies, community and champions, knowledge sharing and transfer resources)

• **Extrinsic elements of the target socio-technical context** (matter of concern, legal and social alignment).

These nine enablers are represented in Figure 2 and described in section 3.1.1, 3.1.2, 3.1.3.
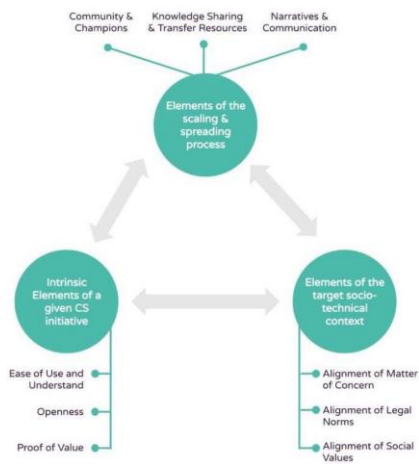

Figure 2. the 9-Drivers Framework for scaling up CS[24]

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[23] *Ibidem*
[24] Image source: Maccani et al. 2020

3.1.1. Intrinsic elements of a given CS initiative to be scaled or spread

- **Proof of Value**: this first driver acknowledges that for a CS intervention to scale, the value of its outcome (in other words, its impact) must be present, clear, demonstrated, and understood[25]

- **Ease of Use and Understanding**: this driver stresses the idea that the more the subject of scaling is easy to use (e.g., technology or specific practices) and understand (e.g., the core subject), the more likely it is to scale[26]

- **Openness**: this driver refers to the use of Open-Source Software (OSS)/Technology and Open Data (OD)[27] and assumes that if OSS or OD are used or developed within CS projects, then the scalability of the projects and/or the technology is facilitated[28]

3.1.2. Elements supporting the spreading and up-scaling process

- **Development and Dissemination of Narratives and consistent Communication Material**: This element includes actions and strategies of communication, dissemination, and the importance of developing narratives to stimulate uptake of innovations[29].

- **Community and Champions**: this driver supports the concept that scaling is not simply about dropping a technology and a methodology into a new (or an extended) context. Rather, these must be supported by an artful work of aligning actors around the shared concern and fostering continuous engagement[30]. It also provides a discussion about the Taxonomy of Community Roles and the role of the Champions.

- **Knowledge Sharing and Transfer Resources**: this dimension acknowledges the role that resources play in sharing and transferring of CS knowledge from one context to another[31].

3.1.3. Extrinsic elements of the target socio-technical context

- **Alignment of Matter of Concern**: This element stresses the importance for the new context to be facing and experiencing similar issues as those tackled in the original intervention; in other words, it suggests that a given CS initiative can be (fully) up scaled in another location if (and only if) the problem is relevant in such a geographical area[32].

- **Legal Alignment**: This element acknowledges the role played by the regulatory and legislative environment and the need for these to be aligned between the initial context and the one within which scaling will take place[33].

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[25] Maccani et al., 2020, p. 22
[26] Ibidem
[27] Including the data collected (i.e. the raw data), its analysis (i.e. the transformation process from data to information to knowledge) and the data outcomes (i.e. the aggregated results) are made publicly available (preferably online). (Maccani et al., 2020, p. 24).
[28] Maccani et al., 2020, p. 22-23
[29] Ibidem
[30] Maccani et al., 2020, p. 24
[31] Maccani et al., 2020, p. 28. For an overview of CS resources see the EU-Citizen.Science Platform page: URL: https://eu-citizen.science/resources
[32] Maccani et al., 2020, p. 29
[33] Ibidem

- **Alignment of Social Values**: this driver stresses the importance for alignment of social values across contexts for scaling to happen (e.g., language, culture, technology)[34].

3.2.   Success factors and challenges of scaling up Citizen Science reported by the MLE CSI-PP country representatives

The elements of the 9-Drivers Framework described in section 3.1 can act as enablers and success factors but can also constitute important challenges as emerged from the qualitative analysis of the responses provided by the MLECSI-PP country representatives to questions 6 and 7 of the survey. These success factors and challenges are reported in Table 2 and discussed hereafter and in section 3.3.

Specifically, Table 2 shows the success factors and challenges reported by the MLE CSI-PP country representatives, assembled using the 9-Drivers Framework. From the observation of these findings, several patterns emerged:

- Responses provided as success factors and challenges could be associated to Drivers 1. Proof of value, 4. Communication and dissemination, 5. Community and Champions, 6. Knowledge sharing and transfer resources, and 9. Social alignment.

- Responses provided only as challenges could be related to Driver 8. Legal Alignment (e.g., data/tech interoperability).

- No responses could be related to Drivers 2. Ease of use and 3. Openness.

- Notably, some of the success factors and challenges reported by the MLE CSI-PP country representatives could not be associated to any of the 9 Drivers (see Table 2, Row "Other"). Specifically,

    – As per the success factors: sustainable funding of the campaign, citizen scientists' capabilities and commitment, robust and flexible project plans, availability of resources (time, personnel, funding) for the citizen scientists.

    – As for the challenges: availability of resources (time, personnel, funding), research integrity and high level of data quality, resistance from non-CS research x commitment.

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[34] Maccani et al., 2020, p. 30

Table 2. Verbatim responses (assembled per the 9-Drivers) of the MLE CSI-PP country representatives to the survey's question 6. *What are the main success factors for scaling up citizen science projects in your opinion?* and question 7. *What are the main challenges in scaling up citizen science projects in your opinion?*

Driver/s	Success factors	Challenges
1. Proof of value	*- Need for CS* *- previously identified needs* *- shown added value* *- empowerment* *- ethical involvement* *- the use of internationally recognised methodologies* *- expectations & need for CS*	*- Unconvincing added value*
2. Ease of use & understanding	--	--
3. Openness	--	--
4. Communication and dissemination	*- Development and dissemination of communication material* *- Good stories, amplified to generate cultural ideas* *- A good multilingual awareness- and recruiting-campaign* *- IT tools and infrastructure* *- Translation, communication.*	*- Multilingual communication* *- Language barriers*
5. Community and champions	*- Community - network building* *- Active networks* *- Citizen-researcher mutual trust* *- Potential of CS campaign topic to "capture the hearts" of citizen scientists* *- Collaborations*	*- Built sustainable cooperation of actors* *- Lack of interest (x2)* *- Answering to the question: what's in it for me* *- Recruiting/Awareness* *- (Micro-)management of sample and community size* *- Engage different actors across different nationalities/regions*
6. Knowledge sharing and transfer resources	*- Knowledge sharing and transfer of resources to relevant actors in science and policy* *- Ownership of the results and data*	*- Organise knowledge transfer* *- Ensure data transfer*
7. Matter of concern	*- Widely spread core principles (not necessarily actual programmes)* *- Adaptability to local contexts & issues*	--

