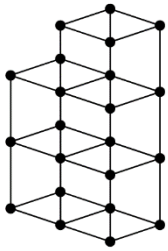

doing it together science

Grant agreement no. 709443

DITOs

Doing It Together science

Coordination & Support Action

D2.3 Good Practices in Participatory Environmental Sustainability

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EU-RES	Classified Information: RESTREINT UE (Commission Decision 2005/444/EC)	
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1 Version Log

Version	Date	Released by	Nature of Change
Draft 1.0	09/04/19	José María Blanco (MP), Carmen Haro Barba (UVA)	First version of the document
Draft 1.1	25/05/19	José María Blanco (MP), Christian Nold (UCL)	Review comments
1.0	28/05/19	Judy Barrett	Final formatting for release

2 Definitions and Acronyms

Acronyms	Definitions
BD	Biodesign
CS	Citizen Science
CSA	Coordination and Support Action
DG ENV	Directorate-General for the Environment of the EC
DIT	Doing It Together
DITOs	Doing It Together science
DIY	Do It Yourself
EC	European Commission
ECSA	European Citizen Science Association / Verein der Europäischen Bürgerwissenschaften
ES	Environmental Sustainability

ESSRG	Environmental Social Science Research Group
EUTEMA	EUTEMA GMBH
GA	Grant Agreement
H2020	Horizon 2020 Programme
KI	Kersnikova Institute
KPI	Key Performance Indicator
Meritum	Centrum Szkolen I Rozwoju Osobistego Meritum
MP	Medialab Prado, Madrid
RBINS	Institut Royal des Sciences Naturelles de Belgique
RRI	Responsible Research and Innovation
SC	Science Cafe
Tekiu	Tekiu Limited
UCL	University College London
UNIGE	Universite de Geneve
UPD	Universite Paris Descartes
UVA	Universidad de Valladolid
WS	Waag Society

3 Executive summary

The goal of this deliverable is to provide a compilation on good practices and validated methods for outreach activities for citizen science and DIY science in the areas of biodesign and environmental sustainability.

During the Doing It Together science (DITOs) project, partners have organised more than 450 outreach events related to environmental sustainability and more than 180 related to biodesign, reaching in total more than half a million people. These events are an important part of the citizen science Coordination and Support Action (CSA), serving to build collaborations between grassroots communities, institutions and industry (as detailed in project deliverable D2.2).This represents a vast knowledge gathered through experience. This deliverable compiles this knowledge through a set of interviews with facilitators and managers in DITOs, as well as other citizen science managers, facilitators and members of grassroots organisations. This deliverable provides guidance of useful good practices and validated methods for the European Commission, citizen science practitioners and project managers.

This document was written in parallel with D1.3 and should be read alongside it. While D1.3 has compiled the most successful DITOs types of events to describe how to implement these from an organisational point of view, D2.3 looks at outreach events from a wider managing and humanistic perspective highlighting factors that are critical to citizen science engagement.

The Good practices in participatory Environmental Sustainability is Deliverable 2.3 (D2.3) from the coordination and support action (CSA) Doing It Together science (DITOs), grant agreement 709443.

4 Introduction

The DITOs project involved extensive encounters with citizen science practitioners and organisers. This concentrated and widespread effort to engage citizens, scientists and policy makers in shaping and conducting research using citizen science strategies has enabled a detailed evaluation of which strategies are effective and which mistakes can be avoided.

The report compiles the lessons learnt from these experiences through feedback from a selection of citizen science facilitation experts, both within the consortium and connected with it through the DITOs innovation hubs (see D3.2 for more detail on innovation hubs) The report aims to 1) help the European Commission to understand the potential and difficulties that citizen science projects face and 2) help the broader community to design and organise citizen science projects and outreach activities.

All the data on this report has been gathered through interviews with people involved in citizen science events and projects. The section, *Methodology*, gives further details about how the team has gathered and analysed this information. Then, a summarised and systematic compilation of the most relevant set of answers and experiences related to specific categories are listed in the section *Good practices and validated methods*. These has been extracted from the most common answers, as explained in *Methodology* section. The last section, *General conclusions and recommendations* provide reflections on the ideas in this deliverable and possible future lines of work.

The report includes an appendix that provides the interview questions used, as well as edited highlights of the most interesting responses from each interviewee, organised by work package and category. Then a full list of questions that anyone organising a citizen science outreach activity or project might find interesting to ask oneself is also given.

5 Methodology

The types of citizen science outreach events, activities and projects facilitated by DITOs are very broad and have different goals, audiences and budgets. This makes the process of compiling good practices guidance complex but compelling.

Since these insights usually just reside in the minds of event organisers' and are not documented, we used a semi-structured interviewing process. McIntosh y Morse (McIntosh, 2015) argue that semi-structured interviews are designed to ascertain subjective responses from people regarding particular situations or phenomena they have experienced. This methodology employs a relatively detailed interview guide whilst providing the participants with the freedom to answer the open-ended questions and explore issues that they think are important. Analytically, this method "*is*

characterised by comparing participants responses by item". The point of saturation of discourse around the raised questions is reached when no new understanding is produced and there is confidence that no more relevant discourses are going to arise. (Valles Martínez, 1999)

Figure 1 Working board with a first selection and organisation of the questions of the interview

The questions for the interviews were selected through an iterative analytical process. First, a brainstorming session was organised where all the partners described their priorities to discuss. A second phase involved refining the initial set of questions. This was done in Madrid through a capacity building workshop between Cindy Regalado (UCL) and Chema Blanco (MP). During the processes, a series of categories were identified, namely: *value, people, science, purpose, evaluation* and *communication.*

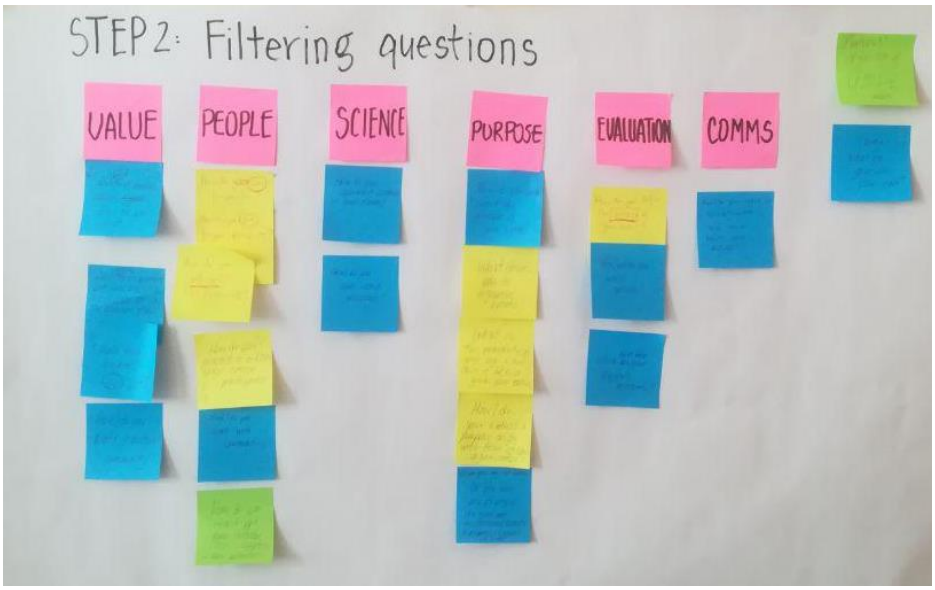

Figure 2 Working board with the first classification of the questions of the interview by categories.

Next, DITOs capacity building workshops were used to test the questionnaires and refine the questions. Then, following the *DITOs final event* in Brussels (described in D4.5), an informal consortium-wide review took place (also attended by the EC project officer) and the questions were adapted to guarantee that every question was related directly to public engagement with citizen science and RRI. Throughout, feedback from the interviewees was been taken into account to polish the questions.

This report is based on 16 interviews with people related to citizen science in different ways. We have interviewed people both from inside and outside DITOs, people that manage citizen science projects and people that facilitate them directly with participants, people that work with adults or kids, people that are professional researchers and people that are not. The goal was to provide a diversity of voices, as well as an overview of ideas, perspectives and practices.

The interviews were anonymised in line with the WP7 ethics and data protection and the WP6 datat management deliverables. Interviewee names have been substituted with Spanish names, while keeping some of the description of their roles responsibilities to provide some context when reading their answers[1]:

- Lucía: facilitator in a community health citizen science project.
- Clara: researcher specialized in policy making.
- María: facilitator of biodesign activities in The Netherlands.
- Julieta: coordinator of H2020 european citizen science project.
- Daniel: member of a grassroot ecological group.
- Gustavo: facilitator of DIY bio activities in Slovenia.
- Ramón: researcher of a community health citizen science project.
- Adolfo: environmental educator, botanist and citizen science manager in Madrid.
- Jaime: EU project evaluator without previous experience in citizen science projects.
- Cristina: biodesign citizen science projects responsible in París.
- Raúl: researcher in biodesign, DIY bio educational activities in Geneva.
- Laura: coordinator of citizen science programs in Brussels.
- Sara: facilitator of environmental citizen science programs.
- Lucas: manager and researcher of environmental citizen science projects.
- Ricardo: social entrepreneur in environmental citizen science projects in Poland.
- Alejandro: artistic director of citizen laboratory in Madrid.

[1] We want to really thank all the people that participated in the interviews. It was a magnificent experience and a real process of integrating perspectives and learning together.

Each interview lasted around two hours and was audio recorded. The conversations were transcribed to a collaborative document, so the interviewee could review them to make changes or provide more context.

To analyse the interviews, an approach based on grounded theory was used. During the analysis of the interviews, the authors coded the responses and iteratively defined a set of categories under which to organise the answers. Nine relevant analytical categories were identified: **science, outreach, participants, communities, team, caring for oneself, evaluation and impact, difficulties and mistakes to avoid, purpose and values**.

This process of analysing and summarising so much contextual information, personal views and very rich situations does mean that some information might be lost. So, the appendix includes more detail from each edited interview. These provide examples and concrete situations that expand summaries and bring lessons learnt to living realities. These might be an extra valuable source of information for every citizen science practitioner, facilitator, manager or researcher.

A complete list of questions that have been considered relevant is also provided in the appendix as a checklist. The goal is that every person can go through this list asking herself each question to reflect upon this set of relevant aspects when organising outreach activities and citizen science projects.

6 Good practices and validated methods

This section compiles in a brief and summarized way the best practices, lessons learnt and best advices gathering through the previous interviews.

6.1 Science

Since this report is talking about citizen science, it is important to analyse how people (the general public, facilitators and scientists) approach science This includes related questions such as: ‘how do you make science accessible?’, ‘how can you improve citizen science?’ or ‘how can citizen science lead to better research?’. In this section, the main ideas found through the text are summarised.

6.1.1 Scientific approach:

- The relation between science and society works both ways: show society how science works and show scientists how society works.
- There are a lot of topics that are being researched in the scientific world that are extremely relevant to society because of their ethical and social impacts. So, there should be a collective research with all the questions that people can make.
- Opening your research can bring important benefits: sometimes, the research questions of citizens are much more interesting than the ones from the scientists; their participation can enhance communication, increase impact and more contrasted experiments.
- Innovation requires time and resources, so any project focusing on funding pressure will be efficient but likely not innovative.
- How to make science accessible:

- Design the process in a way that is fun and friendly but also accurate and without oversimplifications.
- Bring researchers and experts to talk about science but also to show how science is done. Promote science inquiry.
- Read on a regular basis literature in Science Education, Science & technology studies and Science Communication.
- Language matters. It is good to hire communication experts that get inputs from science experts and write the texts for the public.
- The role of facilitator is essential, who must understand the audience through a process of co-creation.
- In every workshop there should be one expert on the topic treated: deep knowledge of the topic provides opportunities for conversation and discussion.
- It is a good practice to enable different-points of entry into an activity (that means for people who do not know anything, something or a lot). Collaboration between citizens with different levels of knowledge about a topic usually works very well.
- Technology can play a role in making science accessible. Design platforms for citizens can break barriers. Accessibility and inclusivity must be carefully considered in every technological design.

"Citizen science is an opportunity where academia, citizens and institutions have a lot of to gain - all of them. Citizens can get empowerment and a better comprehension of reality. Institutions gain a deeper knowledge of what is happening and legitimacy if they recollect citizen requests. Academia gets useful data to take advantage and a greater projection of their work beyond their own circles. The challenge for everyone is go beyond their own logics and inertias to be able to collect the visions of the other two entities."

Daniel

6.1.2 Citizen science considerations

- Citizen science (CS) provides a way for citizens to understand and get knowledge of what it is being researched to enable them to participate with more awareness in these discussions.
- Science for citizens (not professional researchers) usually is more practical; it is about changing things, about taking action.
- Communities are the real drivers of CS. It might be useful to overcome a limited view of CS that only supports understanding and education.
- In CS, it is important to be humble to question own beliefs, emphatic to listen and to work with other people.

- In CS, research questions should be con-constructed. If it is not possible, at least researchers should listen to questions and concerns of the people they expect to collaborate with.
- A CS project is more interesting when it becomes an hybrid between science, art, education, etc. Using artistic supports to communicate CS projects are very useful to make science accessible and increasing impact (e.g.: photo book, exhibitions, etc). The impact is much higher if the citizens are the authors of the art pieces. It also provokes a deeper connection and relation between researchers and citizens.
- Some authors also suggest that CS projects should be explained directly by participants instead of researchers when presenting to the public (not necessarily in science meetings). This creates a better communication and increase confidence between scientists and society.

6.1.3 Why citizen science?

- Citizen science can play a prominent role in analyzing and reducing inequalities in cities.
- Listen to people and design a citizen science project based on their needs and problems are one of the most effective ways to engage citizens and make science accessible: bottom-up projects can have much more impact than top-down projects.
- To harvest the full potential of citizen science, one should be aware that the project might change not only citizens but also facilitators, researchers, organisations and institutions. This is an opportunity to reflect upon the relations between them.
- Citizen science can help policy makers to think in new institutional models that are more permeable to society to facilitate new collaborations, experiments and knowledge production. This might lead to models where divulgation or dissemination becomes coproduction.
- Citizen science has the power to create win-win situations:
  - Citizens get empowered and a better comprehension to reality.
  - Institutions gain deeper knowledge of what happens in society and more legitimacy.
  - Academia get useful data and a better projection of their work.

6.1.4 Tools and documentation:

- Use open hardware and software (better libre) if possible.
- Use Creative Commons licenses for tutorials, instructions and also the documentation of the projects. This means this material is free to use, distribute, change, etc.
- Code, blueprints, designs and documentation must be open, clear, understandable, accessible, complete and easy to find.

6.2 Outreach

Since there are many citizen science projects, there also different ways to reach people and bring them on board, both for science activities and long engagements in a citizen science project. All the interviewees agree in how important is to reach citizens properly to engage them, but also they agree on how difficult it is.

6.2.1 Difficulties in reaching citizens:

- Reaching people is a slow and time-consuming task. So a good practice is to launch pilot projects as soon as possible and to be flexible, since it is very difficult to quantify the actual effort from the beginning.
- It is risky to ignore the specificities of different geographical areas. It is necessary to analyse the demography of the people you want to reach:
  - One mistake to avoid is not taking into account the political ideology of specific areas where resistance to the project can be very high.
  - It is suggested that in areas where the socioeconomic level is higher, people tend to mobilise for entertaining reasons, while in poorer areas people tend to act for a social change.
  - If a specific group is not reached, then try other channels.
- Be aware of the difficulty of creating and sustaining public engagement since communities are based on volunteer work. Otherwise funding is needed to bring on board facilitators and communication professionals that keep specific projects alive through time.
- Hiring a communication specialist is not a wasted cost but a necessary investment.
- Depending on the platform you use to reach people, there is the risk of high drop-out rates and low attendance. A good practice is to send a kind and caring message to all participants a few days before the event to remind them of the event and that their attendance is valued highly.

