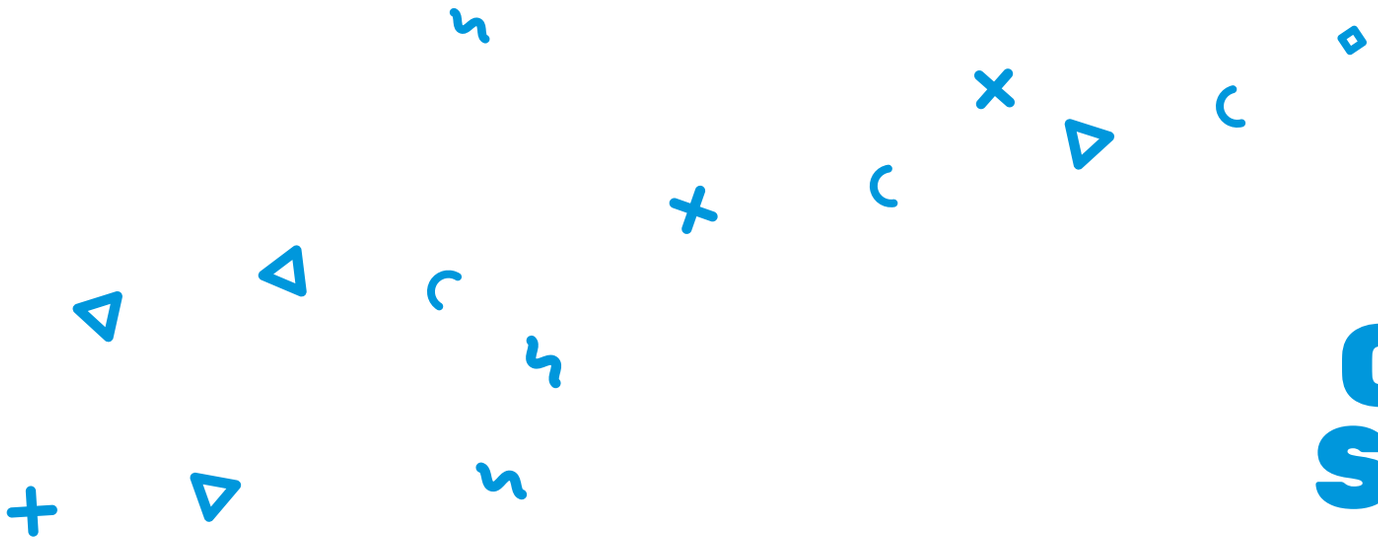

CITIZEN SENSING

A TOOLKIT

Making Sense

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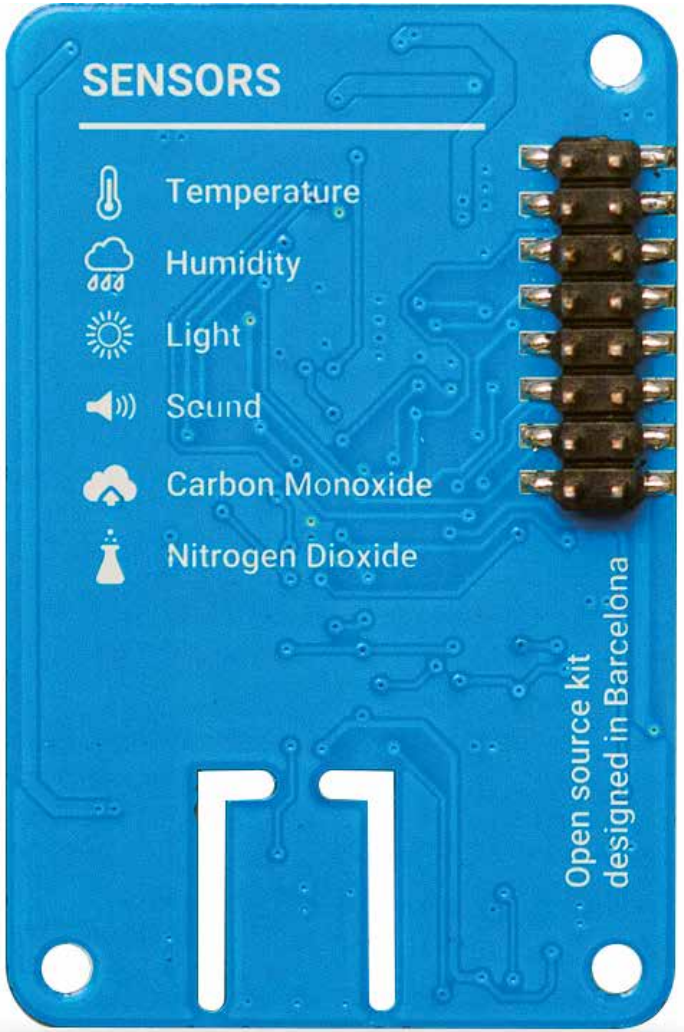

FOREWORD

I am particularly proud of this project. I think it is one of the best examples of what we meant when we set out to investigate the building of "collective awareness platforms for sustainability and social innovation", as ways to harness networking technologies to empower citizens with information coming from each other and from the environment, in order to gain a better awareness of problems and possible solutions, unconstrained by predefined commercial limitations.

The spectacular rise of hyperconnectivity technologies brought with itself a number of promises, assuring to make our lives easier. Many of these promises have become reality, but often at a high societal price, given our increasing dependence on solutions provided by private actors acting on the global scene. These powerful centralised solutions present a number of risks, in terms of privacy, dependability, ownership of data, decisional autonomy, and ultimately of democratic control, which motivate the search for different, more decentralised approaches, where each citizen can and must play an active role.

Governments also must play a role. Countries all over the world are becoming increasingly dependent on solutions provided by multinational industries, and are progressively embedding these centralised solutions in their offering of public services. An open participatory approach, as the one explained in this book, cannot replace the public services, but has a strong potential to enrich them and to protect them from dangerous external control or commercial interests.

Open and participatory approaches should be the preferred option of public agencies, and these approaches deserve preferential treatment (also in economic terms) to become a viable alternative to the commercial alternatives. For their benefits lie not only in the much larger penetration and pervasiveness which can be obtained, but also in the stronger civil sense and civil responsibility of citizens which this empowerment brings about.

I am convinced that open solutions such as the ones described in this book are the only manner in which technology can effectively and ethically become an invisible yet essential part of our everyday life, helping us in creating better and deeper connections with others and the surrounding world, to become more aware and make a better use of our humanity.

Fabrizio Sestini
Senior Expert,
Digital Social Innovation
European Commission DG Connect

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INTRODUCTION

If you are inspired to collaborate with others to effect positive change in the world, this book is for you.

Collaboration using open-source technologies makes it possible to create new and powerful forms of community action, social learning and citizenship. There are now widely accessible platforms through which we can come together to make sense of urgent challenges, and discover ways to address these. Together we can shape our streets, neighbourhoods, cities and countries – and in turn, shape our future.

You can join with others to become the solution to challenges in our environment, in our communities and in the way we live together. In this book, there are ideas and ways of working that can help you build collective understanding and inspire others to take action. By coming together with others on issues you identify and define yourselves, and by designing and using the right tools collaboratively, both your awareness and ability to act will be improved. In the process, everyone involved will have better insights, better arguments and better discussions; sometimes to astonishing effect!

We hope this book will help you engage people to learn more about an issue that concerns you, support you to take action, and change the world for the better. This resource will teach you how to scope your questions, identify and nurture relevant communities, and plan an effective campaign. It will then help you gather data and evidence, interpret your findings, build awareness and achieve tangible outcomes. Finally, it will show you how to reflect on these outcomes, and offers suggestions on how you can leave a lasting legacy.

This book is intended to help community activists who are curious or concerned about one or more issues, whether local or global, and are motivated to take action. This resource can also be of value to professionals in organisations which support community actions and activists. Finally, this book will be of interest to researchers in the fields of citizen science, community activism and participatory sensing, government officials and other public policy actors who wish to include citizens' voices in the decision-making process.

We are a group of researchers, activists, artists and designers inspired by the empowerment of citizens using open-source technologies. Our own experiences have taught us a number of lessons which we can now share with you in these pages. This book is a compilation of our collective knowledge, successes and failures, offering you the tools, methods and inspiration to start your own campaigning.

Our work is informed by a shift towards participatory approaches to science, technology, policy and environmental action. In this context, data becomes more important, and so does the role of non-experts to collect, understand and use such data. This shift has been driven by many actors in many domains, including participatory digital culture and citizen science. However, there is a significant barrier to adopting this way of working, as there is little practical information or guidance on how we do it. Participation is complex, and it can be helpful to shed light on a number of techniques and tools that can help community organisations to deliver impactful and participatory sensing actions and campaigns.

We will introduce a set of values and guiding principles that we propose can help inform and guide any meaningful community action. Our core values are empowerment, openness, co-creation and changemaking; they have brought us a long way. Our starting point is also our long-standing participation in working with and around open-source culture, new media art, maker culture, community activism and research, all of which foster these values.

We produced this book as a part of the Making Sense project, which draws on nine citizen sensing campaigns in Holland, Kosovo and Spain in 2016 and 2017. In them, we have developed a form of citizen participation in environmental monitoring and action which is bottom-up, participatory and empowering to the community: this is called citizen sensing. Over the course of this book, a number of these campaigns will be outlined to give you a flavour of how they developed and why. The rich diversity of the different topics addressed in these campaigns, as well as their environmental, political,

OUR CORE VALUES ARE EMPOWERMENT, OPENNESS, CO-CREATION AND CHANGEMAKING

economic and cultural contexts, will be explored in the framework, tools and recommendations that form the bulk of the book.

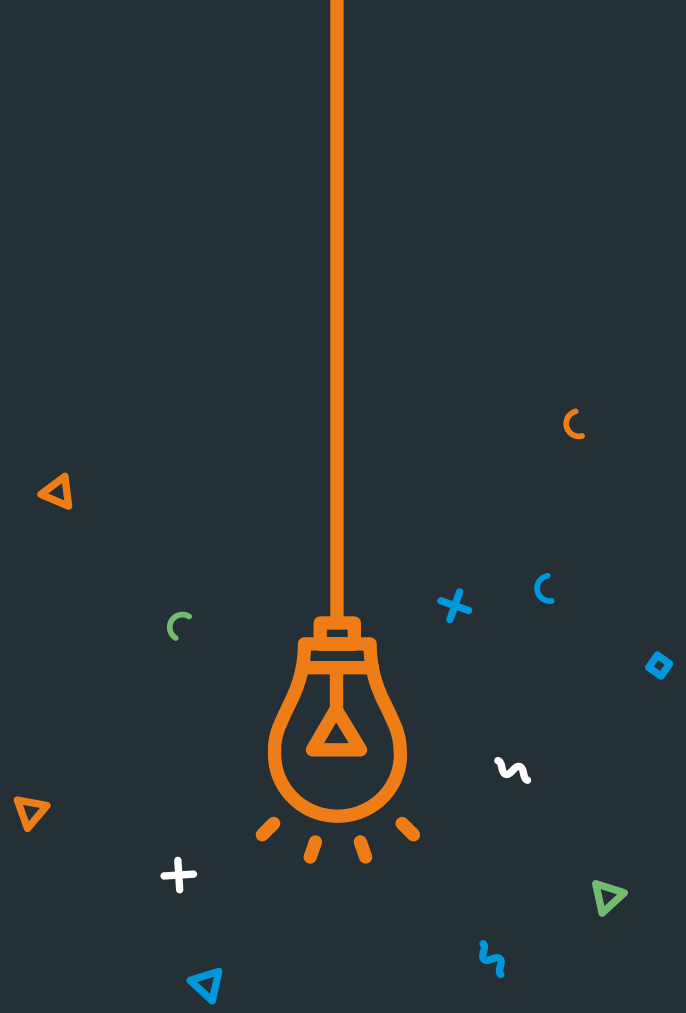
This book will also introduce you to some of the participants who put great time and effort into their campaigns because they cared deeply about the outcomes. Their passion, agility and fearlessness have led to incredibly impactful results, such as a newly proposed air quality law in Kosovo; a national participatory sensing platform in Holland; and changes in the use of public space in Plaça del Sol in Barcelona – all geared towards actually reducing environmental pollution levels.

This work is only possible because it is supported by networks of people and organisations, and because it builds on and contributes to open-source digital tools. FabLabs, makerspaces and hackerspaces occupy a special place in this landscape because they enable the development and application of open-source hardware and open-source design. Over the past ten years, the broad availability of open-source hardware tools, the creation of online data-sharing platforms, and access to makerspaces have facilitated the design of low-cost and open-source sensors. As a result, independent communities of citizens can appropriate these sensors to engage in environmental action.

There is no silver bullet, however. Every issue, every community, every context is different. There is no single formula or 'recipe' that can lead to success in every case. Our tools are not perfect, and there is a lot left to explore. Any campaign or action will require careful consideration and adaptation based on what you want to achieve, and on what happens while doing it. All of our tools can be considered best practice, but response of institutions and authorities can vary, and they may resist conclusions even when presented with empirical evidence. Making successful change may also require advocacy, lobbying and engaging in politics which is beyond of the scope of this book.

We have been inspired by the power of citizen sensing to effect change, and we believe that you can be too. We hope you find this book valuable, and that it supports you in your quest. If you would like a deeper insight into what we have done so far, please take a look at our online toolkit[1] where you will find a wealth of information. We value your feedback tremendously, and would be grateful if you could share your thoughts with us. Good luck!

1 http://making-sense.eu/publication_categories/toolkit/

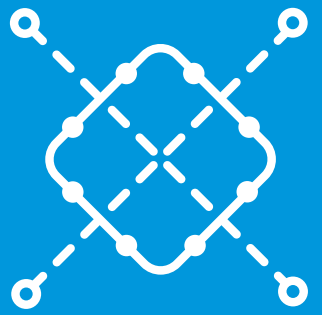


MAKING SENSE

Making Sense is an international project funded by the European Commission within the H2020 Call ICT2015 Research and Innovation, specifically under the *CAPS "Collective Awareness Platforms for Sustainability and Social Innovation"* programme (grant number 688620). Our project was designed to show how open-source software, open-source hardware, digital maker practices and open-source design could be used effectively by local communities to appropriate their own sensing tools to make sense of their environments and address pressing environmental problems. Based on nine pilots in Amsterdam, Barcelona and Prishtina, Making Sense developed a toolkit for participatory sensing aimed at deepening our understanding of the processes which might enable collective awareness. This book is part of that toolkit.

Making Sense ran between 2015 and 2018, and combined the efforts of Waag Society in Amsterdam; University of Dundee in Scotland; Fab Lab Barcelona at the Institute for Advanced Architecture in Catalonia; the Joint Research Centre of the European Commission in Brussels; Peer Educators Network in Kosovo, and University of Twente in Enschede. The Making Sense project builds on and extends the Smart Citizen Kit (an open-source, bottom-up sensing platform developed by Fab Lab Barcelona) and several previous pilots run by Waag Society in Amsterdam, FutureEverything in Manchester, Fab Lab Barcelona and the Peer Educators Network in Kosovo.

Over the course of its lifespan, Making Sense has shown how open-source software, open-source hardware, digital maker practices and open design can be used effectively by local communities to appropriate their own technological sensing tools, meaning that citizens can make sense of their environments and address critical environmental issues concerning air, water, soil and sound pollution. The Making Sense pilots have led us to develop a conceptual and methodological framework for participatory environmental maker practices. This framework acts as a guide to providing citizens and communities with the tools to enhance our everyday environmental awareness; in turn, these tools enable active intervention in our surroundings, change in our individual and collective practices, and ultimately, a hands-on transformation of the environment in which we live.



THE MAKING SENSE FRAMEWORK

INTRODUCTION

This section presents our approach to running a citizen sensing project. To help guide you, key stages of activity will be described here with their corresponding set of cross-cutting principles. These stages and principles are specifically geared towards projects aimed at supporting community action. Taken together, this framework sets out a process that you, as community organisers, project teams, community members or individual citizens, can use as a reference guide when developing and delivering a citizen sensing project.

The stages of the framework provided will give you an idea of who is involved at which point, what usually happens at that time, and key objectives or milestones to be achieved at each stage so that you know when to move on. You can decide to go through these stages in the order provided, and shown in the diagram in this section, or select what is relevant to you in the order you choose. Alongside these stages, you will find the principles which lie at the heart of this process, and these should be used as a guide for participants at any stage, and for citizen sensing as a whole. These principles are co-creation; empowerment; openness; and changemaking.

The framework stages are also described in more detail in the chapters to follow, which explain these methods and tools alongside their examples in action. We hope these pointers will help you gather the resources you need to engage people, deliver the project, and navigate some of the common challenges you might face along the way.

CROSS-CUTTING PRINCIPLES

1. EMPOWERMENT

The feeling of taking control or increased responsibility for yourself and your environment. This can be encouraged with a combination of collaborative approaches and openness using technologies and data which address individual and community issues. This can lead to improved quality of life and greater power for changemaking in corporations and governments.

2. CO-CREATION

The practice of collaborative development, and a way to describe an approach in a project using methods and tools for people to work together on a level playing field. Co-creation is a collaborative process between multiple individuals using a wide range of resources and ideas to create new actions and objects.

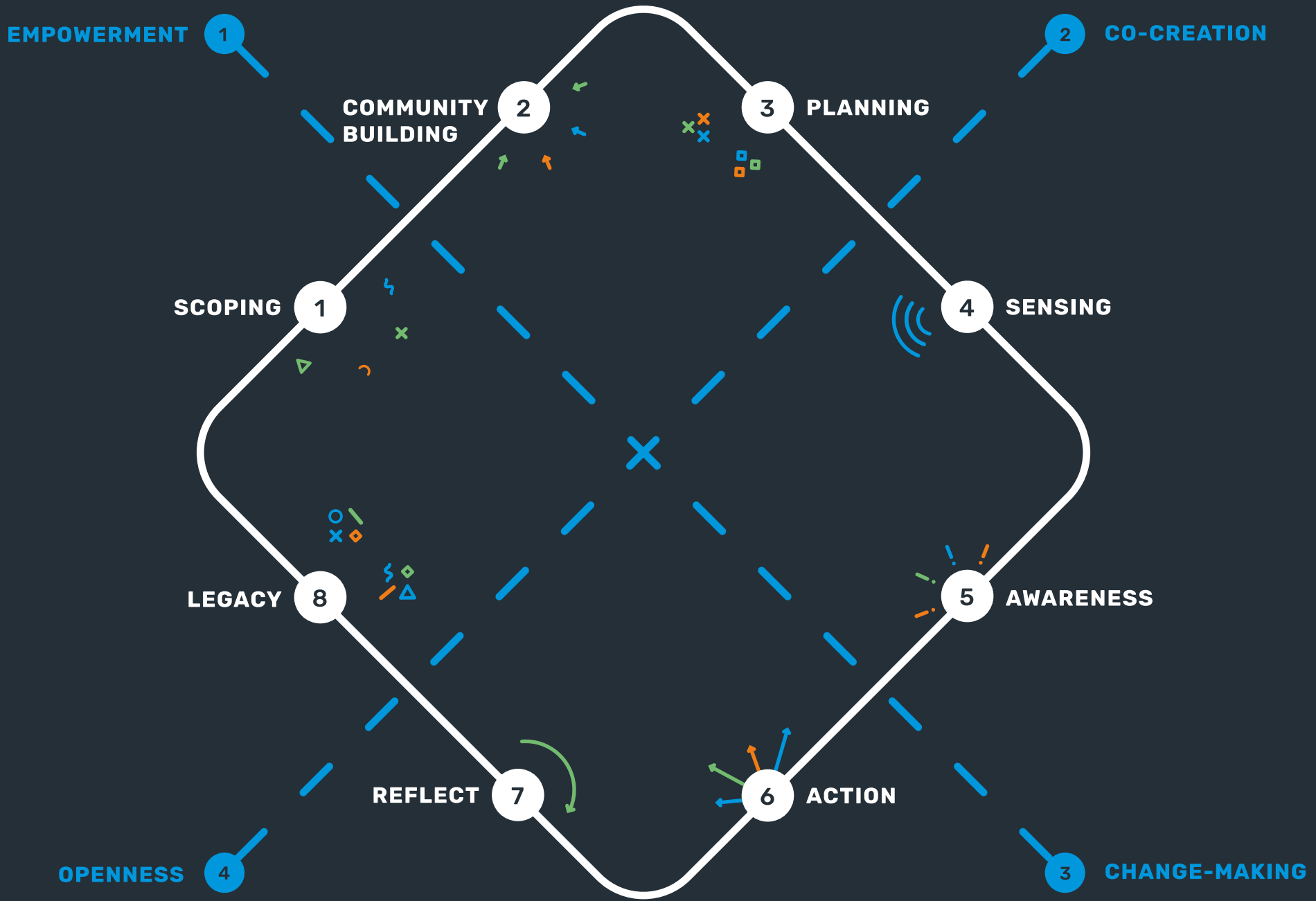
3. CHANGEMAKING

Our aims at changemaking stretch beyond creating awareness of the development of purely technological solutions. This involves change in individuals, communities, institutions and/or cultures, and in thinking, attitudes, values and consciousness. We embrace community-led change.

4. OPENESS

This applies to the transparency of the campaign's organisation, as well as its data and actions. It also extends to strategic priorities in:

Open design
Open science
Open technology and data
Open to the world


EMPOWERMENT 1
2 CO-CREATION
COMMUNITY BUILDING 2
3 PLANNING
SCOPING 1
4 SENSING
LEGACY 8
5 AWARENESS
REFLECT 7
6 ACTION
OPENNESS 4
3 CHANGE-MAKING

FRAMEWORK STEPS

1. SCOPING

At this first stage, the important issues are discovered, mapped and discussed by the key participants. Information is gathered by internet searches; collecting articles, news reports and literature; or by conducting surveys and interviews. At this time existing communities are found and new ones start to form. Scoping has no time limit; it can take a few weeks, or can develop over years.

KEY PARTICIPANTS
community organisers, project team, community members and the public.

2. COMMUNITY BUILDING

The aim of Community Building is for all participants to come to a shared understanding of the issue, the goals of the campaign, the organisation of the project and how to document activities. This is the stage when the skills of the participants are identified and new skills are developed, and it is also when others are brought on board if there are any skills or expertise missing.

KEY PARTICIPANTS
community organisers, project teams and community members.

3. PLANNING

Planning sees participants collectively decide on the project goals, on sensing strategies and on protocols for collecting data. This includes a plan for collecting other types of indicators. It is when the sensing tools are created or developed from existing resources and are tested and calibrated. Participants learn about sensors and are introduced to approaches for understanding data.

KEY PARTICIPANTS
community organisers, project teams and community members.

4. SENSING

Sensing is the phase in which everyone collects data on the issue i.e. environmental pollution. The data can be uploaded to a publicly accessible online platform. Participants can also take notes and record observations about how their lives are affected by the issue. Collecting these indicators can support the sensor data and be used to demonstrate the impacts to external individuals and government officials.

KEY PARTICIPANTS
community organisers, project teams and community members.

5. AWARENESS

Using all the data and complementary indicators gathered during the sensing phase, the information is analysed and discussed amongst the community. Bringing this information together is important for identifying areas for action and change. The aim is to build a collective awareness from the data. The analysis stage can include activities such as data visualisation, and people from professional science or academia.

KEY PARTICIPANTS
community organisers, project teams, community members, data visualisers and external experts.

6. ACTION

Once awareness has been raised on the issue at hand, participants work together to propose courses of action. The aim is to devise, organise and deliver an action, or series of actions, that can generate recognition of the issue, make an impact and make change. Actions can range from an individual change to public-facing activities (e.g. a protest) aimed at widening awareness, or even policy change.

KEY PARTICIPANTS
community organisers, project teams, community members, media outlets and government officials.

7. REFLECTION

Participants reflect on the process to date, and consider what worked well and what could be improved. This can include looking at the data and seeing if there was change as a result of the action. This might require the participants to repeat stages, or return to previous phases (such as 'Sensing').

KEY PARTICIPANTS
community organisers, project teams and community members.

8. LEGACY

A legacy is created by looking towards the future of the project and making a plan for lasting impact. Plans for sharing information and news should be included to ensure that the project is sustainable, the project's tools are being reused, and uptake continues. For community organisations, this is a phase for writing reports and publications, as well as for sharing project assets that might be useful for other initiatives.

KEY PARTICIPANTS
community organisers, project teams, community members, academics and external experts.

TOOLKIT

1.
SCOPING

SCOPING ACTIVITIES CAN HELP MAP OUT THE ISSUES OF INTEREST AND THE WORK THAT HAS GONE BEFORE

WHY IS IT IMPORTANT?

Citizen sensing is often inspired by concern over a critical problem. The first step is to identify the concerns of those in the community and develop an understanding of the issue. This is a collaborative process that informs and guides community action, and helps build a shared position around an issue. It is necessary to focus on and understand the local situation, since understanding the culture and motivations of the citizens and their community will be key to creating successful change. Finding out who else has carried work out in this area will help ensure that you are building on any previous work done: after all, nobody wants unintentionally to repeat others' mistakes, or reinvent the wheel!

WHAT HAPPENS?

Scoping activities can help map out the issues of interest and the work that has gone before, either in the local area or on an international scale.
This stage can involve a review of the literature on the subject, which can involve reading reports and papers about work conducted by other communities. Equally, you may prefer to arrange meetings with people affected or experts on the subject, or conduct hands-on research through interviews and questionnaires. Perhaps you are working with a community that already has an issue they wish to address, and you prefer to discuss this issue with them?