	- Interesting subjects, which address issues that concern a large group of the population and civil society at large (e.g., SDGs)	
8. Legal alignment	--	- Interoperability of data - Interoperability of IT infrastructures and tools - Governance differences that may affect methodology
9. Social alignment	- Culturally sensitive, ability to be communicated to culturally diverse settings	- Cultural/Environmental differences that may affect methodology - Cultural differences - Knowing your target group
Others	- Sustainable funding of campaign - Incentives and benefits for the citizen scientists themselves - Willingness and capabilities of CS campaign team to go large - Scaling-up capabilities in order to adapt the CS project to different contexts - Robust and flexible project plans - Enough time to implement the project in different areas/countries - Enough human resources and funding for a sufficient time period	- Resistance from non-CS research x commitment, person-hours needed to address this - Funding - Ensure research integrity - Ensure a high level of data quality - Have enough time and resources

3.3. Selection criteria for up-scaling Citizen Science projects transnationally

The development of "a set of clear criteria for up-scaling national projects and initiatives" and the identification of "criteria for choosing EU wide campaigns" were indicated by the MLECSI-PP country representatives as ones of the most important issues to address in the MLE CSI-PP Topic 5 Scaling up CS (see Figure 1).

To meet this request, a specific question was included in the survey to collect feedback from the MLE CSI-PP country representatives (Annex A, Question 8. *Based on which criteria would you select citizen science projects to be scaled up transnationally?*). The verbatim responses to this question provided by MLE CSI-PP participants are reported in Table 3. These criteria can serve as a basis for discussion in the working sessions during the Berlin meeting.

Table 3. Verbatim responses (assembled per macro-themes) of the MLE CSI-PP country representatives to the survey's question 8. *Based on which criteria would you select citizen science projects to be scaled up transnationally?*

Based on which criteria would you select citizen science projects to be scaled up transnationally?
• *Data quality*   • *High data quality*   • *Relevance of data*   • *Methodological benefit from big sample numbers or transnational data*   • *Need for a lot of data that researchers are not able to collect themselves*   • *Impact on research*   • *Potential for high impact*   • *Topic of national/ international interest addressing global challenges;*   • *European/Global dimension of topic (e.g., relevance to EU Missions);*   • *Comparative research/transnational topics*   • *Addressing societal challenges*   • *Benefits for citizens*   • *Social impact*   • *Touch people in their daily life*   • *Common interest*   • *Interest from other target groups*   • *Ethical involvement of citizens*   • *Previous successful campaign/project*   • *Willingness of CS campaign team to expand*   • *Potential to engage/activate citizens in a specific policy area (e.g., higher level on the "citizen science escalator")*   • *The project's ability to engage broadly*   • *Campaign fulfilling all ECSA criteria for a CS project*

3.4.   Discussion points and open questions

An analysis of the challenges reported by the MLE CSI-PP country representatives (Table 2) highlights a certain level of overlap with some of the challenges about research integrity and high-level data quality, legal alignment, community engagement and knowledge transfer, which were discussed in the previous MLE CSI-PP meetings covering Topics 2, 3 and 4 (*Ensuring good practices and impacts*; *Maximising the relevance and excellence of citizen science*; *Enabling environments for supporting and sustaining citizen science*). Whether a certain degree of specificity can be claimed for the topic of scaling up CS and for which specific challenges remain an open question that could be worth further reflection during the Berlin meeting.

For this Discussion Paper, we focus on two factors affecting the upscaling of CS projects and initiatives that can be specifically relevant for policymakers: the driver Proof of Value (impact) and Funding.

- **Proof of value**

On a general note, demonstrating impact from CS interventions is a widely acknowledged challenge, reinforced by the nature of EU-funded projects which are more likely about experimenting and learning than providing proof of value[35].

Further to this, it is especially challenging demonstrating impact for upscaling CS projects and initiatives because as outlined in Section 2.1 the drivers and the metrics usually applied for measuring scalability in the Innovation Society (i.e., economic value/profit) cannot be applied to CS projects which conversely target social value and impact on people's lives in geographically and socially site-specific contexts[36].

- **Funding**

How to financially sustain the projects and their scalability is another challenge reported by the MLE CSI-PP country representatives (Table 2, Row "Others") that more broadly reflects a scarcity of specific funding lines, programs and policies for scaling up CS projects at the European and national level confirmed by the pool of experts interviewed (Appendix B).

Maccani[37] acknowledged funding is missing from the 9-Drivers Framework[38], although is a key enabler because it is hard to find calls that support scalability of CS projects although the European Commission (EC) through its programmes and calls encourage the EU-funded projects to re-use outputs/outcomes/toolkits/platforms produced by previous projects[39].

Notably, Passani[40] pointed to the cascading grants mechanism supported by the EC as a potential line of funding for scaling up CS projects and illustrates the examples of the EU-funded ACTION and IMPETUS[41] projects. As for the latter, IMPETUS will launch 3 calls to fund 125 projects, out of which 25 will be for ongoing projects to support their sustainability, especially projects run by independent researchers, NGOs, and social organisations. According to Passani (2022), the selection criteria for these ongoing projects are under definition, but it can be anticipated that novelty cannot be one of these criteria, whereas impact can be a criterion to use.

Contrary to this, Balestrini[42] made an original point by arguing that it is time for the CS community to move from piloting to sustaining and upscaling successful CS projects starting from a reconsideration of CS projects' business models. In so doing, Balestrini said, we need to find other funding sources, such as private ones, foster knowledge transfer to industry and the commercialisation of the outcomes of the CS projects as products.

These considerations about impact/proof of value and funding open up questions that could be discussed during the Berlin meeting, such as:

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[35] Maccani 2022
[36] Passani, 2022
[37] Maccani 2022
[38] Maccani et al. 2020
[39] see for example the call Innovative governance, environmental observations and digital solutions in support of the Green Deal HORIZON-CL6-2022-GOVERNANCE-01
[40] Passani 2022
[41] https://impetus4cs.eu/
[42] Balestrini 2022

- Where does the innovation lie for CS today[43]?

- What criteria can be applied by policymakers for measuring impact/proof of value of CS projects and initiatives?