6.2.2 Good practice for reaching citizens:

- Keep a humble attitude to citizens.
- Put oneself in other's place.
- Adaptation and control of the language is essential to bring and engage people. Specially to promote DIYBio activities, where most of the practitioners have science background, being able to adapt the language to reach other publics becomes critical.
- When working with specific communities or areas:
  - Collaborate with established structures. Common ones: local neighbourhoods associations, schools, NGOs and local administration resources.
  - They know the social fabric of the area, they can open doors and make proper connections, always by being aware of the different sensitivities.
  - Other useful allies are libraries, urban orchards, etc. And meeting active individuals that know well the area and open doors is very advisable.

  - Usually it is necessary to go physically where they are, where they meet, where they live.
  - Face to face activities are needed. Building bridges of confidence works.
  - The role of facilitator or mediator that visits the places and knows the area becomes very important to approach specific contexts. This can take months of work but participation will be increased dramatically.
- When being part of a group or facilitating space to a community, it is advisable to set regular meetings to ease other people join if interested.
- A good practice is also to train trainers, so the impact of specific project can be exponentially increased.

Good practice for inviting scientists and researchers (Sara)

I share a sample email text from when organising film nights:

Subject: Invitation to film night

"...it is very useful to be able to talk directly to scientists about science documentaries because they often lack scientific depth or are out of date. I am therefore looking for a guest scientist at our event to join us for a convivial post-screening discussion with members of the public. The audiences to our events very keen on meeting with and discussing the state-of-the art in research and its applications. Guest speakers are not asked to give a presentation but rather join a relaxed conversation and help demystify science and university research..."

6.3 Participants

This section talks about what to do with participants that are already in an activity or a project. How to treat them, how to keep them engaged, how to acknowledge their effort, how to make them be an active and enriching part of a project.

"If you want to engage people, you need to listen, not only teach and lecture. Why? Because engagement means empowerment. If you really want to engage someone, you have to give them power to some degree. For example, the power to influence discourse. It means really to take people seriously."

Jaime

- It is good if possible to meet some participants in advance to understand their expectations.
- Assisting citizen science conferences and meetings is good because it allows teams to learn different experiences, ideas and ways of working with people to improve their own strategies.
- An exquisite care for participants must be always considered:
  - Attending participants must happen also before the event: it is good to give them all the available information and be accessible to solve any doubts.

  - Ice-breaking activities, playful check-ins, etc are a must.
  - It is advisable to provide your participants with healthy food and drinks.
  - Meeting place should be comfortable.
  - Meeting hours should comply with the participants schedule limitations
  - Too much activity might be overwhelming and counterproductive. Breaks matter.
  - Providing not only food, but also accommodation (if needed), services for children, etc, help to guarantee equal opportunities and to be more inclusive.
- Making activities to raise their self-confidence work. Especially with kids.
  - Allow your facilitators to sometimes answer: "*I don't know*", which totally changes the relation with participants. Change power relations between who teaches and who learns.
  - Allow everybody to access equally to all the equipment: microscopes, projectors, etc.
- Acknowledging participants is essential. There are different views of how to do so:
  - Participants usually are diverse, so they might not expect the same acknowledgement.
  - Making sure the activity meets their interests.
  - Sometimes creating bidirectional communication is enough: listen to them actively and take their recommendations very seriously (nest event might be tailored to their needs).
  - Co-creation is a very effective way of listening to and acknowledging participants.
  - Sometimes paying participants is very important, especially when they are showing their work and are not being paid by an institution. Pay per diem in advance is usually the best for them (not everybody has money to pay things in advance and capability to make the administration paperwork).
  - Including their contributions in the project documentation.
  - Letting participants to be the main communicators of the of the project.
  - Ownership of the project might be collectively shared.
  - Providing an (official) diploma to include in their CV could be an option.
- Working with people is not easy, especially in a medium and long term. Good and bad moments will happen and the team must be prepared to face this constructively.
  - When working with vulnerable population, giving them voice is a must.
  - If the project continues, provide regular feedback to participants is necessary.
  - It is advisable to make sure facilitators are available for individual conversations.

  - Give more time to the critics than to the ones that shared your vision. It is good if their visions can be integrated.
  - Create collective agreements.
  - Including every proposal sometimes help to create cohesion.
  - When organising projects that can have social consequences, it is essential to be very careful to avoid creating expectations that cannot be fulfilled.
  - In many cases is not about the results of the project itself, but about creating social fabric, a united group that can go beyond these initial results in the next projects. Having people that agree, work together and are self-organised is very valuable in itself.
- In case there is any app, product, etc that is released for free, it is advisable to set which uses third parties might do, including to make profit out of it.

6.4 Communities

Getting a good coordinated team to work is never an easy task. Moreover, teams in citizen science projects have to deal with tens, hundreds or even thousands of people that participate. This might be an exhausting task but also incredibly rewarding. In this section, the interviewees provide their experience to make the team work together:

- Citizen science means teamwork, intersectional and on many occasions it requires a long-term view.
  - A team means diversity of people and citizen science projects promote it even more. Being aware that everybody has their own concerns and motivations and knowing them to integrate them helps to create a nice working atmosphere.
  - Work must be felt as useful for everybody, at least in the long term.
  - It is good to have an “onboard document” in case somebody new comes to the team.

> *“The less you pressure people, the most they work. I hardly had problems with people working too little, but I had problems with people working too much”.*
>
> Raúl

- Having a team that love what they do and that like to work together is essential. Getting it is complex and it has a bit of magic but there are things that help:
  - Paying the team as much as possible helps.
  - Giving responsibility and freedom to act to everybody in the team seems to be very advisable by the majority of the interviewees.
  - Creativity should be encouraged. Integrate suggestions and ideas of everybody of the team. Having co-created projects help to share vision and having a cohesive team.

  - Non-pressing people works for some teams. People working too much can cause problems.
  - Providing interesting articles about the theme or event/workshop to the team as food for thought.
  - Talking about successes and failures in past events helps to set a good background within a team, so to build upon it. Documenting these is very advisable.
  - Creating a good atmosphere requires work:
    - Giving value to other's time is important: being on time matters. Meeting protocols help: "no agenda, no meeting", for example.
    - A good practice is to spend a lot of time with mentors and too often have a relaxed non-formal event to discuss other things than workshops, so one can communicate openly and all of the work is more transparent. Sharing all the information with the team promotes transparency and trust.
    - A good practice might be to become friends with your team. When you know someone personally, you also care more for them.
    - Sharing a place where problems can become jokes and one can laugh every day, creates a very constructive attitude. At the end of the day problems must be solved, and instead of complaints promoting humour helps.
    - The responsible of the team should take the blame if anything does not work.
    - When things are going wrong, you should improvise and make them work. But you never should evaluate during an event or workshop because atmosphere is incredibly important. You can evaluate after, but not during.
    - Giving compliments to somebody in public (in front of the team) and suggest improvements and solve problems with somebody in a private, constructive atmosphere also helps to build trust.
- Hacker and DIY cultures are very fun but are prone to burnouts (for example, people often work during their free time).
- As a warning, working with citizens and communities might be incompatible with standard family life: you team work with people when these have free time, that usually matches your team's free time. It is important to take this into account to plan agenda in order to spend quality time with them.
- If working online, planning personal calls with facilitators to share and reflect on their work is very advisable. Project coordinators should have time to speak and connect with each of the members of the team (specially in Pan-European projects).

"*Cohesion does not come from nothing: you have to encourage it to be generated"*

Daniel

6.5 Caring for oneself

Since citizen science is full of people enthusiastic about what they do (either they do it professionally or not), it seems necessary to share some practices for self-care which often are ignored when putting project results as more important than own life. Most are obvious, but still needed to make it explicit.

> *"As my first measure, I try to make sure that everything I do has meaning."*
>
> Daniel

- Selecting carefully the projects where to be involved is first priority. Meaning is important.
- Learning to work in team and being careful on how to delegate and to communicate is essential.
- Preparing as much as possible in advance helps to make that only unpredicted things have to be handled in the last minute.
- Sometimes helps to meet participants personally since they give purpose and meaning.
- Not to work during free time.
  - Spend time with people one likes.
  - Sports are a must according to all the interviewees.
- If travelling is needed, make sure it is done with enough time.
- Stop if necessary.

> *"I try to meet participants personally, especially kids, that give me purpose and meaning. I also try to build actual things and instruments, since being in touch with the materials makes me keep sane."*
>
> Raúl

6.6 Evaluation and impact

There are very different ways to evaluate success, engagement or to assess impact. This is not supposed to be a complete guide, but a list of different perspectives, strategies and thoughts to help and inspire which anyone to design her own methodology.

6.6.1 Evaluation methods:

- The scientific dimension can be evaluated by number of articles (and impact), conferences, given presentations, students trained through a project.
- Questionnaires and evaluation surveys are widely accepted but sometimes fail for several reasons:
  - people do not want to use their time to answer them;

  - some institutions have their own standard feedback mechanisms so it is difficult to do introduce modifications or propose new ones;
  - sometimes standard questionnaires might prevent facilitators from asking the right questions.
- The number of people that has attended a workshop or has been reached by social networks is a very weak measurement to evaluate actual success or impact.

> "*A deep change in one thousand might be better to one million retweets*."
>
> Raúl

- Demographics are necessary to see if people without science training have been reached.
- Qualitative evaluation is advisable to find out what participants think.
  - It is a good practice to train oneself in observing and listening to participants.
  - Interviews are a fruitful way to get deeper insights.
- Find useful ways to measure learning (knowledge), changing attitudes and conceptions. Sometimes a simple drawing explains more than a five-page questionnaire.
- Longitudinal studies to see if activities change the future behaviour of participants are very advisable. For example: "students involved in citizen science are more likely to include citizen science methods if they become researchers later in their life".
- Sharing a coffee after an activity in another informal place allows facilitators to gather relevant information out of the record.

6.6.2 Impact assessment:

Suggested criteria:

- When their inputs at the end of a workshop have changed from the ones they had on the beginning.
- When participants by their own initiative troubleshoot their work in the end of a workshop.
- When ex-participants come to a new workshop and uses knowledge from previous ones.
- When people stay longer to chat to other participants or ask more questions.
- When next time people repeat ("level of permanence") but also bring friends and family.
- When communication is successful, the outputs of the project might be shown in different places and spread through different media.
- When results are attractive for different stakeholders.

- When body language suggests engagement.

6.7 Difficulties and mistakes to avoid

In this section common mistakes and difficulties around certain topics are listed. This can be used for institutions, facilitators, scientists and policy makers to ease processes where citizen participation is needed. Some of them might be reflect the opposite of a good practice previously identified.

> "*A common mistake is to think that when you publish an open call in Internet, this is accessible, but actually it is not."*
>
> Alejandro

6.7.1 Workshops, projects and public engagement:

- Complexity of certain topics can be counterproductive.
- CS projects can reduce their impact if citizens do not participate in its communication.
- People are very diverse.
  - It is a mistake to think there is something called the *general public*.
  - Do not consider citizens as an empty container that must be filled.
  - Openly publishing information on internet does not mean necessarily that is accessible and inclusive. Internet does not reach many kinds of public.
- It is easy to underestimate:
  - the cost in time and money of hand-on learning experiments.
  - the cost in time and money of reaching and engaging people.
  - the importance of working and mediating with civil society organisations.
  - the effort in having people comfortable, welcomed and involved.
  - how difficult is to listen truly to people.
  - the importance of share properly the vision of a project.
  - how ignorant are scientists about science education.
- It is a mistake not to invite journalists and communication experts to public presentations.

> *"Be careful when estimating participants number. Food and money might be wasted. An average of 50%-70% of people register seems to be a reasonable measurement of the actual people attending activities."*
>
> Laura

6.7.2 Funding and bureaucracy:

- When working with citizens and practitioners, sometimes is advisable to pay them. However, some things should be improved to ease this process: 1) administrative paperwork should be done by the institution and not by the citizen; 2) It is better to pay per diem and always in advance; 3) many people cannot and do not know how to invoice and this shouldn't be a problem.
- Every citizen pays taxes just for being a citizen. It seems coherent that also citizens can apply for funding without the need to be part of a bigger organisation or having some legal structure.
- Hiring a person to help develop projects can be very difficult according to local laws and internal rules of institutions.
- Stability is hard for innovation.
- It is a common mistake to underestimate the inertia of institutions and organisations, and therefore their resistance to change.
- There is a high degree of labour uncertainty and instability within the professionals that manage citizen science projects and environmental education.
- When joining to EU projects, you usually are part of an European consortium but to make projects work you need to join to local networks. Sometimes these networks are not part of the project what complicates things. It is necessary to be aware that in these cases you need to meet expectations from both types of partners.
- It will be a good practice for European projects in public engagement to have international facilitators meeting besides consortium meetings to share good practices and lessons learnt by experience in the field.

6.7.3 Citizen science momentum:

- Top-down traditional approach in research hinders project codesign and the support of non-professional scientists to do science. Then opening institutions for bottom-up approaches is still a difficult challenge.
- The power of participatory research sometimes is not fully understood in academia and people are still not trained to conduct it.
- Identifying citizen science with free labour and costs reduction is very dangerous to promote citizen science.
- Prioritising research before people can contribute to incoherence and misunderstandings.
- A facilitator vision of citizen science that empowers citizens and shares power to build a better society sometimes crashes with an institutional view of citizen science based in science communication or science marketing.
- Citizen laboratories might be the institutional model that better answers to citizen science paradigm, since they offer space for collaborative experimentation, they promote communities of practice and therefore learning and knowledge creation and overall they encourage networks of collaboration.

6.8 Purpose and values

Through many conversations with facilitators and citizen science project organisers, it was clear that sometimes production was encouraged over reflection. This is why it seems interesting to talk about purposes and values which show different frames that shape citizen science practices. To give a working definition as a ground, Sara talks about *purpose* as "the reason for which something is done or created or for which exists". In general, before a joining or starting a project, they suggest to face directly the question: "Why are we doing this?" and keep the answer clear through the whole project. Here, there is a list of which are the purposes and values of the interviewees when carrying out projects related to citizen science.

> "*Through promoting critical thinking, we don't teach people, we make people."*
>
> Gustavo

6.8.1 Societal purpose

- Building better citizens and better society.
- Promote citizen labs that connect the actual diversity of the city.
- Showing that participation of citizens is essential for social, political and environmental changes.

6.8.2 Community purpose

- Supporting bottom-up practice (create spaces to share knowledge, to build collective expertise).
- Catalysing civic action.
- Creating deep interactions.
- Bring together diverse people with diversity of perspectives, experiences and knowledge.
- Help people to solve their problems and engage them in this process.

6.8.3 Scientific purpose

- Creating purposeful experience.
- Promoting critical thinking.
- Disseminate knowledge
- Encourages citizens to be interested in science.
- Demonstrating that scientists are not getting all the necessary information to understand the challenges of the whole ecosystem

6.8.4 Value

Since people are driven by different values, the table below shows the ones that were mentioned.