Whatever the case, it would be useful at this stage to define who you will be working with if you have not already done so. Who will the community be? Who are the other stakeholders? Perhaps the local government should be involved at some point? You should also consider planning your internal organisational processes in this phase: for example, a group of community members may come together to take responsibility for seeing the process through, and at this stage, they could be considered as the project team. However, it should be possible for other members to join this team at later stages and for different people to have different levels of involvement. This type of leadership may also emerge in one of the later stages.

WHO CAN DO THIS?

The people conducting this process are likely to be community leaders, or a research team who are planning to work with a community. This could also be a co-operative activity, in which people with different roles and goals work together. It may be facilitated by an organisation with the capacity to support the community.

WHEN DO WE DO IT?

Scoping is the first activity you should do before getting started on any planning or sensing work. The amount of time this will take will vary depending on how much you want to talk to your community, and how deeply you want to dive into the issues at hand. Once you are familiar with the issues and the challenges facing your community, you can feel comfortable moving onto the next stage.

HOW TO DO IT

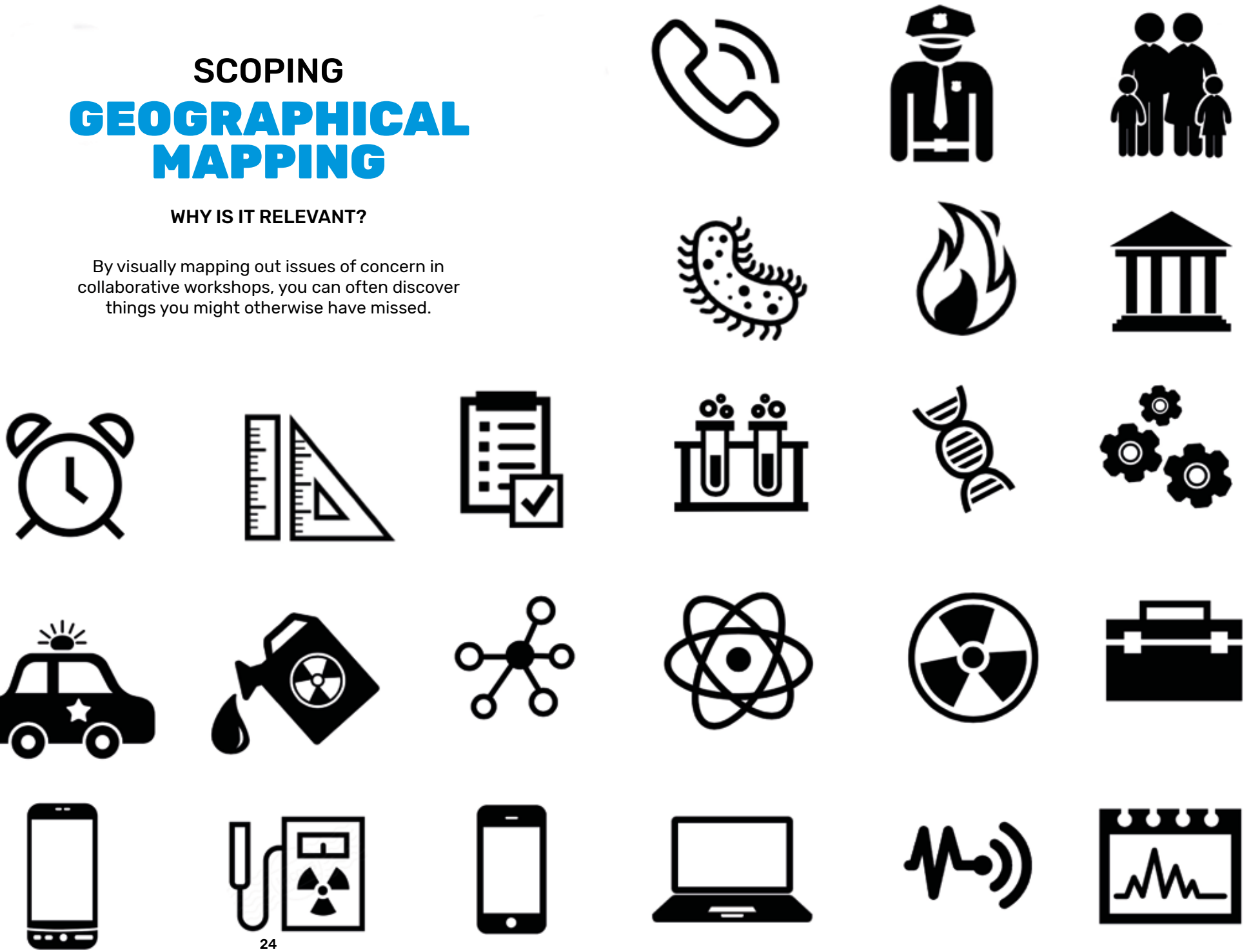
On the following pages are a list of tools that we recommend for this stage. You can use or adapt these to your own project as required.

SCOPING

GEOGRAPHICAL MAPPING

WHY IS IT RELEVANT?

By visually mapping out issues of concern in collaborative workshops, you can often discover things you might otherwise have missed.



DESCRIPTION

There are many reasons why you might choose to use geographical mapping, depending on which stage of the campaign you have reached. In the early stages, you might want to find out anecdotally the nature and location of problem hotspots. Perhaps you might also want to cross reference these hotspots with helpful data, such as proximity to resources, schools, hospitals and neighbourhood associations, as well as to the participants themselves. At a sensing stage, a map can help you devise a sensing strategy by visually representing the location of the sensors you will deploy. The key with geographical mapping is to make it a hands-on affair, with participants discussing and mapping the issues themselves, so that they too can fully understand the magnitude of the issue at hand.

KEY QUESTION

WHERE DOES THE ISSUE OCCUR, AND WHY DOES IT HAPPEN THERE?

GROUP WORK
45 Minutes

PRESENTATION
30 Minutes

PARTICIPANTS
Community

RESOURCES NEEDED
Markers, Post-Its, Scissors

RELATED TOOLS SENSING STRATEGY
STAGES FEATURED IN SCOPING, COMMUNITY BUILDING, PLANNING

STEPS

1. Divide the community members into groups. Give each group an A3 map (minimum size), sticker dots of different colours, and several A4 icon sheets containing icons relevant to the subject. These can be supplemented with other icons (e.g. Lego figures).

2. Have groups discuss their questions and concerns regarding the issue(s) of concern, thinking about the location(s) which seem(s) to affect them the most, before using the map and icon sheets to map out their findings.

3. Additionally, map out resources and other factors that contribute to the problem, as well as those that might help solve the problem. It is very useful to have the participants add brightly coloured sticker dots to locate themselves on the map to see exactly how the community is organised.

4. Present and discuss findings to make sure everyone is of one mind. If working with multiple groups, collate the findings onto a larger map, and keep this visible when developing sensing strategies.

METHOD IN ACTION
GAMMASENSE AMSTERDAM

Geographical mapping is an essential tool for any citizen sensing project. Mapping has been used throughout all the pilots, where it has helped community members to discuss their local situation, make their issues concrete and define useful strategies to improve their circumstances. A workshop setting allows citizens to discuss their concerns regarding environmental problems, such as sound pollution or nuclear radiation. The goal of Geographical Mapping is to visualise not only the issue in an intelligible manner, but also to identify patterns, key existing, resources and infrastructure that might support the development of the campaign.

In the case of the GammaSense workshop, which was organised by Waag Society, WISE (World Information Service on Energy) and the RIVM (Dutch National Institute of Public Health and the Environment), the speakers began by tackling the issue of nuclear radiation. Each speaker offered a different perspective: first, the necessity of tools and data that anyone could access; second, the complexity of measuring radiation; and third, the urgency of reducing the amount of nuclear power plants and waste. Groups then mapped their questions and concerns about this issue.

ENVIRONMENTAL ISSUES ARE COMPLEX AND DIFFICULT TO UNDERSTAND

Environmental issues are complex and difficult to understand, even if community members are intrinsically motivated to learn more about them. In this context, geographical mapping helps to level the playing field in the discussion. It brings the issue back into the neighbourhood domain, where the citizen is the expert. And it shows how important it is to involve all types of stakeholders in the process of change.

SCOPING

COMMONS MAPPING

WHY IS IT RELEVANT?

Community projects never start from nothing! We all have something to contribute, be it time, skills, resources or ideas. Revealing this wealth of untapped potential at the outset can foster contributive behaviours.

DESCRIPTION

The Commons Mapping tool is a large wall canvas which openly allows people to log contributions that they are willing to make to the campaign, such as resources (e.g. sensors, meeting space, funds), time, or even specific skills. Facilitators can fill out the fields in the chart according to the specific needs of the campaign. Participants' contributions can be mapped using sticky notes on the big target where they will also find an instructions sheet and a call for participants to provide their name and contact details. The participants then stick these notes to the chart to describe the type of contribution that they can offer. Crucially, the closer to the centre the citizens place their Post-its, the more time they feel they can dedicate to their contribution. When complete, the Commons Mapping tool provides group awareness of the resources within their community, as well as any gaps that might need to be filled. This tool was initially developed at Knowle West Media Centre as part of The Bristol Approach to Citizen Sensing.

KEY QUESTION

WHAT, WHERE AND WHEN CAN I CONTRIBUTE?

TIME NEEDED

15 Minutes

PARTICIPANTS

All

RESOURCES NEEDED

Commons Mapping Target, sticky notes holder, sticky notes, markers

RELATED TOOLS SENSING STRATEGY

STAGES FEATURED IN SCOPING

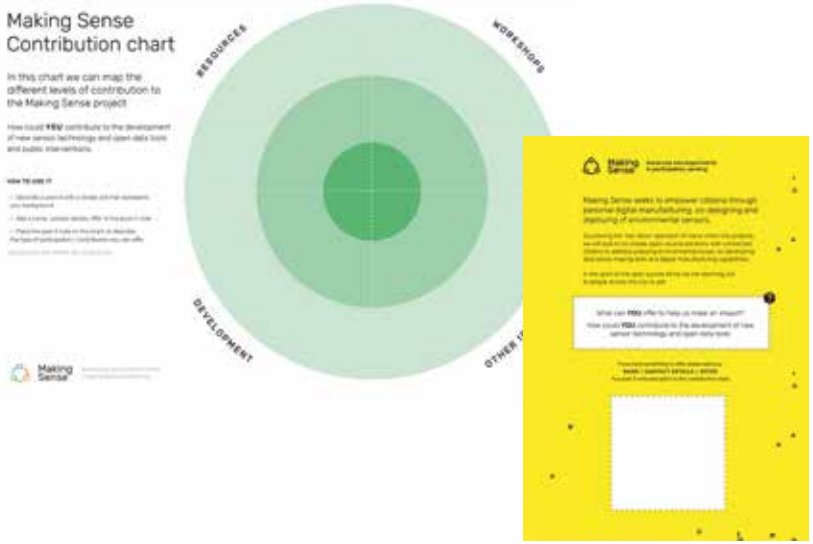
STEPS

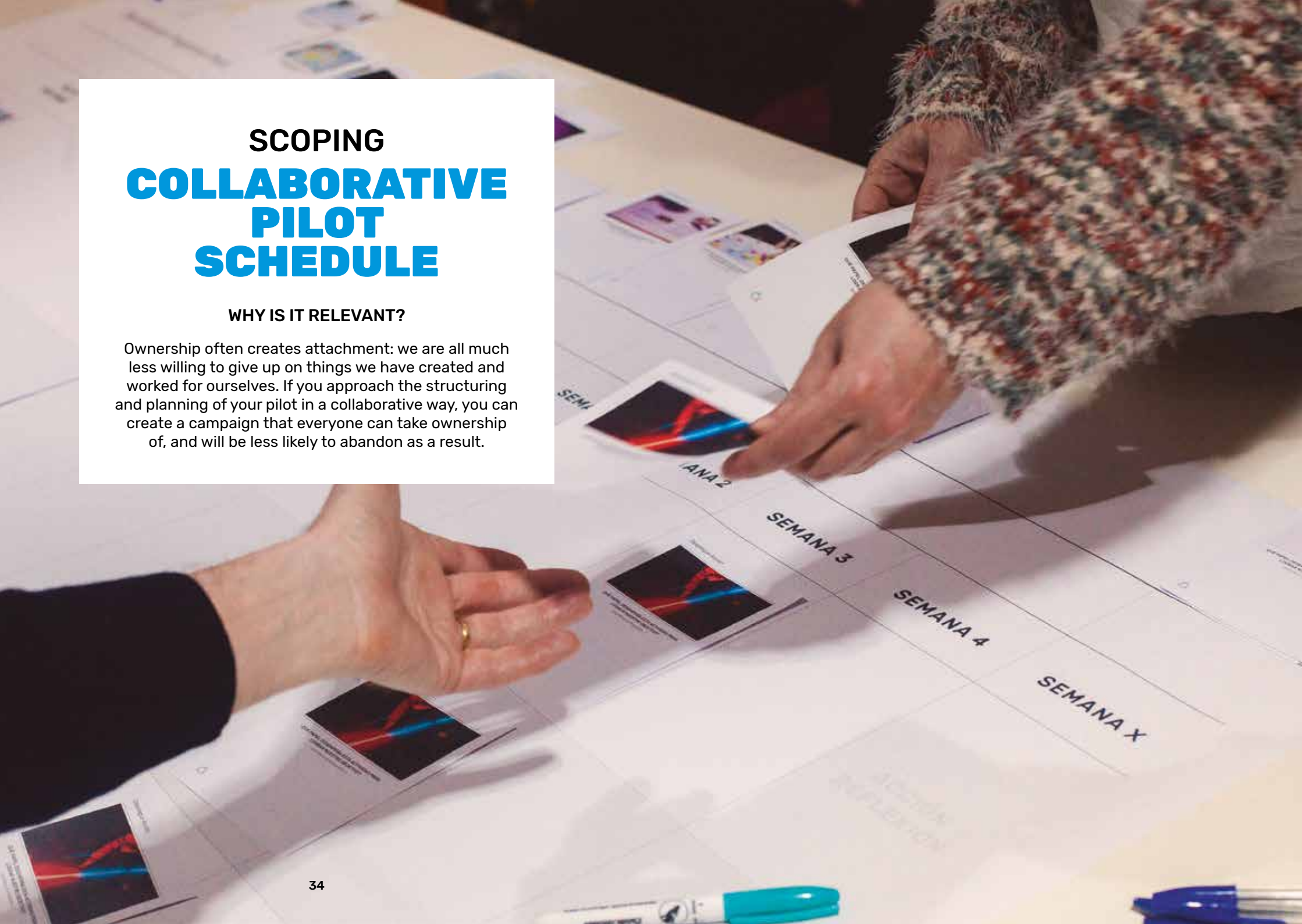
1. Define the key types of contributions needed for the project. These can vary from project to project, but 'Technological', 'Workshops', 'Development' and 'Resources' are common contribution categories. It is also good to leave a space for 'Other Ideas'. Write up these category headings around a very large target, leaving equal space between each.

2. Have participants write their suggested contribution on a Post-it, including their name and contact details, and place it onto the target. Contributions might range from simple attendance, to expertise, or offers of venues and contacts.

3. The closer the Post-it is to the centre, the more time or resource the participant is willing to dedicate to the project.

4. Participants can make multiple contributions if they so choose. The important thing here is to be able to visualise the areas with ample support and resources versus those which do not.





SCOPING

COLLABORATIVE PILOT SCHEDULE

WHY IS IT RELEVANT?

Ownership often creates attachment: we are all much less willing to give up on things we have created and worked for ourselves. If you approach the structuring and planning of your pilot in a collaborative way, you can create a campaign that everyone can take ownership of, and will be less likely to abandon as a result.

DESCRIPTION

It is often tempting to devise a campaign behind closed doors before a final reveal to participants. However, the net effect would be to turn your 'participants' into little more than facilitators. By opening up the planning process, you can design a campaign that takes into account the needs and aspirations of the community, as well as the availability of individual members. Each time you revisit the campaign to take account of developments and follow-ups, the schedule should be updated with each iteration. After a period of reflection, new stages can be contributed and removed by participants, which will eventually lead to a streamlined and rewarding experience.

KEY QUESTION

WHAT DO I NEED TO DO TO GET THE INFORMATION I AM LOOKING FOR?

TIME NEEDED

60 Minutes

PARTICIPANTS

All

RESOURCES NEEDED

Schedule canvas (or a large sheet of paper)

STAGES FEATURED IN SCOPING, PLANNING, REFLECTION

RELATED TOOLS PILOT APPRAISAL

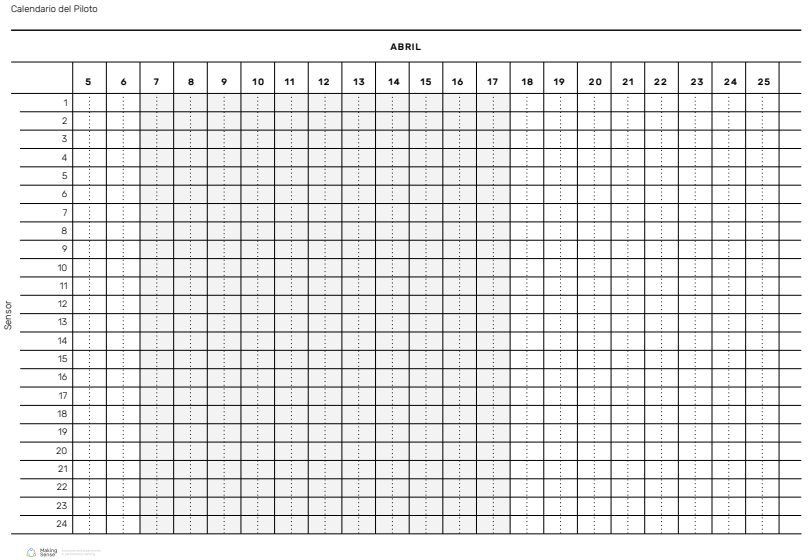
STEPS

1. Print or mark out a sizable calendar canvas covering a date-range of your choosing. This can be the length of time you have to achieve your goal, or a specific timespan for the campaign as a whole.

2. Have the participants think of key events that will need to take place for each goal to be achieved, from sensing periods, to analysis, to discussions and more. Write these onto Post-its or action cards, and map them onto the calendar. Discuss how each action will help achieve the goals of the project.

3. Discuss decisions. Arrange (and rearrange, as required).

4. Participants should also put their name down for the activities they wish to and are able to attend, allowing everyone to spot gaps in planning. Make sure there is a venue and a time allocated for each event.



2. COMMUNITY BUILDING

THE PROCESS OF COMMUNITY BUILDING CAN HELP IDENTIFY AND VOICE SHARED VALUES TO GUIDE THE CAMPAIGN

WHY IS IT IMPORTANT?

This is the time to start work on engaging people in the community, or building a community around the issue. At this stage, you could find value in bringing together different types of communities who have distinct motivations and skills: for example, this might mean a community of makers joining with a community of concerned residents. Citizen sensing is about people coming together to tackle a challenge or concern, so community building is central to this concept. The process of community building can help identify and voice shared values to guide the campaign. These values could include principles of empowerment or transparency, for example. Fostering community cohesion and communication is crucial to the sustainability of the community throughout the process. Community building is also about developing relationships between different people - such as specialists with knowledge of the issue, or members of government agencies - who can ultimately help bring about change.

WHAT HAPPENS?

Engaging and recruiting the community (or communities) will involve shaping the issue, tapping into a desire to participate, building a timeline and an understanding of the process - as well as what might happen along the way. Setting up spaces and times for the community to meet together is key to this process. It is also important to plan the management and governance of the project team, and determine how the communities will manage themselves. It can be useful at this stage to identify the skills available in a community to plan how you might foster or bring on board new skills to address any gaps (see 'Commons Mapping', p.39). For the project team, it is important to plan how the team is going to document your progress, as well as considering any surveys which might show evidence of changes in attitudes and behaviours in your community. This is usually a highly collaborative stage: the community can make these plans, or project leads take on these community-building decisions together with the community.

WHO CAN DO THIS?

You may be a community representative yourself, or you may already have a close relationship with a community. If not, you will need to recruit and build a community for the project. It is helpful if there are one or more intermediary organisations involved, as they may have contacts to community representatives and government officials, and can offer experience in bringing together diverse stakeholders.

WHEN DO WE DO IT?

This type of community building should take place after the scoping stage, but before getting into the more detailed planning of citizen sensing. This may be quite a long stage, depending on the types of skills available in the community and how cohesive the community already is. There may be a period focused on community building at the start of the project, but it rarely ends there: community building extends throughout the life of a project.

HOW TO DO IT

In this section is a list of tools that we recommend for this stage. You can use or adapt these to your own project as required.

COMMUNITY BUILDING
ONBOARDING KIT

WHY IS IT RELEVANT?

Social interaction and good team spirit are integral to a healthy community of participants. A well-thought-out onboarding kit welcomes and guides a new participant into the project and the team. It is composed of both informative resources as well as community-building tools.

DESCRIPTION

It can be daunting to join a citizen sensing campaign, especially to those not familiar with the subject. To ease participants in, a basic set of informative resources can go a long way. The onboarding kit should include information and tools not only relating to the issue at hand and community building, but also to technological issues and ways to contribute.

KEY QUESTION

WHY ARE WE HERE, AND HOW CAN WE WORK TOGETHER?

TIME NEEDED

1 Week

PARTICIPANTS

All

RESOURCES NEEDED

Context dependent

STAGES FEATURED IN COMMUNITY BUILDING

RELATED TOOLS SENSOR GUIDES

STEPS

1. **Issue**
The first part of your onboarding kit should deal with bringing the participants up to speed on the issue. Put together some information on the topic, such as effects, possible causes and findings to date. This not only raises awareness, but also imparts an urgency. In here, a basic overview of the project, team, and any need-to-know information is also a great way for people to understand exactly what they are getting involved in from the outset.

2. **Community**
This might be the most obvious, but it has two parts. First of all, there is a very real, physical side to community building, which can take the shape of simple introductions, chats and discovery exercises, as well as team-building objects (such as T-shirts, tote bags, pins and stickers), all of which create a sense of team belonging. Secondly, there is the digital component, which becomes the forum where the community can congregate when not meeting physically. The platform used will vary from community to community, with some preferring social media, others email, and so on. Find what works best with your community, and then co-create a safe space for discussion.

3. **Technology**
This is often the reason participants get involved with the project. It often helps to create a mini-guide so participants can become acquainted with the technology.

4. **Action**
Finally, a tool to encourage contribution is an excellent addition to your welcome pack. The sensing journals are a great option, or even a basic notebook. Whatever you choose as your method of recording actions, this could be a useful inclusion when new participants join a later iteration of the campaign.

COMMUNITY BUILDING

EMPATHY TIMELINE

WHY IS IT RELEVANT?

A little empathy can go a long way when aiming for change in the public domain. Drawing an empathy timeline helps us better understand the issue at hand, as it encourages us to look at both sides of the problem and how we might understand our role in it.

DESCRIPTION

This method involves asking community members to think about the complexities of the issue at hand. Community members can become aware of their own subjective viewpoints on environmental problems, as this approach allows participants to think about their own personal perceptions. This reflexivity can be achieved by having community members talk about the ways that they are affected by the issue, but also the ways that they contribute to it. An empathy timeline facilitates community building by bringing people together to discuss issues and consider them in a way that they perhaps have not often done before.

KEY QUESTION

HOW WERE YOU AFFECTED BY THE PROBLEM, AND HOW DID YOU CONTRIBUTE IN THE LAST 24 HOURS?

TIME NEEDED

30 Minutes

PARTICIPANTS

Community

RESOURCES NEEDED

A1 sheets of paper, markers, shapes and icon cut-outs, sticker dots

STAGES FEATURED IN COMMUNITY BUILDING

RELATED TOOLS SENSOR STRATEGIES, COMMUNITY LEVEL INDICATORS

STEPS

1. Using A1 sheets of paper, draw two parallel lines horizontally across each sheet. At the ends of both lines, mark out a 24-hour timeline (midnight to midnight). Also, in preparation, cut out different icons or images related to the issue at hand. Include some abstract shapes too, adding anything that might spark creative thought.

2. Have the community members form small groups, and ask them to fill in the timelines. In the first half of the exercise, the first line represents the ways that the participants were affected by the problem in the previous 24 hours. Ask them to consider what they encountered throughout the day in relation to the issue, specifying that they include positive things as well as negatives. Then switch to the second timeline, asking the participants to repeat the process to represent how they contributed to that issue, and the times they did so.

3. Once the groups have populated the timeline with all their activities, ask the community members to use green and red sticker dots to identify which things they consider to be positive, and which negative.

4. Ask each group to present their findings back to the other participants, with particular attention paid to their discussions and the insights that they had during the task. This is a truly eye-opening activity, and phenomenal for building relationships between community members!

COMMUNITY BUILDING
RECRUITMENT

WHY IS IT RELEVANT?

Building your community is a key element for your project, but the way you reach out to the multiple relevant communities and how you bring them on board is even more essential. A number of recruitment tools may help you save time and recruit more efficiently.

DESCRIPTION

There is no one 'recipe' that works without fail when it comes to building local communities: it all depends on the context (cultural, political, social and economic) and the type of community you wish to build. It is up to you to decide whether the recruitment tools below fit your needs, or whether you need to tweak, adapt or reappropriate them for your own purposes.

KEY QUESTION

WHAT ARE THE SKILLSETS AND BACKGROUNDS OF PEOPLE YOU NEED TO RECRUIT INTO THE PROJECT, AND IN WHICH COMMUNITIES CAN YOU FIND THEM?