- What criteria can be applied by policymakers for selecting CS projects to up-scale transnationally?

- What kind of funding mechanisms can be developed by policymakers for supporting the upscaling of CS projects and initiatives?

- Is the EU cascading grants mechanism replicable at the local/regional/national level?

- How can policymakers support CS practitioners/scientists to develop alternative business models for upscaling and sustaining CS projects and initiatives?

4. Lessons from the field: examples of up-scaled Citizen Science projects

To overcome the little knowledge about the approaches developed in the MS for scaling up CS projects, this Discussion Paper presents examples of up-scaled CS projects, drawing on the experiences shared by the MLECSI-PP country representatives.

4.1. Five up-scaled Citizen Science projects shared by the MLE CSI-PP country representatives

Five exemplary up-scaled CS projects are presented hereafter: The Plastic Pirates – Go Europe! citizen science initiative, FotoQuest GO, The Star Spotting Experiment, The Tea Bag Index, and Dugnad for Havet (in English: Marine Citizen Science). These projects were submitted by the MLE CSI-PP country representatives via Part B of the survey (Appendix A). The text in Italics inserted in the tables below is verbatim.

CS Project #1 - The Plastic Pirates – Go Europe! citizen science initiative
Member State: *Germany*   **Lead Institution**: *DLR Project management agency as the action's coordinator*   **Timescale:** *2016 - ongoing. The Plastic Pirates project started in 2016 in Germany and was upscaled to Slovenia and Portugal in 2020. In 2022 the PlasticPiratesEU action began with the Europeanisation of the initiative to Austria, Spain, Italy, Lithuania, Hungary, Belgium, Greece, Bulgaria. The action will run until 2024.*   **Aim:** *The objectives of the action are to Europeanise the Plastic Pirates – Go Europe initiative; have a more comprehensive assessment and monitoring of plastic litter in Europe's rivers, coasts and seas; contribute to the Mission Restore our Ocean and Waters by 2030 and support the implementation and monitoring of EU policy objectives; raise awareness among citizens on the impact and benefits of R&I in their daily lives; and*

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[43] Schade 2022

engage schoolchildren and young people in research activities.

- **Reason for selecting this project as an exemplary one:** *Applicability and Topic. The main reason for this project to be a success in scaling up is its applicability across Europe as well as the relevance of the topic of plastic waste pollution.*

- **Elements scaled up:** *number of participants, geographical reach (number of countries), materials translated, number of data sets gathered, number of researchers, citizen scientist involved.*

- **Success factors:** *Extensive collective expertise and experience, frequent exchange and consultation, well-chosen network of partners, successful national campaign before scaling up.*

- **Challenges:** *Conveying the correct implementation of the methodology/protocol, regional and cultural differences in approaches to education and science, differing educational systems, differing landscapes (river shores, coastlines, beaches), data comparability*

- **Mitigation actions:** *To convey the correct implementation of the protocol via in person training-the trainer workshops were held. To overcome cultural and regional differences the materials have been slightly adapted without jeopardizing the applicability of the protocol. When there are differing landscapes that do not fit the instructions of the protocol, local partners advise on how to adapt. To ensure data comparability, all partners have been trained in data processing and validation. In addition, there is regular exchange with the coordinator and amongst all partners involved in the initiative.*

- **Sustainability Plan / Business Model:** *A plan to make the project sustainable is in the making.*

- **9-Driver Framework Check-List:** see Appendix C.

CS Project #2 - FotoQuest GO

- **MS:** *Austria*

- **Lead Institution.** *IIASA*

- **Timescale:** *3 campaigns: 2015, 2016 and 2018 - still ongoing without prices and micropayments.*

- **Aim:** *Mimic the LUCAS (Land use and land cover survey) data collection protocol and collect data on land cover and land-use on selected points of interest overlapping with established survey points. Monitor changes in land use on those points to previous information of years before. Raise awareness of land-use and land cover change. Test accuracy of citizen data versus authoritative data.*

- **Reason for selecting this project as an exemplary one**: *Because once we allowed European and not only Austrian people to contribute to the project we got many ground points / LUCAS points classified by people living in other European countries such as Germany, UK, Spain, Netherlands, etc. The app was unfortunately only available in English and German so there were some language barriers.*

- **Elements scaled up:** *Geographical area, more people contributing, more diversity of contributors.*

- **Success factors:** *Language, budget available, media coverage and personal feeling to be part of an important project, immediate feedback technology was added.*

- **Challenges:** *Money available for micro-payments, outreach activities and making people aware of the existence of the project, to motivate /incentivise people to participate, multilingual needs.*

- **Mitigation actions:** *English was added as another language, different outreach channels being used in particular personal contacts in respective countries.*

- **Sustainability Plan / Business Model**: *Yes.*

- **9-Driver Framework Check-List:** see Appendix C.

CS Project #3 - The Star Spotting Experiment

- **MS:** *Sweden*

- **Lead Institution:** *Public & Science (VA) and Lund University*

- **Timescale:** *2019-2020*

- **Aim:** *The objective was to test a new method for measuring light pollution, based on the principle that the more stars you see in the night sky, the less light pollution. The method used was simple and did not require any prior knowledge. All that was needed was a compass and a measuring instrument consisting of a cardboard tube with a protractor attached to it. Each participant counted the number of stars they could see through the tube, in nine predetermined directions. The observations were then reported in the Star-Spotting app or via the web and the observer was instantly told how light-polluted it was at that particular observation location.*

- **Reason for selecting this project as an exemplary one:** *Interest. The main reasons were that there was an interest from other organisations in other countries to be part of the Star Spotting Experiment, something we had just started in Sweden. Through contacts we started collaborating with people in Spain, Ireland and the UK.*

- **Elements scaled up:** *Participation, instructions, manuals.*

- **Success factors:** *Good communication materials.*

- **Challenges:** *Letting others take over communication, letting go of the control of details.*

- **Mitigation actions:** *This can be overcome by ensuring you collaborate with people and organisations you trust and that you know will do a good job. Close communication within the project is also essential.*

- **Sustainability Plan / Business Model:** *No.*

- **9-Driver Framework Check-List:** see Appendix C.