Table 1- Values identified by interviewees

Passion	Equity	Connections
Justice	Democracy	Ecology
Solidarity	Trans-disciplinarity	Coherency
Mutual support	Interdependence	Sustainability
Meaning	Strategy	Community stories

7 General conclusions and recommendations

This report has collected and described many experiences told by some of the main characters of citizen science practice, including both managers and facilitators of different activities, events and projects. Although getting and organising this information has been a complex task, the need to gather the experiences collected by the people involved in DITOs together with other practitioners seemed to be essential to improve CS practices.

There is not one type of citizen science project or activity, but a whole ecosystem of practices, perspectives and approaches that range from top-down projects, designed by research institutions that approach citizens to communicate science and get data for an academic research, to very bottom-up experiences, where a group of people affected by a common problem self-organise to look for solutions and actions based on science. There is a whole diversity of projects, what is coherent with the idea that people are basically diverse. So, under this premise, this report has collected many of these views, but not everyone, so further work could be done to get even more diverse perspectives.

Purpose and values have been revealed as a primary tool to start building a project and to cohere a team around this. According to the project, science can be communicated and become accessible by many strategies, but three of them must be highlighted: using different language for different audiences is essential, hands-on experiments and practical experiences encourages questions, critical thinking and therefore learning, and finally research questions should be co-created to engage and empower citizens. In order to reach people and work with communities, working with local associations and promote alliances seems to be the best way not only to communicate but to reach and involve all kinds of audiences. Being very careful and sensitive when approaching citizens is necessary and it needs to be trained explicitly. Having professional facilitators and mediators within the team that are trained to listen to others and bring their interests, concerns and problems to make them be integrated in a project is a very encouraged strategy.

Once the project is running, listening carefully to all the participants might be the key to success, although it can even mean to change the research question. Caring is not only a necessary tool, but a human need, and caring for every person involved in a project is something cannot be ignored or stated implicitly. Caring strategies should be designed explicitly within the team, for every participant and even for oneself.

When evaluating, questionnaires and evaluation forms seem to have been overrated, and according to facilitators a more personal approach usually works better (personal conversations, interviews, informal gatherings, etc.) when measuring the degree of satisfaction and to learn from mistakes for future events. To assess impact, check learning and change of attitudes are advisable as they are longitudinal studies.

Both difficulties and mistakes have been also identified. The need to consider citizens as a useful ally to conduct science projects should be promoted within academia and accordingly to ease this involvement administrative barriers should be lowered.

Finally, an apparently simple common action has been repeated by almost every interviewee when doing CS projects and activities: to listen. Listening to your team, to your participants, to your public, to other institutions, to other communities, to critics, etc seems to be the key for successful participatory research, to develop quality citizen science and therefore to contribute to excellence in science while aligning with the principles of RRI. This report suggests that listening to others is precisely the key to do science together.

Besides the best practices, validated methods and lessons learnt shown in this report, a common agreement among interviewees was the importance for self-reflection and team reflection. This process seems to be particularly promising during the phase of designing or co-designing a CS project or activity, but it should be maintained during the whole process. This helps to provide meaning to everybody's work and effort and might have a positive effect in engagement and impact. This will also help to refine initiatives to make them more aligned with RRI practices. In order to ease this process, two additional outputs have been included in the Appendixes of this report. On one hand, the template of the questions that was used for this interview is provided in section 9.1 and more importantly, section 9.2 provides a complete set of questions organised as a "checklist" that can guide this process of self-reflection.

8 Bibliography

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APPENDICES

APPENDIX 1 Template of the interview questions

Here there is the template of the questionnaire that has been refined over this project. This acts as a guide through every interview, but interview is alive, so if during this

process a new question or detail emerges that is worth to explore, the interviewer will ease that.

A. **Introduction to situate the reader**
   - What do you do and where do you do it?
   - Which kind of events do you do?

B. **Science**
   - How/ do you make science accessible?
   - What are the biggest mistakes you've made or pitfalls you've found when trying to make science accessible? What things should you have considered?
   - Do you think that CS and outreach activities can link research and educational institutions to work with communities? If so, how (do you have an example) and which benefits have you found?
   - How/ do you think your research improves and becomes excellent through CitSci?

C. **Call** (how you try to advertise your event and reach people)
   - How do you design and spread your call?
   - How / do you reach people from outside your circles (out of citizen science communities, communities of interest, etc) to get new audiences?
   - How / do you reach excluded groups? (just if you do anything different from previous questions)
   - Which are the biggest mistakes you've made or pitfalls you've found in your calls? What things should you have considered?

D. **Evaluation**
   - How / do you define and assess/measure the success of your event?
   - Which have been your biggest mistakes when organising an event? What things should you have considered?
   - What is the "impact" of this event for you? How / do you measure it?
   - How / do you follow up the event?

E. **People**
   - How / do you care for your team? (strategies, reasons to do it, etc)
   - How / do you care for your participants? (How / do you pay or reward your participants?)
   - How / do you acknowledge your participants?
   - How / do you build and sustain a community? (How / do you work with communities?)
   - How / do you care for your own well-being?

F. **Purpose & values**
   - What is the purpose for your projects/events? And how do you decide or select the purpose for your projects/events?
   - Are there/ Which are the common values across all your projects/events?
   - Do you face any institutional barriers or incoherencies to carry out your work? If so, which ones? Do you have any strategies to overcome those?

G. **Any other question that you miss here?**

APPENDIX 2 Checklist of to ask oneself questions

This section provides a set of questions that were considered relevant for self-reflection during the interviewing process. This is one of the most interesting outputs of this report. We encourage every CS practitioner to go through these bullet points in the process of defining and designing an specific CS project or activity. Perhaps not every question can be specifically answered, but the mere fact of reflecting upon them will ease the whole process of design and will help to create a common vision when working within a team.

8.1 The big questions

- What is citizen science?
- What is not citizen science?
- What should and should not be?
- How citizen science and DIY science relate to each other?
- What happens if people that are not scientists participate in doing science or even if the whole knowledge production happens outside the normal academic context? Can we still talk about science?
- What are the ethics and concerns about crowdsourcing?

8.2 Purpose and values

- What is the purpose of my activity/project/event?
- Is your event about people or about science? About both equally?
- How do you determine the values for your activity/project/event?
- What value does your activity/project/event create and promote?
- Are your goals well defined?

8.3 About an activity/project/event

- Is your communication to the target audience clear enough?
- Do you have communication professionals for proper writing and disseminating?
- How do you get funds for your activity/project/event?
- What will be the budget / time needed to do this activity/project/event?
- Is it efficient enough to justify to hold this activity/project/event?
- What is for you that your activity/project/event has been successful?
- How will you measure that your activity/project/event was successful?
- Is it enough a survey to know what you want to know about the success of your activity/project/event?
- How will you use the results of the survey you led?
- How do you plan to sustain interest throughout your activity/project/event?

8.4 About science

- How do you select your tools & techniques?
- Which are your science sources?
- How do you share knowledge in your event?
- Do you want to teach?
- What do you want to teach about?

- Does science benefit from your event? / How?

8.5 About institutions

- Which are the coherences and incoherences between your institution and the project/event to carry out?
- Do you care for our institutions? How? (organisational culture change)
- Does your institution cares for people (team, participants, others...)?
- Is your institution open to criticism and change?
- How do you encourage and improve constant and bidirectional communication between institutions (including educational ones)?
- Have you planned to work with educational institutions? Which ones? How?
- Have you planned to work with civil society organisations? Which ones? How?
- Have you planned to involve policy makers? Which ones? How?

8.6 About people

- How do you provide a human touch in activity/project/event?
- How do you listen?
- Do people benefit from your activity/project/event? / How?
- What is your responsibility when doing science outreach activity/project/event?
- Which kind of language do you use?
- Is it adapted to the audience you want to reach?
- How do you obtain/engage/seduce collaborators?
- How do you link/care communities and the topic you've selected?
- Do you plan to build and sustain engagement? How?

8.7 About outputs

- How / do you select the objectives/goals of your project/event?
- What are your KPI's?
- What is the impact you want to get on your project/event?
- How do you define impact?
- How can you assess impact?
- Do you ensure production of knowledge? How?
- How can you give feedback to my audience and keep them interested / involved?
- Do you produce scientific knowledge during your project/event? Which?
- Do you plan to create documentation? How?
- What do you plan to document? Experience, success, evaluation process, impact, science results, good practices, lessons learnt, mistakes, blueprints, code, success cases, audio and video, etc?

8.8 About you

- What is your motivation in doing science?
- What is your motivation and goal in organising this event?

APPENDIX 3 **Results of WP1 interviews**

8.9 Science

[Gustavo: facilitator of DIY bio activities in Slovenia]

Gustavo explains that in their approach to science they try to **identify relevant sources of information** when tackling the technical and scientific part in the design of their workshops. He works with kids, so they made a big effort to assure that **the process is fun and friendly** but at the same time **accurate and without oversimplifications**. They try to use **open software and hardware** (**libre** if possible), and every code they write is licensed with **GPL license** which gives power to the use and it is published on the gitlab webpage. All of the designs and instructions are licensed under **Creative Commons and are free to use, distribute, change, sell, etc**. They spend some **time to teach participants where to get all of the parts that they need** for this workshop (gitlab, other webpages). All of these components **makes science accessible even after the workshop is finished**.

[Cristina: biodesign citizen science projects responsible in París]

Cristina, through the Center for Research and Interdisciplinarity at Paris Descartes University, makes science accessible in two different dimensions. On one hand, they organise events for different publics (for example in schools) where they **bring researchers and scientists to talk about science and to really show how science is done**. On the other, they do policy engagement by going where policy makers are to talk to them and they also write **policy brief recommendations**.

For her, citizen science plays an important role in excellent science: since CS it is about **opening research**, that builds a bridge that allow people to be involved, what, in turn, can provide **more feedback and data for scientists what means more rugged science**. Besides, opening the process favours that some experiments are repeated and therefore results might be contrasted several times.

[Raúl: researcher in biodesign, DIY bio educational activities in Geneva]

When approaching science, Raúl is not only interested in scientific facts, but also in the nature of science and science inquiry, so they want to show and teach how actually science works, and this involves tofail sometimes, to make visible the disappointments of science. Their **facilitators answer some questions saying "I don't know", what totally changes the relation with participants**.

They are inspired by Paulo Freire and Enriz Mazur, and they try to **change the power relationship between who teach and who learn**, by **breaking privilege spaces in class**, **adopting the approach of hackers and tinkers** and approaching peer instruction. Everybody has same access to microscopes, projectors and they all can write freely in the blackboards. The class where they organise the courses is perfectly symmetrical so at some point of the class the teacher who was at the front, goes to the back and continues teaching, so nobody can stay at the last row during the whole class and everybody gets engaged.

He explains that one of his biggest **mistakes was to underestimate how expensive in terms of time and money is focusing on hands-on learning**. Although the cost-efficiency ratio might be higher in traditional teaching methods, these are focused on what the teacher want a student to learn instead of promoting inquiry. For him, **innovation takes time and resources, so any project focusing on funding pressure will be efficient but not innovative.**

In order to improve their practice, **they read continuously literature in Science Education, Science & Technology studies (STS) and Science Communication.** He states that it is **often underestimated how ignorant are scientists about science education** and points out that between scientists and society a good dialogue cannot be created unless **a scientist knows how society works and society knows how science functions**.

When talking how **citizen science** can constitute a excellent link between scientists, education and communities, Raúl highlights how important **humility and empathy** are: humility **to question own beliefs** (specifically if you are a professional scientist) and empathy **to listen and to work with other people**. According to him, to promote and spread citizen science, it is essential that the **research question is co-constructed** to avoid these situations where a scientists basically use volunteers to have the work done. Perhaps this cannot be done all the time, but at least the **scientist must listen to the questions and concerns of the people** she is working with. Sometimes their questions are very good.

Moreover, he illustrates that citizen science can improve traditional science with a simple example: it is well know the distribution of rare species of birds but scientists did not know much about common birds. Citizen science has totally changed this: ornithologists have learnt a lot thanks to citizen observations. Citizens are very good at spotting local environmental problems, and local is very important because it rises awareness when you are dealing with a problem that affects you directly. One example of a good approach is the one taken by *Public Lab (https://publiclab.org/).*

[Jaime: EU project evaluator without previous experience in citizen science projects]

Traditionally, Citizen Science looks at citizens as people that need to be improved by teaching them science but Jaime learnt that this is very questionable. He called this the "**deficit model**". He thinks **scientists need to be more open to the interests, concepts and understandings of citizens**.

For Jaime, in order to make science accessible, **the role of the facilitator** i**s essential. They must understand the audience in a process of co-creation**. He thinks it is a **mistake to consider citizens as an empty container that needs to be filled**. For him the relation between citizens, facilitators and organisations need to remain open to react to citizen science activities. This might **change not only the citizens but also the facilitator or the organisation** if the full potential of citizen science really wants to be harvested.

From his work with UCL, they learnt that science for institutions often is a theoretical activity but **for citizens is very practical** sometimes: it is not so much about *understanding* but **it is about *changing* things, it is about *action***. So citizen science can constitute a link between institutions and **communities**, but the communities are the ones that **are the real drivers of citizen science**. For him it is

necessary to overcome a view of citizen science that supports only understanding and educative goals.

He thinks that beyond the fact that citizen science can **contribute to excellence of science** by having citizens collecting vast amounts of data, **citizens are very creative and science should take advantage of this**. Moreover, this contributes to **question the relation between scientists and citizens**, so it constitutes an opportunity of reflection for scientists and facilitators.

[María: facilitator of biodesign activities in The Netherlands]

In Waag, Maria brings science to society by **finding a hook** close to someone's own life an interest. For example: when doing something in relation with bio experiments, **they look for something close to people**: food, households, beauty products, health care or subject topics that have been widely read in media.

They organise hands-on workshops where people experiment by themselves. In every workshop **there is people with different levels of knowledge**. Almost always a **workshop is a mix between getting info and hands-on activity** and during the workshop they discuss about the topic.

Language is very important: they try to make very understandable what is the workshop about when they announce it. They also try to make complicate topics to be accessible not only by the event itself but also language wise to not exclude people. This is always a difficult thing because **you don't want to simplify a topic**. So it is a trade-off. **Experience** is very important to do this. They pay much attention to this element: there is a whole communication team: **the science experts give the input but the communication team are the ones that write the published texts**.

Through experience they also realised that **deep knowledge of a topic is important** even for the smallest workshop, since it provides opportunities for conversation and discussion with participants. So, either facilitators are experts on the topic, or there is at least one expert on it.

She really strongly believes that a lot of **topics that are being researched within scientific world are extremely relevant to society**. And because of that you need **perspectives** since there are **a lot of ethical and social impact in scientific research**. For instance: when you think about bo sciences but also on IA, there are so many questions and as a society you need to think which relation you want to have with these technologies. There should be a collective research with all the questions that also people from outside the scientific world can make. There are some **questions that emerge that are very interesting that do not come from scientists**. They can also shape your research questions. You can have different perspectives and insights that scientist can benefit of that.

8.10 Outreach

[Gustavo: facilitator of DIY bio activities in Slovenia]
He thinks that best thing to do to attract people is to show presentations on the relevant faculties/universities, open forums, other hackerspaces, etc. A good advice is if you are part of a community or a community meets on your place, **to ease other**

people to be involved is very useful to set regular meetings, like weekly so everybody knows when and where to find you.

[Cristina: biodesign citizen science projects responsible in París]

One thing she thinks is **important is to be aware of the language to use and adapt it when talking to people** and try to adapt language every time communicate something to make sure it is understandable for the kind of public they want in each event. Even it is advisable to test it with family and friends.