TIME NEEDED

90 - 120 Minutes

PARTICIPANTS

Project Team

RESOURCES NEEDED

Issue - Experts

STAGES FEATURED IN COMMUNITY BUILDING

RELATED TOOLS NONE

STEPS

1. Map out the skillsets and backgrounds of people you need to recruit into the project. Keep your scope broad, and consider the rich variety of skillsets and backgrounds that will give added value to the project.

2. Once you have identified the types of skills and background experiences you need from the community, it is time to consider where you Can find these people, and in what environments they are likely to be found: for example, if you are looking for young tech programmers, you may consider looking at local hackerspaces; or if you need legal support, consider law students, who usually are keen to put their knowledge into practice.

3. By now, you should have clear idea of the skills you need in the community, as well as the environments where the identified skills can be found. At this point, time to prepare your recruitment strategy and find the best tools to bring in the relevant people who can help make your project a success.

METHOD IN ACTION
PRISHTINA KOSOVO

Kosovo is the youngest country in Europe, with under-25s making up over 50% of the population. Therefore, it seemed natural to harness the potential of youth by getting its young people involved in tackling air pollution in Kosovo's capital city, Prishtina.

Prishtina is the main hub in Kosovo for all major national and international organisations, as well as all major universities. This being so, it is not easy to attract young people due to the high number of new events, activities and initiatives in the city. But when the team mapped out the skills needed for the implementation of a grassroots citizen science project, we identified a requirement for a broad range of profiles. These profiles included students who study environmental science; young educators; community leaders; political activists; and artists, among others.

Thanks to a mapping exercise, the team came up with a number of recruitment tools. Below are four core ideas that helped the team to recruit young activists in Prishtina

1. BE WHERE THE YOUTH IS
Every youth-related event organised by local associations, international organisations and other institutions was identified so the team could be present to recruit young people.

2. USE MIXED-MEDIA CHANNELS
This approach helped us reach out to all the young people in Prishtina, whether they had access to the internet or not. As a result, we used social media channels to recruit young people by issuing periodical calls for committee members, roles that were made to be filled by young activists. Equally, we also used the mainstream media, reaching out via radio, newspapers and TV.

3. BRING THEM TOGETHER
It is important to offer citizens a platform where they can develop existing competences, learn new

things, get to know each other, and be part of the project. In Prishtina, we organised a three-day workshop where newly-recruited young activists were trained on citizen science, data collection, and campaigning, and were familiarised with the project.

4. ENSURE THEY HAVE OWNERSHIP
It is essential that young people feel central to the project. To avoid our activists becoming alienated, we ensured they had ownership of the project. Thus empowered, they were the ones who decided what the public campaign against air pollution in Prishtina would look like and what actions should be taken on the ground; they also decided which locations of the city should be measured, and which times of the day these measurements should take place.

3. PLANNING

THIS STAGE IS MORE DIRECTLY FOCUSED ON PREPARING THE COMMUNITY FOR DATA COLLECTION

WHY IS IT IMPORTANT?

While the previous stage was focused on engaging and bringing the community together, this stage is more directly focused on preparing the community for data collection, interpretation, and the resulting action. The decisions made at this stage will affect the type of sensing conducted and the kinds of data you collect. Making sure your community is prepared for the tasks ahead should encourage better engagement within the community, as well as stronger feelings of empowerment.

WHAT HAPPENS?

It's important here to think about your goals for citizen sensing: why you are doing it will have an effect on how you do it. This includes what kind of data collection you choose, and what kinds of tools or methods you need to do so.

Data collection can be carried out in different ways: this could involve using sensors, or simply having people walk around taking notes. Your project will also have to decide where to collect the data to make it suitable for analysis later on. You may also be setting up teams of people with different tasks depending on the type of citizen sensing you intend to carry out.

Communication is key here. Think about collecting information that can supplement your sensor data, such as photographs or data journals, which can be useful for a deeper understanding of the sensor data. At this stage, you may find that you need to consider new skills training in your community, such as making sensors and understanding how they work, as well as understanding what data is and how to interpret it. Finally, once these other decisions have been taken, the sensors must be acquired and calibrated before moving on to the sensing phase. This is important to ensure the accuracy and reliability of the data.

WHO CAN DO THIS?

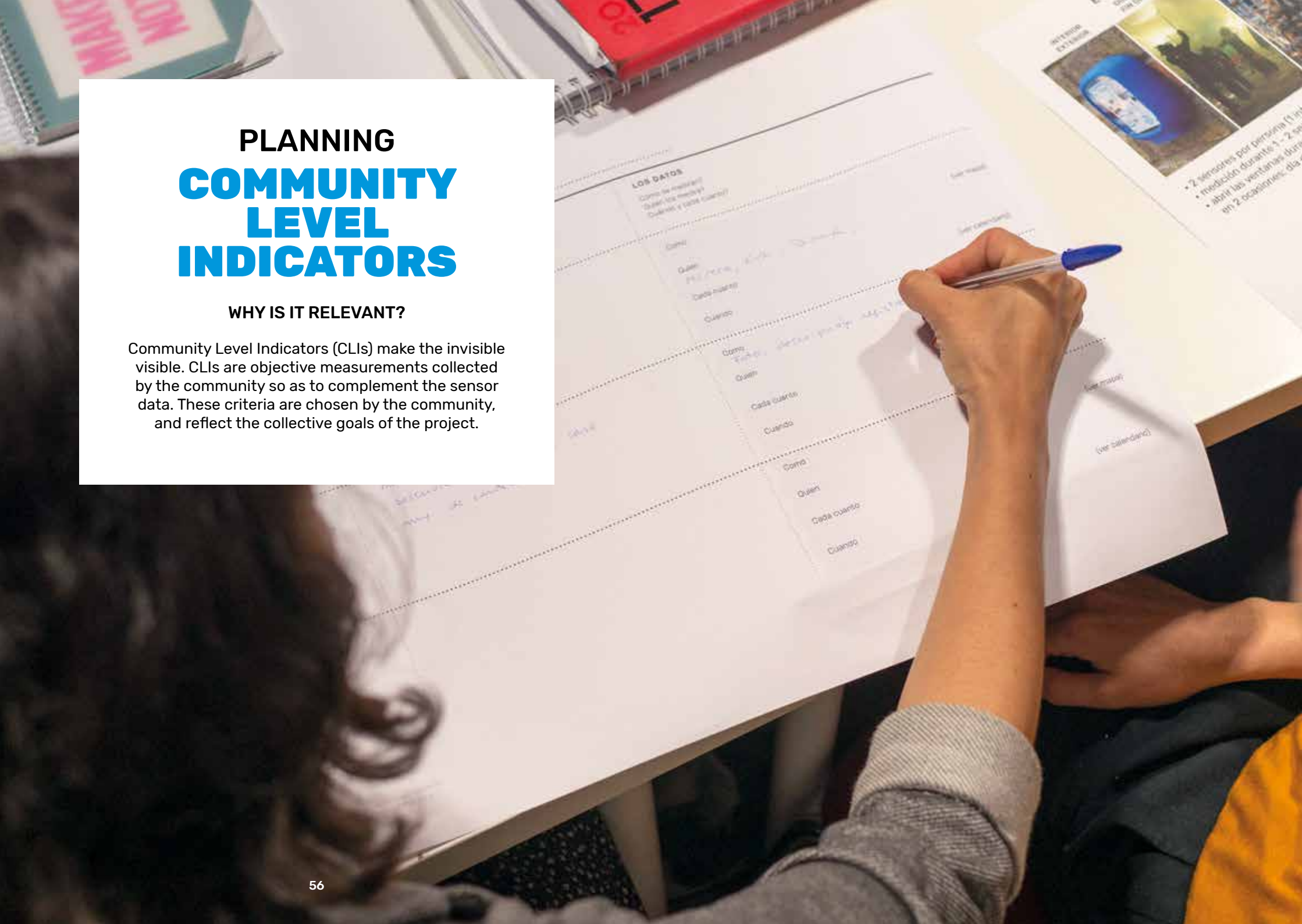
This type of planning involves collaboration with the community you have built in the previous stage. There may be value in including intermediary organisations who have skills or knowledge in making sensors or understanding data. You might also want to consider including a researcher if you wish to collect data on changes in attitudes or behaviour

WHEN DO WE DO IT?

Planning should happen before any sensing takes place, but after you feel your community has the necessary skills and understanding to get the most out of the process of citizen sensing. This can be a reasonably long stage, depending on the scope of your citizen sensing activity.

HOW TO DO IT

In this section is a list of tools that we recommend for this stage. You can use or adapt these to your own project as required.



PLANNING

COMMUNITY LEVEL INDICATORS

WHY IS IT RELEVANT?

Community Level Indicators (CLIs) make the invisible visible. CLIs are objective measurements collected by the community so as to complement the sensor data. These criteria are chosen by the community, and reflect the collective goals of the project.

DESCRIPTION

In citizen sensing, people sometimes struggle to understand how data is relevant to their lives, or how it is connected to the challenges they face. This is especially true when decisions about what constitutes an important barometer of change are taken in a non-transparent way and do not relate to the community's concerns. CLIs are a good way to connect the dots between sensor data and real life. They also help those involved see the impact of their actions by tracking and measuring real change. This process encourages participants to choose collaboratively what information will be collected, and how. Ideally, this is also a tool that people can continue to use after the campaign ends to see how their actions have made a difference.

KEY QUESTION

WHAT CHANGE DO WE WANT TO SEE HAPPEN, AND HOW CAN WE MEASURE THAT CHANGE?

TIME NEEDED

60 - 90 Minutes

PARTICIPANTS

Project team, community members, external experts, government officials

RESOURCES NEEDED

CLIs canvas, sticky notes, pens, sticker dots

STAGES FEATURED IN PLANNING, SENSING, AWARENESS, ACTION, LEGACY

RELATED TOOLS EMPATHY TIMELINE, SENSING STRATEGIES, SENSING GUIDES, AWARENESS SHEET TOOL, COMMUNITY WEBSITE, FUTURE NEWSLETTER

STEPS

1. During the early part of Planning, gather all participants together to decide on the collective goals of the campaign. Use a brainstorming exercise and sticky notes for everyone to jot down what they want to see change. Once these goals have been identified, cluster any similar ideas together. After this editing process, ask everyone to vote with sticker dots then agree on the two goals they would most like to achieve.

2. Then, divide everyone into groups of 4-5 people. Each group chooses a goal, and uses the CLIs canvas to decide on indicators which can be monitored to track the progress towards that goal. Each group also agrees on a strategy and logistics for collecting this data. Ask the groups to consider; how, when, how often and by whom these indicators will be measured.

3. The group repeats this process for up to three different indicators. When the activity is finished, the groups presents their results back to everyone. Then, using sticker dots, everyone votes openly on the indicators they would most like to monitor. The indicators with the highest number of votes are then taken forward and tracked.

4. Participants keep a record of their indicators using the data journals (see p.84), or other devices, such as smartphones, to note information or take photographs. The indicators should be shared and analysed alongside the sensor data during the Awareness activities (see p.100-117).

Community Level Indicators

Beta Pilot · Barcelona · 11/2016

GOALS What are the goals of the pilot?	INDICATOR 1 An objective measurement that tracks the progress of the campaign	GATHERING INDICATORS How will it be measured? Who will measure it? When and how often?	INDICATOR 2 An objective measurement that tracks the progress of the campaign	GATHERING INDICATORS How will it be measured? Who will measure it? When and how often?
Goal 1		How Who When How often		How Who When How often
Goal 2		How Who When How often		How Who When How often

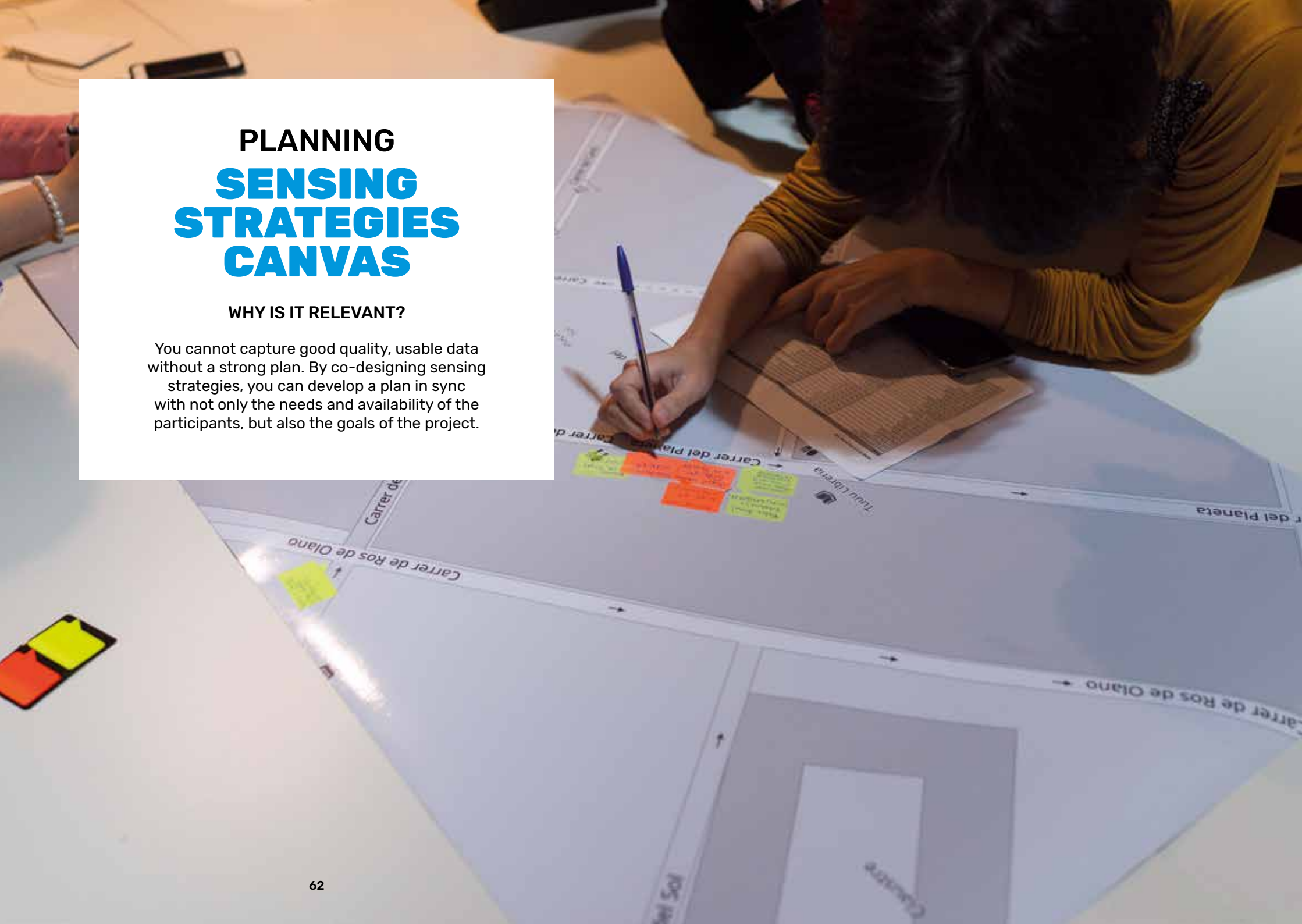
METHOD IN ACTION
PLAÇA DEL SOL BARCELONA

For the pilot in Plaça del Sol, the project team put together a workshop featuring community members and Community Champions. First they agreed upon a sensing strategy, this included mapping where in the plaça, at which floor of the apartment buildings sensors would be installed and how many sensors would be attached to the outside of the building and how many would be located inside their apartments. To do this they used the Sensing Strategy tool, which is explained on p.62.

Then, using the CLIs canvas, the groups were asked to co-create one or two other indicators that could be used for data annotation in combination with the sensor strategy. The CLIs tool helped groups think about the problem of noise pollution differently: for example, some community members wanted to track the public presence in Plaça del Sol by following people's movements through the square in relation to the position of the sun over the course of the day. They wanted to compare this information to the noise sensor data.

This tool was beneficial in two ways. Firstly, it allowed the community members to overcome a culture of blame, and instead, see the possibilities of collaborative decision-making. Secondly, when given the opportunity to break out into smaller groups in order to discuss CLIs and strategies to make sense of the sensor data, the groups did so readily. By using their collective energy, the community were able to plan approaches that would build on the sensor's datasets to reveal deeper insights into the problem.

In one case, a community member used her phone to photograph the number of people on the street. These images perfectly illustrated the source of the problem in Plaça del Sol. Once the sensor data had been gathered, she used these images alongside the sensor data to demonstrate the problem to local government officials. This indicator allowed her and her fellow community members to prove that the high level of noise pollution was directly related to the number of people socialising in the square at night.



PLANNING

SENSING STRATEGIES CANVAS

WHY IS IT RELEVANT?

You cannot capture good quality, usable data without a strong plan. By co-designing sensing strategies, you can develop a plan in sync with not only the needs and availability of the participants, but also the goals of the project.

DESCRIPTION

The Sensing Strategies canvas helps communities co-create plans for deploying their sensors and capturing data. It blends expert knowledge with community engagement in critical decision-making processes, thus encouraging commitment. The first stage of the tool involves discussing options with experts in the field, generating consensus on which plans are not only valid, but achievable, given the resources at hand. The canvas then moves on to a stage of planning out the sensing effort (where to position sensors, how the data is collected, how often, and so on). By co-developing this with your sensing participants and experts, your project should find itself with a plan that everyone can get behind.

KEY QUESTION

WHAT SHOULD BE MEASURED; AND WHEN, WHERE, HOW AND BY WHOM?

TIME NEEDED

2 Hours

PARTICIPANTS

All

RESOURCES NEEDED

Sensing Strategy cards, calendar canvas, map, sticky notes, markers, voting resources

STAGES FEATURED IN PLANNING

RELATED TOOLS GEOGRAPHICAL MAPPING

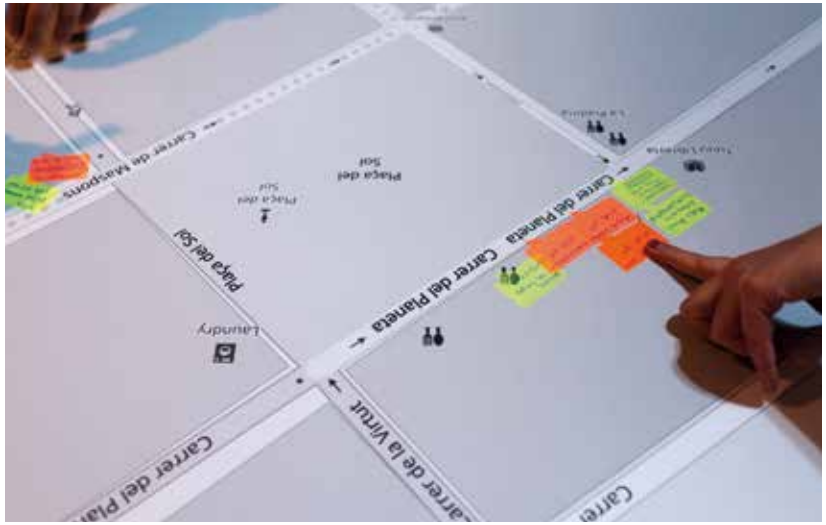
STEPS

1. **Producing the Sensing Strategy cards:** Think of reliable ways to collect the type of data that will help solve the issue. Be aware that the standard ways to measure the data which interests you may not capture the impacts you had hoped. For example, if the measurement of city air quality ignores local variations, it says little about individual health impact. You can measure things in a different way, as long as you follow a basic scientific method.

2. **Consensus:** Discuss the strategies in relation to the problem, as well as the community's needs and expectations. What do we want to know, understand or prove? What is the most realistic way of collecting the data? If consensus is difficult, participants can vote to make a choice.

3. **Calendar canvas**: To agree on when to collect the data use a calendar canvas. Participants place the number of the sensor and the name of the sensor host on designated squares (e.g. John has sensor 5 to collect data from the 7th to the 16th April).

4. **Deployment map**: The location of data collection can be critical to success. Using a map of the deployment area will help participants make decisions, recognise opportunities or spot challenges.



PLANNING
CALIBRATION

WHY IS IT RELEVANT?

This tool enables calibration of your measuring devices, as well as validation of the link between your device and other devices certified for specific measurements, using comparative data analysis.

DESCRIPTION

Calibration is used for several reasons: first, to ensure that the data is valid and calibrated against scientifically reliable measures. Second, after recruiting new community members, it is important to ensure that they receive hands-on training in the calibration process, to ensure the future sustainability of the project. Finally, the calibration process is seen as an ongoing methodological process that is constantly checked, verified, adopted and updated. Without calibration, the numbers your campaign produces are scientifically meaningless. When approaching any institution to challenge its view on the issue you are monitoring, it is important to ensure your campaign cannot be dismissed because of the questionable reliability of your data.

KEY QUESTIONS

HOW DO I ENSURE MY DATA IS CREDIBLE?
WHEN, WHERE AND HOW TO ORGANISE CALIBRATION?

TIME NEEDED

12-24 Hours 3 times over a week, during different extremes in pollution

PARTICIPANTS

2-3 participants to collect data, an expert in comparative dataset analysis

RESOURCES NEEDED

Sensing Strategy cards, calendar canvas, map, sticky notes, markers, voting resources

STAGES FEATURE IN PLANNING
RELATED TOOLS NONE

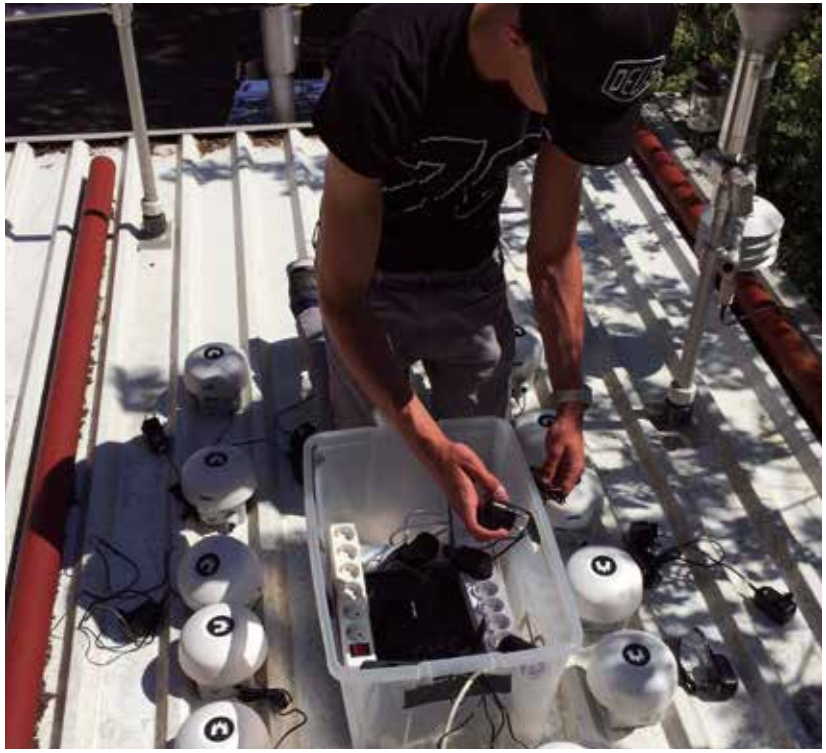
STEPS

The following method was used to complete the calibration process in Kosovo:

1. Set an appointment with a relevant institution using nationally or internationally certified sensors producing credible data.

2. Leave your sensor to run alongside the institution's certified device for the specified period. If possible, do this multiple times over the course of a week to ensure that data has been collected during periods of high and low levels of pollution.

3. Compare the data charts from the devices in the institution and those from your sensor, analysing both to find the different scaling factors, response times and saturation curves.



PLANNING

TARGETED MEASUREMENTS

WHY IS IT RELEVANT?

You can investigate air pollution at very local level, targeting specific locations which you have identified as being of particular interest to your campaign.

DESCRIPTION

The use of targeted measurements allows you to embed yourself within a community, and become more agile and fluid by capturing data in every corner of the city. Targeting also offers the ability to assess personal exposure in citizens' everyday lives, instead of the city-wide or countrywide averages typically offered by statutory measurements. By targeting one particular location, you can also create more authentic relationships with the community in that location – whether it is a school, neighbourhood or other community hub. In turn, these relationships will help you engage the community further on in your campaign.

KEY QUESTION

HOW SHOULD I RUN TARGETED MEASUREMENTS?

TIME NEEDED

2 Hours

PARTICIPANTS

All

RESOURCES NEEDED

Air pollution sensors, identified location(s), a few committed people.

STAGES FEATURED IN PLANNING

RELATED TOOLS NONE

STEPS

1. Identify the location(s) & engage with the community: We recommended that you identify at least two locations for systematic measurement and investigation: one in the most polluted area, and the other in a relatively non-polluted area. This way, you will have two different parameters to compare. Once you have identified the locations, visit them and familiarise yourself with them.

2. Make a plan: Now, make a plan to take your measurements using four stages: create a schedule of measurements on a calendar; identify the exact locations where you want to measure; create a working group to carry out the measurements; start measuring.

3. Be systematic: Make sure you stick to your schedule. We suggest you run measurements for one to two months, and at least three times a week. We also suggest monitoring the area and roads near the location(s), and keeping notes while measuring (for example, if you smell something strange, write it down).