CS Project #4 - Tea Bag Index (TBI)

- **Member State:** *Austria*

- **Lead Institution:** *AGES - Agentur für Gesundheit und Ernährungssicherheit GmbH*

- **Timescale:** *2010 – ongoing*

- **Aim:** *The TBI method measures decay of plant material by using two types of tea (Green and Rooibos) as standard plant litter (Keuskamp et al., 2013) in plastic mesh bags. Tea bags are placed in the soil and weight loss is determined after three months. With the TBI method, it becomes easy to compare sites in a standardised way and test climatic forcing on decay with a high resolution. The TBI App has been developed to facilitate the application of the TBI method.*

- **Reason for selecting this project as an exemplary one:** *Standardisation: With the TBI method and the TBI App it becomes easy to compare soil health across Europe in an easy and standardised way. This would increase local soil data that is missing in Europe and empower citizens to care for their soils. The TBI App has also been seen as an excellent teaching tool in Austria, thus, it could be rolled out in various educational campaigns. The TBI App is currently available in English and German only, thus, for a European rollout it would be necessary to bring in more languages.*

- **Elements scaled up:** *Digitalisation, i.e. the creation of the TBI App in 2019: https://teatime4schools.at/teatime4app. Easy accessibility, step-by-step instructions and data generation in App.*

- **Success factors:** *funding for coordination and science communication, easy accessibility of the methods, protocols and data generation using the TBI App (Android & iOS); step by step instructions on how to conduct the methods in App using infographics and easy texts; media coverage; connection to the EUSO WG on citizen engagement so we could show that the data is valuable and used for European soil monitoring, investigation of students and teachers individual learning outcomes enables us to learn about the motivations of our citizens.*

- **Challenges:** *languages (now in English and German only); financial funding (to overcome language barrier, science communication, adding automated calculations to the TBI App, enabling continuation of App maintenance and development, having a person actively working for the project).*

- **Mitigation actions:** *until now the App is available in German and English only, on the TBI website, however, TBI protocols can be downloaded in 12 different languages; funding: proposals + AGES is paying for the App maintenance.*

- **Sustainability Plan / Business Model:** *not yet well developed.*

- **9-Driver Framework Check-List:** see Appendix C.

CS Project #5 - Dugnad for Havet (in English: Marine Citizen Science)

- **Member State:** *Norway*

- **Lead Institution:** *Institute of Marine Research, Norway (IMR)*

- **Timescale:** *2020-ongoing*

- **Aim:** *The Marine Citizen Science project aims to increase ocean literacy by involving participants in monitoring and registering marine life and rubbish along Norway's coastline. Observations are reported on a marine platform. Researchers at the Institute of Marine Research are monitoring how well the marine fauna is doing. Participants can report anything they find on the platform, but the scientists are focusing on selected species, for the moment this includes mussels, oysters, seaweed, rubbish and algal blooms. The project involves citizens, schools, camps or other groups, for long-term monitoring of biodiversity in their local communities. Read more on their web page, choose English: https://dugnadforhavet.no*

- **Reason for selecting this project as an exemplary one**: *The project has managed to uphold high levels of quality across the board, broad societal engagement, high data quality, internationally renowned researchers are involved. There has been a rapid increase in the number of CS participants involved. The project has attracted nation-wide attention. Without large marketing or campaigns, the Marine Citizen Science project DugnadforHavet has become known by word of mouth among recreational and commercial fishers, divers, schools, staff at oil platforms. Data has been collected from across Norway, of all ages and genders. Since 2020 large amounts of data have been reported.*

- **Elements scaled up:** *functional digital dialogue platform, rapid feedback from scientists to the CS. Use of digital and nationwide news media, to present particularly interesting observations.*

- **Success factors:** *Personal dedication. An existing well-functioning data base. Experience with citizen communication. A well-developed IT-system and staff, with many of the necessary functions for CS communication in place. IMR being the national level marine research institute, covering the whole country.*

- **Challenges:** *No dedicated funding. Low priority among the tasks of IMR. Lack of access to necessary skilled staff, in particular to maintain and make the data accessible outside the institute. The project participants within IMR are continuously asking for dedicated funding.*

- **Mitigation actions:** *Applications for funding have been sent for national and commercially sponsored research funding. Short-term funding has been found in running projects with CS -profiles, but on a lower scale than the national level.*

- **Sustainability Plan / Business Model:** *no.*

- **9-Driver Framework Check-List:** see Appendix C.

4.2.   Discussion points and open questions

In Section 4.1 of the Discussion Paper, we presented five examples of up-scaled CS projects reported by the MLECSI-PP country representatives. From the data provided by the MLECSI-PP country representatives about the exemplary CS up-scaled projects, success factors, challenges & related mitigation strategies were gathered and reported in Table 4 and Table 5 respectively.

Table 4. Overview of the verbatim success factors of the five exemplary CS up-scaled projects reported by the MLECSI-PP country representatives.

Success factors
Extensive collective expertise and experience; Experience with citizen communication   *Frequent exchange and consultation*   *Well-chosen network of partners*   *IMR being the national level marine research institute, covering the whole country*   *Successful national campaign before scaling up*   *Language*   *Media coverage (x2)*   *Good communication materials*   *Budget available; Funding for coordination and science communication*   *Personal feeling to be part of an important project; Personal dedication*   *Immediate feedback technology was added*   *Easy accessibility of the methods, protocols and data generation using the TBI App (Android & iOS)*   *Step by step instructions on how to conduct the methods in the App using infographics and easy texts*   *Connection to the EUSO WG on citizen engagement so we could show that the data is valuable and used for European soil monitoring*   *Investigation of students and teachers individual learning outcomes enables us to learn about the motivations of our citizens*   *An existing well-functioning data base*   *A well-developed IT-system and staff, with many of the necessary functions for CS communication in place*

Table 5. Overview of the verbatim challenges & related mitigation strategies of the five exemplary up-scaled CS projects reported by the MLE CSI-PP country representatives (grouped per topics).