It happened to them that the **most of the people working on DIY Bio have a science background**, but when they wanted to promote this activities they faced some difficulties. As she points out, firstly, **it is not easy to make it accessible**; secondly, **not everyone wants to engage in a DIY Bio projec**t. Another issue that she explains when they organised an event is that they wanted to reach some marginalised groups, but the most of the people that appeared were already familiar with DIY Bio, they had science backgrounds and there were people that could use their time in these kind of activities, so they were somehow privileged. So **in her experiences there are two types of citizen science practitioners**:

1) **People who really need to do DIY science because they don´t have another way to do some research** (for example they have to build their own tools because they do not have access to professional labs, or they have to create their own medicines and drugs since they are too expensive).

2) **People that have the means and the resources but they do DIY science for fun**.

The experience they had is that people used to come to one or two events, but **it is very difficult to create and sustain a deep public engagement, since everything is based on volunteer work**.

Also she this is important to **properly design the calls**. For example, when lookingfor collaborators, they provide **a form with a list of questions that helps them to select half of the participants with science background and the other half with other backgrounds suchs as design, architectures, photographers, etc or without any specific background**. In the case of schools, they use to ask to the academic inspection for a list of schools to contact with. They never contact to students directly. For those schools that are interested they provide some **teacher training**.

In order to reach very different types of public they contact with **high schools that are in the suburbs of Paris, where attend a public that hardly ever go to a museum**. They also collaborate with a project called *Solidary fablab* that involves drug addicted students. Besides, through the DITOs Science Bus, they could integrate science into other events to approach to people not previously interested.

[Raúl: researcher in biodesign, DIY bio educational activities in Geneva]

When organising outreaching activities Raúl highlight the importance of being critical with who come to their workshops and **analyse their demography. If a specific group is not reached, they try other channels**.

> "*There is no such a thing as a general public*".
> Raúl

Twitter and the web attracts specific public, but when working with certain communities or excluded groups is **essential to go where they are, to collaborate with NGOs and other civil society organisations**; or even to go to other spots such as public spaces or parks to engage with a different public.

[María: facilitator of biodesign activities in The Netherlands]

When you communicate, text and image are crucial: what it is about, what you expect from participants, what you want to achieve (impact: you want to explore a topic in a workshop - like experiment- or you want to cause an impact or act ion specific area - likely you need to engage people for a longer time and that is a different story).

8.11 Participants

[Gustavo: facilitator of DIY bio activities in Slovenia]
They develop their workshops in a manner that **gives every individual some freedom to express him/herself**. Since they know that every kid is good in something, they give a lot of **attention to the individuals**. He states that as the **food** is very important part of the human beings, they tries to feed their participants with healthy decisions, such as fruit, drinks without sugar, etc.
About rewarding participants, he **treating them equally** and give them the chance to participate actively in the workshops what tend to **rise their self-confidence.** According to him, this is crucial for their creativity and collaboration in the workshop. If they feel **comfortably enough**, they tend to make proposals and ideas for the rest of the workshops. Most of the times **they include their wishes and ideas and we adjust the rest of the workshops**, so it is even more interesting for kids. Basically they give them the chance to **co-create the workshops**. This generates a positive loop where the facilitator teaches about science and also he gets new proposals for the events.

[Cristina: biodesign citizen science projects responsible in París]

When caring for participantes, Cristina distinguish two phases:

1. **Before the event, where they send them all the information they need and make themselves available to answer their questions**.
2. When the event starts, participants are welcome with **ice-breaking activities** and the facilitators remind them the objectives of the activity. She highlights the importance of having breaks, so participants can breathe. The **place should be beautiful and comfortable**, they provide **food** and facilitators try to talk to participants to see if the event has satisfy their expectations. And if

the group is not big, sometimes they try to do something together in the evening such as dinner all together or a tour in the city.

A mistake she tries to **avoid is to overload participants with too much activity.**

[Raúl: researcher in biodesign, DIY bio educational activities in Geneva.]

Raúl states **how important is to pay participants sometimes**. For example, where some practitioners, such as biohacker, run an experiment or demonstration in a workshop. However this rises a very essential issue: **it is very difficult to pay an individual from an institution since this usually does not have cash, need invoices, etc.** In order to find a solution for this difficulty they suggest that institution firstly **need to understand how independent people work** (sometimes they have two jobs, they do not have a secretary or an accountant, many times they cannot advance the money or even invoice). As an advice he thinks that **it is much reasonable to pay per diem (always in advance)** that reimbursing costs and **institutions must keep the paperwork for themselves**. He explains that for DITOs Biofabbing conference he had to use his personal credit card to get cash and pay some participants there.

[Jaime: EU project evaluator without previous experience in citizen science projects]

For the events they have organised, he tries to make sure he **meets their interests and their constraints** (such as schedule). Since it is difficult to know everybody's needs in advance, **he tries to meet some people before hand, talks to them and then generalise**.

To **acknowledge participants**, he tries to demonstrate that there is an opportunity for them: for example, that they can provide input for a policy brief. So this is **about bidirectional communication: actually listening to them and taking recommendations on board very seriously**.

8.12 Communities

[Gustavo: facilitator of DIY bio activities in Slovenia]

Gustavo says that **the most important thing of the community is that you have at least one person that is passionate about the idea, that community is following**. That passion has to be transferred to new members. Their **meetings must be on the regular basis**, so people know when to find you. He also says that an important lesson learnt is to **give communities freedom about the program they want to do**.

> "*Community has to feel welcomed at your institution, which means that they have access to the kitchen, know the people who works there and attend your events."*
> Gustavo

For example on the "Rover to Mars" set of workshops (where kids built a rover from scratch by kids, http://biotehna.org/en/dogodki/friday-academy-next-stop-mars/), they included a lot of ideas that arrived from participants. The kids identified themself

with Rover so much, that they asked the facilitators whether they could come to Kersnikova once per week and continue to upgrade the Rover. They met every Tuesday and KI provided the infrastructure with all of the materials, tools and professional help that they needed. They have freedom on what they will do, but **Kristian also tries to inspire them with art pieces**. They finished the "Rover", but they decided to continue, and in the last couple of months of this interview they have been building a quadcopter from scratch.

[Cristina: biodesign citizen science projects responsible in París]

To promote specific communities, they try to i**nvite people that they know they share same values**, and organise networking activities during the events so they can connect easily. For specific events they even create a email group/mailing list or a Facebook group so people can still be in touch.

The strategy to sustain a community is much more difficult because **people are busy**. They simply care for their Skype of Facebook channels and make sure everybody can use them every time they want. So in a way, she thinks the **community must be self-sustainable**, but it helps to invite again and again the same people to promote the contact among them.

[Raúl: researcher in biodesign, DIY bio educational activities in Geneva]

Although he is not very experienced in working with communities, he proposes to have a **community manager that give participants continuous feedback**, what basically costs money. He also points out a very fundamental issue: **this work often is incompatible with standard family life**. For example, if you do DIY Bio, although this is fun, it is done after 20h or during weekends. This is one of the reasons that are adult women are not that common in these kind of communities. So **in order to be more inclusive it is necessary to care about this**.

[Lucía: facilitator in community health citizen science project]

When working with communities, she does think one can sustain them. What she does is to accompany them or to **favour or facilitate a comfortable situation to let the connections that support a community emerge**. When working with **vulnerable communities, giving them voice** is essential.

[María: facilitator of biodesign activities in The Netherlands]

When you want to engage people for a longer period of time and create a community, you have to make sure your are reaching the right audience that means that they should have already a drive or an interest to participate (internal motivation). They look for already motivated people. For example: in topics related to health, food or environmental issues. It is important to inform people on a regular basis (newsletter, ej). And also you need leaders (community leaders) that bring people together. They do research (look online what is happening in a specific area) to find these communities of interest, and then we go and talk to people of these communities. Sometimes they publish articles and calls in local newspapers, and the first event is just to inform people of our plans and invite them to join.

8.13 Team

[Gustavo: facilitator of DIY bio activities in Slovenia]

In order to care for his team, Gustavo **provides interesting articles about the theme** of each particular year as **food for thoughts** because they help them to cope with the events. Some members of the team are **mentors**. He works constantly with them and **talk to them about past workshops** to share what was good and what was not that good. If there is any problem on a workshop, they discuss it and try to find solutions.

[Raúl: researcher in biodesign, DIY bio educational activities in Geneva]

Raúl has one team in Bioscope and two research teams. He advices to form a group with **people that love what they do but also love working togethe**r although getting this is very hard. He thinks there is **partially magic** but it can be eased by **giving everybody responsibilities, so everybody is a chief or boss for something** (e.g.: biodiversity, public events, diy tools, etc), what constitutes a partially flat organisation. Besides, **he pays as much as he can to his team**.

> "*The less you pressure people, the most they work. I hardly had problems with people working too little, but I had problems with people working too much*".
> Raúl

He highlights the importance to find **trade-offs between performance of the group and the well-being of the team**: sometimes it is necessary to forget about some crazy deadlines. He also reminds that **hacker or DIY culture is very fun but it is prone to burnouts and this is something that must be explicitly treated**.

[Jaime: EU project evaluator without previous experience in citizen science projects]

Jaime tries to give certain **degree of autonomy to his team**, since he thinks it is a mistake to micromanage everything.

[Lucía: facilitator in community health citizen science project]

Having leisure moments is important, **eating together and bring food to cook altogether is also a fantastic experience**. To provide **emotional spaces** where you can say how you feel openly, including how you feel with the rest of the team. It is very important, specially in hard situations to **bring opportunities to laugh together**. **Give value to others time, so be on time is important**. Let other people speak and feel heard.

8.14 Caring for oneself

[Gustavo: facilitator of DIY bio activities in Slovenia]

Gustavo tries **not to work during his free time**, and **sports** as much as he can (Ryu Kyu Kempo, Modern Arnis, cycling). Besides he also tries to enjoy long mornings and **spend evenings with people he likes**. He also **reads articles connected with his work but because he likes them** (usually about new technologies or biotechnology).

[Cristina: biodesign citizen science projects responsible in París]

For Cristina it is very difficult especially since **she was working by herself for a long time**. She says that **she put a lot of pressure on herself** and that she was not caring at all. After some time, in her words, she realised that **nothing is very serious and she learnt to trust people, to delegate, to communicate to your colleagues and collaborators, to prioritise, to have feedback from others and the importance of not working on her own**. Once she could have a colleague to work with, she came back to **sports** and **get a lost balance again.** Anyway, she says that she stills check her emails during the evening on weekends, but only looking for emergency emails.

[Raúl: researcher in biodesign, DIY bio educational activities in Geneva]

Raúl tries not to work so much, but sometimes he does not succeed. He tries to **meet participants personally**, especially kids, that **give** him **purpose and meaning**. He also tries to build actual things and instruments, since being in touch with the materials he manages keeps him sane. **Running** empties his brain.

[Jaime: EU project evaluator without previous experience in citizen science projects]

One way to care for oneself is **making sure he has enough time for travel,** so he avoids meetings in Europe that forces go and back in the same day. However this does not work sometimes. One advice he gives: "**carefully select your project**".

8.15 Evaluation and impact

[Gustavo: facilitator of DIY bio activities in Slovenia]

For Gustavo a workshop is successful firstly when participants by **their own initiative troubleshoot their work in the end of the workshop**. This means that they have learned enough to know how it works. Secondly, when participants actively discuss at the end of the workshops and their **inputs are different from the beginning**, what shows that they have understood the issues of the workshops.

> "*The biggest success is when you meet ex-participants at the next event and they include knowledge from the previous workshops.*"
> Gustavo

In order to assess the success of an activity for kids **they tried different paper questionnaires, but he says they all failed miserably**. Participants just do not

want to spend their time on the questions about the knowledge they have obtained: they resemble school tests. So what they do nowadays is **a special ceremony**. In the first part of it, **participants present what they have done and what was the most difficult thing to do**. In the second part they **receive diplomas**, and in the last part, **they explain one-on-one to their parents how does the final product works**. If they can explain what they did and how it works, it means that they learned something on the workshops.

[Cristina: biodesign citizen science projects responsible in París]

For Cristina there are different criteria to evaluate. **First one is whether or not people smile, yawn or leave very soon**, as ethnography observation. Their second method is talk to participants through interviews or informal conversations. Their third one is through questionnaires, either on paper or electronic.
Cristina thinks that one **mistake to avoid when organising an event or an activity is to focus on the organisation without previously asking oneself**: “why do we want to organise this event? What do we want to have at the end? What could be the deliverables? What are the interests like the motivations for us as organisers to this? what could be the motivations for the public, for the guests?”. Another related **mistake is to have so many events that prevent the team precisely to ask themselves the right questions**. She thinks that is important to be aware that one cannot please every single person, and it is very almost impossible. That is the reason why it is usually much more efficient to be more specific in the kind of public you want to attract.

[Raúl: researcher in biodesign, DIY bio educational activities in Geneva]

Raúl explain another common mistake they used to make: to **underestimate the importance of evaluation, that is, measuring learning, changing attitudes and conceptions.** He advices to resist to usual metrics (e.g.: number of people reached) and states that **is much useful to provoke a life change in one thousand people than reaching one million in Twitter.** As an example, they did an activity in soil biodiversity. Ten years old children drew soil around the school. Basically they drew concrete. Afterwards they saw soil in microscope and they make a second drawing. Now this shows that soil is plenty of life and beings, what in a very simple way this shows how they see nature. Below both pictures are shown.