4. From targeted measurements to targeted actions: Once your team collects the data, it has to be analysed and interpreted: for example, what does this mean in terms of pollution, or impact on health? Which periods of the week and which days are most polluted, and in which areas? Once the data has been analysed and interpreted, your team can discuss what they wish to do with the results.

METHOD IN ACTION

PRISHTINA KOSOVO

In Prishtina, our team decided to use targeted measurements as a tactic to differentiate our work from the government's statutory measurements. Following a discussion with our committee members, it was agreed that the first location to be investigated would be Faik Konica primary school in Prishtina city centre, an area which had consistently shown patterns of air pollution. After taking the decision to investigate the air pollution on school grounds and nearby, the team organised several meetings with school staff, explaining the project and the work, and inviting the school staff to collaborate. This helped our team to establish honest, open and authentic co-operation with the school staff.

The committee members established a plan for targeted measurements: for approximately two months, measurements were taken systematically (morning and afternoon, three times a week). The committee members also decided the locations of measurements: these included the entire playground, different classrooms inside the school building, and some roads around the school (usually the roads used by pupils to come to school).

Every time the committee members ran measurements, they would note down their observations, and send photographs and measurement results via our Whatsapp group chat. Our experience suggests it is good practice to run measurements in teams of at least two people: not only is it easier to double-check each other's work and observations, but one can help the other in the field if required. Additionally, for safety reasons, a team of at least two is preferable.

After completing our measurements, the data collected was uploaded online in GitHub. From there, the data was received by another team member who was able to analyse the data, then visualise and interpret it by providing a short overview of the values, air pollution levels and possible health impact. This 'brief' was then picked up by another team member, who turned it into investigative pieces for mainstream and social media[1]. Last but not least, this brief was distributed to

1 For an example of one of the project's investigative pieces based on targeted measurements, see this page: http://bit.ly/2zAfmFU

committee members, who used it to discuss potential campaigning actions to tackle the issue.

As an outcome of our work in the primary school, the team ran a campaign to raise awareness on pollution in the school. On the back of this, we also organised a Digital Bootcamp with the pupils' parents and school staff; and ran a non-formal environmental education assembly for pupils. There was such an overwhelming local response to these two workshops that the 'Green School Community' was established to take over the project in the longer term.

4. SENSING

WITHOUT SENSING, THERE IS NO WAY TO GATHER INFORMATION ABOUT THE ISSUE THAT CONCERNS YOU

WHY IS IT IMPORTANT?

This stage is key to the whole process of citizen sensing! After all, without sensing, there is no way to gather information about the issue that concerns you.

WHAT HAPPENS?

This is where the actual collection of data happens. Sensors are used to measure the local environmental issues which have been identified, using the type of sensor(s) and location position(s) which have been decided in the previous stage. You will be collecting data, but how this data is collected and fed back to the community depends on the technology available: this could be via mobile apps or reading the sensor's display.

You may also be taking photos or collecting other information to supplement your sensor data. Handing out surveys can help to give you an idea of how people feel at this stage. You may wish to combine this with similar surveys at the end of the process so you can gauge if there are any differences in how everyone feels at different stages.

WHO CAN DO THIS?

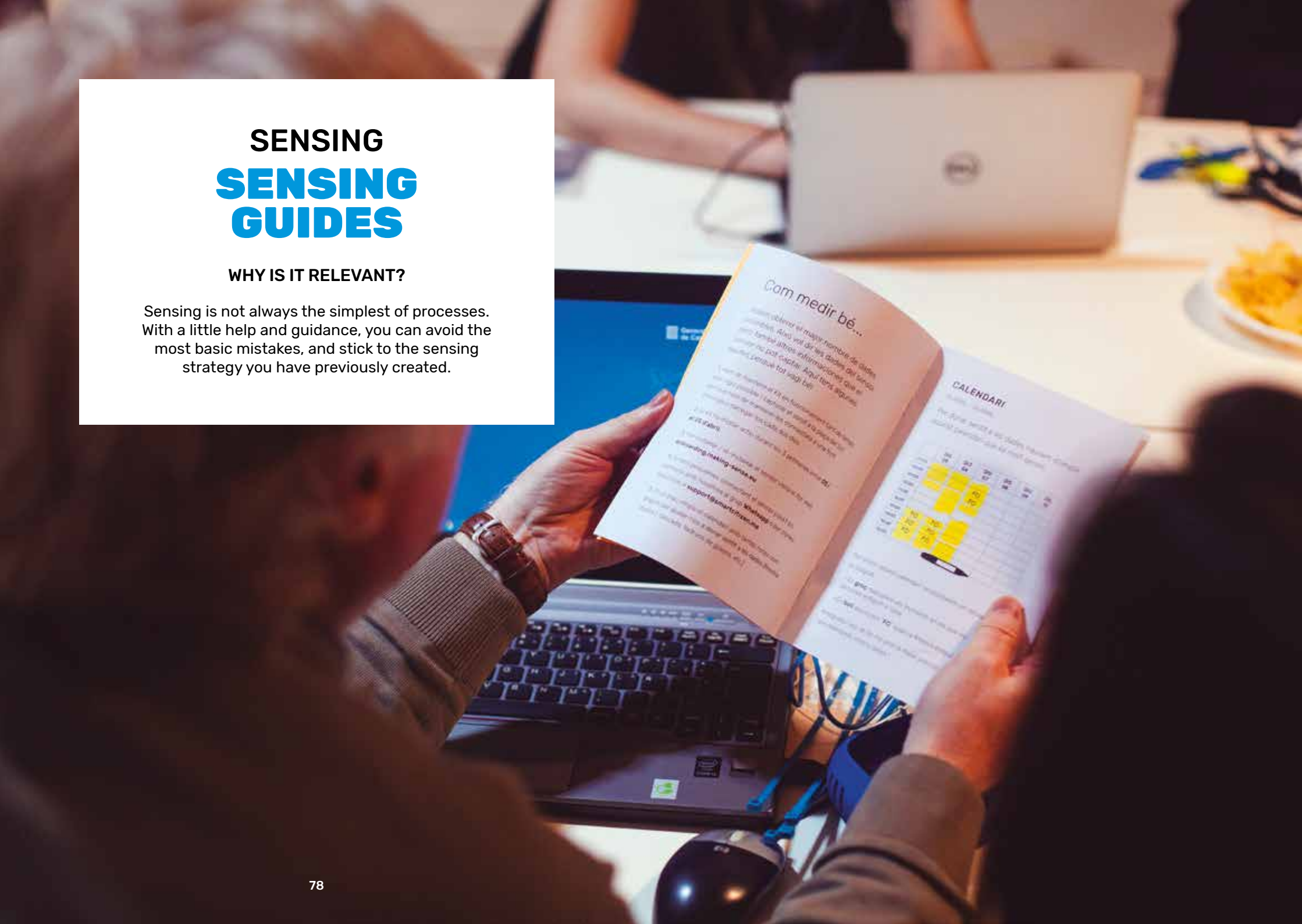
As your community will be collecting data, it is worth repeating that this data can take many forms. As a result, you may find you need support from intermediary organisations to assist with any technology issues, and to keep things running smoothly while sensing is ongoing.

WHEN DO WE DO IT?

Sensing should start once all the planning and building has been completed, or once you feel your community is ready. The sensing stage will last different lengths of time, depending on your goals and how these goals have informed your planning choices.

HOW TO DO IT

In this section is a list of tools that we recommend for this stage. You can use or adapt these to your own project as required.



SENSING

SENSING GUIDES

WHY IS IT RELEVANT?

Sensing is not always the simplest of processes. With a little help and guidance, you can avoid the most basic mistakes, and stick to the sensing strategy you have previously created.

DESCRIPTION

Technology can be a daunting aspect of citizen sensing for many participants, especially those with little technical or scientific expertise. The purpose of having a quick sensing guide is twofold: firstly, it helps everyone keep track of the sensing activities (i.e. what is being measured, how and when) which are all things that have already been discussed, but can be found here for easy access. Secondly, this guide helps with the basic operation and maintenance of the sensor, serving as a basic field guide on how to operate the technology (as well as how to troubleshoot when things do not go as expected).

KEY QUESTION

WHAT MIGHT I NEED TO KNOW IN ORDER TO CAPTURE DATA?

TIME NEEDED

Duration of sensing stage

PARTICIPANTS

Sensing participants

RESOURCES NEEDED

Paper, pens

STAGES FEATURED IN PLANNING, SENSING

RELATED TOOLS SENSING STRATEGY, DATA DASHBOARD

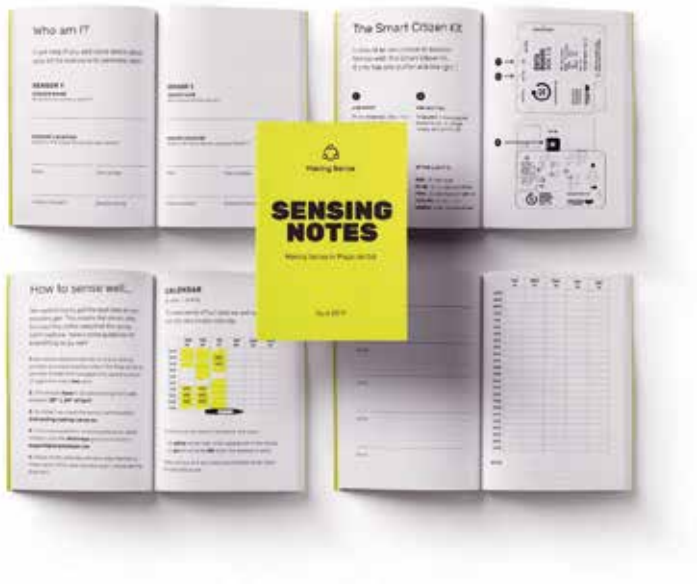
STEPS

1. Outline the key aspects of the chosen sensing strategy using clear headings or bullet points. Try to avoid confusion by making sure you only include information that is absolutely necessary in the guide.

2. If regular data collection is a key aspect, think about how to log those measurements and how to display that schedule. Try to think about the context in which the person will be using this guide. What is the simplest format to use?

3. Add space for data logging, journalling and notes. Try to turn the guide from a resource into a tool. As a participant's source of reference and constant companion throughout the project, this will go a long way to creating familiarity with the sensing process.

4. Co-creating this guide with the community of sensing participants could offer some valuable insights into what shape this guide should take. For some communities, a digital tool might work better, whereas for others, good old-fashioned pen and paper will be the preferred choice.



METHOD IN ACTION

PLAÇA DEL SOL BARCELONA

In 2017, we worked with a community of neighbours in Plaça del Sol square in the heart of Barcelona. The community was made up of people from a variety of different backgrounds, age groups, and more importantly, levels of technological know-how.

During the course of a previous pilot, we had found, again and again, that problematic sensors were left abandoned, and sensing targets were not met when participants began to lose track of the process and methods. On investigation, it seemed that a little guidance could have gone a long way to preventing the most common and basic of failures.

Together with the Making Sense Community Champions, we developed a series of take-home booklets that facilitated the sensing process, from technical annotation to data journalling - both of which are key to accurate data capture. A key discovery from this roll-out is that the sensor hosts were far more likely to stick to the agreed sensing strategies when they had a guide to refer to.

When creating your guide, try to include a basic activity that helps the participant to learn by doing and repeated actions, and to understand and stick to the process. Collectively ticking through boxes while assembling a sensor, or regular measurement entries and annotations are very simple ways to engage participants in the technological and strategic aspect of the sensing phase.

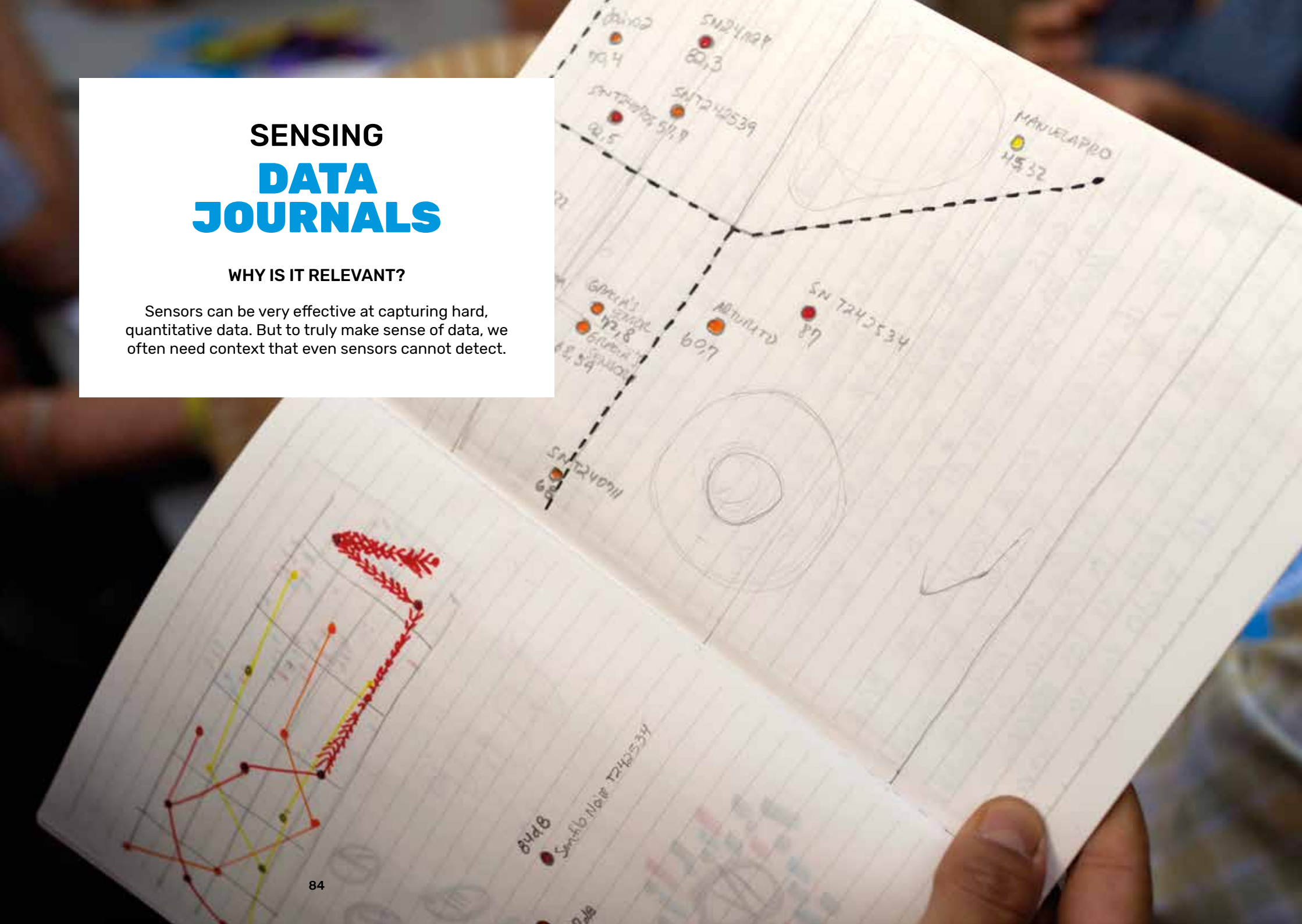
A LITTLE GUIDANCE COULD HAVE GONE A LONG WAY TO PREVENTING THE MOST COMMON AND BASIC OF FAILURES

SENSING

DATA JOURNALS

WHY IS IT RELEVANT?

Sensors can be very effective at capturing hard, quantitative data. But to truly make sense of data, we often need context that even sensors cannot detect.



DESCRIPTION

Data journals can be great companions to hard sensor data. You can think of them as annotations to the data – what was happening when the sensor recorded that high or low point? Often this is particularly helpful in flagging false-positives and outliers on the data. The key to journalling is to keep the annotations as focused as possible. These annotations will also likely be individual to the type of measurement the campaign is focused on. For example, in an environmental sensing campaign, observation of personal and physical effects - such as mood changes or impairment at different stages - might help establish a pattern between the data captured and the effects on the participants. These are things the sensor alone cannot capture.

KEY QUESTION

WHAT ARE THE IMPORTANT THINGS THAT THE SENSOR CANNOT DETECT?

TIME NEEDED

Duration of sensing stage

PARTICIPANTS

Sensing participants

RESOURCES NEEDED

Paper, pens

STAGES FEATURED IN PLANNING, SENSING

RELATED TOOLS SENSING STRATEGY, DATA DASHBOARDS, ISSUE MAPPING, COMMUNITY LEVEL INDICATORS

STEPS

1. By the end of the scoping and planning stages, many anecdotal, personal annoyances will have likely been recorded. Consider how a journal might track the frequency of these events.

2. Community Level Indicators are a useful starting point for data journalling (see CLIs Tool p.56). Consider how participants might record the indicators they are tracking 'in the wild', and how this process might be more engaging. For example, does it have to be written down? Perhaps it can be sketched, photographed or visualised in some other way.

3. Consider what the common false flags are with your chosen data capture process. From sudden environmental shifts, wildlife and tampering, to regular or random events, there are many helpful annotations participants can contribute in order to ensure more accurate data collection. Whether the high spike in the noise sensor was their own pet or a passing ambulance, annotations like these help us make sense of the data.

4. Gauge the participants' engagement level and attitude, but do not ask for too much, and keep expectations reasonable. Complex data entry tasks can lead to invalidating errors, making participants frustrated and more likely to abandon the process.

SENSING

OPERATION MANUALS

WHY IS IT RELEVANT?

We all get a little stuck sometimes. A good operations manual should go a long way to helping participants get back on track should any problems occur with the technology or the process.

DESCRIPTION

User manuals are easy references for the most frequently asked questions, as well as for other sticking points participants might not have considered, or are perhaps too shy to ask in group environments. In addition to establishing accessible communication channels for troubleshooting, you can use the operation manual to address the most basic details: this would include instructions for turning the sensor on and off; for sensor maintenance and care; and for capturing data as accurately as possible. The other purpose of the operation manual is the sensing strategy. Giving participants a timeline or chart they can refer to, preferably one they can add to themselves, will help keep them focused on the task at hand.

KEY QUESTION

WHAT DO I NEED TO KNOW WHEN SOMETHING GOES WRONG?

TIME NEEDED

Duration of sensing stage

PARTICIPANTS

Sensing participants

RESOURCES NEEDED

Paper, pens

STAGES FEATURED IN PLANNING, SENSING

RELATED TOOLS SENSING STRATEGY, DATA DASHBOARDS, SENSOR

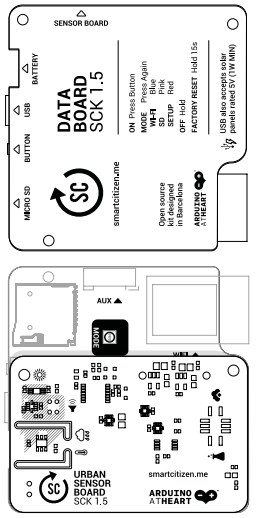
STEPS

1. Thinking about basic sensor operation, prepare a list of instructions to explain the process. Consider things like: How does it turn on? How does it charge, and how often? How is data extracted? Does it need calibration? If so, what is the process?

2. Think visually. Unusual words can confuse novices and experts alike. Where possible, draw the object you are referring to. For technology, even low-fidelity images can be very useful in pointing out the locations of key components.

3. Consider actions and situations which can halt the sensing process and interfere with readings. Some basic 'Do's and Don'ts' might help mitigate a lot of avoidable issues.

4. You will need to provide the participants with information on how the data is collected, and when. Often a crude roadmap or timetable can help paint a bigger picture and show the collective vision. The development of this roadmap will likely take place during the 'Sensing Strategy' workshop. If so, it is useful to re-create this in an operation manual so all can refer back to the sensing strategy and annotate the data accordingly as the sensing phase goes on.



Tips to care for the Smart Citizen Kit

The Smart Citizen Kit is an environmental sensor, that has been designed to be used by just about everyone. It's very easy to take care of.

BATTERY

If not plugged in, the battery last around a couple of days

CHARGING

Every two days you should charge the kit by plugging the blue cable to the power, like a mobile phone.

CHARGING TIME

To fully charge the kit, it takes around 3 hours.

PLUGGING-IN

You can leave the Smart Citizen Kit constantly plugged in to a computer or the mains

SENSING

OPEN HARDWARE

WHY IS IT RELEVANT?

If you cannot open it up, you do not own it. Open hardware allows you to find and use cheap and versatile sensing equipment. You can inspect its inner workings, change and extend its functionality, and share your own tweaks freely with others.

DESCRIPTION

Most commercially available sensors are expensive, and cannot be altered or extended to accommodate your specific data collection needs. In open hardware, the blueprints of the device are open, so can be freely used and changed. By tapping into the increasing wealth of available open hardware tools, you can find cheap(er) and malleable sensors that can be adapted to do what you want them to do. This will, however, require some technical knowledge: this could come from inside the community itself, or sourced from FabLabs or makerspaces, of which there are thousands worldwide.

KEY QUESTION

WHAT TECHNOLOGY WILL ALLOW ME TO MEASURE WHAT I NEED TO KNOW?

TIME NEEDED

Several weeks to several months depending on design

PARTICIPANTS

Technically-skilled community members or open hardware volunteers

RESOURCES NEEDED

Hardware knowledge, access to open designs (as well as FabLabs or makerspaces)

STAGES FEATURED IN PLANNING, SENSING

RELATED TOOLS SENSING GUIDES, OPERATION MANUALS

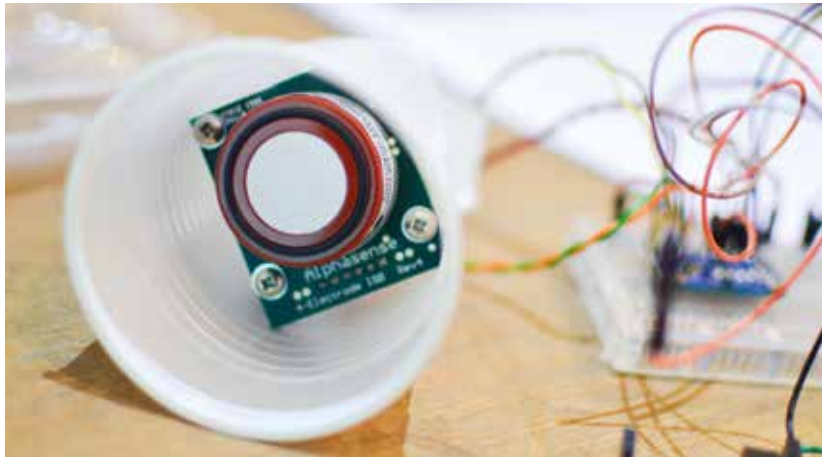
STEPS

1. Define your sensing needs. The best place to start is with your campaign issue. Once you define its attributes, you can start to see the different ways you can measure the problem, and what technology might help you achieve that.

2. Browse the internet for available open-source sensors that could obtain these measurements (for a good place to start, see http://fablabs.io). Open-source sensors are plentiful online, and for bespoke builds, open-source component providers such as Arduino would be a good start to look at how to create your own sensor (see https://www.arduino.cc).

3. Adapt sensor blueprints and any associated software to your specific needs, and produce as many sensors as you need. The key here is not to get blinded by technological novelty, but to think very clearly what features you will need to obtain the measurements you require. When it comes to assembling bespoke technology, makerspaces, FabLabs and other similar communities can be of great help in facilitating this process.

4. Share the new sensor blueprint and software for others to find and use. If you have designed something that has helped you and your community, chances are, it can also help others. Uploading your plans to an online repository will enable others to build your sensor for themselves, as well as adapt your plans to fit their own requirements.



METHOD IN ACTION

URBAN AIR Q AMSTERDAM

In the UrbanAirQ pilot, the community wanted to measure air pollution in real-time, and decided on nitrogen dioxide (NO_2) as the most reliable indicator of air quality. NO_2 is mainly produced by various kinds of traffic and power plants. Air with high concentrations of NO_2 can irritate human airways, and longer exposure can lead to diseases like asthma.

AIR WITH HIGH CONCENTRATIONS OF NO_2 CAN IRRITATE HUMAN AIRWAYS

The community put forward a number of specific concerns about air pollution in the form of questions, including: What time is better to open my front or back window? What is the difference in air pollution on a main street versus a secondary road? What is the difference in air quality during the daytime versus night-time? Analysis of these questions revealed that our pilot would need around fifteen NO_2 sensors to be able to provide a meaningful result.

In collaboration with Wageningen University, RIVM and the SenseMakers Network, Waag Society adapted an open hardware sensor from a similar exercise in Amsterdam which had run a year previously. The result was called the Bora sensor (for further details, see https://github.com/waagsociety/air_quality_sensor_kit). In the end, we produced sixteen of these sensors, and after careful calibration, these were distributed to the participants in line with the co-designed measurement strategy.

METHOD IN ACTION

COMMUNITY CHAMPIONS BARCELONA

From urban noise pollution to temperature, humidity and light in rural environments, the issues at the core of each Barcelona pilot were very different. Accordingly, we required a robust, multi-functional sensor capable of tackling them all.

Fab Lab Barcelona has long been developing an open-source sensing platform which, with some appropriation, quickly became the go-to solution for the pilots in Barcelona. This platform, Smart Citizen, is an open-source set of tools comprising a sensor kit, the Smart Citizen Kit

partners. Smart Citizen provides individuals with the technology they need to be better informed about their environments, and can use that information to have a say in what happens in their neighbourhoods.