Topic/s	Challenges	Mitigation strategies
Interoperability & Comparability (protocols, methods, data)	*Conveying the correct implementation of the methodology/protocol* *Data comparability*	*To convey the correct implementation of the protocol via in person training-the trainer workshops were held* *To ensure data comparability, all partners have been trained in data processing and validation. In addition, there is regular exchange with the coordinator and amongst all partners involved in the initiative*
Social and geographical alignment/s	*Regional and cultural differences in approaches to education and science, differing educational systems, differing landscapes (river shores, coastlines, beaches)*	*To overcome cultural and regional differences the materials have been slightly adapted without jeopardizing the applicability of the protocol. When there are differing landscapes that to do not fit the instructions of the protocol, local partners advise on how to adapt*
Communication	*Multilingual needs* *Languages (until now the App is available in German and English only)*	*English was added as another language* *On the TBI website, however, TBI protocols can be downloaded in 12 different languages*
Outreach, citizen engagement, motivation	*Outreach activities and making people aware of the existence of the project* *To motivate /incentivise people to participate*	*Different outreach channels being used in particular personal contacts in respective countries*
Management	*Letting others take over communication, letting go of the control of details*	*This can be overcome by ensuring you collaborate with people and organisations you trust and that you know will do a good job. Close communication within the project is also essential*
Funding	*Financial funding (to overcome language barriers, science communication, adding automated calculations to the TBI App, enabling continuation of App maintenance and development, having a person*	*Funding: proposals + AGES is paying for the App maintenance*

	actively working for the project)	
	No dedicated funding. Low priority among the tasks of IMR. Lack of access to necessary skilled staff, in particular to maintain and make the data accessible outside the institute. The project participants within IMR are continuously asking for dedicated funding	*Applications for funding have been sent for national and commercially sponsored research funding. Short-term funding has been found in running projects with CS - profiles, but on a lower scale than the national level*
	Money available for micro-payments	

From the observation of these findings, several questions about the uptake for policymaking arise. These questions are listed below and can serve as a basis of discussion during the Berlin meeting:

- What lessons can be learnt from the exemplary CS up-scaled projects?

- What are the common success factors in the approaches underpinning the up-scaled CS projects?

- What are the success factors to consider for developing a roadmap for transnationally up-scaling CS projects?

- How can policymakers support the alignment of approaches and the increase of co-operation?

- How can policymakers contribute to tackling the challenges represented by scaling up CS projects and initiatives?

- What uptake for policymaking can be derived from the success factors of the up-scaled CS projects?

5. Towards the Berlin meeting

During the Berlin meeting, we will have three working sessions dedicated to discussing the topic of scaling up CS projects with an emphasis on the uptake for policymakers. Specifically:

- **Working sessions #1** and **#2** will focus on challenges and success factors for scaling up CS, specifically discussing:

    - Definition(s) of scalability and its dimensions for the MLE CSI-PP country representatives

- Lessons learned from the field, looking at success factors, challenges and mitigation strategies/action plans shared by the MLE CSI-PP country representatives and best practices from the literature

- **Working session #3** will assess the uptakes for policymaking and reflect upon operational recommendations for policymakers aimed at supporting the scaling up of CS projects and initiatives, with a focus on:

  - Assessment and selection criteria for CS projects and initiatives to scale up

  - Funding lines and mechanisms, and business plans to support/incentivise the upscaling of CS projects and initiatives.

Policy-oriented outcomes of these three working sessions could include:

- A shared/common MLE CSI-PP definition of scalability/upscaling for CS

- An updated framework of drivers/success factors for scaling up CS projects

- Mitigation strategies/ action plans that policymakers can support to address major challenges identified by the MLE CSI-PP country representatives

- Operational recommendations/a roadmap for policymakers for the creation of policies/programmes/funding lines to support the scalability of CS projects.

5.1.   Overview of the guiding questions for the working sessions

During the Berlin meeting, the discussion in the working sessions can be supported by the open questions reported below per topic. Additional open questions and points of discussion can be provided by the MLE CSI-PP country representatives and the participants during the Berlin meeting.

#1 – Definition of scalability and its dimensions for the MLE CSI-PP country representatives

- What does scalability in CS mean for the MLE CSI-PP country representatives?

- Is scalability in CS a quantitative and/or qualitative construct?

- Should scalability and its dimensions in CS be 'responsible'[44]?

- What are the dimensions that should define scalability in CS?

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[44] The term refers to the EC RRI framework: https://rri-tools.eu/about-rri

- What are the differences (if any) between the term scalability, replicability and adaptability for the MLE CSI-PP country representatives?

- Can a common definition of scalability in CS be relevant for policymakers?

- How do the scalability's dimensions interrelate and affect the scalability of CS projects?

- How can scalability and its dimensions be measured by policymakers?

- The seven Questions of the Scaling Ambition Framework[45]

    1. What do we want to scale?
    2. For whom? Who is our target group?
    3. Where? What is/are our target intervention area/s?
    4. How many? What is the size of the target group aimed for?
    5. By whom the scaling process is led?
    6. By when will we reach the desired scale?
    7. Why? What is the system change we contribute to?

#2 – Lessons from the field: success factors, challenges and mitigation strategies/action plans

- What lessons can be learnt from the exemplary up-scaled CS projects?

- What are the common success factors in the approaches underpinning the up-scaled CS projects?

- What are the success factors to consider for developing a roadmap for transnationally up-scaling CS projects?

- How can policymakers support the alignment of approaches and the increase of co-operation?

- How can policymakers contribute to tackling the challenges represented by scaling up CS projects and initiatives?

- What uptake for policymaking can be derived from the success factors of the up-scaled CS projects?

#3 – Scaling up CS: A Roadmap for policymakers

- Where does the innovation lie for CS today[46]?

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[45] Adapted from Maturano 2020
[46] Schade 2022

- What criteria can be applied by policymakers for measuring impact/proof of value of CS projects and initiatives?

- What criteria can be applied by policymakers for selecting CS projects to up-scale transnationally?

- What kind of funding mechanisms can be developed by policymakers for supporting the upscale of CS projects and initiatives?

- Are the EU cascading grants mechanism replicable at the local/regional/national level?

- How can policymakers support CS practitioners/scientists to develop alternative business models for upscaling and sustaining CS projects and initiatives?

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7. Appendices

7.1.   Appendix A – Survey

PART A

Section 1 - General information about the Respondent

1. Member State

2. Institution

3. Name of the country representative

Section 2 - General questions about scaling up Citizen Science projects

4. How would you define scalability in citizen science?
   Please briefly elaborate on the meaning(s) of scalability in citizen science.

5. What are the key dimensions of scalability in your opinion?
   Please answer this question using key words.

6. What are the main success factors for scaling up citizen science projects in your opinion?
   Please answer this question using key words.

7. What are the main challenges in scaling up citizen science projects in your opinion?
   Please answer this question using key words.

8. Based on which criteria would you select citizen science projects to be scaled up transnationally?
   Please describe them using key words.

9. Does your country have any existing or planned polices / funding programmes / infrastructures specifically aimed at sustaining the scalability of citizen science projects? *If yes, please provide the details.*

Section 3 - Assessment of the impact of the Mutual Learning Exercise CSI-PP

This section is aimed at collecting evidence of the impact of the whole Mutual Learning Exercise CSI-PP within your organisations. Your answers to these questions will be used as a knowledge basis for the Reflective Exercise held on Day 2 of the MLE Meeting in Berlin (8 November 2022).