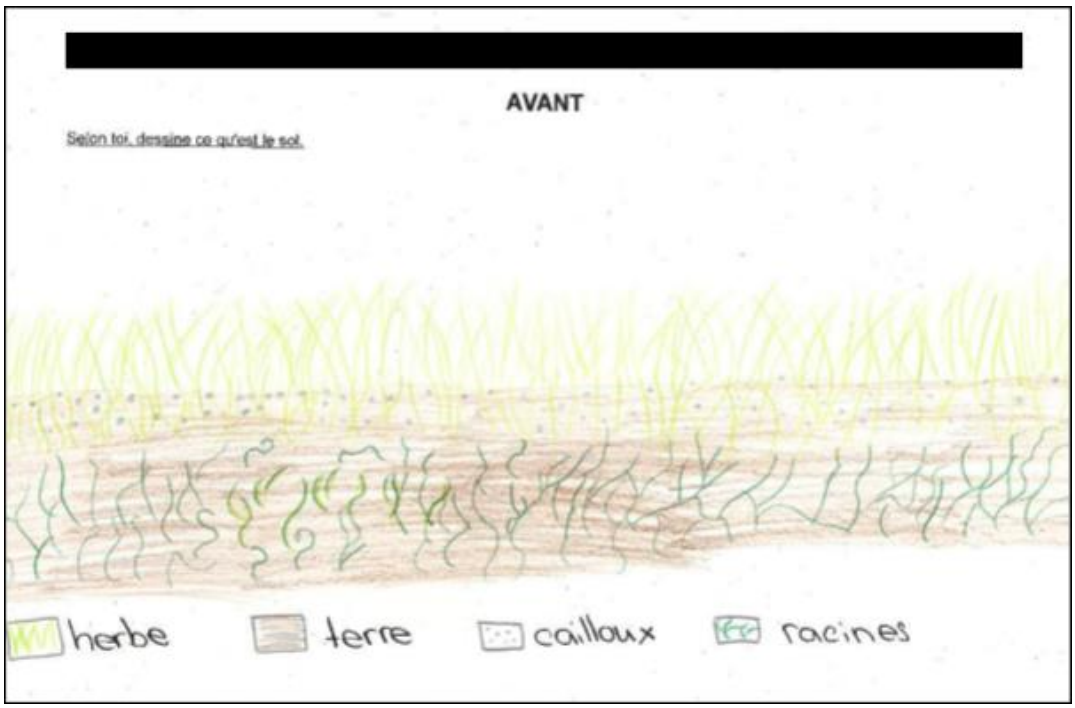

Figure 3 View of soil of a ten years old kid before an experiment

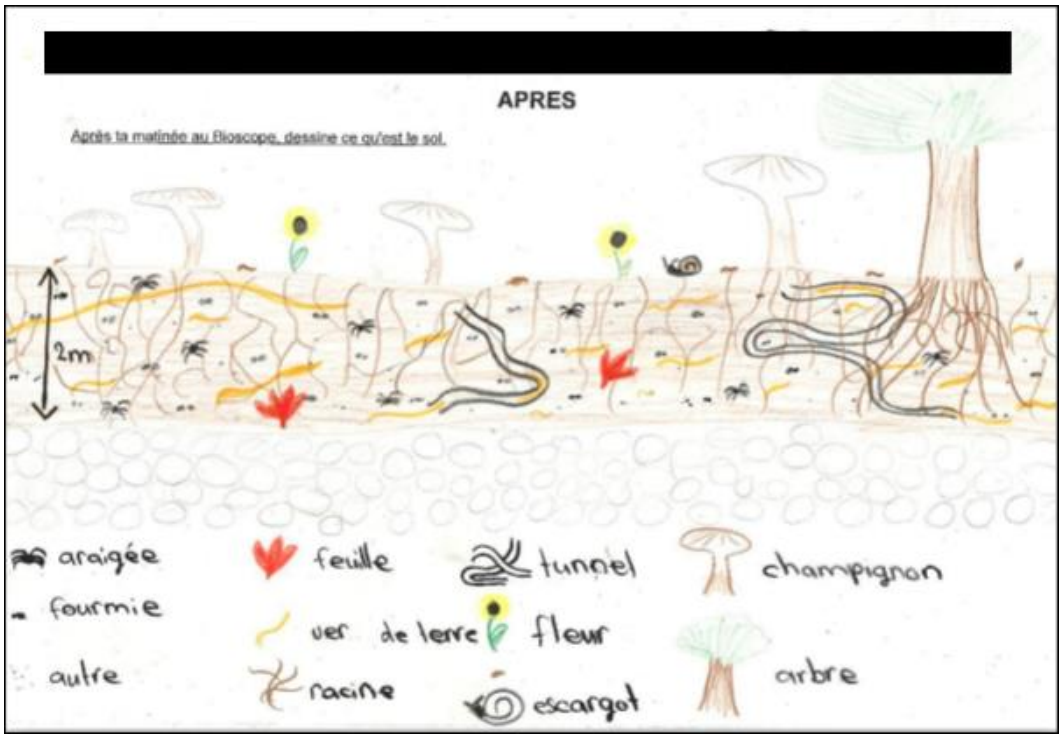

Figure 4 View of soil of a ten years old kid after experiment with a microscope

He provides four dimensions that should be systematically evaluated:

1. Learning outcome (knowledge): it can assessed through **quantitative and qualitative** measurements. They have doctoral students that design that. One good example is the picture of soil that can be seen above.

2. **Attitudes** (towards science, the environment, health, etc.): these can be evaluated through **formal questions (questionnaire)**. Sometimes it is advisable to perform evaluation even months later to asses long term effects.
3. **Counting number of people and check if they were happy**, but he thinks this is not the most interesting.
4. **Demographics**: it is really the reality check since a lot of science outreach activities reach people with a lot of training of science what it is not very interesting.

[Jaime: EU project evaluator without previous experience in citizen science projects]

Jaime worked on the D5.3 about evaluation. He describes three components:

1. Backwards: what DITOs team has been doing.
2. Assessment: where are we right now.
3. Forward looking: This makes the connection to "value": what does it imply for the future?

So when considering a successful outreach event, on one hand we can question how many people did we reach, how much they were interested, how much did we change them, but these are more backward questions. Their evaluation show that many **participants learnt something**, so there is an educational component that can be evaluated and tested, but this limited to consider that this is the success.

But if we look into the future, he thinks that other questions arise: "**Will the citizens behave differently in the future?** Will they be more active in their communities? Will they educated their children differently?". Notably they discovered that **students involved in citizen science are more likely to include citizen science methods if they become researchers later in their life** and this makes and impact. However, **in order to evaluate precisely this, longitudinal studies are needed so people can be followed over extended periods.**

He makes a difference between impact and engagement. **Impact is about long term change**. Engagement. however, is related to interaction.

> "*If you want to engage people, you need to listen, not only teach and lecture. Why? Because engagement means empowerment. If you really want to engage someone, you have to give them power to some degree. For example, the power to influence discourse. It means really to take people seriously."*
>
> Jaime

Besides, for Jaime, during the evaluation process of DITOs activities they found **how difficult is to collect questionnaires from participants because they had underestimated existing rules of organisations that limited the questionnaires** (some had some questionnaires already in place, other had rules because of the funders, and so on, so add another one in the case of DITOs was difficult).

[Lucía: facilitator in community health citizen science project]

Their indicators are participation, but more importantly they promote the reflexive discourses from people. They will confirm if the goals the team pursued have been achieved. If the alliances and connections remain among the participants, perhaps they do not prove success, but it is a very valuable side effect.

8.16 Difficulties and mistakes to avoid

[Gustavo: facilitator of DIY bio activities in Slovenia]

Gustavo identifies as an issue in their workshops the **complexity of the chosen topics**, since they sometimes need some **expert knowledge that is not available at that time**. He also explains that they always prepare the prototypes for the workshops in advance, but sometimes they do not work so they have to work over the night to fix or change it. In order to avoid this, he states that **time is crucial**, since it allows to prepare the content more error-free.

[Cristina: biodesign citizen science projects responsible in París]

The main difficulties Cristina has found to carry out their activities are **human, money and time resources**. She mentions that **in France citizen science is quite a new trend and it follows a much more top-down approach**, more related to participatory science than to citizen science. This has been a **barrier to make institutions support non-professional scientist to do science**. In fact, **some people from the current DIY community left institutions where they worked as professional researchers because they did not like how research was being done**. Part of her job has been understanding both motivations and trying to build bridges between the two. One of this efforts was to organise a round table in 2017 to discuss **which ways are possible to open institutions to let citizen have access to their knowledge, resources and even have access to the experts that work there**. One of the **challenges she identifies is how institutions can open the doors to people who are not involved in the system already**. She also identifies some **incoherences**: for example when researchers promote citizen science but their goal is just to train people to get some **free labour through volunteering**, where only the scientist truly get advantage of this situation. She thinks that an strategy to overcome this is to be **transparent** and look for true **win-win processes** what can only be done by **listening to people's needs**, what basically means evolving to a **bottom-up approach**.

[Raúl: researcher in biodesign, DIY bio educational activities in Geneva]

Raúl highlights **how easy and dangerous it is to underestimate the importance of working and mediating with civil society organisations**, that structure micro-publics, before approaching to certain groups. **Schools are very interesting because they usually provides a good broad sample of people** at a certain age. They work also with retirement homes, which he says it is very fun and also provide completely different views of nature.

The University of Geneva supports one third of his budget, but Raúl says that is **difficult to work with the institution because it does not share the same values**.

The institution wants them to do science communication or science marketing, but what they really want to do is to **empower people and build better citizens**. He adds that academia should be place to reflect , but there is a lot of resistance to change, and **stability is hard for innovation**.

> "If you believe in co-construction, in participatory research, etc, you are sharing the power of academia with other people and that is something many people do not want to do. "
> Raúl

[Lucía: facilitator in community health citizen science project]

In many health projects, the organisation defines the action to be taken without having listened to the people who are going to affected, and when being part of the institution you have to work with indicators that do not make sense because they are not adapted to the environment you are studying. In many occasions you can not change this dynamic, but on a personal level, and from a **voluntary point of view, outside the organisation you end up contributing or participating in what you think is missing**.

One of the biggest **mistakes** she pointed out is **organising an event without knowing the context** where it was going to happen.

[María: facilitator of biodesign activities in The Netherlands]

She points out a pair of difficulties:

1. Finances are always the problem to continue researching lines. You always have to find a project that make it possible to continue. There are so many relevant topics but you have to focus on the ones that have funding. The problem is that you never know when your project will continue to be granted.
2. They join a lot of UE projects and usually they need local networks to make it work, but sometimes they are not part of the consortium, what makes it more complex. You have to manage this with your EU partners but also with the local ones to meet expectations from both.

It will be a good practice for European projects in public engagement to have international facilitators meeting besides consortium meetings to share good practices and lessons learnt by experience in the field.

8.17 Purpose and values

[Gustavo: facilitator of DIY bio activities in Slovenia]

For Gustavo, KI tries to **promote critical thinking in the field of new arising technologies** such as virtual reality, biotechnology, artificial intelligence, etc. In order to facilitate the emergence of this critical thinking **they inspire participants with contemporary investigative arts.** Besides, they decide the purpose of each workshop for next year based on the artist that will arrive in kapelica.

> "*Through promoting critical thinking, we don't teach people, we make people*."
>
> Gustavo

From a more personal view, he was researching in science before he joined KI, but he was not totally fulfilled with science and he missed the core questions such as "why are we doing this?" and not just "how?". However in Ki they uses art to reflect about the uses of technology, science or development. Now he uses precisely art to teach kids critical thinking so they can think by themselves why to use one technology instead another.

Although his personal values are aligned with those of the institution, he is in a constant struggle with how we could finance the activities. Not only they promote software libre and healthy food but they also pursue coherence, so it is difficult to accept big international sponsors with a lot of money that precisely have opposite values. Apart from that, they do not feel big barriers to do their job and one of the reasons is that the whole team share mostñy the same values.

> "*So my advice would be have values or have money, you can't have both*."
>
> Gustavo

[Cristina: biodesign citizen science projects responsible in París]

For Cristina, the purpose of the project usually is how to **engage and connect people,** specially people that do not know each other, and facilitate translating languages and lexicon (scientists, policy makers, other citizens, etc). She tries to build bridges by **recommending policy makers ways to empower people**. And on the other hand, **encourage people to do something without waiting for policy makers to react**. Their main values that crosses all their events is **opening science, making science accessible, promoting empathy, and encouraging critical thinking**.

> "*Our shared purpose is to fundamentally transform the life science and democratise biotechnology to inspire creativity and improve lives by organising life science change-makers and bio enthusiasts to build and inclusive global network, cultivate an accessible commons of knowledge and resources, launch community laboratories and projects and enable local educators*.''
>
> Cristina

[Raúl: researcher in biodesign, DIY bio educational activities in Geneva]

Raúl learnt from Public Lab that **producing a list of values** is very important for team building. The building process is an occasion for everybody to say what they want and why they are doing what they do. The idea is to agree overall on main values. This builds confidence and trust.

Here it is the inspiring list of values Raúl talks about:

Values of Bioscope:

1. **Research**: Bioscope promotes a better understanding of the nature of science, research practices, the life of a researcher and researcher, and forges links between researchers and researchers and the city.
2. **Emancipation**: Bioscope gives its participants a sense of competence and opportunity for life sciences, medicine, scientific knowledge and medical knowledge.
3. **Relevance**: Bioscope scientifically addresses the concerns of its participants with respect to their daily lives and the issues of life sciences, medicine and health in society.
4. **Inclusion**: Bioscope encourages the inclusion of under-represented social, cultural and gender minorities among its participants, partners and team.
5. **Listening**: Bioscope listens to and respects the value of the questions, beliefs and knowledge of its participants, partners and members of its team.
6. **Sharing**: Bioscope collaborates, in a spirit of reciprocal sharing, with all partners pursuing the same objectives and supports their own efforts.
7. **Respect**: Bioscope promotes to its participants and collaborators the principle of sustainability, respect and curiosity towards the diversity of nature and people.
8. **Excellency**: Bioscope creates innovative educational activities and devices, based on educational research and professional excellence, stimulates individual and collective creativity, and promotes the most recent results of scientific research.
9. **Convenient**: Bioscope encourages learning by doing, including experiential learning, peer learning, and participatory research.
10. **Reflexivity**: The Bioscope evaluates its own pedagogical activities and its functioning to get closer to the principles set out in its Charter of Values. Source: https://scienscope.unige.ch/bioscope/bioscope-2/presentation/

[Lucía: facilitator in community health citizen science project]

She carries out participatory actions where it is the population who detects and identifies the needs they have and they propose and organise actions and solutions. In this case, the role of facilitator is to **accompany and facilitate** with the resources available to those **solutions that the community wishes to carry out**.

Her purpose is to maximize the strengths that the community has. Interestingly research suggest that the most participatory communities (both in decision-making and in action) are the healthiest. She thinks a good practice is to design projects that put the **focus and emphasise the individual and collective capabilities to allow connections among others**.

[María: facilitator of biodesign activities in The Netherlands]

A project can start in a very different ways. Waag is a middle crowd organisation. They look into **impact of technology of society**. “Can we empower citizens?” By giving access to new technology they can give citizens voice to talk to local

governments or by helping them to get data. In the case of DNA or IA, there is a lot of attention in the media, but it is complicated, and it is super important that citizens engage in these discussions with knowledge so they decide to focus on that and develop projects in that area. Waag looks for social controversial things and issues in society and society problems and they create the program or decide the project to do. They are a project-based organisation, so as soon as they detect there is a topic that is important for society they start developing a project around it.

One thing that is important for a long-term engagement with the groups is "**expectation management**": **what they can expect for you**. She says that you have to be very clear and honest about it: even if you have a lot, **your expertise is always limited** so you can never guarantee that you will succeed. In citizen science projects, you need some mentality in the people that we engage, because outcome is not certain so people need to understand it since it is a collective research.

APPENDIX 4 Results of WP2 interviews

8.18 Science

[Sara: facilitator of environmental citizen science programs]

Sara tries to lower the perceived barriers to engage in scientific inquiry. Their different activities treat the subject of science in a variety of ways: their **cafes and their film nights** discuss science (science communication) and in their **DIY hands-on workshops** they do scientific experiments and set up hypothesis and work through protocols to engage in scientific inquiry.

They **provide training and instructions for DIY scientific inquiry**. For example a **good practice for making science accessible is to enable different points of entry into an activity** - to cater for those to whom scientific inquiry is new as well as to those who already have experience. For the later, at a workshop for example, they ask them if they are happy to **mentor someone who is not so familiar with the subject or materials**.

[Ramón: researcher of a community health citizen science project]

There is not just one kind of citizen science project, it really changes according to its goals, objective audience, research question, science discipline, etc. Therefore this makes that every project can have different methodologies.

One of this is called *photovoice*: it is a participatory research-action methodology. Here photovoice was used by Ramón in a public health and urban health research. His background is on epidemiology, and the goal was to **study which is the food that is available around a specific community**. In this case they selected a humble neighbourhood of the south of Madrid. Briefly, the photovoice methodology enabled residents to take pictures to the food they can buy in their streets. Afterwards the researchers facilitated community discussions that were analysed later. Besides the scientific outputs such as scientific articles and conferences, they produced a **photobook and an exhibition that contain not only some of the pictures taken by the participants, but also their thoughts and**

their own pictures as coauthors of the project. This methodology has a **huge power to approach science to the public**: on the first hand, because it forces **researchers to have a very deep relation with participants** (around 20 people in each of the three research they have done); on the second hand because a **photobook and an exhibition is codesigned with citizens** mixing science and art which can be easily understood by everyone. So **using artistic supports for science project is very useful to make science accessible**. Perhaps one of the keys is that this kind of art is developed by citizens, and not by the artist, so accessibility is encouraged.