The SCK is compatible with Arduino (https://www.arduino.cc), and all the design files are open-source. Details of the hardware documentation and API are available on the Smart Citizen website (www.smartcitizen.me).

The SCK is a piece of open-source hardware, and is comprised of a sensor

BUILDING DISTRIBUTED TOOLS AND FOSTERING A COLLECTIVE REBUILDING OF THE CITY

(SCK), an online platform and a mobile application. It was launched in 2012, initiated by Fab Lab Barcelona at the Institute of Advanced Architecture of Catalonia (IAAC), and supported by public and private international

shield, data-processing board, battery and a case. The shield contains sensors that measure air quality (CO and NO_2), temperature, humidity, light intensity and noise levels. Once the sensor is set up, the device can stream data through

a Wi-Fi connection, or it can store the data on a MicroSD card. The SCK has a low power consumption, making it ideal for placement on balconies and windowsills. The device can be charged either by solar panel or mini-USB connector.

The SCK was created to read, process and post data, as well as intermittently indicate battery charge level once set up. All the elements of the SCK, from the interface to the API, are available online, and can be copied or modified. The data collected by the SCKs can be uploaded and shared through social networks, making it openly available

online to all without charge. Connecting data, people and knowledge is the main objective of the Smart Citizen platform. It is intended to act as a springboard for building distributed tools and fostering a collective rebuilding of the city by its own inhabitants. By taking advantage of open-source hardware and software solutions like the Smart Citizen platform, citizens are able to hit the ground running: they can start sensing with little to no modification or re-engineering necessary, rather than spending months creating, testing and deploying sensors from scratch.

5. AWARENESS

CONSIDER HOW THE COMMUNITY THINKS ABOUT AND UNDERSTANDS THE DATA THEY HAVE COLLECTED

WHY IS IT IMPORTANT?

It is of vital importance to ensure data is not only shared, but also understood within the community (and potentially, within intermediary organisations or local government). Understanding the impacts of the data on areas such as the environment or health make it possible to identify opportunities for change and action. This type of sharing and transparency will be key to encouraging action at a policy level, and will help to empower the community.

WHAT HAPPENS?

Once the data has been collected, it needs to be interpreted so it is understandable and actionable. You will want to consider how the community thinks about and understands the data they have collected. You may also wish to consider the role of official sensor measurements, if this type of data exists for your specific goals and aims. After the data has been analysed, it is useful to present or visualise it in an easy-to-understand format.

WHO CAN DO THIS?

These data analysis and interpretation skills may be available within the community. If not, they can and should be found somewhere else, perhaps from an intermediary organisation or external experts.

WHEN DO WE DO IT?

Data awareness should be promoted as soon as the sensing and data collection phase is over. Once the community feels they understand what the sensor data means, you can move on to thinking about potential areas for action.

HOW TO DO IT

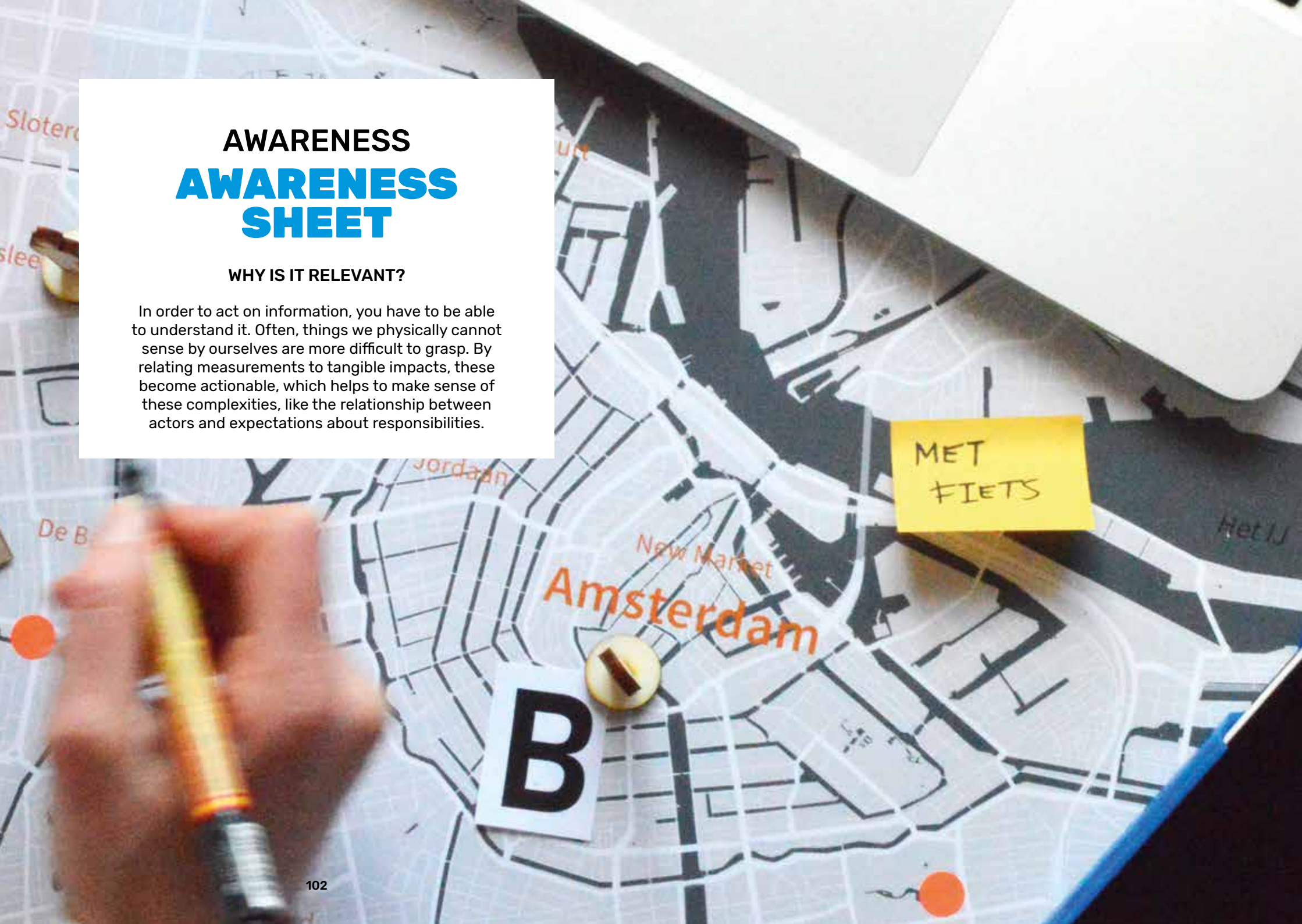
In this section is a list of tools that we recommend for this stage. You can use or adapt these to your own project as required.

AWARENESS

AWARENESS SHEET

WHY IS IT RELEVANT?

In order to act on information, you have to be able to understand it. Often, things we physically cannot sense by ourselves are more difficult to grasp. By relating measurements to tangible impacts, these become actionable, which helps to make sense of these complexities, like the relationship between actors and expectations about responsibilities.



DESCRIPTION

Some events in the environment cannot be sensed without scientific equipment, and even with it, are hard to understand without specialist training. Developing an understanding can also be challenging when people have strong views on an issue. It is important to understand the measurements you have collected and how these relate to impacts: for example, if you measure a high level of air pollution at a certain place for half an hour, what does that mean in terms of health impact? How does that relate to the legal limits on air quality, which might be designated in 24-hour or annual averages? 'Relating measurements to action' is a technique aimed at helping community members understand the broader implications of their measurements, and their options for action as a result.

KEY QUESTION

WHAT ARE THE IMPLICATIONS FOR YOU AND YOUR COMMUNITY OF CHANGES IN THE ENVIRONMENT YOU CANNOT SEE?

GROUP WORK
30 Minutes

PRESENTATION
30 Minutes

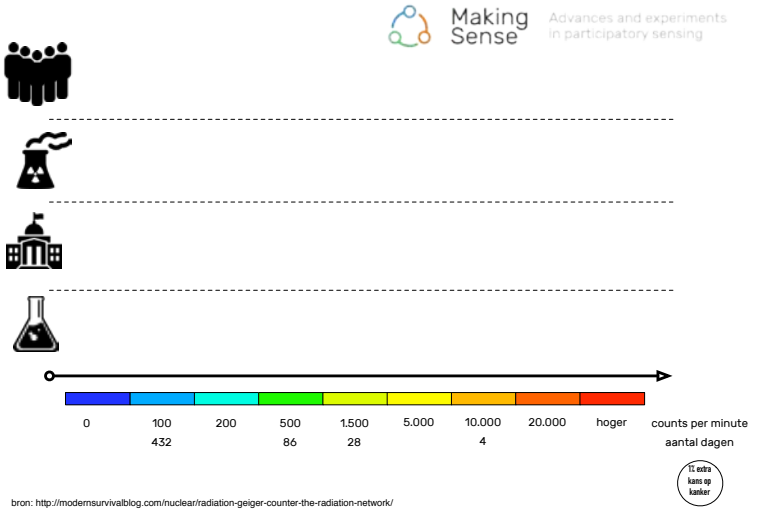
PARTICIPANTS
Community and experts

RESOURCES NEEDED
Pens, markers, Post-its, possibly icons

RELATED TOOLS COMMUNITY LEVEL INDICATORS, DATA DISCUSSION SHEET
STAGES FEATURED IN COMMUNITY BUILDING, PLANNING

STEPS

1. Divide everyone into small groups of 4 or 5 people, giving each an A3 print of the Awareness Sheet, and offer clear instructions before starting.
2. The tool has two important elements: the 'action' layers and the scale.
3. There are four 'action' layers: community, industry, government, academia. They represent different stakeholders that play a role in the situation.
4. The scale at the bottom illustrates a potential value that is measured. The example shows radiation, but this can be replaced by any measurement scale.
5. Groups can determine together which action they can take, and which action they expect of others at different measured values. For instance, at a low level of radiation you might stop eating lettuce from your garden. At higher levels you might expect Government to supply iodine pills.
6. Have groups present their findings to each other at the end of the session.



bron: http://modernsurvivalblog.com/nuclear/radiation-geiger-counter-the-radiation-network/

METHOD IN ACTION

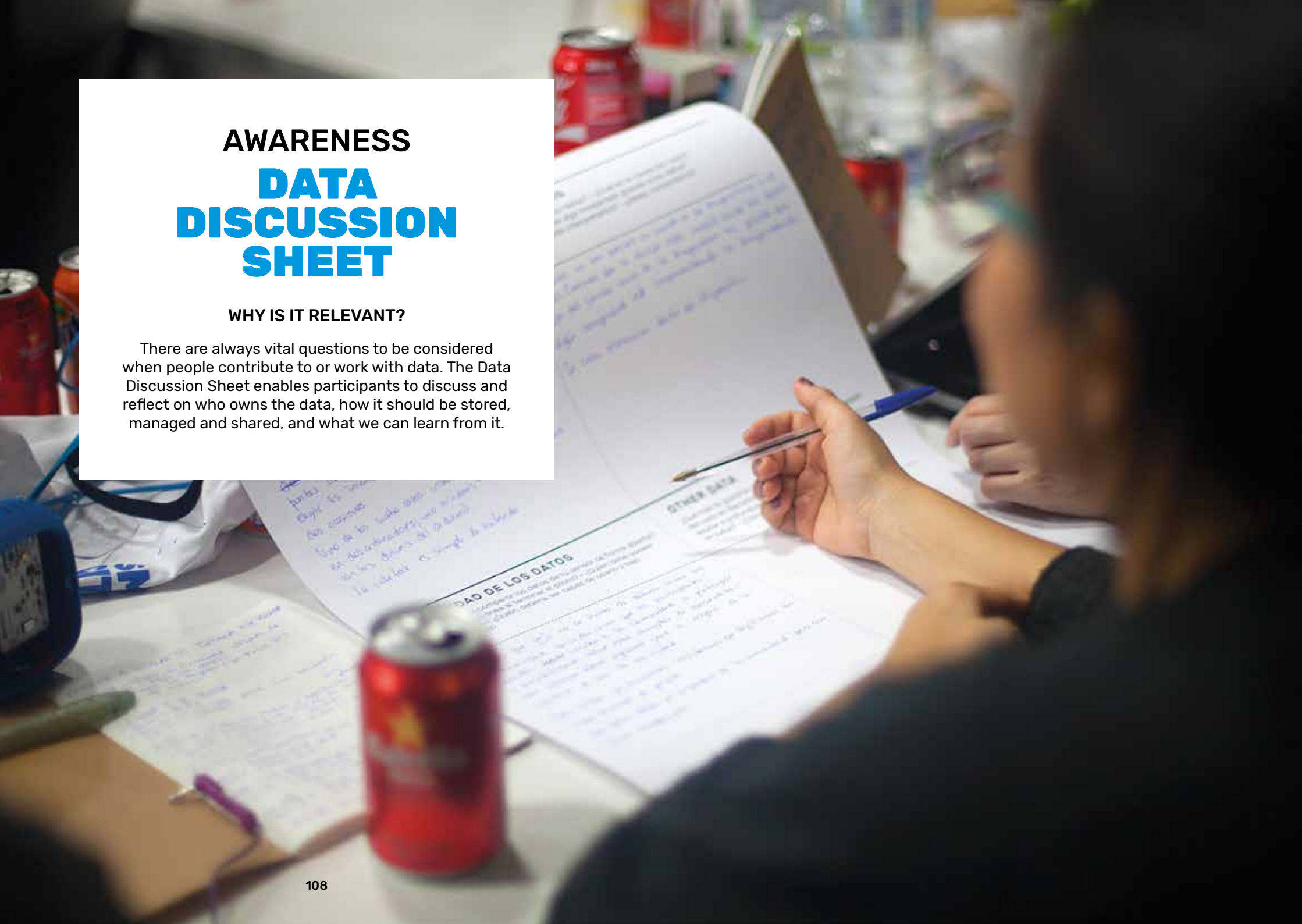
GAMMASENSE AMSTERDAM

As part of a community workshop near the Tihange nuclear power plant in Belgium, we used the Awareness sheet to get people talking about what radiation means to them. The workshop was held about a month before a big demonstration (organised by our partner WISE), which would see a human chain form between Tihange, Belgium and Aachen, Germany, crossing the city of Maastricht, Netherlands. The left-wing party, *GroenLinks*, was heavily involved in this demonstration, and two city council members invited us to the boardroom of City Hall for the workshop, and asked their constituency to join us.

Nuclear radiation is an issue which could be greatly advanced by citizens and experts coming together and exploring sensing strategies. Yet sensing knowledge and the meaning of different values is currently confined to expert and safety-oriented organisations, and it can be difficult for experts to see the potential value of citizen-led measurements. For laypeople not specialist in radiation and nuclear energy, understanding the impact of invisible waves on your body is quite an abstract notion. The Awareness tool translates this abstract environmental data into actions participants can take themselves (or can expect from others).

In previous workshops, we found that the topic of radiation can lead to confusion if not translated into a human context. Using the Awareness sheet in groups, participants were able to discuss different strategies at different radiation levels: they not only spoke from their own perspective, but also from an academic, government and business viewpoint.

This workshop shows how important it is to use tools that translate abstract notions into concrete actions. The tool was used for gamma radiation, but could be reappropriated to suit other environmental issues like air, water and sound. By mapping the possible actions to take at different 'pollution' levels, you can make the problem more understandable and manageable.



AWARENESS

DATA DISCUSSION SHEET

WHY IS IT RELEVANT?

There are always vital questions to be considered when people contribute to or work with data. The Data Discussion Sheet enables participants to discuss and reflect on who owns the data, how it should be stored, managed and shared, and what we can learn from it.

DESCRIPTION

During a citizen sensing campaign, participants become involved in data collection, analysis and sharing. The Data Discussion Sheet can help participants to discuss the technology used, the data collected, data ownership and privacy concerns, and what other data they would like to collect. It helps to articulate concerns and fosters opportunities for data awareness and decision-making. This tool can also help facilitators to frame the rest of the awareness phase by revealing gaps and opportunities for learning.

KEY QUESTIONS

WHAT HAVE WE LEARNED FROM THE DATA?

HAS THE DATA COLLECTION PROCESS REVEALED TENSIONS AROUND ACCURACY, PRIVACY, AND MANAGEMENT?

WHO OWNS THE DATA, AND HOW SHOULD IT BE STORED, MANAGED AND SHARED?

TIME NEEDED

90 Minutes

PARTICIPANTS

Participants who collect data, experts and facilitators

RESOURCES NEEDED

Data Discussion Sheet, Post-it notes, markers

STAGES FEATURED IN AWARENESS

RELATED TOOLS COMMUNITY LEVEL INDICATORS, ONBOARDING TOOLKIT

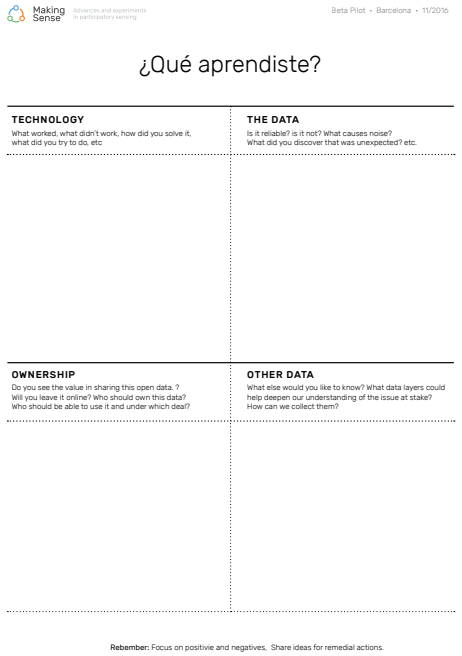
STEPS

1. Divide participants into groups of four or five. Hand each group a Data Discussion Sheet, Post-it notes and markers.

2. The first ten minutes are earmarked for participants to brainstorm ideas on their own, addressing each theme individually. Ask them to write their ideas on Post-it notes.

3. The next thirty minutes are dedicated to group discussion, and ask each participant to share their ideas with the group. Each group then works collaboratively to cluster ideas under each theme in order to decide on a collective position.

4. In a final round, have the groups present their themes to everyone, sharing what they have learned from the data, the issues encountered, their position regarding data ownership, and whether they would like to collect other data to strengthen their findings.


Making Sense
Advances and experiments in participatory sensing
Beta Pilot • Barcelona • 11/2016

¿Qué aprendiste?

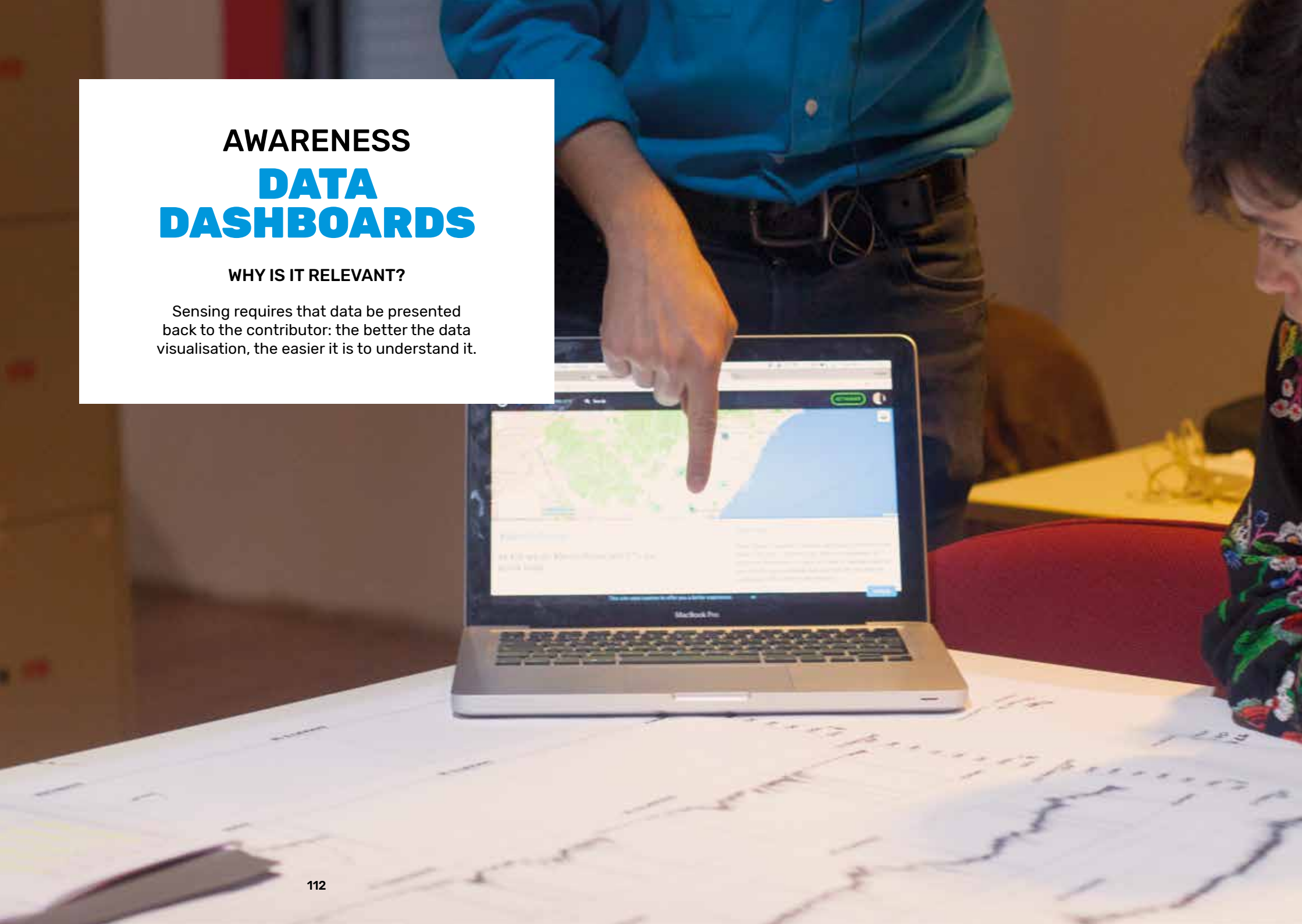
TECHNOLOGY
What worked, what didn't work, how did you solve it, what did you try to do, etc

THE DATA
Is it reliable? is it not? What causes noise? What did you discover that was unexpected? etc.

OWNERSHIP
Do you see the value in sharing this open data. ? Will you leave it online? Who should own this data? Who should be able to use it and under which deal?

OTHER DATA
What else would you like to know? What data layers could help deepen our understanding of the issue at stake? How can we collect them?

Rebember: Focus on positivie and negatives, Share ideas for remedial actions.



AWARENESS

DATA DASHBOARDS

WHY IS IT RELEVANT?

Sensing requires that data be presented back to the contributor: the better the data visualisation, the easier it is to understand it.

DESCRIPTION

Data dashboards should visualise the data that people have contributed in a manner that makes the data accessible and open for everybody involved. Ideally, the dashboard will visualise the data in a way that can address the issues and questions the community have flagged as relevant to them. A data dashboard can play an important role in increasing knowledge and understanding for the whole community, and can become a catalyst for further action.

KEY QUESTIONS

HOW CAN WE ACCESS THE DATA, AND IN WHAT FORMAT?

HOW IS THE DATA VISUALISED?

WHAT DOES THE COMMUNITY WANT TO FIND OUT?

WHAT INFORMATION IS MOST RELEVANT TO THE COMMUNITY?

TIME NEEDED

Duration of awareness stage

PARTICIPANTS

Development team, input from community

RESOURCES NEEDED

Sensors producing data, data storage, access to GitHub

STAGES FEATURED IN PLANNING, SENSING

RELATED TOOLS SENSING STRATEGIES CANVAS, COMMUNITY LEVEL INDICATORS

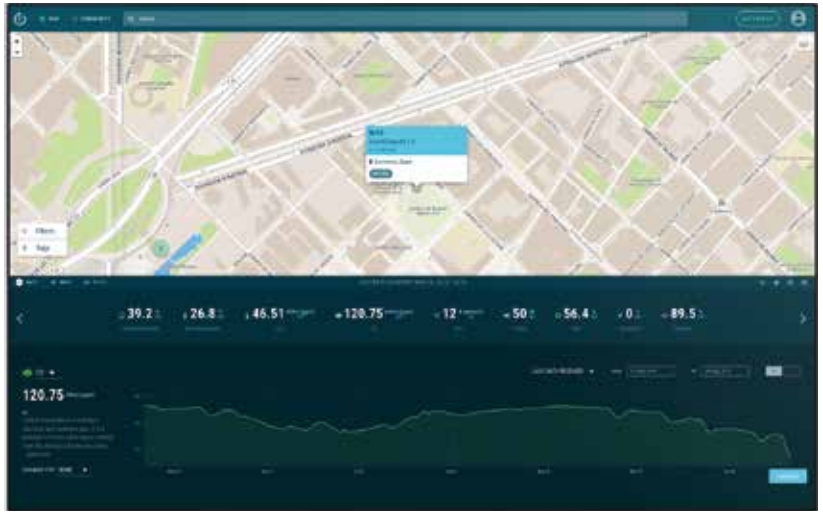
STEPS

1. In collaboration with the development team, assemble ideas put forward during the Scoping and Planning phases to understand what type of data will be gathered. Research existing open tools and dashboards that could potentially suit your needs or act as a starting point for development.

2. The Sensing Strategies & Community Level Indicators canvasses are useful here. These will help the community plan what they want to know, and a data dashboard can help visualise key questions. Keep in mind that the dashboard should, at the very least, give a brief snapshot of activity on the campaign issue, based on the indicators you are measuring and the sensors that have been deployed.