10. Have the activities of the MLE CS already had an impact (in the broadest sense of the word including any evidence of outcomes and outputs, however small) within your organisation? *If so, please describe the impact for e.g., on researchers, policy makers, government, public*

11. Has your organisation already started or is planning actions as a result of the lessons learned/information obtained from the MLE CS? Examples may include: drafting a new policy for funding CS projects, having a network of European policymakers, practitioners and experts committed to mainstream CS in their countries

PART B – OPTIONAL

Section 4 - Selected Citizen Science Project – OPTIONAL

Please describe a citizen science project from your country that was / is successful in scaling up. Please provide as many details as possible. If needed, please contact the Project Principal Investigator to provide the information.

12. Name of the selected project

13. Name and link to the website of the selected project

14. Lead institution

15. Project leader answering the questionnaire

16. Start / end year – ongoing

17. Funding received – *Please indicate the amount.*

18. Funding received – *Please indicate the funding programme & line of funding.*

19. Aim of the project. *Please briefly describe it.*

20. What is the main reason why you consider this selected project as a success in scaling up?
    Please answer this question using a keyword and a descriptive sentence.

21. What are the elements of this selected project that have been successfully scaled up? *Please answer this question using key words.*

22. What are the main challenges faced in scaling up this selected project?
    Please answer this question using key words.

23. How have these challenges been addressed?
    Please briefly elaborate on the challenges indicated above.

24. What are the main factors contributing to the successful scaling up of this selected project?
    Please answer this question using key words.

Section 5 – Drivers of scalability of the selected project – OPTIONAL

This section uses as an assessment tool the 9-Driver Framework developed by Maccani et al. 2020. Please answer the following questions using as a reference the citizen science project from your country indicated in Section 4.

25. What is the proof of value of the selected project?

26. Is the subject of the selected project easy to use and understand?

27. Does the selected project make use of Open Source Software? *If yes, which one?*

28. Does the selected project make the data collected (i.e., the raw data), and/or its analysis (i.e., the transformation process from data to information to knowledge) and/or the data outcomes (i.e., the aggregated results) publicly available (preferably online)?
    If yes, please briefly explain how.

29. Does the selected project develop and disseminate narratives and consistent communication materials, e.g., scientific journal publications, publications in the local and global media, consistent updates of the social media accounts?

If yes, please briefly list them.

30. Does the selected project involve communities and champions in scaling up the project? If yes, please indicate if the involvement occurs via:

    a. Local networks (neighbourhood to city scale)

    b. International networks (global scale)

    c. Both

31. Does the selected project offer knowledge sharing and transfer resources? If yes, please indicate the types:

    a. Inventories and Catalogues;

    b. Best Practices, Education, and Training;

    c. Tools, Guidelines, and Tutorials.

32. Does the selected project present a similar matter of concern (i.e., similar issues) in new contexts where it has been scaled up?
    If yes, please briefly describe the matter of concern (i.e., the problem tackled)

33. Does the selected project address similar legal frameworks / legal norms in new contexts where it has been scaled up? If yes, please briefly describe the kind of legal framework (e.g., data protection, privacy, etc.)

34. Does the selected project align with social values of the new contexts where it has been scaled up? If yes, please briefly describe the kind of social aspects (e.g., culture, language, equity, inclusion, digital accessibility etc.)

35. Does the selected project have a sustainability plan or a business model? If yes, please briefly describe it.

7.2. Appendix B – Interview questionnaire and list of interviewees

List of the interviewees (in alphabetical order)

- Dr Mara Balestrini, ESADE-Ramon Llull University, ESADEGov Center for Public Governance. Interview with Dr Antonella Radicchi, August 3 2022, Zoom

- Claudia Fabo-Cartas, ECSA. Interview with Dr Antonella Radicchi, July 27 2022, Zoom

- Patrick Lehner, Ludwig Boltzmann Society. Interview with Dr Antonella Radicchi, July 27 2022, Zoom

- Dr Giovanni Maccani, Ideas for change. Interview with Dr Antonella Radicchi, July 12 2022, Zoom

- Dr Antonella Passani, Partners and Head of Research at T6 Ecosystems srl. Interview with Dr Antonella Radicchi, July 27 2022, Zoom

- Dr Sven Schade, Joint Research Center, European Commission. Interview with Dr Antonella Radicchi, June 29 2022, Zoom

- Prof. Dr. Lech Suwala, Technical University of Berlin. Interview with Dr Antonella Radicchi, August 8 2022, Zoom

Questionnaire

- How would you define scalability in citizen science? What are its dimensions in your opinion?

- What are the main challenges for scaling up citizen science projects?

- What are the success factors for scaling up citizen science projects?

- Based on which criteria would you choose citizen science projects to be scaled up transnationally?

- Can you please share examples of citizen science projects that have been successfully scaled-up?

- Can you please share examples of polices or funding programmes or infrastructures specifically aimed to sustain the scalability of citizen science projects?

- Can you please share any key-readings (e.g., articles, reports, webpages) addressing the topic of scaling up citizen science? Or readings dedicated to scalability in other fields of research?

- Any other comments? Thoughts?

7.3. Appendix C – 9-Drivers Framework Check List of up-scaled Citizen Science projects reported by the MLE CSI-PP country representatives

Table 6. The 9-Drivers Framework Check-in List illustrated in this table provides an overview of the verbatim responses to Questions 25-34 of the survey (Annex A) addressing the 9-Drivers Framework of the five exemplary up-scaled CS projects reported by the MLECSI-PP country representatives.