[Alejandro: artistic director of citizen laboratory in Madrid]

Alejandro thinks that talking about how to **make science accessible has already the assumption that there is a distance between citizen and science** and according to him, it is the **institution the one that states that both are separated**. Scientific research can happen in many ways, and not only in those places that are consolidated as science places. For example citizen science is part of much more open and wider view, where other models of organisation and institutions take place where citizens play a much more active role. Besides, nowadays Internet increase the possibilities of cooperation, where professional scientists are not the only ones that get and exploit data. **Citizen science can help them to think in new institutional models that facilitate new collaborations, experiments, and knowledge production.** And more importantly these methods promote documentation, sharing and dissemination of what it is done locally. In Medialab they try to promote these approaches where different perspectives come together in place in hybrid projects where science is mixed with art or education for example.

One of the most relevant advantages for citizen science is not that it reduces costs, what is insufficient, but its power to **rethink about the model of scientific institutions and the model of scientific research** that we have nowadays to generate more permeable spaces. For Alejandro that would be good that professional scientific labs would have a part of citizen lab where they can relate to citizens in other ways. **This might lead to models where divulgation or dissemination becomes coproduction.** Besides, these new approaches together to the power of interconnection of internet, question the traditional distance between disciplines. Today it seems that a fundamental complementary way to advance in science is to cross disciplines in a transdisciplinary or even *antidisciplinary* way. And there it is **where the citizens labs and participatory research has a lot of potential** and the concept of **procomun can articulate a narrative that connect different areas.**

[Adolfo: environmental educator, botanist and citizen science manager in Madrid]

Adolfo states that the key to make science accessible is first to have an **enthusiastic team that believe in what they do**, and second to **spread this enthusiasm** to other citizens and participants. For example, people usually ignore lichens, but once they know its importance from an ecological point of view, that it is a bioindicator of the air quality and that our health really depends on having a rich and divers lichen flora, people start looking at lichens differently.

Second, he also thinks that **language must be carefully adapted** to the people you are communicating. T**his involves some psychology to figure out the interests of the group and of course a proper control of non-verbal language**.

Third, the **discourse cannot be only theoretical. Some participation is needed**. This can be as simple as anecdotes, examples, etc, but that can related to other subjects so they can relate it to their previous knowledge.

Besides, when enthusiastic volunteers participate in a citizen science project, researchers **take advantage of their contributions and therefore sciences is improved**. But it is **important that these scientists return and acknowledge this effort to citizens, by, for example, including the names of the people or organisations that have contributed**. **This creates confidence in society and in science and even creates complicity**.

[Laura: coordinator of citizen science programs in Brussels]

Laura states that **science is at the core of every activity we do**. And there is a large range of formats and programmes delivered by the Museum to the visitors or participants (workshops, exhibitions, hands-on in the science truck, STEM and nature observation with XperiBird). Science is made accessible through **museologists in the exhibitions** (a science adviser consulting researchers for a specific topic and translating this into a scenario, story and giving shape with most of the time specimens from our collections or specimens dedicated to exhibition), **through the education programme** (usually in link wit the school programme) and **through the news on our research on the website, and social media.**

[Lucas: manager and researcher of environmental citizen science projects]

Within Citizen Science, Lucas makes science accessible by **creating useful platforms for CS**: they try to **develop systems that break any barriers in the realms of knowledge, technology and language**. So their goal is to design every kind of participatory systems that are as inclusive as possible.

He has learnt through experience that is essential to establish and strengthen good communication channels, and in many occasions the channels one has been used are not adequate for the public you try to reach. **He advises to include communication professionals in CS and has a plan to engage specific communities**. He also thinks that is a mistake thinking about CS as another kind of communication because it has also a **strong scientific component**. People tend to be more active and it needs more prominent communication channels than in other spaces.

According to Lucas, one of the key elements for the future is **how to interleave citizen science and education**. This is the basis for the future, since participation might imply certain degree of training. It is relevant to include CS actions into the educational programs.

He says that although is difficult to admit, sometimes for specific scientific channels, scientists have not capability with conventional methodologies to get enough data, and this can be solved by participatory means. He is convinced that in some cases

the results are far better than with traditional techniques. **With CS you can get some results beyond traditional science**, but **it needs important resources** (it needs communication specialists and community managers).

[Ricardo: social entrepreneur in environmental citizen science projects in Poland]

Ricardo adopts a slightly different approach. His goal is to **help people to find how to solve their problems**: they work with school trainers and communities. What actually happens is that t**hrough the discussion to the problem to solve, science arises** as it is seen as a necessary useful tool to learn, so it is the need the one that motivates people to approach science.

He mentioned that a **mistake they committed at the beginning was to try to engage people to CS just by showing and promoting some applications**. Later on they discover the importance of knowing the drives of the people and there for design CS projects based on people concerns was the right way to go.

For example they were working with hackers that had built some air quality sensors but they did not know if the measurements of these were right. So through Meritum they open a relation to the university with professional equipment and they could test their devices.

[Daniel: member of a grassroot ecological group]

Daniel mentions a successful citizen science project they did with *Ecologistas en acción* as a grassroot organisation: they did a rigorous research about mercury emissions in thermal power stations. With the data they got, they went to policy makers to take actions. He sees citizen science as an opportunity where academia, citizens and institutions have a lot of to gain all of them. **Citizens can get empowerment and a better comprehension of reality**. **Institutions gains a deeper knowledge of what is happening and legitimacy** if they recollect citizen requests. **Academia gets useful data** to take advantage and a **greater projection of their work** beyond their own circles. Challenge for everyone is go beyond their own logics and inertias to be able to collect the visions of the other two entities.

Another example in Madrid is the **scientific reports they did about the renaturation of Manzanares river** (it was canalised between concrete walls and stopped by different gates). Madrid city council used those reports to take action (they opened the gates and let the river flow freely) and inform citizens about the reasons of taking this decisions including science components to justify them. So this was clearly a win-win-win situation.

[Julieta: coordinator of H2020 european citizen science project]

Both to make science accessible and to reach people, the most important thing is to **start from something that worries them**. In Julieta's case they work with the contamination with odors and people who are affected by it. A first step is to look for an **affected group and try to use an inclusive approach**. She tries to involve all the groups in an affected neighborhood. They do not want anyone to be left out by educational level, gender, socio-economic level, etc. So in order to achieve this they **adapt the speeches and participation strategies** for those with whom they speak

to. **If a group does not have a smartphone to participate, they look for another way to include them**.

They want people to **participate from the definition of the problem, in all phases of the process, in an inclusive manner**. Affected people are the ones who know the best what smells and how it smells, so they are really the key to see what is happening. There may be several research questions. What and how does it smell, and what can we do to change it? What happens with the odors of the sewers? (Citizen's question).

[Clara: researcher specialized in policy making]

Clara had been working on the policy side of citizen science, and she points out how important was for them **to work on terminology and on the big questions** when talking about science. They realised that answers are not the same for every practitioner of science or citizen science, so they had to do some work asking "*what is citizen science?, what is not citizen science?, how citizen science and DIY science relate to each other?, what can be citizen science?, what should and should not be?, what happens if people that are not scientists participate in doing science or even if the whole knowledge production happens outside the normal academic context? Can we still talk about science?*". She emphasizes the need to have discussions with participants on these questions, since they usually come from different backgrounds and they have not only personal opinions but also professional ones. There is never a single answer and the field is still developing. So this is the reason at ECSA there is not a unique definition of what citizen science is but a catalogue of 10 principles: https://ecsa.citizen-science.net/engage-us/10-principles-citizen-science.

She also likes to talk about "citizen sciences" and "sciences" instead their singular counterparts. She thinks it is useful to see research as process. Here it is an open discussion that they started with members of ECSA, the Living Knowledge Network and the French ALLISS network on what Citizen Science can mean in relation to other terms and important questions that arise when you think about this. For them these discussions were part of starting a longer cooperation. They wrote them down for other to use it and add to them: https://etherpad.wikimedia.org/p/ParticipatoryResearchBackground. She also recommends to read Bruno Strasser's paper.

The variety of definitions what also shows is that there is a very pluralistic community, so it raised a very important question: "when we do policy engagement... for whom is this?". **There is not a single representative in citizen science but it involves very different practice communities and they should be involved**.

When being asked about how citizen science can help to do excellent science she believes that we need to closely look at how "excellent science" is understood today and mostly we need to make sure it addresses the needs of people for better lives.

8.19 Outreaching

[Sara: facilitator of environmental citizen science programs.]

To attract people from outside their circles they **partner with organisations whom they can complement**. For example, they can bring connections with scientists and researchers to an NGO whose mandate is to specifically work with disadvantaged communities. Together they deliver something that we wouldn't be able to separately.

She warns that when using online community platforms like Meetup.com, combined with a 'free-entry' approach you often run the **risk of high drop-out rates and low attendance**. They thought there was very little we can do as event facilitator to change those trends but one of their participants, who also runs their own events shared some good practice: **He makes sure to send a kind and caring message to all participants a few days before the event** to remind them of the event, to let them know that their participation and attendance is valued highly; that we understand if they cannot make to event because life is full of happenings but that we would appreciate greatly if they could change their attendance status to 'not going'.

[Ramón: researcher of a community health citizen science project]

In the case of photovoice, Ramón and his team needed to study specific areas of Madrid with different socioeconomic features. They were working with an **organisation** called "Madrid Salud" (**belonging to the city council**) that works specifically on the studied neighbourhoods. This cooperation was essential since **this organisation has a lot of relations with the social fabric of the area**, so they could be connected with the different neighbourhood associations and with specific **socially active people that had a profound knowledge of the area**. They really recommend to work with local associations and stakeholders that works in the specific areas to study since they really open the proper doors to reach citizens. Specifically for the photovoice, since they were interested in citizens to take pictures, they also promote the project in spaces of the neighbourhood where photography courses were taking place.

Then to make discussions or further conversations take place, **it is also important to go to these local places** instead of trying to make people travel to the researcher's offices. Impact is increased if interaction is done in the local places of citizens.

It is interesting to mention that in areas **where the socioeconomic level is higher, people tend to mobilise for entertaining reasons, while in poorer areas people tend to act for a social change.**

[Alejandro: artistic director of citizen laboratory in Madrid]

In Medialab Prado, they have been publishing and spreading open call for projects and collaborations for almost 13 years. They do local, national and international open calls what requires different efforts. Alejandro thinks that in order to improve their strategy and reach more people and other public, i**t is a good idea to join thematically different workshops** because one feeds the other and the call is more powerful. Secondly, the idea to **involve a specific set of agents that are linked to the public for which the call is published** can improve dramatically the success of this. He explains how for "Experimenta Distrito", a workshop focused on specific

district of Madrid, they hired a team of **three mediators that work for six months together with the social fabric of that area what was essential to design and spread the call**. He also gives a lot of importance to the power of a **proper documentation, exhibition of the results of the workshop and the continuity of the projects**. He emphasizes the **labour of cultural mediators to reach other public**.

As a good advice he proposes **map active agents that works on a topic similar to the call, to map potential resources and intervention spaces where to spread the call.** He also thinks that the **topics of the workshops defines or select the type of public they will attract**. For example, if the topic is working with textiles, it has an effect on attracting old women to the workshops.

As a common mistake, he thinks that **a good text on the web page is good, but not enough**. It is better to spread the call by other means such as writing universities, people that might be interested, etc, that in turn might act as multipliers of the communication of the call.

[Adolfo: environmental educator, botanist and citizen science manager in Madrid]

To engage people, in addition to organise workshops and promote activities in social networks, they save some time to be available for queries from citizens. They also keep **records of different groups of interest** so they mail them (according to the law). In many cases they prefer to **train trainers, so word can be spreaded exponentially**. This is the case when working with environmental education centers, city councils, associations and teacher training centers. Anyway he clarifies that they try to weave an increasingly wider network what is quite a long time process.

He highlights that a common mistake is to think that the knowledge they transmit is quite general, but actually not everybody is interested in citizen science. Besides, **citizens are submitted to a constant overload of information**, so sometimes it does not matter the quality of the information you spread or how many social networks you use. He also warns that **all the systems (apps, servers, etc) must work and be properly maintained** to avoid losing participants.

[Laura: coordinator of citizen science programs in Brussels]

Activities such as **Bioblitz helped to bring another kind of audience that may be familiar with the museum exhibitions and workshops, but not with taxonomy and field work**. This allowed them to discover another facet of the Museum and were eager to participate to other such activities.

[Lucas: manager and researcher of environmental citizen science projects]

Lucas says that they have taken a lot of advantage of **social networks to encourage participation** plus **exploiting the networks of other involved partners**. They have also reached local communities using precisely their own tools. It is also difficult but very effective to reach an important media channel. This is why there is the **need of a communication specialist**.

In order to bring people from outside our circles, he makes a big personal effort to do **face-to-face activities**. They try to go the specific places and events related to the activities they promote. Personal contact is essential.

To reach excluded groups they take advantage of specific programs that ease these links. For example, *Escuelas Magnet* (*Magnet Schools)* that connect areas at risk of exclusion with scientific institutions.

In the cases of events or projects that will be developed in a big area, he advices to **identify people or institutions at a local level that can take this initiative as its own to create a snowball effect.** Having local disseminators and local promotion is essential in order to do something massive.

One of the biggest **mistakes they have committed is to think that they were really reaching a community when this was not really happening**. He thinks that having mechanisms to make sure they have reached all the collectivity they want would be interesting. He suggests offline or online conversations to check if the community knows the activity is going to happen.

[Ricardo: social entrepreneur in environmental citizen science projects in Poland]

Ricardo emphasizes that one of the **biggest mistakes they commited was to go to science festival to organise a workshop on CS in general.** Since CS is so broad, the discussion with participants was too abstract and mostly useless, so then they decided to work on a much more specific topic that affect people: air quality.

Since then, in order to bring people and participants into the project, what they have tried is to find partners and work on different topics around air quality. For example they have been collaborating to create an app with a Katowice group that was working on policies for smoke. Secondly, they use social networks to share their knowledge and good examples of what they are doing, so thanks to these they have been able to contact other people and collaborate together.

For Ricardo, a good strategy also **when engaging people is to organise small workshops (for 15 people) where he can have a lot contact to participants and it can designed to be very active and engaging**. In this way you give space to people to show their knowledge, learn something and **creates an atmosphere where people can start developing and proposing new ideas**.

[Julieta: coordinator of H2020 european citizen science project]

Proper use of language is crucial to lower barriers. They try to **include everybody (using a model called 'quadruple helix')**. There is also the question of **trust**. When you approach civil society but you are working for a public institution they wonder "which are your truly intentions?". In the beginning they tried to approach the policy makers of the city council because of their important role in odor control, but precisely this caused suspicion in citizens. It is necessary to be very sensitive and be aware that it is a very slow process.

She mentions that by working with schools, a project can scale much, and at the same time you are providing science education. Working with schools is like a snowball effect and very win-win situation.

In their case, to reach people the best strategy has been to **really walk the neighbourhoods**. **"You need to fish where fish are"**. That implies that you have to go where people of the neighbourhood are: **libraries, sport centres, bars, squares, parks, etc**. This is a field work. Using informal spaces actually opens a lot of new doors. Getting to know key people in the area is also very useful.

In any case, bringing people on board is a very slow and time consuming tasks. So, according to Julieta, they have thinking a lot of how to acknowledge the participants in DNoses. They are working to include in the app social media features and gamification processes to encourage participation (in this case it is very good that the same person do measurements in different moments in time or in different places). The want to reward participacion through the app.