3. Create an open development space (like GitHub) early on so you can share your work, and give other community members the opportunity to contribute.

4. Set up a step-by-step development cycle connected to community meetings. Use these meetings to present and further develop the dashboard, remembering to get feedback for the next iteration.



METHOD IN ACTION
GAMMASENSE AMSTERDAM

Governments often struggle with the issue of openness whenever calamities occur. In the aftermath of Fukushima, the Safecast[1] citizen science project developed and deployed DIY Geiger counters together with local communities: this allowed the general public to access information unavailable to them from governmental sources, and in turn, informed the government. While this project is without doubt a big leap in the direction of openness, at the time of writing, Safecast's bGeigie Nano[2] radiation sensor still costs $600 USD (as a kit) to $1500 USD (fully assembled), which could prove to be an obstacle for a fast roll-out. Aside from the price tag, Safecast's sensor has other logistical problems: every time an incident happens, the public wants to be informed immediately, since the first 24 hours are the most important. The question was: What readily available technology is already in our homes that could empower us today?

This is where the GammaSense Data Dashboard comes in. The aim of the dashboard was to turn any laptop and smartphone into a radiation sensor. We built the dashboard with a core team of developers and designers, but also quickly enabled a group of people who were interested in programming, citizen empowerment and nuclear monitoring to help enhance the algorithm used to calculate a CPM (counts per minute) value from a video stream.

WHAT READILY AVAILABLE TECHNOLOGY IS ALREADY IN OUR HOMES THAT COULD EMPOWER US TODAY?

1 https://blog.safecast.org

2 https://blog.safecast.org/bgeigie-nano/

For the last few years, a new idea has been buzzing around the science and technology community: technically, it should be possible to use devices with a digital camera as gamma detectors. Research from the Australian Nuclear Science and Technology Organisation (ANSTO) showed a linear connection between the amount of gamma radiation and the number of white spots and streaks that appear in images taken by cameras covered by black tape.

This technology was implemented in several apps developed for smartphones. It is important to note that the gathered data is not yet available openly, and the current app design is not quite futureproof. Yet the GammaSense project has impressive aims: to develop an emergency infrastructure that can be deployed within minutes, simply by activating any (covered) camera from a webpage.

https://github.com/waagsociety/GammaSense

6.
ACTION

ANY ACTION CAN BRING ABOUT POLICY CHANGE, OR HELP SOLVE THE PROBLEM THAT CONCERNS YOUR COMMUNITY

WHY IS IT IMPORTANT?

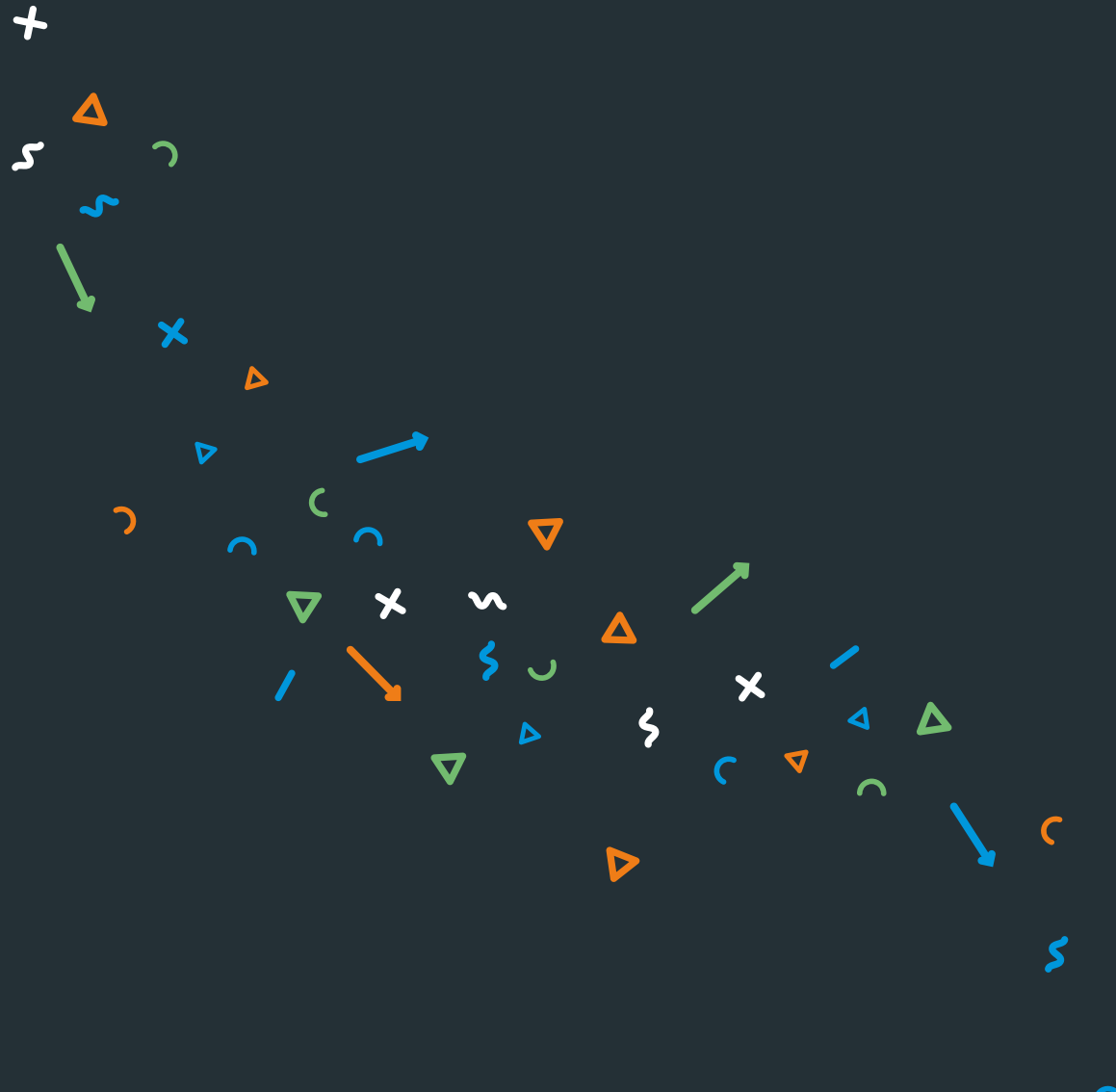
This stage is crucial to achieving your goal to effect change, either in your local environment or wherever it is needed. Any action you initiate can bring about policy change, or help solve the problem that concerns your community.

WHAT HAPPENS?

Once your data has helped your community identify where action is needed or where you think you can effect change, you can begin planning and co-creating actions that can lead to change. These can take many forms, including protests, artistic interventions and displays, public forums and presentations. At this stage, these actions should come from the community, and are most effective when carried out locally (i.e. in the area where sensing was originally conducted).

WHO CAN DO THIS?

The community should decide what the next steps should be based on insights they have gleaned from interpreting the data. There may be a co-designing or supporting role for intermediary organisations (assisting with producing materials, for example), but any action should be fully community-led. This will ensure actions have a real impact in the community itself.



WHEN DO WE DO IT?

Action should only take place once the community understands the implications of the data. This stage may be long or short, depending on the issue in question and whether change happens quickly or not.

HOW TO DO IT

Below is a list of tools that we recommend for this stage. You can use or adapt these to your own project as required.

ACTION
DIGITAL PRESENCE

WHY IS IT RELEVANT?

This is a great way to share your community's goals, hard work and findings. By creating a digital presence, you can ensure this content and data are easily accessible to everyone.

DESCRIPTION

A digital presence does not have to take the form of a dedicated website: there are various other platforms, such as blogging or Twitter, which you can use to promote your campaign. The aim here is to document the ambition of your community of participants, the progress towards your goal, as well as your findings to date. This can serve as a handy reference when explaining the efforts of the campaign to anyone from news outlets to policymakers, and can also prove useful when recruiting new participants.

KEY QUESTION

WHAT ARE THE GOALS OF OUR CAMPAIGN?

WHAT HAVE WE FOUND SO FAR?

TIME NEEDED

1 Day

PARTICIPANTS

Designers, developers

RESOURCES NEEDED

Computers

STAGES FEATURED IN COMMUNITY BUILDING, AWARENESS, ACTION, REFLECTION, LEGACY

RELATED TOOLS COMMUNITY LEVEL INDICATORS, DATA DASHBOARD

STEPS

1. A good exercise is to workshop the goals of the project. Why is everyone involved? What are the aims of the campaign, and how best might you articulate these?

2. Don't overcomplicate things. With the vast array of social media platforms available, a simple hashtag on a social media account or a micro-blogging platform is often more than enough to create a conversation

3. Stick to skills you have at hand. Being resourceful is very important for this exercise. It is often tempting to shell out for things like bespoke website creation, but this entails recurrent costs and is hard to maintain without the proper in-house skills.

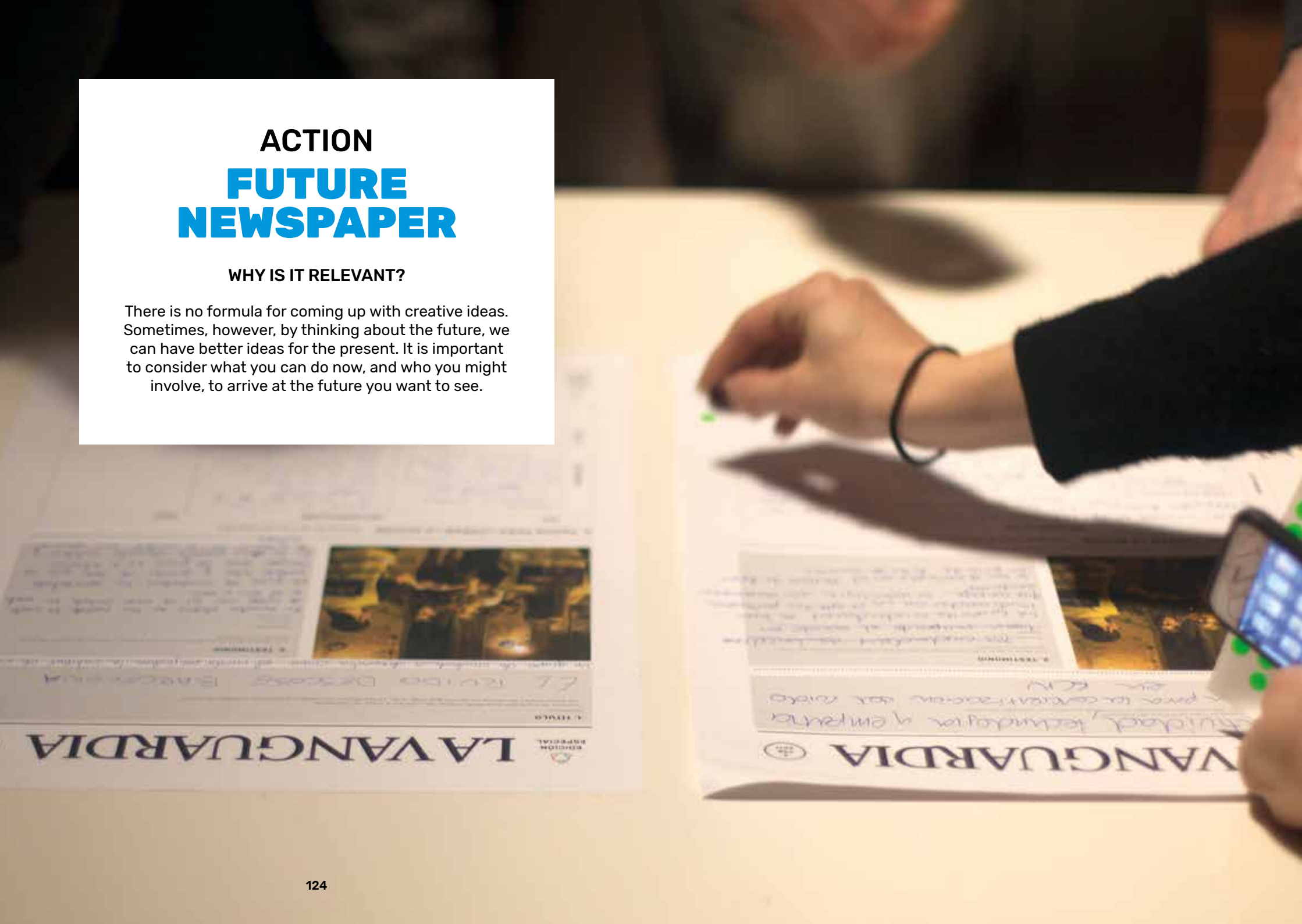
4. Involve the participants in the creation of the digital presence. This is a great way to encourage ownership of the campaign and content management, but it also fosters community building.

ACTION

FUTURE NEWSPAPER

WHY IS IT RELEVANT?

There is no formula for coming up with creative ideas. Sometimes, however, by thinking about the future, we can have better ideas for the present. It is important to consider what you can do now, and who you might involve, to arrive at the future you want to see.



DESCRIPTION

For the untrained and unassisted, the creative process can be a loose, unproductive affair. With so many variables, making sense of what to do can often feel like a daunting task. The Future Newspaper tool helps kick-start the creative and critical process by asking participants to imagine a variety of desirable futures. Then, by working backwards from those visions, participants can articulate the conditions, resources, stakeholders and events which might help lead to those outcomes. These can then become discussion points which the community can vote on to create actions and interventions.

KEY QUESTION

WHAT WILL THE SITUATION LOOK LIKE IN TEN YEARS?

TIME NEEDED

2 Hours

PARTICIPANTS

Community members

RESOURCES NEEDED

Future Newspaper canvas, markers, sticker dots

STAGES FEATURED IN ACTION

RELATED TOOLS CO-CREATION ASSEMBLY

STEPS

1. Divide participants into groups of three to five. Give each group a Future Newspaper Canvas and Post-it notes for brainstorming.

2. Write a headline which reflects the community's desired future. It is often easier to start from the glorious landmark change they want to see in their particular context. This can be as realistic or outlandish as you want: however, this choice will have a direct impact on the ideas generated after.

3. How do we get to that future? Using the canvas, participants will think about, discuss and strategise what resources, conditions, people and events have to come together in order to reach the future they have envisioned.

4. Lay out all the Future Newspapers, and after a brief presentation and discussion on the merits of each, a round of sticker-dot voting can help reach a consensus on which route to take.

METHOD IN ACTION

COMMUNITY CHAMPIONS BARCELONA

The Making Sense Community Champions pilot in Barcelona joined participants to develop ideas for public interventions which would raise awareness of the high levels of noise in Barcelona, as well as the potential health implications of noise pollution.

With more than thirty participants with different levels of creative training and skills, reaching a workable consensus for interventions was a particularly tricky task. Ideas would often 'float around' without any structure, objective or feasibility.

Using the Future Newspaper tool, the pilot participants wrote different futures: in these, they imagined their data was already actionable, and the outcome reported in a newspaper three months from the date of the workshop. Then, they wrote the 'lead' under the headline: a few sentences detailing the events that had happened to generate that headline. Finally, using a set of pre-designed thought-starters, the participants were asked to mix, match and decide upon the different types of data, people and resources needed to create that intervention. After a brief presentation of each proposal, a round of sticker-dot voting chose the winner.

Given clear parameters in which to ideate, the participants decided a physical installation should be placed in the centre of the Plaça del Sol. This installation was designed to raise awareness of the noise in the square at different times of the day, as well as its potential implications on health. The secondary aim was to start a conversation about noise awareness, and draw in locals to engage with citizen sensing who could potentially take part in a future campaign.

ACTION

CO-CREATION ASSEMBLIES

WHY IS IT RELEVANT?

When people collaborate in the creation of something, they are more likely to agree and support its implementation. By co-creating the change you want to see, and doing so in concert with those who are part of the issue to begin with, you can create a solution that works for everyone.

DESCRIPTION

Co-creation assemblies are events in which desirable possible futures are proposed, discussed and prototyped. In these assemblies, it is important to include as broad a range of stakeholders as possible, especially those who might be considered antagonistic to the campaign. Issues can be grouped into themes, with each theme assigned to a table. At each table, themes are discussed at length in order to find common ground and potential solutions. This exercise is also helpful in understanding the various ways in which participants perceive and address the issue, and how it fits into the community's sense of itself. Following a co-creation assembly, a report with suggestions for future actions can be drafted to begin conversations with policymakers.

KEY QUESTION

WHERE DO OUR NEEDS AND WANTS CONVERGE WITH THOSE OF OTHERS?

TIME NEEDED

2 Hours

PARTICIPANTS

Experts, Antagonistic participants

RESOURCES NEEDED

Paper, pens

STAGES FEATURED IN AWARENESS, ACTION

RELATED TOOLS FUTURE NEWSPAPER

STEPS

1. Unpack the campaign issue into key themes, thinking about what the pillars of this issue are. For noise pollution, for example, you might identify the cause of the noise as one theme; another as the architecture and urban planning that have enabled this noise pollution; and a third as the law, policy and health concerns associated with noise pollution.

2. Identify the thought leaders on each theme. Key experts can bring credibility and sensible mediation to discussions on your chosen themes. Their role is not to make decisions, but to guide the conversation and moderate using their expert knowledge of what works and what does not.

3. Give each table a theme, with each led by an expert on the field. For a balanced discussion, aim to arrange each table so it includes those affected by the issue as well as those causing it.

4. Initiate a discussion mediated by the table leader, starting with a brainstorming session to open up the field of potential solutions. At this stage, it is important to establish compromise and fairness in opportunities to contribute. By going on to map these potential solutions, some can be explored and proposed as a co-created solution to the problem.

METHOD IN ACTION

PLAÇA DEL SOL BARCELONA

A co-creation assembly offers citizens an opportunity to imagine, discuss and articulate solutions. When an issue is complex and involves many stakeholders, an assembly provides the backdrop for dialogue, compromise and consensus in an open, democratic manner.

During the pilot in Plaça del Sol, participants collected data which demonstrated that public gathering and drinking until late at night was causing severe noise pollution in the square, and this was having a negative impact on the lives of the residents. The solution is clearly complex, as it includes issues related to architecture, urban planning, local policy, social behaviour, urban health, and economics.

To create an opportunity for dialogue, and to encourage participation and consensus between those frequenting the square and those living nearby, we organised a citizen assembly. The goal was to reclaim the public space, present the pilot and its findings, and co-create potential solutions to noise pollution.

DRINKING UNTIL LATE AT NIGHT WAS CAUSING SEVERE NOISE POLLUTION IN THE SQUARE

To foster participation, we developed a series of methodological resources:

- **A wooden totem.** This was used to present the key phases of the experience, a summary of the data collected, and a screen showing a documentary. It also included a slot for attendees to post pre-addressed postcards to the Town Hall with recommendations about the square.

- **Five thematic tables.** The problem was broken down into key themes to provide focus and facilitate consensus: architecture and design; urbanism and economy; urban health; young people; and open (for topics not included in the other four tables). Each table was facilitated by an expert who used a set of resources, including a description of the specific theme for the table; a set of fact cards; generic profiles of people and groups that should be considered when proposing solutions; and a newspaper template dated in the future to document proposed solutions, as well as how these were implemented and what impact was achieved.

The co-creation assembly provided an opportunity to galvanise people into sharing concerns, ideas and aspirations. It fostered community cohesion, and attracted new participants. It resulted in the co-creation of a great number of solutions from a diverse range of viewpoints. While consensus is not always easy to achieve, a well-organised public assembly can help transform a climate of blame and stalemate into a pleasant environment where people feel invited to contribute and be part of the solution.

7.
REFLECTION

IF YOU ARE PLANNING MORE ACTIVITIES IN THE FUTURE, IT IS IMPORTANT TO THINK BACK ON WHAT WORKED WELL

WHY IS IT IMPORTANT?

Looking back on the process thus far is a valuable exercise. If you are planning more activities in the future, it is important to think back on what worked well and what could be improved: you might consider how you would use a method differently, or how you might use a different sensor. It is also important to think about whether the community will want to continue working together after the end of process, and how you might continue to assist in sensing work or creating action.

WHAT HAPPENS?

The community and any intermediary organisations should take the opportunity to think back on the whole process to date. At this stage, you may want to collaborate on making changes to sensors or methods. You may also wish to consider collecting data to determine how the community's knowledge and feelings have changed over the course of the campaign. In this phase, you can also begin scoping and planning a new citizen sensing process, building on the lessons you have learned so far.

WHO CAN DO THIS?

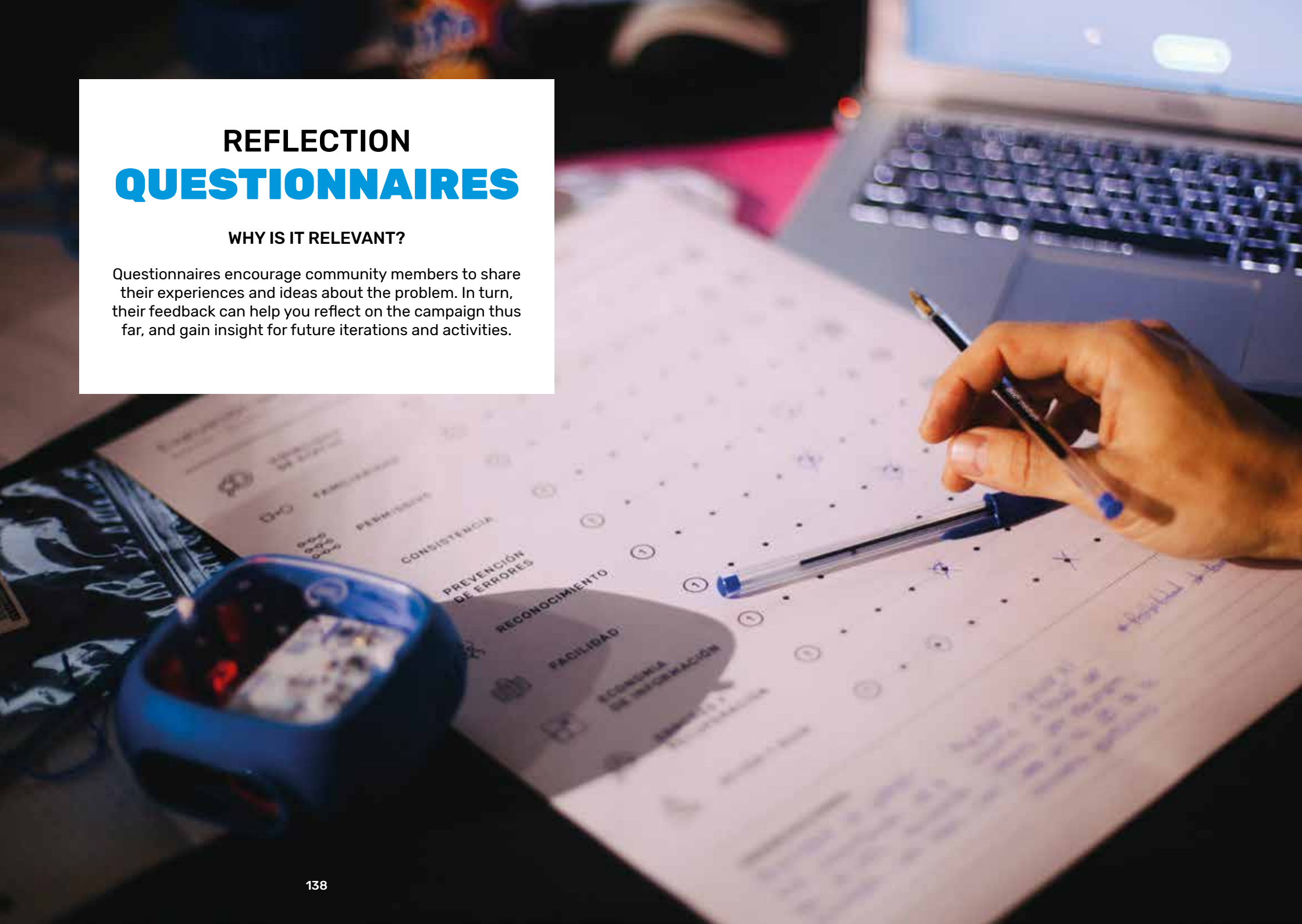
Everyone involved thus far should try and reflect on their experiences across the citizen sensing process. It is important that the community members in particular take the time to think about everything they have contributed over the course of the campaign.

WHEN DO WE DO IT?

Reflection should take place after your sensing and actions have been completed, but could also occur throughout the process. Deciding when to end the reflection stage can be difficult: however, it can help to plan a gathering to celebrate what has been accomplished, since this can create some closure.

HOW TO DO IT

In this section is a list of tools that we recommend for this stage. You can use or adapt these to your own project as required.



REFLECTION
QUESTIONNAIRES

WHY IS IT RELEVANT?

Questionnaires encourage community members to share their experiences and ideas about the problem. In turn, their feedback can help you reflect on the campaign thus far, and gain insight for future iterations and activities.

DESCRIPTION

If you are looking to develop a long-term strategy for change, which may involve multiple measurement activities and many communities, it is particularly helpful to go through a period of reflection to identify what worked well, and what could be improved. A simple questionnaire is a great way to get anonymous feedback on the strengths and weaknesses of the project. This can become especially useful if paired with a pre-project questionnaire: together, these can help you assess whether the project had any personal impact on the participants by gauging their responses before and after.

KEY QUESTIONS

WHAT DID YOU LEARN?
WHAT DID YOU WISH YOU HAD LEARNED?
WHAT WENT WELL, AND WHAT DID NOT?