MLE CSI-PP countries / 9-Drivers	Austria	Austria	Germany	Norway	Sweden
Name of the project	*FotoQuest GO*	*Tea Bag Index*	*The Plastic Pirates – Go Europe! citizen science initiative*	*Dugnad for Havet (in English: Marine Citizen Science)*	*The Star Spotting Experiment*
Project website	*http://fotoquest-go.org/*	*https://teatime4schools.at/teatime4app/* global project webpage: *http://www.teatime4science.org/*	*https://www.plastic-pirates.eu/en*	*https://dugnadforhavet.no/*	*https://forskarfredag.se/researchers-night/mass-experiments/the-star-spotting-experiment-2019/*
Driver 1. Proof of value --	*It crowdsources the collection of valuable land-use and land cover data and empowers citizen to observe those changes at the same time raising awareness about our*	*Creation of the TBI App for easier data collection, global decomposition map (in the process of being published), the use of the TBI method by both citizens and scientists*	*Accompanying research was part of the funding in order to show the impact on the participants*	*At least three non-native species have been reported through the project in the last three years, leading to national efforts to curb unwanted marine invasions. Observations*	Question not answered

Q25. What is the proof of value of the selected project?	*changing environment. The data can be used to improve statistical data about land-use change and for training reference data to create satellite based land cover and land-use maps*	*(at the moment ca 2500 locations covered globally), an active TBI community that meets on a regular basis to discuss the developments: http://www.teatime4scie nce.org/Symposium/, increased awareness about soil and climate (BSc thesis Anna Wawra, 2019)*		*through the project have delivered important new information to institutional research projects, that do not have enough capacity to cover the coast on a national scale. Young CS have shown how participating in CS motivates future marine scientists. The interest and skill in observation of the coast life has increased in the public and media since the Marine Citizen Science project was lauched.*	
Driver 2. Ease of use and understanding **--** Q26. Is the subject of the selected project easy to use and understand?	*Medium*	*Yes. Colorful step by step instructions (infographics and easy to read texts) guide through the methods in the App and on the website.*	*Yes*	*Yes, it is easy for citizen scientists to understand the aim of the project. The website is easy to find. The form requires registration and observations are to be shown as photo as well as described. This is fairly easy, but the photos can be of low quality, missing or downloaded from the net. This makes it perhaps harder to assess the observation correctly than for the*	*Yes*

				citizen scientists to deliver.	
Driver 3. Openness **(a) Open Software** **--** Q27. Does the selected project make use of Open Source Software? If yes, which one?	*It uses Unity which is proprietary but freely available*	*No*	*No*	*The software is the IMR Norwegian Marine Data Centre software, licensed and developed for marine science.*	*No*
Driver 3. **Openness** **(b) Open Data** **--** Q28. Does the selected project make the data collected, and/or its analysis and/or the data outcomes publicly available (preferably online)?	*Yes, is currently planned to make the data available. We have not done this as the main objective was to test the quality and LUCAS is anyway available. So published results in papers are available but we are currently working on making also the raw data available.*	*Yes, the collected data of the TBI App is all available online:* *https://www.spotteron.com/teabagindex/* *and it will also be connected to the global TBI database:* *http://www.teatime4science.org/data/map/. We are also in the process of opening the data in a more accessible way, following the publication of the global decomposition map.*	*Yes. Open source scientific journal publications, press releases, social media posts, newsletters, website entries*	*The collected data is visible online, after being controlled and verified by experts/scientists.*	*No*
Driver 4. Communication and dissemination	*Yes e.g.:* *https://www.mdpi.com/2073-445X/9/11/446?type=check_update&version=2*	*Scientific publications and global media. Selected list here: http://www.teatime4science.org/publications/),*	*Yes. Open source scientific journal publications, press releases, social media*	*The project has a professional website tailored to the average citizen and scientists. The project is*	*Yes, very much. The project was communicated through national and regional newspapers, radio and*

-- Q29. Does the selected project develop and disseminate narratives and consistent communication materials, e.g., scientific journal publications, publications in the local and global media, consistent updates of the social media accounts?		*e.g. https://www.frontiersin. org/articles/10.3389/fev o.2021.703794/full, htt ps://soil.copernicus.org/ articles/8/163/2022/, https://www.mdpi.com/2 071- 1050/12/18/7745 — Social media: Facebook (Tea Bag Index - Oesterreich, TBI. Instagram (teatime4schools), Twitter (Tea Bag Index)"*	*posts, newsletters, website entries*	*presented at national and international CS seminars The Norwegian Research Council, the European Marine Council), conferences (OSM 2022) and in policy notes and scientific papers.*	*TV. A few examples: - Nyhetsmorgon, TV4, Sweden (national TV) - Sveriges radio, Sweden (national and regional radio) - EL PAÍS, Spain (National newspaper) Also, frequently adressed in social media by all involved partners, including Public & Science, Lund University, Swedish National Space Agency, Natural History Museum, London, UK.*
Driver 5. Community and champions -- Q30. Does the selected project involve communities and champions in scaling up the project?	Question not answered	*Not yet, but has been planned in proposals*	*Yes, International networks (global scale)*	*Local networks (neighbourhood to city scale)*	Question not answered
Driver 6. Knowledge sharing and transfer resources --	Question not answered	*Inventory: the map of data, best practices, education and training: we have organised many teacher training sessions, written a book chapter where the TBI App is presented*	*Best Practices, Education, and Training*	*Tools, Guidelines, and Tutorials*	*Tools, Guidelines, and Tutorials*

Q31. Does the selected project offer knowledge sharing and transfer resources?		*(https://www.iuss.org/publications/soil-publications/soil-sciences-education-global-concepts-and-teaching/), we have also written e Lesson Plan through the Soil Science Society of America; Tools, Guidelines and Tutorial: the TBI App that includes guidelines for all the steps, Infographics of the different parts of the TBI App, tutorials have been done in the form of workshops for teachers and other citizens + events for schools (European Researcher´s Night, Summer university, Ferienspiel, Viennese Girls Days).*			
Driver 7. Matter of concern **--** Q32. Does the selected project present a similar matter of concern (i.e., similar issues) in new	*No*		*Always depends on the context and stakeholder group.*	Question not answered	*Yes*	Question not answered

contexts where it has been scaled up?					
Driver 8. Legal Alignment -- Q33. Does the selected project address similar legal frameworks / legal norms in new contexts where it has been scaled up?	*Yes*	*Yes, high standards on data ethics, EU based data hosting and server locations, and a no-user-tracking policy ensures the safety of participants beyond the requirements of the GDPR on a professional IT cloud environment, optimized for performance and reliability of user-oriented applications.*	*Yes, data protection, data privacy, availability of the data, data ownership*	*Privacy, data protection, use of private photos*	Question not answered
Driver 9. Social Alignment -- Q34. Does the selected project align with social values of the new contexts where it has been scaled up?	*Not really*	*Yes; language: at the moment only in English and in German; equity: we directly contact and engage diverse groups of teachers, farmers and otherstakeholders in order to ensure a gender-equal, intergenerational and intersectional participant group; ethics: high standards on data ethics, EU based data hosting and server locations, and a no-user-tracking policy ensures the safety of participants beyond the requirements of the*	*Yes. Education, language, culture, environmental protection, awareness, empowerment*	*N/A*	*Don't know*