8.20 Communities

[Alejandro: artistic director of citizen laboratory in Madrid]

According to Alejandro the creation of a work team in Medialab happens through the **call for projects and the mediation team** eases some participation diversity. Once they have built the first prototype, it is up to them to continue so the **sustainability of the groups really depends on its members**. Mediation projects are the ones more prone to be sustainable since there is a paid person working in Medialab. Other **workgroups continue thanks to the persistence of specific volunteer individuals**. This is the case of *Wikisfera*, leaded and sustained by Patricia Horrillo, a workgroup that edits wikipedia. They organise some events call *editatonas*. These specific events nourishes the workgroup and vice versa.

Institutions tend to focus on producing events, but it is interesting the model where events are designed to nourish more stable processes. One factor that helps **a community to be sustainable is having a project that has an impact**. This is the case of *Autofabricantes*, that creates cheap prosthesis for children. An important thing to say is that workgroups are not isolated, but they work in a place where other work groups operate what sometimes make direct interactions happen. An if they are part of something bigger, this is a motivation to make people involved and therefore their community continues.

[Laura: coordinator of citizen science programs in Brussels]

The RBINS has relation with some local communities of citizen scientists active in the park nearby (willing to improve water management in Brussels neighbourhoods or reviving some wild lands and fighting against real estate constructions for example). The **RBINS is an adviser to them identifying the biodiversity present and providing guidance in conformation to the National biodiversity strategy**. The benefits for RBINS are clear: RBINS has gained more visibility towards the neighbourhoods as biodiversity safeguard, and it has promoted more involvement into the local concerns.

Among the communities in link with the institute there are members that share a tool dispersed all over Belgium and they are forming a network (for example, the schools equipped with XperiBird nest boxes that reports their observations through camera).

These are **sustained by project manager** that **sends back information and organises events taylored for them** (teachers, etc).

Other communities have been collaborating for a long time with researchers of the institute in arachnology, entomology, malacology, paleontology, bird ringing service. These are sustained through common field work and shared passion between them and our researchers and the access to our collections, writing of common **publications**.

A lesson that they learnt is that sometimes the communities are very demanding and RBINS cannot always respond to their immediate requests because of lack of time and people. So, it is important to be aware of this and to give an adequate answer in proportion of what they can do. Besides they try to maintain their interest by sending invitations to the events linked to the one they participated in and the others being organised at RBINS and giving them feedback.

[Lucas: manager and researcher of environmental citizen science projects.]
What Lucas and his team tries is to promote **a community of communities**. They look for **mechanisms to let communities to sustain themselves** since they answer to their same interests. It is interesting to make them feel that they participate in the globaility of the project keeping its own local specificity, so their role is acknowledged.

[Sara: facilitator of environmental citizen science programs]

Sara had the opportunity of being invited to various communities of practice to share their tools and techniques, in particular their DIY environmental monitoring. She always starts with **thorough introductions to understand what the community does and what their story is**. It is also an opportunity to establish initial expectations and needs. She then does a site visit to begin **designing an activity together that is relevant to them and that matches their needs**. They also continue working on the design and the division of tasks and resources in a shared online document that can be updated at our own convenience and that can be shared with all other interested parties. Because she has mostly been invited to communities, the initial barrier to entering communities or introducing my work is lowered. **They most often come to her because they already know that she might have something (tools or techniques) that adds to their work**.

Her aim is not to build or sustain a community - i.e. a physical community of practice or interest. **She values one-time engagement too** (participants who attend one event only) because you never fully know what people's barriers to engagement might be (it might be out of your hands) or why they are attending your event (they might just be passing by). However, she does try to focus on **building infrastructure that helps sustain practice** - **in particular with skill-development workshops** such as Public Lab's DIY environmental monitoring using aerial photography. In this case they put in place a 'materials lending library' for equipment loans at a local community centre and train people how to maintain it. **For her is also essential to carry out work to connect communities to create complementarity.**

8.21 Team

[Sara: facilitator of environmental citizen science programs]

She ran events mostly by herself at her institution. While this gave her a lot of autonomy, it became challenging at times, especially when organising large events. In these cases **she enlisted the help of friends or members of our community to design, organise, and delivery events**. In these cases **she worked with them to listen to and integrate their ideas / suggestions and give them ownership over aspects they were more passionate about**. This was the case for the co-designed and delivered 'Maps without Borders' exhibition.

As project coordinator, she really cared for her project team. She organised **monthly calls with project facilitators as a space to share, reflect on their work, to have someone to speak to, and share tips and practical experience.**

She thinks that an essential practice is that **project coordinator(s) take the time to speak and to connect with each of the members of the team - especially in very large pan-European projects where people are working remotely** and at risk of becoming siloed. **It creates a sense of caring and of project 'whole' that boost the team.**

[Ramón: researcher of a community health citizen science project]

> "*By doing citizen science it is important to be aware that this is a team work, it is intersectional and it requires a long term view. If you don't have this clear, it is better not to do it."*
>
> Ramón

For Ramón there were three key pillars for the team and these are the strategies to care for them:

- A sociologist that worked as a project manager and controlled not only logistics, but also the methodologies. She was paid and they try to give her all the visibility she deserved in every event and trip they did.
- A photographer that taught the participants how to take pictures, that designed and curated the exhibition and photobook. He was paid, they gave him as much visibility as possible (he made the videos but also appeared in them), and if he want to write new projects, the researchers will support him.
- Young researchers that analyze all the aspects of this project. They are paid, but they should be given the opportunity and support to write excellent papers and being published in the journals with high impact so their career can advance properly.

[Alejandro: artistic director of citizen laboratory in Madrid]

Alejandro tries to care for his team giving **some degree of freedom** to people that coordinate projects to carry them out. He **tries to listen to things that might be improved** and to **generate discussion spaces to think about organisation, to**

listen to each other, to stop and to think how it is better to work. A meeting protocol is a relevant tool in these processes. The results are the project itself that improves and **the creation of a collaboration and mutual support network: a human infrastructure**.

[Adolfo: environmental educator, botanist and citizen science manager in Madrid]

Adolfo thinks that human relationships are fragile, so it helps if the people in the team have a proactive, constructive mind but also tries to enjoy. According to him, they work more than what they should, but everything is easier with a good working atmosphere. But this is not free, this must be promoted. It is good that **you can laugh every day, that problems become jokes**. **Experience tells him that everything is relative, so when problems arise is absurd to get mad because this problem will be solved anyway**. He also highlights **how important is not to be afraid. Controlling fear is essential for a better life, and if you can spread this on your working place, things will go easier**.

> "*It is good that you can laugh every day, that problems become jokes. Experience tells us that everything is relative, so when problems arise is absurd to get mad because this problem will be solved anyway."*
>
> Ramón

He thinks that teams should be multidisciplinary to provide different visions and ideas and contrast these to make compatible your goals so they fit in the team.

[Laura: coordinator of citizen science programs in Brussels]

The DITOs team at RBINS is composed of three people. There are 2 different tasks that the team performs: 1) communicating on the activities to DITOs partners and the outer world and 2) coordinating and developing the activities with other staff members of RBINS and collaborators or participants.

To care for her team Laura tries to give them **as much autonomy as possible** and **creativity is very much encouraged**. If anything goes wrong she is the person responsible and **she will take the blame** if any. She want her colleagues to be able to trust and rely on her. She advices to be as transparent as possible and share all the information to the team, and ask the same to them to build relation of trust. also suggest as a good practice is to **value both the work the facilitators of every activity and the one of the participants. It is essential that everybody (both sides) gains new knowledge or improves his experiences.**

[Lucas: manager and researcher of environmental citizen science projects]

Including the team, but giving a more general reflection, in CS projects Lucas thinks that one needs to **be aware that they are going to work with a big diversity of people**, and this requires trying to adapt to each one. Within his team **every person**

has its own concerns and motivations and he tries everyone to feel comfortable, involved and acknowledged. For example there is people more interested in being part of relevant scientific activities (scientific paper oriented) but others are more interested in learning or interacting with very different groups. His rule is **try to identify what is more valuable for each person and to adapt to their expectations**.

[Daniel: member of a grassroot ecological group]

Daniel describes a set of keys that are basic to care for a team:

1. Make sure that the **work the team do is relevant and useful** (things are not stored in a drawer forever).
2. Make a conscious effort to l**isten truly to the team**: for example when people is overloaded with work, when they need a more coordinated work, when they need more time to carry on their tasks, etc. It is necessary to answer to logical requirements according to circumstances.
3. Make sure **everybody respects the agreements** that have been reached. To make this happen people need to have participated in decisions. Imposing agreements does not work.
4. **Care for emotional and affective part** that happens within groups. This must be understood and there should be spaces to manage it properly. Time must be saved in order to do this, and specific capabilities and knowledge are needed. This means that people need to be trained specifically.
5. It is important to **care for spaces where cohesion happens**. They are good practices to have a beer after meetings or have spaces where discomfort can be collected after hard decisions, but avoiding complaint culture.
6. Make sure that **everybody is different, and that managing a group does not mean to treat everybody equally**. Some people has more need of recognition or creative freedom, etc, and it is healthy to try to give them (without taking it from others).

> *"Cohesion does not come from nothing: you have to encourage it to be generated"*
>
> Daniel

8.22 Caring for oneself

[Ramón: researcher of a community health citizen science project]

Ramón says that **sometimes is necessary to stop**. He likes to spend as much as possible with his daughters. If he has to work more, **he steals these hours to sleeping but never to his family or friends**. It is important also if you can work remotely so you can spend more time with your family. Besides the internationalization of science gives him an opportunity to travel and enjoy.

[Alejandro: artistic director of citizen laboratory in Madrid]

Alejandro states that he has been such a long time in this position that he does not remember how it was before. He states that the work can be infinite and since he likes it, there is the **danger of not putting limits**. He also has a painful feeling of not doing enough since there are always things to improve.

[Laura: coordinator of citizen science programs in Brussels]

For every activity Laura tries to **prepare as much as possible in advance** so that the event goes smoothly and **only unpredicted things have to be handled in the last minute**. It is not easy because there are often many aspects to consider. She emphasizes the **virtuous effect of delegation**: being able to delegate parts of the tasks to other members of the team is really making things easier and sharing the burden of the whole organisation is relaxing. In order to do that, of course, it is essential to have the right people for that working with you.

[Lucas: manager and researcher of environmental citizen science projects]

Lucas has being working on participatory activities from the eighties (CS term was not used yet) before **as a hobby and now as his job**. He says he cannot to ask for more. He adds that sometimes he tries not to be totally hooked by this and **give time to friends and family.**

[Ricardo: social entrepreneur in environmental citizen science projects in Poland]

Ricardo tries to care for himself by **planning the work in advance** and **foresee future burdens of work**. He recommends to have an quite flat structure organisation that allows very fast and easy communication with the board. That helps a lot when some problem appears.

[Daniel: member of a grassroot ecological group]

As his first measure, he tries that **everything he does has meaning**. He says that apart from that, the rhythm of work is quite excessive and he reduces time from leisure and rest. He considers that a minimum of physical exercise, rest and leisure is essential.

[Julieta: coordinator of H2020 european citizen science project]

Julieta says that she does not care much for herself and this is a mistake. She points out the **difficulty to combine professional and private life** when doing citizen science projects because usually **participants can meet in their free time that is also the free time of the researcher**. So this is something to take into account.

8.23 Evaluation and impact

[Sara: facilitator of environmental citizen science programs]

Sara explains that as she runs events, over time she has developed sensitivity to people's needs and reactions. **A good practice is to be observant and a good listener and this comes with practice.** For example, noticing people's interest or engagement levels or making note of people's questions or comments. She feels that **an event is successful if people stay longer to chat with each other or with her** after the event has officially finished; or if **they are able to make themselves comfortable asking questions or take relaxed postures**; and ultimately if next time **they bring along not only themselves but also another friend or a family member**.

[Ramón: researcher of a community health citizen science project]

For Ramón they used different indicators to assess their success:

1. **Scientific**: how many articles, conferences, presentations are given and how many students are trained by this project.
2. **Qualitative evaluation** of what the participants think about the project and how this has being changing their way of thinking.
3. **Communication**: they wanted to deliver a photobook and an exhibition. They gave two photobooks to every participant. About the exhibition, this was shown three times in different places in Madrid and two times in Brussels (in the parliament and the commission), what was considered as very successful.

By using a methodology such as a photovoice, one local politician considered that it was very **powerful in terms of impact** because it mixed citizen science, local participation and art, so the project **can be attractive for very different stakeholders**, engage very different kinds of people, but without losing its clear political impact, that actually works because the project itself offer opportunities for dialog and the own participants are already giving ideas for solutions.

[Alejandro: artistic director of citizen laboratory in Madrid]

Alejandro says that for every workshop there are **meetings between the facilitators and the participants**, and some **surveys are sent to gather data.** He emphasizes one of the workshops (Interactivos?'17) where a research, a survey and some interviews were done. Documentation is also important, but **have a good group of people makes that the space be perceived as vibrant an contagious**.

For Alejandro a mistake would be to be closed to other disciplines or to do something not totally grounded on your own discipline. Being **open is always interesting**.

[Adolfo: environmental educator, botanist and citizen science manager in Madrid]

Adolfo uses **evaluation surveys** after an activity has ended and uses social networks to analyze the success of the activity. They assess not only the **scientific impact** but also the **satisfaction of the participants**. Besides, he tries to **share a**

coffee with them so the team can gather comments off the record on an informal atmosphere. Another proof of a successful event is when media gets interested. They also tries to disseminate scientific results through media.

[Laura: coordinator of citizen science programs in Brussels]

A successful event is the one that has **positive feedback from its audience**, either through w**ords of mouth or a brief email** from a participant. Another criteria of success is the **number of participants attending compared to the number of expected participants**. If this is really low compared to expectations then it is disappointing. Laura provides **evaluation forms** to be filled in by the participants during or just after the event but before they leave (to guarantee the return and have the fresh impression of the participant) and through **interviews of the participants**.

[Lucas: manager and researcher of environmental citizen science projects]

For Lucas the first indicator to evaluate the success of a project is firstly **how many people has participated**. Secondly he values the "**level of permanence**", that is how many people repeat in a row of events. Sometimes people assume the project as its own and start doing their own projects. This is something to promote: to **make people feel the project as their project**. For example, in Natusfera they can create their own projects. He also evaluates how many activities and additional projects are generated and how many people keeps being active within a project. It is also advisable to follow up the process in social networks and see how long specific hashtags keeps being active.

For him there are **different scales of impact**: immediate impact of an event can be assessed counting the number of participants and how often appears in media. In a medium and long term, they assess how these activities generate information that drive both to scientific results and evidences that let to take decisions. However **there is the risk that the impact is seen a long time after**. Then people might think that this effort is useless so it is interesting to think about more immediate return strategies.

[Ricardo: social entrepreneur in environmental citizen science projects in Poland]

Ricardo says that they usually do not have resources to assess key performance indicators, so they moved to more **people-oriented evaluations**. So at the beginning of the workshop they do a fast round asking questions such as "**what do you expect from this workshop?**" and later, once they have finished a workshop, they save about twenty minutes to have feedback from participants and see if they have learnt something, if they were happy, if their motivations had change, if they would recommend it to friends and family, etc.

[Julieta: coordinator of H2020 european citizen science project]

Julieta is approaching local problems caused by humans. For her a way to measure success is one hand to measure **how many citizens have been involved, how**

many data has been gathered, the variety of the data (different places, different times, dates, etc) **and the improvement of citizen observations** (that will be train through the project).