TIME NEEDED

10 Minutes

PARTICIPANTS

All participants

RESOURCES NEEDED

Questionnaire form

STAGES FEATURED IN PLANNING, REFLECTION
RELATED TOOLS COMMUNITY LEVEL INDICATORS

STEPS

1. Ask the participants about their personal hopes and aspirations in relation to the project. At the end, check back to see if they were met. Why are they taking part? What do they hope to learn?

2. It is useful to ask the same questions about the project. Find out what they hope to achieve with their efforts, and even what worries or unease they feel in relation to the campaign issue and the way the project has unfolded.

3. If there is a coordinating team leading the project, feedback on their activities will also be very useful for constant, iterative improvement. Questions about the organisation and team members can also be complemented with enquiries about suitability of venues, meeting times and their frequency.

4. Consider your next steps. How might you improve? Given what the participants now know, how might they improve the experience? After reflecting on all the positives and negatives of the project, applying some future-forward positive thinking can help make all the difference to the next iteration of activities.

Making Sense

Making Sense Amsterdam Pilot
Questionnaire April 2016

Making Sense

REFLECTION

PILOT APPRAISAL

WHY IS IT RELEVANT?

The key to success is continuous improvement. At the end of each milestone or campaign stage, a session reflecting on the successes and failures of that milestone can go a long way to creating better campaigns in the future.

DESCRIPTION

A pilot appraisal is a great way to sense-check the collaborative efforts of both participants and organisers. It can be a formal or informal session, but the objective is the same: to find out what went well and what could be improved. There are many methods for achieving this, but to overcome any group shyness in expressing criticism, an approach that pairs cards explaining the methods with some sticker-dot voting works nicely. Finally, this could be paired with a secondary task of planning a future pilot using insights gained from the appraisal.

KEY QUESTION

WHAT WERE THE STRENGTHS AND WEAKNESSES OF THE CAMPAIGN?

TIME NEEDED

1 Hour

PARTICIPANTS

All participants

RESOURCES NEEDED

Action cards, sticker dots

STAGES FEATURED IN REFLECTION

RELATED TOOLS COLLABORATIVE PILOT SCHEDULE

STEPS

1. Start with a discussion. Set up a safe environment to talk about positive experiences and frustrations with the pilot. Record everything.
2. Using flashcards, write down the titles and a short description of the stages of your campaign.
3. With sticker dots, vote on the activities that were enjoyable and useful in one colour, and the activities that were frustrating or less useful in another colour.
4. At this point, you can dive into discussions on specifics. You can disregard the more negatively rated activities, as well as suggest activities that were perhaps missing from the previous campaign. This step is a great lead into the process of planning a new pilot.

REFLECTION

GRADUATION CEREMONY

WHY IS IT RELEVANT?

Community belonging is an excellent way to encourage engagement with a project. By 'graduating' participants to members of the organising committee, or simply to fully-fledged citizen scientists, this can go a long way to creating attachment between participants, the organisation and the cause.

DESCRIPTION

It is always nice to be recognised for your efforts. A symbolic graduation ceremony is a great way to end the reflection stage. Gathering participants and celebrating their achievements is not only a heartfelt gesture to the participants, but also a way to nurture Community Champions in your project. To go from 'participant' to 'Community Champion' is not only symbolic, but can also be a way of increasing agency and accountability. This means having more vocal champions, and more hands-on-deck for future activities.

KEY QUESTION

WHAT DID YOU LEARN?

TIME NEEDED

1 Hour

PARTICIPANTS

All participants

RESOURCES NEEDED

Diploma

STAGES FEATURED IN REFLECTION

RELATED TOOLS QUESTIONNAIRE, PILOT APPRAISAL

STEPS

1. Gather all the names of the participants who have made it to the end of the project.
2. Design and fill out a diploma with their details. This can be as serious or as playful as you like.
3. The certifier should describe the contribution made by each participant to the group, inviting that person forward to receive his or her diploma and to share a word or two about the process. (Take note of any participants' experiences that might help devise future pilots.)

8. LEGACY

THE CHOICES YOU MAKE HERE WILL AFFECT THE IMPACT OF YOUR WORK, AND HOW FAR-REACHING THAT WILL BE

WHY IS IT IMPORTANT?

The point of creating a citizen sensing campaign is to effect some sort of change. This is the stage where the impact of that change can be long-term, and where there may be continued life in the communities you have built, the knowledge you have gathered, and the tools you have developed or used. The kinds of choices you make here will affect the impact of your work, and how far-reaching that impact will be.

WHAT HAPPENS?

Ideally, the overarching legacy from the work conducted would be a measureable change in the world, such as better air quality or lower noise levels in the local environment. This can be achieved by creating changes from outside the community, such as local council policy changes. You may want to think about making available all the data and tools employed by your campaign so that other communities can use them. You can post these tools and information online, meaning that all your community's hard work to date can be accessible to others. You might also think about publishing some of your work formally, or sharing it in reports or newspaper articles.

WHO CAN DO THIS?

The community organiser or activist is the main person responsible for this, but the baton can be picked up by an intermediary organisation or any member of the community. Researchers can play an important role in disseminating validated tools and outcomes.

WHEN DO WE DO IT?

You have a greater chance of achieving a lasting impact if you have been thinking about your legacy all the way throughout the project. To realise and sustain this impact, you should focus on disseminating your findings and advocating for change. This stage can last as long as you want your work to have an impact.

HOW TO DO IT

In this section is a list of tools that we recommend for this stage. You can use or adapt these to your own project as required.

LEGACY
STORYLINES

WHY IS IT RELEVANT?

Participants' experiences can be a very powerful tool to raise awareness of the project and its aims, as well as being helpful in recruiting future collaborators.

DESCRIPTION

Storylines can take a variety of forms (and formats). In the end, the most important thing is to convey the key aspects of the project as chosen by the community, and in a manner that those creating the storylines can commit to. Storyline themes can vary greatly from project to project, depending on your objectives. If the goal is recruitment, storylines with participants' positive experiences and tales of impact can go a long way; if it is to raise funding or awareness, then participants' stories of urgency and change might have more impact.

KEY QUESTION

WHY ARE WE ALL HERE DOING WHAT WE ARE DOING?

TIME NEEDED

A few minutes

PARTICIPANTS

Any participant

RESOURCES NEEDED

Video, blog posts, photos

STAGES FEATURED IN LEGACY

RELATED TOOLS RECRUITMENT

STEPS

1. Define your storyline objectives for the project. What is it that you hope to achieve by telling people about what you are doing and why?
2. Identify themes that can help you articulate your storyline objectives. Are there any community anecdotes that might support these themes?
3. Define a medium. Think about the skills and resources you have available, as well as what the participants feel most comfortable sharing. Is video an option, or a step too far? Do you have the capabilities to deliver in your chosen medium? Will a social media post or well-written blog entry suffice?
4. Create, compose and distribute.

LEGACY

TRAINING THE NEXT GENERATION

WHY IS IT RELEVANT?

Working with communities also means ensuring sustainability and legacy in the post-project period. As a result, this work will keep the legacy of the project alive, meaning it could potentially be scaled up in the future.

DESCRIPTION

There is one principle which is key to ensuring the legacy of a project: empowerment. Real empowerment starts with training and developing the competencies (knowledge, practical skills and attitudes) of the communities you are engaged with. Empowerment means that the people you are working with are not passive community members, but active participants. As such, they deserve encouragement to develop the necessary skills to understand the issue critically, and be able to tackle it from various angles, such as activism, science or education.

KEY QUESTION

HOW DO WE BUILD SUSTAINABLE COMMUNITIES THAT ENSURE THE LEGACY OF THE PROJECT?

TIME NEEDED

Several Days

PARTICIPANTS

All pilot participants

RESOURCES NEEDED

Sensors, issue-experts

STAGES FEATURED IN COMMUNITY BUILDING, LEGACY

RELATED TOOLS SENSING

STEPS

1. Define the objectives of your work with the community, and identify what competencies you wish to build. Consider things like data collection, campaigning, or even data analysis.

2. Organise an event where everyone can get to know each other and have access to training in various fields. Your training sessions could include: theoretical knowledge on the issue and its impacts and consequences; practical skills in how to engage with the media; skills for using various sensors to capture data on pollution; uploading data online and developing a scientific approach (i.e. what does the data say about the air quality?) and a critical skills (i.e. what actions do we need to undertake to fix the situation?).

3. Conclude the event with concrete follow-up actions where you identify the work to be undertaken over the next three months, and the responsible persons involved.

4. Completing the event does not mean that the community is ready to undertake the work: they need further mentorship and coaching. As such, it is crucial to create weekly or bi-weekly meetings (either face-to-face or virtual) to discuss the work and any potential challenges. It would also be helpful to establish more real-time communication channels, such as mailing lists or mobile chat groups: this will provide the community with access to real-time responses, as and when required.

METHOD IN ACTION
PRISHTINA KOSOVO

In Prishtina, our team piloted the idea of 'targeted measurements': this meant a location was selected by committee members (young activists involved in the project), and that location was monitored systematically for a period of time. This was usually around one to two months, with measurements taken three to four times a week, in the morning and afternoon. One of the locations selected during the second pilot was Faik Konica primary school, located in the centre of Prishtina. The area where the school was located had previously shown possible patterns of air pollution.

In order to investigate the area around the school, our team created an authentic partnership with the school by engaging the directors, school staff, pupils and their parents. The team considered the legacy and sustainability of the project from the beginning, which informed our rationale to engage with all the key actors.

Once all the air pollution measurements were collected and the data was processed, interpreted and visualised, our team organised a three-day Digital Bootcamp for parents and some of the schoolteachers. In this workshop, we presented the outcomes of the measurements and brainstormed together about future actions. During the adult-orientated Bootcamp, the team also held a three-day non-formal environmental education workshop for pupils.

One of the key insights that came out of the Bootcamp was the need expressed by the parents' council and school staff to organise a community in the school which would include parents, pupils and teachers. This is how the Green School Community of Faik Konica primary school first took shape: since then, it has become a pioneering model of how to engage with local communities and ensure a longer-term project legacy. However, Faik Konica school taught us one fundamental lesson: never push or force your ideas onto the community. Rather, try to facilitate a process whereby they can explore on their own what they need and what they can implement.

CASE STUDIES

Citizen sensing campaigns begin with citizens who are concerned or curious about the environment, and see them come together to form groups with varied backgrounds and capabilities. Together, they capture environmental data, learn how to question data (scientifically and critically) and look for lessons within the numbers so they can create public activities to raise awareness of their findings. By becoming aware and understanding the data produced by the world around us, we all have a better chance of improving the quality of our lives.

CASE STUDY
GAMMASENSE

ISSUE

Gamma Radiation

PARTICIPANTS

75 - 100 People

LOCATION

Eindhoven Maastricht
Amsterdam, Bergen op Zoom

ISSUE

The Dutch National Institute for Public Health and the Environment (RIVM) currently has around 150 official measuring stations for gamma radiation in the Netherlands. Every ten minutes, accurate and reliable values are determined and uploaded. However, according to the RIVM's own reports, this number is actually quite low, should a nuclear disaster occur somewhere in Europe. If there is radioactive fallout over the Netherlands, the government needs to know where and how radioactivity is spreading in order to advise the public accordingly. In this scenario, citizen sensing is crucial to accessing granular, real-time information.

COMMUNITY

Through our partnership with WISE, we were able to reach out quickly to local groups and stakeholders within the local municipalities, as WISE's function is to advise local groups on nuclear power plant issues. Community reactions to our initiative were mixed, and highly dependent on their proximity to nuclear power

THE GOVERNMENT NEEDS TO KNOW WHERE AND HOW RADIOACTIVITY IS SPREADING

plants: for example, Bergen op Zoom (6 km) and Maastricht (30 km) were more open and participatory compared to Eindhoven (70 km). In fact, the latter openly wondered if and why it was an issue at all. The same pattern emerged with local citizens: in Bergen op Zoom and Maastricht, citizens openly agreed that the plants should close down as quickly as possible. In Eindhoven, however, there were fewer participants, and they were more worried about Wi-Fi and mobile phone-induced radiation.

STRATEGY

Since 2012 or so, a host of different smartphone apps on the market have emerged that claim to measure gamma radiation. Some of these are tested by independent labs and actually function quite well, although the data they gather is not open. In a nuclear emergency scenario, governments can buy the data from commercial labs. However, these measurements are not mapped or accessible to the public. Equally, the formulas for determining counts per minute values (CPMs)

PROFILE

PEER DE RIJK

COMMUNITY LEADER

Peer is the director of WISE, an organisation that advocates against nuclear energy. Peer wants to empower his community by providing tools for gathering and understanding data on nuclear radiation.

"Leading up to a major demonstration in the Netherlands, Belgium and Germany in June of 2017, I hoped to be able to set up a first iteration of an alarm network for gamma radiation. I engaged with my contacts in several Dutch cities close to nuclear power plants in order to involve the municipalities, the official safety organisations and the citizens in setting up such a network. Throughout the year, I host many workshops in the Netherlands - especially when nuclear energy, power plants and waste are topical in a specific area. I know that it is difficult to connect to my community when this is not the case. The upcoming demonstration has allowed me to add sensing as a strategy for people in their fight against nuclear energy, and find out what the questions and concerns measuring radiation can potentially support."

PROFILE

NATHAN TER BLIEK

OPEN SOFTWARE DEVELOPER

Nathan works at Waag Society, an organisation dedicated to creating open, fair and inclusive technology for social innovation. Here, he has tinkered with cameras, laptops and smartphones to create an open sensing network for gamma radiation.

"The cool thing about GammaSense is that it uses technology that is already readily available to regular people. Just taping over your smartphone or laptop camera turns it into a sensor for one of the components of nuclear radiation, making it possible to create an alarm network. The collaboration with experts from the government was extremely important. To create a working algorithm, we needed access to a radiation source - not something you can find in any shop! Under controlled circumstances, the RIVM allowed us to test our open-source webapp and tune the underlying algorithm."

from the images are secret.

On the back of this work, Waag Society set itself the goal of producing an open, web-based app for use in case of emergency which could quickly generate data with devices that people already have to hand (laptops, tablets and mobile phones). In order to guarantee a minimum reliability of the data, our team worked together with the RIVM in the calibration process. This resulted in the creation of an open tool for reliably measuring gamma radiation.

IMPACT

Our interest in nuclear radiation arose from our research into a trusted citizen science experiment: SafeCast. Upon seeing the exemplary approach taken by a highly engaged community near the Fukushima Daiichi nuclear disaster, we were struck by the lack of low-cost emergency infrastructure available in this field. The RIVM had published an overview of measuring apps utilising smartphone and laptop cameras to measure gamma radiation. However, none produced accessible data, and almost all cost money to download.

Creating this low-cost infrastructure has been an effective approach to helping the communities in the Netherlands and nearby to understand the potential of citizen sensing. Our partnership with WISE, who has been hosting sessions with citizens for many years, helped us organise in this domain. Additionally, the RIVM was on hand to provide expertise during our sessions. Their involvement has sparked a policy line in their organisation, which is now embracing citizen sensing as a valid addition to their sensing strategy.

TIMELINE

GammaSense ran from March 2017 until 2018.

DOCUMENTATION

https://gammasense.org

Project website - https://goo.gl/McKzL9

Blog - https://goo.gl/df6Liz

GitHub - https://goo.gl/bHCtgJ

CASE STUDY

URBAN AIRQ

ISSUE

AIR QUALITY

PARTICIPANTS

20 People

LOCATION

AMSTERDAM

ISSUE

Amsterdam has a network of eleven official, expensive air quality measurement stations, that provide reliable real-time data on air quality across the city. However, the network is too small to give an accurate picture of street-by-street pollution levels. To increase the density of sensors, an alternative, affordable and inclusive solution was needed. We aimed to empower citizens who live in streets with poor air quality with the knowledge and experience to understand air quality issues. As a result, we enabled citizens to come up with questions about air quality around their homes, to have those questions answered, and to be able to change their behaviour depending on the air quality in their home environment.

COMMUNITY

A flyering and online campaign in two of the most polluted streets in Amsterdam, Valkenburgerstraat and Weesperstraat, led to a group of residents joining our pilot. We engaged with existing community leaders, neighbourhood groups and the neighbourhood network, and used social media and fyers to reach out. The participants formed an enthusiastic group whose main motivation was their concern about the quality of life in their city. Many of them were also active outside of the pilot regarding issues concerning the liveability of their city and neighbourhood.

To create a community centred on citizen sensing, we matched people with environmental interests with those with technical skills. The community neighbourhood groups were already well established and organised on the issue of air quality. They attended meetings on the topic, and many had already been in contact with the city council about this problem. Some community members had a vested interest in the issue and our pilot, as they suffered from lung problems or related diseases. We involved participants with a technical background from Fab Lab Amsterdam, University of Wageningen and people with experience from the Amsterdam Smart Citizens Lab. For expertise on data, air quality, calibration and interpretation, we invited one local and one national official measurement organisation to collaborate. Due to its interest in the links between air quality and health, the Lung Foundation was also involved.

STRATEGY

We conducted three citizen meetings, a workshop and a meetup prior to the sensors being installed. During the workshop, citizens interacted with air quality experts, and heard about the kinds of technologies available for collecting data.

PROFILE

GIJS BOERWINKEL

COMMUNITY MANAGER

Waag Society is a civic organisation based in Amsterdam. Gijs is a community manager bridging the gap between institutions such as universities and governments, and citizens and civic-minded organisations.

"I want to show the value of citizen-led decision-making through hands-on participatory and co-creative processes. During the campaign period, I was available almost full-time to answer questions, host meetups and bring people together. This helped me to understand the needs of different communities, and how they can be empowered to create change. It was amazing to see the eagerness of people learning about the problem… and to be able to turn that into positive action."

The citizens voiced their questions concerning air quality, then co-created measurement strategies to answer these questions.

Sixteen sensors were distributed to the participants. These were adapted and updated versions of the open-source sensors developed in the Amsterdam Smart Citizens Lab project conducted in 2015. The sensors would connect to the participants' Wi-Fi networks, and measured NO_2, particulate matter, humidity and temperature. Sensors were placed in specific locations so as to produce data that answered all of the citizens' questions, including the differences in air quality between ground floors and higher floors. Data was collected for three months and subsequently interpreted by an expert.

IMPACT

The participants used their new knowledge for several purposes: from the personal (opening the window at the front or back of their house according to air quality) to the city-wide (setting up meetings with the local council to discuss the air quality in their area). One participant even created his own start-up called TreeWiFi[1] which makes birdhouses containing sensors to measure and visualise air quality.

At an institutional level, Urban AirQ has also had an important impact: the Lung Foundation created an online tool allowing citizens to find out about air quality levels in their area. The local Parliamentary Commissioner for Administration is in the process of leveraging the success of Urban AirQ to expand local sensing to noise pollution. Furthermore, the Dutch National Institute for Public Health and the Environment (RIVM) has implemented a national citizen science strategy on citizen sensing.

TIMELINE

The pilot began in March 2016, and ran until August 2016.

DOCUMENTATION

Project website - https://goo.gl/fYtYAn
Blog - https://goo.gl/oiVJSH
GitHub - https://goo.gl/MdroiS

1 http://treewifi.org/

PROFILE

RIA TEEFFELEN

ACTIVIST

Ria has lived for many years in the Amsterdam city centre, in what is now one of the most polluted areas in the city.

"I would like to know whether or not it is safe to sit outside, in front of my house. For comparison, I wanted to hang a sensor both in my front porch and at the back of my house, where I have a lovely courtyard. The data coming from the sensor showed that there is a substantial difference at certain times during the day. With this data and new information I got during the meetups, I can now make an informed choice about where to sip my coffee."

CASE STUDY
KOSOVO PILOT 1

ISSUE

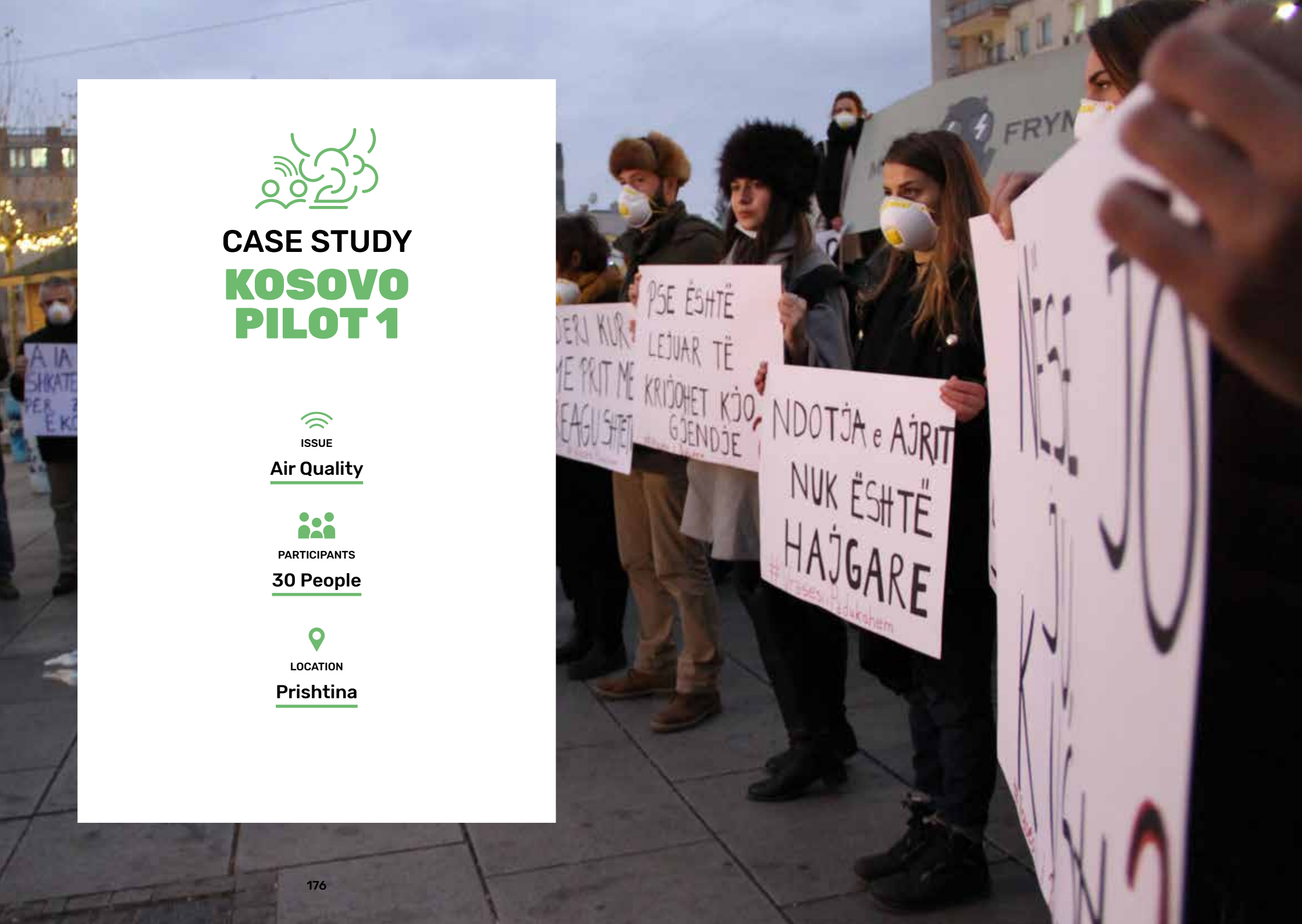
Air Quality

PARTICIPANTS

30 People

LOCATION

Prishtina



ISSUE

There has been an ever-increasing number of Kosovan people suffering from cancer, heart problems, cardiovascular diseases and other health problems related to air pollution. The World Bank in Kosovo conducted the only research ever undertaken on the topic, linking Kosovo's air pollution to serious consequences for health and the economy. However, the problem could not be properly evidenced, as Kosovar institutions refused to publish data on air quality. At the time, citizen concern was growing as a result of increasing ill health among the population and the lack of institutional response.

COMMUNITY

The Kosovo Making Sense community was formed with members of a previous citizen science project, Science for Change[2]. Using an environmental festival as a springboard, the former members were presented and additional members were asked to join the new project. Together, these formed a young and motivated local community. The community structured itself into the form of three self-organised internal committees, where members joined various groups depending on their skills and interests: 'Data Collection and Research', 'Education' and 'Campaigning'. The committees host monthly general assemblies, which serve as a forum for decision-making and reflection.

STRATEGY

At the general assembly on July 7th, 2016, all the members agreed that 'snapshot' measurements should be taken to establish an understanding of air pollution in Kosovo, which might enable to identify patterns of air pollution in different parts of the country. Once these hotspots were identified at a national level, the measurements would then focus on a local level, narrowing down the scope of our investigation. We also co-created various iterations of our procedure and schedule, from data collection in the field to data interpretation, as all of these processes were relatively new to everyone[3].