		GDPR on a professional IT cloud environment, optimized for performance and reliability of user-oriented applications; inclusion: the TBI app was co-developed with an agricultural school class and their teachers and the students were able to give their comments and wishes throughout the process; digital accessibility: for users without smart device, an interactive web-application allows participation via browser on desktops and laptops			

Appendix D - Impact of the Mutual Learning Exercise CSI-PP

Responses to Section 3 of the survey – Assessment of the impact of the Mutual Learning Exercise CSI-PP		
	10. Have the activities of the MLE CS already had an impact (in the broadest sense of the word including any evidence of outcomes and outputs, however small) within your organisation? If so, please describe the impact e.g., on researchers, policy makers, government, public.	11. Has your organisation already started or is planning actions as a result of the lessons learned/information obtained from the MLE CS? Examples may include: drafting a new policy for funding CS projects, having a network of European policymakers, practitioners and experts committed to mainstream CS in their countries.
Austria	*a) Better coordination/communication of funding/ministry agencies and CS practitioners (see national Task Force for MLE)* *b) More awareness on CS in strategic policy process (e.g., national recommendations for EU Missions implementation)* *c) Knowhow building around CS that flows in national discussions and processes (CS part in stakeholder/public engagement activities)* *d) Showcasing more the Austrian CS community among the national FTI Stakeholders (e.g., FFG's "Horizon Europe Community Österreich")* *e) Citizen Science actions from ERA Action Plan have been included in the national ERA action plan priorities.*	*In early planning phase:* *a) Raising awareness of CS in FFG's national funding programmes (in evaluation processes, in call documents)* *b) Know-how transfer within the Austrian NCPs and national programme managers*
Belgium	*yes - we woke up to the importance of the concept and we are looking for ways of implementing it*	*not yet*
France	Survey not filled out	Survey not filled out
Germany	*The knowledge, gained by the exchange of information, experiences and insights of citizen science practices in other European countries*	*No – we will wait until the final results of the MLE are published.*

	will be considered in future projects and strategies.	
Hungary	Survey not filled out	Survey not filled out
Italy	Survey not filled out	Survey not filled out
Norway	*To some extent; by knowledge sharing within the Research Council of Norway and within the Ministry, increased collaboration and knowledge-sharing between the Research Council and the ministry, developing a common taxonomy, sharing best practices, creating synergies. Efforts have been made to include CS in coming policy documents.*	*To some extent, if the available budget in the Research Council allows it, the ambition is to develop a model for funding CS projects that can be implemented in 2023 or 2024. The ambition is also to look into how we can use current policies for Open Science, including CS and other policy documents to ensure more visibility and focus on CS. To some extent, this can be viewed as mainstreaming.*
Portugal	*Not yet.*	*Not yet, but lessons learned in sessions more related to our field (e.g., role of science museums for CS) started being discussed internally to start reflection on how organisation could be an enabling factor for more collaborative/co-created CS (as opposed to contributive versions now dominant in Portugal).*
Romania	*MLE CS was a great source of information, experiences and good practices on citizen science and also a great opportunity to build our citizen science capacity as part of the open science umbrella; we really appreciate we had the opportunity to participate in this European learning exercise.* *The activities of the MLE CS contributed to improving the knowledge and expertise of the Open Science Knowledge Hub team within UEFISCDI which is the main Open Science facilitator& policy adviser at national level; provides a permanent connection to the Open Science major initiatives at EU level; provides support and access to OS information, including citizen science to our RDI community; and also is the main national research funder for the RDI competitive funds.* *After each participation in the MLE CS, we also elaborate a report regarding the discussions within the*	*Before the start of the MLE, citizen science was already included in the proposed Strategic Document regarding the Open Science Development Framework in Romania which is the Green Paper on the Transition to Open Science (2022-2030) but as a result of the participation of UEFISCDI representatives at the MLE CS it was reinforced the importance of citizen science as part of this national strategic document; the information obtained from the MLE CS (e.g. info presented regarding the results of the Special Eurobarometer 516-European citizens' knowledge and attitudes towards science and technology) contributed to improve the presentation/ description of the European context regarding citizen science as part of this national strategic document; one of the proposed actions dedicated to CS that is included within this document is the development of a national network dedicated to citizen*

		science at the RDI community level in Romania, based on the model of those existing at the European level. In August 2022 the proposed Strategic Document regarding the Open Science Development Framework in Romania was put in public consultation until the end of September 2022. In order to collect feedback on the 8 OS recommendations and the related actions proposed for each recommendation, including the ones dedicated to citizen science, the Open Science Knowledge Hub team within UEFISCDI developed a short questionnaire and asked stakeholders to specify how relevant each recommendation is to his/ her activities. We will see which actions dedicated to CS are considered to be the most relevant/ important for the Romanian community after analysing the feedback received as a result of the public consultation. Afterwards these actions could be implemented only after an official approval of the Ministry of Research, Innovation and Digitization.*
	MLE CS which is disseminated within our institution. *Information about UEFISCDI's participation in the MLE CS, as well as all the reports and discussion papers that have been developed so far have been disseminated to our RDI community through our communication channels.* *We think that through the MLE CS a network of Member States representatives that participated in the MLE was developed. We intend to constantly keep in touch with them in order to share information and good practices on CS.*	
Slovenia	*Connecting with co-workers preparing National Action Plan for open science + exchanging ideas harvested from the MLE on what measures to include in the Action plan.*	*same as above*
Sweden	*Discussions to include it in the national plan for open science* *We are a very small organisation, and I have only attended one meeting, but I have shared my experience within my organisation. I really value the new knowledge I have gotten, and the inspiring examples I have heard about, but also very much the contacts with the others in the MLE network.*	*Yes* *Not yet, but will definitely do in a near future.*

The purpose of this Discussion Paper is to introduce Topic 5 "Scaling up citizen science" to the participants in the Mutual Learning Exercise Citizen Science Initiatives – Policy & Practice (MLE CSI-PP) and provide inputs for discussion in advance of the Topic 5 meeting that will take place in Berlin (Germany) in November 2022. In this Paper, Topic 5 is addressed by discussing the meaning(s) and dimensions of scalability, the drivers, success factors, challenges and related mitigation strategies of scaling up citizen science projects, backed up by data provided by the MLE CSI-PP country representatives in response to a survey. Finally, this Paper provides discussion points and guiding questions that can be discussed during the working sessions of Topic 5 meeting in Berlin.

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