She identifies impact with an improvement of air quality in the city, with getting industry to apply correcting measures on a medium term and of course with the city council regulating odors after its participation in the project. Moreover she values the improvement of community relations and the citizens' increase of science awareness. She would also like to bring more women to technology and science.

8.24 Difficulties and mistakes to avoid

[Sara: facilitator of environmental citizen science programs]

Sara thinks that Citizen Science is still a new approach and practice. The research group **ExCiteS has to sometimes explain itself to other departments** and 'defend its ground'. But she finds that **individual researchers and scientists are receptive** to their cause when she reaches out to to invite them to take part in their events if they are explained why they are doing the event and what they are expected to do at the event.

[Ramón: researcher of a community health citizen science project]

According to Ramón, for communication purposes, a **mistake is not to invite journalists to public presentations and debates and not to analyze the discourses** that emerge in discussions. Another mistake in public events is to mix to much science, participation and journalism, when likely is better to focus on the specific idea you want to promote in each event.

One mistake they think they did commit is that since researchers are the ones that asked for funding, and the main promoters of the project, they are the ones that are explaining and communicating the project. They think that **the project could have even more impact if it was explained by the own participants**, although they know there is a big tension to open and truly democratize science because **some traditional sectors of science still do not know or understand fully the power of these participatory methodologies**.

Citizen science is very powerful to do excellent science, however the needed structures are still missing and in **general scientists are not yet trained properly to conduct this type of research**. As Ramón says A change of view is needed, and traditional science sector seems not to be ready yet: "when you explain these methodologies to a science pope, they do not take seriously". It is important to mention that citizen science is just another way to do science, with clear benefits, but it is not a substitution of the current approach, but totally complementary. For him **citizen science really provides a new approach to analyse and reduce inequalities in cities**.

[Alejandro: artistic director of citizen laboratory in Madrid]

For Alejandro, a big **mistake is when a citizen science project deepens the distance between scientists and citizens**. It usually happens when the scientist uses citizens, what makes these projects far less interesting. On the contrary the most powerful ones are the ones that open platforms and spaces for collaboration. Moreover, he thinks that citizen science can constitute a great opportunity to **connect the university with the city**, where different people (a scientists, a student, an activist, other citizens) bring their own knowledge and experience to work on a common project.

Medialab is a public institution, and according to Alejandro, this generates a lot of **administrative bureaucracy** and also some incoherences such as the incomprehension about its model. According to him, it does not help that is an experimental project and he and his team have not developed **good indicators**. He emphasizes that it is very hard when he faces the dissatisfaction of his workers and colleagues.

He points out that **a common mistake is to think that when you publish an open call in Internet, this is accessible, but actually it is not**.

When talking about how EU citizen science initiatives might be developed, Alejandro thinks that a network of collaboration should achieve something greater than the sum of the contributions of each partner. Sometimes in EU projects it is not clear how the different actions have contributed the other ones. In a citizen science project this should be central. **Maybe the consortium models of 5-10 partners where there is quite a lot of bureaucracy should be rethought. Citizen science may not just provide a theme for a programme but it provides an opportunity to experiment new ways of doing and designing EU networks of collaboration.** Citizen science experiments are powerful when they scale up and the EU offers a perfect field for that.

He proposes to **design open calls for citizen science projects that allow for an easy participation of many different institutions**. These would promote the creation of big enough networks. But in order to do that it is necessary that small institutions, like schools and public libraries could get involved, so **procedures should be accessible and easy to manage.** EU commision should take care of the network and part of the bureaucracy, encouraging documentation and promoting connections between the members of the network. On the infrastructural level another programme could be started to promote citizen laboratories. **Citizen laboratories are the institutional model that better answers to citizen science paradigm**, as they offer places for open collaborative experimentation, for building communities of learning and practice, and the creation of networks of collaboration.

[Laura: coordinator of citizen science programs in Brussels]

For Laura, the term **Citizen Science sometimes might act as a barrier**. At the RBINS, collaborators & amateurs have been working with inhouse researchers for hundreds of years but they did not call it “citizen science”. Collaborators and Aamateurs collect and publish with researchers have a volunteer or collaborator contract but they are not considered as staff part of any research the institution and work they usually during use their free time. Since they contribute to some provide research which results sometimes as and contribute to publications they might be

called citizen scientists. When these kind of result is not produced then Otherwise the citizens involved are more taking part to it should be activities in science communication. But what happens with the rest of collaborators?

On the Museum side, Besides, for the museum and the educators part,, citizen science this label is brand new and the added value for the facilitators and educators m is not easy to be integrated, since they relate citizen scientists to research. A good approach to overcome this gap between researchers and science educators/communicators was the project XperiBird: it is about observation of blue birds into nests with a camera and the observations go back to ornithologists and analyze them. They have nests with cameras all over Belgium and their migration can be tracked. This is possible because of kids that are watching the cameras and providing those data. The kids have to install the camera and to report the data through the system. DITOs has supported a poster which enables the kids to know what to do during each season. This project has overcome the barrier because first the school teachers were willing to be involved in such a program. They perceived it as new, easy, nature observation, involved technology and they see it also as a way to establish a link with the museum. They also become a part of a network of schools and they know that their observations are useful for science. On the other side, we have an ornithologist collecting the data and processing them in order to asses migration. Finally, the program manager is a science educator who answers all the questions and solve all the difficulties that the kids and teachers experience, and also she makes the follow up and ensures that data is properly collected and get the students feedback. So she thinks this **project has been very successful** because **they have designed a win-win-win situation for researches, the museum** (science educators) **and the citizens** (teachers and school kids). So by a hands-on experiment they have overcome a communication difficulty and everybody is doing it together. As pointed out XperiBird is also a good example of **how citizen science contributes to excellence in science** and acts as **a link between researchers, education institutions and local concerns**.

She adds that one common mistake is to **overestimate the participants number.** This leads to food waste and waste of time from the organisers. We usually consider that only a part **(between 50-70%) of the people having registered** will really appear and attend. It is important **not to underestimate the communication effort** to be deployed: mostly, to deploy specific communication tricks and to use specific channels to have decision makers attend.

[Adolfo: environmental educator, botanist and citizen science manager in Madrid]

They have found several difficulties when managing citizen science projects:

1. **Lack of interest of decision makers** on environmental and citizen science topics.
2. Sometimes decision makers forces to do specific events or projects in **dates that are not appropriate**.
3. It happens quite often that when you are preparing a proposal for a grant or funding, the citizen science project must be **adapted to the terms of the call which many times are not ideal**. For example this tend to happen when preparing proposals for projects with schools, where these should be designed to fit within the school calendar.

4. There is **high degree of labour uncertainty and instability within the professionals that manage citizen science projects** and environmental education. This really limits to accept commitments in the medium and long term.

[Lucas: manager and researcher of environmental citizen science projects]

Lucas identifies as a barrier the **skepticism of the academic community**. This generates problems when this skepticism is found in funding institutions. They usually suggest them to go to **science communication calls**. It is important that they understand that this is also another way to do valid science.

[Ricardo: social entrepreneur in environmental citizen science projects in Poland]

The main problem for Ricardo is **financing** since they are **quite small organisation**. This means when they finish the money of the first payment, they need to imagine how to run events without costs since they cannot advanced the budget for later payments.

[Daniel: member of a grassroot ecological group]

Daniel states that every organisation faces institutional barriers. Every institution has inertias and it is complicate to perform changes. Specially when people have been for a long time in an organisation is difficult for them to understand the vision of other people.

Likely a good practice to change the momentum is to **consider changes as processes**. This means that the start of the change must be tangible but it should be done at a pace not too fast to make sure the changes are assumable. This pace should be adapted according to circumstances. Secondly, it is advisable to share the change with everybody involved and let them to influence it: that means **give them voice and vote**. Thirdly, it is important to **explain the reasons and sense** of the change. So if it cannot be shared, at least it should be understood. Lastly, it is advisable to do it in some kind of seduction spiral: first you involve the people who is more prone to change and they start sharing their visions with more people.

[Julieta: coordinator of H2020 european citizen science project]

Julieta mentions as a possible **mistake to be very clear and self confident**. She thinks this attitude can be understood by some people as a way to impose things and they might react by opposing to it. As many other interviewees, she suggest to listen and understand the context first, and to be very **sensitive and humble** every time. She encourages to put oneself in other people's place: what involves to do for other person what you want him to do.

[Clara: researcher specialized in policy making]

With her experience, Clara found that when you try to do **advocacy work for a EU-project,** which means looking for a common message between a group of partners from different countries and contexts, **the joint message is going to be very broad and basic.** For example: *what is CS, we need more CS*. This kind of work has, arguably, been important in a first phase at the EU level.

She thinks that advocacy should work on more specific topics of concern, such as **what ethical standards should be in place to use CS in health sciences, how to acknowledge participants, how to work together with affected communities in equitable ways** or **how to ensure that science communication accompanying projects is empowering**.

8.25 Purpose and values

[Sara: facilitator of environmental citizen engagement programmes]

For Sara, purpose is the reason for which something is done or created or for which something exists. She organises these events because they matter to her and she believes in what they do through her community group *Science has no borders*. Her main drive is the **passion for citizen-led science and the opportunity to create spaces to build collective expertise and catalyse civic action. This passion is fulfilled through creating deep interactions in their events**. She thinks that **a good practice in designing and delivering events is to connect with that drive - to reflect "why are we doing this?**" - that helps during trying times!

The UCL research group Extreme Citizen Science (ExCiteS) where she was working during most of DITOs time **supports bottom-up practice** that takes into account **local needs, practices and culture and works** with broad networks of people to design and build new devices and knowledge creation processes that can transform the world. The work done through "Science has no Borders" - in particular their approach to DIY science - is directly aligned with the research group's mandate. The link across all their events is **making science accessible.** "Science has no Borders" is a group committed to highlighting the power of ordinary people's capacity to act as civic agents; the aim is to co-create purposeful experiences that enrich our understanding of ourselves, the world around us, and our relationship(s) to it.

> "*It is about honing our critical thinking (questioning the world around us) and co-creating new ways of knowing, seeing and doing (by experiencing different perspectives). Many of the values I hold stem from my work with Public Lab and I have found that a good practice is to convey and share our values is through sharing stories about the organisation's work; stories tell who we are, where we come from, and what we stand for*."
>
> Sara

[Ramón: researcher of a community health citizen science project]

Ramón selected an university that provides him **independence and freedom**. On the other hand, this is not the most prestigious university in Spain, but it is good enough and this freedom balances this out. Besides this, in his research area (social epidemiology) values such a **social justice, equity in health, and research on (social, gender, economic) inequalities** are always an essential part of it. He states that inequalities are growing so there is moral imperative to change this trend and citizen science constitutes a powerful tool to help on this.

The biggest frustration is that **these participatory methodologies are not always welcome in *hard science* international forums** and sometimes there are seen even with slight by some scientists. We know that these are complementary powerful methodologies and we do actual science. It is hard but step by step **these new approaches are penetrating into the science sector. As they already are RRI methodologies.** He says that citizen science cannot be used for every sector, but RRI can. Anyway, including citizens will force you to select different wider goals, become more **transdisciplinary**, give more weight your **communication strategies** and more importantly even doubt of your own knowledge.

[Alejandro: artistic director of citizen laboratory in Madrid]

For Alejandro the purpose is to create **communities of shared knowledge**. So they take advantage of the diversity of experiences in a city to create a meeting place where concrete projects might be assembled. He points out that keeping **different people with different perspectives** for a long term is difficult because people tend to stay with those with shared interests, but precisely this difficulty is the main reason to promote **citizen labs that connects the actual diversity of the city.**

Besides, for Alejandro thinks that we must **cultivate the interdependence between human beings**, since the world we have inherited seems not to be aware of this, so it is his goal to make effort towards that direction. Moreover, he gives importance to the need to share knowledge, since from his point of view, knowledge cannot happen if this is not shared, reviewed and contrasted.

Another motivation that moves Alejandro is the idea of **inequality**. According to him, we do not have same resources to participate. It is essential to review and correct this constantly. However, there is a maximum level of diversity that is manageable, and to get a wide range of diversity is a slow process.

[Laura: coordinator of citizen science programs in Brussels]

Laura indicates that among the missions of RBINS one is to **disseminate knowledge** and **encourage the public to be interested in science**. The research institute, produces new knowledge and shares it through publications and with volunteers and amateurs and collaboration thus raising awareness on the research at work and sharing research methodologies with citizens willing to collaborate. The museum develops and runs a large variety of tools, games and workshops to

encourage the general public and more particularly kids and families to be involved into science.

The decision to perform some citizen science events and projects is taken according to the themes in place at the museum or at the research institute, always aligned with the purpose of the institution.

For Laura, more personally, she likes the process of putting all the people together to organise something but of course the challenge of getting something out of it. It is very important for her to **extract the feedback from the participants and the facilitators** to assess if they are happy, if they **have learnt something**, what they have got and of course **to learn if something was wrong to learn from that**. There is also the key that every event being organised gives visibility to the museum which is more than needed in this difficult times.

A good advice would be to **try to work in an organisation whose values are aligned with yours**. A lesson that she has learnt although values are aligned, a l**ack of internal communication can slow down the processes**. It is important to **communicate as well as possible with the people you want to collaborate**. Also it is advisable to be able to **predict the risks and have a plan b**. Everything needs a lot of work and trust towards your team.

[Lucas: manager and researcher of environmental citizen science projects]

The biggest goal for Lucas is to demonstrate that **scientists are not getting all the necessary information to understand the challenges of the whole ecosystem**. He thinks that CS is one of the most effective solutions to satisfy this need. He also works to make the academic community accept CS and to demonstrate to the most skeptical group that this science methodology is at least as good as anyone else.

From a social point of view, he works to show that the **participation of the people is essential** since it can give rise to taking political and environmental decisions. In fact, involving people is one of the biggest challenges to struggle against climate change.

As values he highlights the importance to create **activity and connections at a local level**. They use every project to **promote cohesion between different groups** and the growth of a supra-community.

[Ricardo: social entrepreneur in environmental citizen science projects in Poland]

For Ricardo, his main purpose is to **help people solve their problems and engage them to solve these problems together**. Ecology and sustainability are the main values that drive them. They try to be **coherent** in every single step so in their workshops they only provide vegetarian food, they avoid using plastics and recycling is a must.

[Daniel: member of a grassroot ecological group]

In *Ecologistas en Acción* every decision in an horizontal way in an assembly. This causes an actual discussion where people develop the best arguments but also the

interests of the people. It must be said that **this is a volunteer activity so it is very important to attend people's interest**. So there is a rational part in the discussion but also the need to attend individualities. There is third factor: since it is an environmental organisation it is really affected by reality and current political agendas.

Daniel says that in order to organise an activity, **it is essential that makes sense for him. Otherwise he will try not to do it**. Sometimes it does not make sense from an individual point of view, but it does within a group. For him, the key is that every proposed **project should be strategic to improve human existence conditions and the conditions of every other living being**. Not every project can be strategic, but the idea is that they should not be mere anecdotal.

His main values are **solidarity, mutual support, democracy, justice and sustainability**. He mentions something obvious but relevant to make it explicit: he says that he is lucky to work in organisations whose values are aligned to his, but he has been working for this **consciously and even building their projects around their values**.

[Julieta: coordinator of H2020 european citizen science project]

For Julieta, the best citizen science projects are the ones that **align society needs with research**, that engage people and are inclusive, that educate in science and those which **develop new scientific knowledge**.