This is how, during three intensive weeks between August and September 2016, committee members came to be in the field, generating 73 sessions of data from every region of Kosovo. As an outcome, we noticed a slight pollution trend

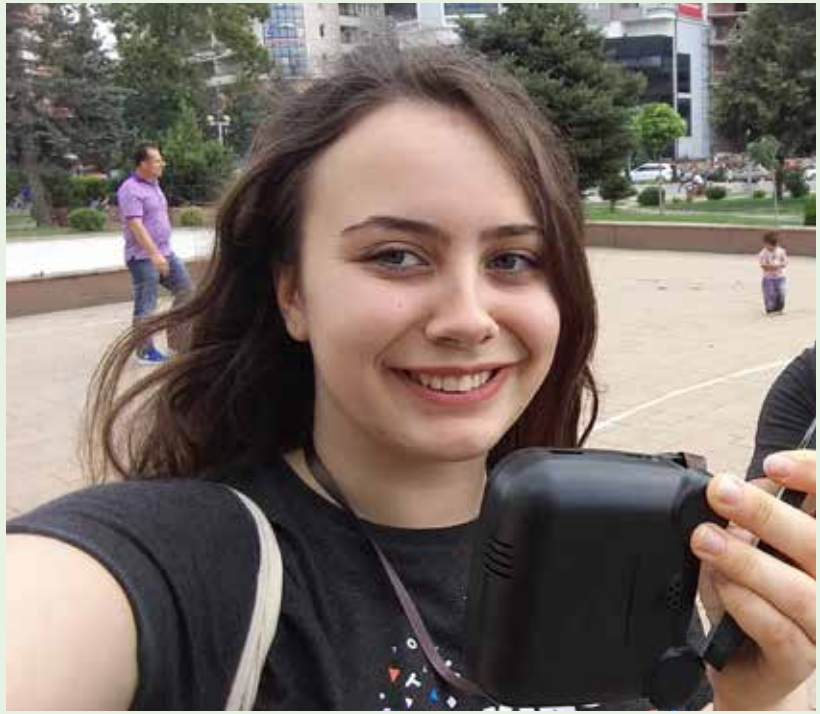
2 http://www.citizenscienceks.org

3 To differentiate our measurements of air pollution from those of the government (who are fixed in one location), we made a decision to implement targeted measurements which focus in one location (e.g. the school). This made it possible to investigate air pollution at very local and specific level, something that was impossible for government's measurements.

PROFILE

DIONA KUSARI

COMMUNITY ACTIVIST



Diona joined the project because she was interested in improving the air quality in Kosovo. Although she studied law and was not directly involved with air quality in her career, she was very keen to help the environment. Her dedication and passion led her to be one of our key community activists who participated in every Making Sense activity possible.

Diona would simply explain her motivation by saying: *"Community growth and care means also personal growth. The more I support the community, the further I develop myself."* - Diona's enthusiasm, good humour and attitude always re-energised everyone involved - especially in freezing temperatures, when we were all protesting outside in winter!

PROFILE

BARDH RUSHITI

YOUNG ATHLETE

Bardh is a sports enthusiast who wanted to get more involved in the community and promote healthy lifestyles. Fresh out of high school, his passion for healthy living, sports and a clean environment led him to join the Making Sense project from the start.

Bardh was involved with most data collection activities and workshops, and really excelled at campaigning. He managed to persuade his parents to change their heating system to a more ecological model to prevent the causes of pollution at the source. He also led two lectures as part of an environmental class he took at university, blending his academic knowledge with his newly gained skills in environmental campaigning to increase awareness and train fellow students in air pollution strategies.

He gave the project an immense motivational boost, and actually managed to change the attitudes of many friends and family members. Last but not least, he was among the core team groups who trained, mentored and coached in the soon-to-be pioneering Green School Community.

in Prishtina: slight, because summer always keeps air pollution low, but present. Once we identified Prishtina as a suspected site of high pollution, we narrowed our investigation down to focus solely on Prishtina.

IMPACT

Our activities generated never-before-seen public discourse – especially in the period between November 2016 and February 2017, when the Kosovo Environmental Protection Agency (KEPA) started to publish its data regularly. This was a remarkable about-turn for the KEPA, as it had never done this before. The Agency has since disclosed all its data since 2013, which it had previously kept secret or only selectively published.

Also, media coverage has been a major outcome of this pilot. Previously, air pollution, and environmental issues generally, had never been part of public discourse. It was only in December of 2016, when citizens started to protest for the first time, that the major media outlets began to speak out, and social media channels were filled with concerns over air pollution. By framing the narrative around air pollution, packaging scientific research in citizen-friendly language, and being in media headlines, we achieved our key outcomes: changing and reclaiming public discourse on environmental issues.

Finally, we have created a strong community of 'practitioners' who authentically engage on three fronts: education; research and monitoring; campaigning and mobilisation. This community was built on a foundation of radical democracy, participatory approaches, non-exclusive models and semi-horizontal structures, with an emphasis on ownership of the project and building their competencies. Because of this, the community has proved to be immensely useful in running investigations, taking action against air pollution and carrying the project forward. Never before has Kosovo's youth engaged in such an intensive, long-term project on environmental issues: this truly is a first.

TIMELINE

The Pilot ran from April 22nd, 2016 to April 22nd, 2017

DOCUMENTATION

Project website - https://goo.gl/ys2xv9

Facebook - https://goo.gl/M5PsMW and https://goo.gl/8p26ET

CASE STUDY
KOSOVO PILOT 3

ISSUE

Air Quality

PARTICIPANTS

30 People

LOCATION

Prishtina

Image by Andreas Welch, CC BY-NC-SA

ISSUE

The first Kosovan pilots established the key sources and levels of pollution in Prishtina. The third pilot was implemented during the summer when pollution levels are low. This enabled us to isolate the emissions from the power stations, confirming these as ongoing sources of air pollution. Both environmental injustice and environmental racism[4] were present in this pilot, which partly informed the rationale of our approach.

COMMUNITY

Pilot 3 was comprised of the same participants as the earlier pilots: the committee members who made decisions in the general assemblies, and carried out the air quality measurements and campaigning activities. Additionally, another community was established: the Green School Community of Faik Konica primary school in downtown Prishtina, comprising children, parents, carers and teachers. Also, external supporting groups were introduced, including a number of young people from Plemetina, as well as a professor and students from the Department of Environmental Science at the University of Prishtina.

STRATEGY

Systematic measurements were taken based on a sensing strategy adopted by the General Assembly. Participants meticulously collected measurements to cover the morning, afternoon, evening and midnight. The measurements in Obilic, Fushe Kosova and Krushevc were run by committee members, while the measurements in Plemetina were coordinated by Avdyl Mustafa and run by a youth group from Plemetina.

The second strategy involved bio-indicator measurements, designed and coordinated by Adhurim Hoxha. This was inspired by the 'European guideline for mapping lichen as an indicator of environmental stress'[5]. Our bio-indicator protocol combined rigorous scientific discipline with the creativity of citizen science. A map was produced defining the areas to be covered, and a strategy document was developed and presented to the General Assembly. The strategy also involved stationary sensors of air pollution, which served as a reference to support the findings of the bio-indicator research.

4 Our use of 'environmental injustice' refers to a process of environmental marginalisation forced upon part of the population living in toxic areas. We use 'environmental racism' to denote an environmental injustice within a racialised context.

5 https://www.researchgate.net/publication/303255153_European_guideline_for_mapping_lichen_diversity_as_an_indicator_of_environmental_stress

PROFILE

ADHURIM HOXHA

ECOLOGY STUDENT

Adhurim is a Master's student in Environmental Studies at the University of Prishtina.

When Adhurim became a member of the Making Sense project, he started to participate in all general assemblies, took part in calibrating the sensors, conducted measurement sessions using digital tools, and also supported with training of other community members.

Adhurim explained that his involvement with the project was the only opportunity for him to gain real hands-on skills in tackling environmental issues in a way that can actually bring about change in Kosovo. His crowning achievement came in a separate activity which he proposed: bio-indicator sensing of air pollution, using lichens as bioindicators of air pollution in several areas near the power plants. This research brought together all the skills he had honed over the course of the project and his academic career – designed both for the Making Sense project and as a topic for his Master's thesis on air pollution.

PROFILE

AVDYL MUSTAFA

COMMUNITY LEADER

Avdyl has been a prominent advocate for the project, and also a representative and activist for the Roma community in Plemetina[1], which is also one of the closest villages situated around 500m from the two coal power plants, Kosova A and B.

Avdyl was the lead person in all activities linked to Plemetina. His motivation was linked with his daily struggle with air pollution, and the plight of the Roma community in Plementina. He stated that: “This is the place where I live, and I will do my best to improve the living conditions and air quality of the people. This place has one of the highest cancer rates in Kosovo, and I won’t stand by while more people become sick!”

Avdyl had previously participated in projects relating to environmental issues, media and youth work and he brought much knowledge and experience to the project. He was highly skilled at community building and engagement. Avdyl led multiple air quality measuring efforts in Plementina, drafted and conducted campaigns, inspired all of his fellow community members.

1 Plemetina is a small village with around 2,000 inhabitants located around 12kms outside Prishtina, and is mainly populated by Roma, Egyptian and Ashkalinj communities.

IMPACT

In this pilot, we evolved our data collection methods to incorporate street-level interviews with local residents. Two preliminary findings were used to inform further measurements: the observations by residents in Obilic that they experienced increased discomfort & breathing issues after 10pm on some days; and the reporting of direct pollution from the power stations. This data proved that the power stations were indeed an ongoing source of pollution.

The project had a significant media presence during the national elections and managed to address key environmental concerns that were left out by the political parties during the turmoil that was generated by the snap election and the political tensions that led up to it.

In May 2017, we published that the Kosovo Environmental Protection Agency (KEPA) had not disclosed any data on air quality since December 2016. Four days later, the missing data was published.

Pilot 3 also demonstrates how Making Sense has become a movement embedded in Kosovo. Organic development has led to autonomous and networked activities, including the Green School Community, bio-indicator research and co-operation with the Institute for Biology Research. At the same time, in the wider field of innovation and institutional activities, there has been an increasing engagement with citizen science, for example in the annual Doku:Tech event.

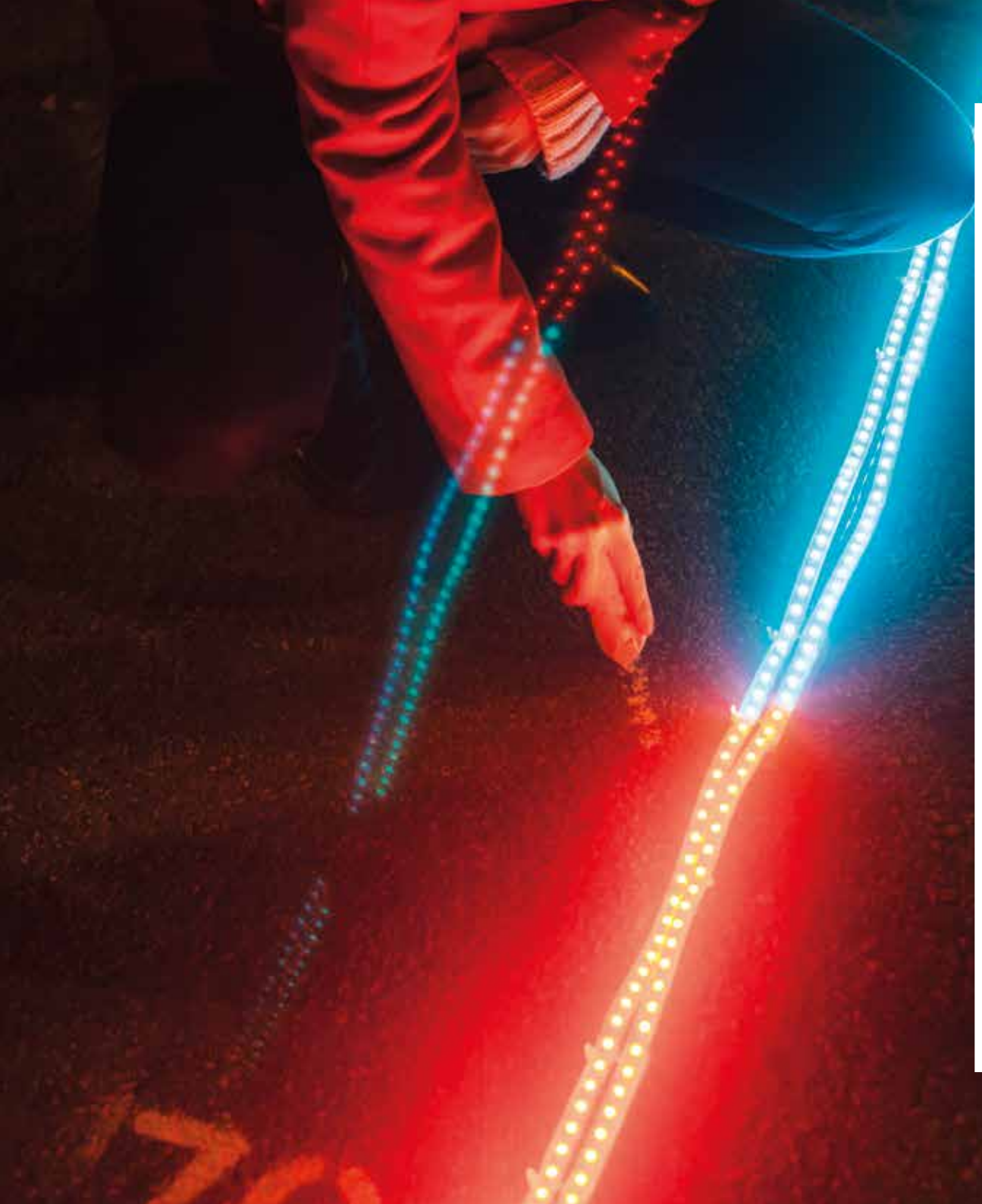
Additionally, the outcomes of the measurements and bio-indicator surveys were visualised in a heat map, which created a clear pattern of pollution impacts on plant life. This confirmed that the closer plants were to power stations, the less diversity there was, and that the roads between the power stations and Prishtina also showed less diversity. This visualisation of bio-indicators supported our digital data, establishing an even more credible dataset using complementary methodologies.

TIMELINE

Kovovo Pilot 3 ran from May 3rd, 2017 to July 16th, 2017

DOCUMENTATION

Press - https://goo.gl/Vw3574 and https://goo.gl/bpvE6q



CASE STUDY

BARCELONA BETA PILOT

ISSUE

Noise

PARTICIPANTS

20 People

LOCATION

Plaça del Sol

ISSUE

In Europe, we know that more than 30% of the population is exposed to noise levels exceeding what is deemed to be healthy. At night in Barcelona, noise levels can often exceed 70 decibels (dB) – the equivalent of sleeping through the roar of a vacuum cleaner.

This is 30 dB over the recommended maximum (WHO, 2017). We know from our experience in Barcelona that high noise levels can have serious health impacts ranging from hearing impairment, hypertension, heart disease, anxiety and sleep disturbance[6]. In addition, we have observed disruption to people's immune systems. It is also with great concern we have learned that birth defects have been associated with noise exposure[7]. In Barcelona, there are imposed limits on noise levels, and the vast majority of complaints there involving the police are noise-related[8].

COMMUNITY

This community was comprised of people with a keen interest and variable technological skills. We had local resident designers, teachers, developers, economists and activists in attendance (some were all of the above!). In this case, these citizens were drawn to the campaign because of the issue of noise pollution. However, they also had a desire to use and form a better understanding of sensors, as well as see first-hand how community technology could galvanise people and empower them to achieve positive social and environmental impact.

STRATEGY

This first pilot was known locally as the 'Beta Pilot'. It was aimed at developing a community of citizen-sensing participants who would take an active role in co-designing the methodologies and technologies to be used in subsequent pilots, while investigating environmental issues in the city. Our campaign deployed over 25 sensors in Barcelona, allowing the Community Champions to collect data on noise levels in different areas of the city. The campaign was structured so as to strengthen the community by sharing skills and interest, and regular workshops and social media enabled the Community Champions to form a strong network.

6 http://www.euro.who.int/en/health-topics/environment-and-health/noise
7 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4143841/
8 http://mediambient.gencat.cat/web/.content/home/ambits_dactuacio/atmosfera/contaminacio_acustica/jornades___cursos/2010/recull.pdf

PROFILE

ANDREAS MANZ

NOISE EXPERT COMMUNITY CHAMPION

"I engaged with Making Sense because I'm interested in everything related to FabLab culture, and as a sound specialist I wanted to offer my collaboration. One thing that motivated me to participate is that there is still a big lack of awareness regarding noise pollution. Initially I thought - and now I know - that Making Sense was the way to create awareness. I describe the experience as wonderful in terms of the people who collaborate, both the leaders and the Community Champions, and very useful in terms of the results obtained. One key thing I learned is how citizen collaboration can change our quality of life."

IMPACT

On Saturday 11th of March 2017, more than 100 people gathered at Plaça del Sol in Gracia to take part in the final action of our beta pilot in Barcelona[9]. This took the form of a launch event for the next pilot: attendees heard about the activities of the Community Champions; discussed the work produced; listened to citizen science presentations; and heard calls to action for our upcoming campaign. We found our Community Champions to be highly engaged: we retained almost 90% participation, and many went on to join the next pilot, 'Gracia Sounds'. Exhibits were easily seen by passers-by and invited interaction, which proved to be an effective way of communicating within the group and attracting attention from the public, the media and the municipality.

TIMELINE

Our campaign ran from November 2016 to March 2017, with project scoping starting eight months prior to launch

DOCUMENTATION

Project website - https://goo.gl/khuQoZ
Community website - http://plazadelsol.cat/
Report - https://goo.gl/JqLH9n

9 http://makingsenseeu.tumblr.com/post/158961291905/on-saturday-11th-of-march-around-75-people

PROFILE

LUCAS LORENZO PEÑA

TECHNOLOGY DEVELOPMENT COMMUNITY CHAMPION

"I was working on a Master's thesis in interaction design and I wanted to create a 'smart city' experience around sound in public spaces. After talking with team members, I realised that I could contribute to Making Sense while also satisfying the goal of my thesis. Fundamentally, what motivated me to participate in the Beta Pilot, and later throughout the entire process, was how Making Sense served as a way I can be hands-on in creating experiences for individuals leveraging municipal systems, fostering communities and creating positive sustainable change. I describe the experience as amazing! I met a wide range of people with different interests and skills, but all of whom shared a common goal. Creating technology to up-skill individuals while lowering the barrier of entry to IoT [Internet of Things] devices proved to have such a significant impact in creating and maintaining momentum. I learned how to develop technology that can be appropriated and applied for a variety of different general use cases and users. I came to a realisation that the power of our understanding, decisions, and actions resides in hands of the collective… which is the future."

CASE STUDY

BARCELONA GRACIA SOUNDS PILOT

ISSUE

Noise

PARTICIPANTS

55 People

LOCATION

Barcelona

ISSUE

During the Beta Pilot, our team in Barcelona had discovered that the Plaça del Sol was seriously affected by noise pollution: however, a deeper understanding of the problem was required. To begin this process, the community explored the history of the square using a timeline featuring memories, anecdotes, pictures and different kinds of data. The community had an interesting debate about the current character of the square. They agreed that Plaça del Sol had lost the diversity of uses and users it once had: now, the Plaça was mainly seen as a nightlife destination for young people from all around the city. In May 2017, we collected data that put noise averages in the square at 70 dB before midnight. However, in the early hours of the morning, our readings were often much higher, with peaks of more than 85 dB between 2am and 5am on several occasions.

COMMUNITY

The pilot brought together a range of people, including residents, our Community Champions from the previous campaign and also a group of residents from the neighbourhood of Gracia, who had been struggling with noise pollution for several years. Living with this issue day-in and day-out for so long was causing serious distress, as it affected the residents' wellbeing on a nightly basis. Later in the pilot, two external sources came onboard: the first was 300.000km/s, a firm of architects, urban planners and engineers that offered help in understanding urban logistics; and Domestic Data Streamers, a data design studio that helped use the data to paint a picture of Barcelona. Altogether, the pilot community comprised 14 Community Champions and 35-40 neighbourhood participants.

STRATEGY

The pilot focused on addressing the issue by demonstrating that noise levels in the area were above those recommended by the World Health Organisation (WHO), and were incompatible with local legislation. More than fifteen meetings and workshops were held and through these events we developed an understanding of how citizen participation, open-source technology and data could help us tackle environmental issues. For example, during the first meeting, a public exhibit (which had been created by the Community Champions group in the previous campaign) was shared with the new community to help them visualise noise levels in situ.

Using our Issue Mapping activity and tool, we discovered that many people were interested in hosting a noise sensor at home, as well as in developing and taking part in public-facing activities to raise awareness of noise pollution.

PROFILE 3

MIREIA BASTARDES

PLAÇA DEL SOL COMMUNITY CHAMPION

"I got involved in Making Sense because it seemed like a very interesting project to empower citizens and make their concerns and complaints visible. What motivated me to participate was the belief that it is possible to change things with our actions. The experience was very positive: working with the Making Sense team has been very enriching. I think the project is very useful because the neighbours now have real and reliable data on the noise pollution that we suffer in the square. It serves to make the problem visible. However, getting definitive solutions to the problem is another issue since that requires political will. Something key that I learned is that it is important to work as a team to visualise a conflict and to join forces."

Residents of the Plaça del Sol installed 25 Smart Citizen Kit sensors in their houses and terraces. These participants co-created measuring strategies which involved collecting data 24 hours a day over a period of six weeks so they could identify which days and times were the loudest each week. They also measured noise levels inside their homes and documented the type of windows installed to identify what works best for soundproofing. To get a clearer picture of the noise problem in Plaça del Sol, the participants used the data from their sensors, identified other indicators of noise using the Community Levels Indicators tool, and noted down observations in their booklets.

IMPACT

In Plaça del Sol, the community came together to address an important social and environmental issue by harnessing active participation, technology and open data. This meant that a supported community of neighbours (many of whom had never met before) was able to capture data, make sense of the information gathered, and co-create solutions to make a positive change to their living conditions. Since the end of the pilot, the neighbourhood community have been galvanised by the issue, repeatedly stating that they now "feel empowered". They continue to meet at their hub at Kubik every month to continue their activities against noise pollution. In this time, the city council has launched an awareness campaign to make people who use the square conscious of the impact of night-time noise on local residents. Furthermore, following recommendations from the participants, the city council has initiated refurbishment works – such as the installation of large flower planters - to deter revellers from congregating in some areas of the square. Importantly, the council and local residents are actively engaged in dialogue to achieve more permanent solutions.

TIMELINE

The pilot began on 11th March 2017, and ended in late July 2017. However, many community members have kept their sensors online, and remain in touch with the Making Sense team.

DOCUMENTATION

Project website - https://goo.gl/oe1ohL
Legislation - https://goo.gl/fcqze5
WHO Website - https://goo.gl/CNS9bn

PROFILE

REMEI POLLS

PLAÇA DEL SOL COMMUNITY CHAMPION

"I became involved in the Making Sense pilot because I was interested in the idea of being able to collectively visualise the problem of noise pollution that the residents of the square suffered individually. Making Sense offered us the technological opportunity [the sensors] to focus on the problem and to objectify it. This is important, because it opens up opportunities to establish a dialogue with the City Council that is based on evidence. I was motivated by the idea of sharing the problem of noise pollution with my neighbours. Many of us hardly knew each other, and yet, we suffered the same problem daily in our homes. The idea of participating in workshops with people who were not from the neighbourhood and who could give a different vision or approach also motivated me.

The experience was very comforting: it was like a liberation, because I stopped feeling like a victim of the situation, and felt part of a collective that seeks the solution. One of the most important effects is, without a doubt, how it united the neighbours. The ability to change reality from real-world individual experiences begins by recognising the problem collectively. I learned to participate, to share, and this confirmed, once again, that knowledge is power. Making Sense has given us the means [technology, spaces for dialogue, workshops] and the opportunity to develop our capabilities to achieve a common good. And also try to find and experience a creative way to exercise this 'power'. We still continue to have the problem, but we are a little more free."

KEY INSIGHTS

Here you will find key insights from Making Sense for other projects in citizen sensing or beyond. These are a reflection of the activities and debates that took place within our own project, and the multiple ways that Making Sense evolved in Amsterdam, Barcelona and Prishtina. These insights are not meant to provide categorical solutions or perfect strategies for every citizen sensing campaign out there, but we strongly believe they can help other communities devise more sustainable action plans for successful projects. They are presented here in no special order and you should be able to use them together or separately in multiple phases of your project. We want to pass them on to you, both as a set of best practices developed with and by our project communities, and as a set of cautionary tales drawn from our own missteps in having to 'learn on the job' from time to time. We hope you and your projects will add new insights to ours, and that by combining our collective knowledge, we can all continue to contribute to real and lasting change.

MAKE SURE TO BRING THE COMMUNITY FULLY ON BOARD EVERY TIME KEY DECISIONS ARE MADE

CO-CREATE AT ALL TIMES

Co-create with people and communities at the start, middle and end of your project so the project can better reflect their views, needs and expectations.

Everything your project does should address your community and the needs of its members first and foremost. Your focus should be on processes, tools and results that can be built by all, are easy to understand and readily actionable to fit your community's current and foreseeable needs. Make sure to bring the community fully on board every time key decisions are made about what the project's next steps are, or even just whenever a new process or tool needs to be designed and tested. This may not always be easy to do: co-creation can open up conflicts, and everyone will need to work hard to find a compromise. Strong management skills are required to reach consensus and support the co-existence of different views, but collaboration is the best way to ensure the project does not slip into top-down territory where those at the helm operate independently and alienate their community members.

While other technological, scientific, cultural or political agendas may be central to the project, try not to let these stand in the way of what the community wants to achieve. Collectively set realistic goals to manage expectations, and be prepared for those moments of frustration when community members stop feeling part of the process and decrease their engagement. This cannot be an excuse to curb your project's ambitions or limit your plans, however, as adaption and readjustments must be at the core of what you do. Indeed, even when participants are highly motivated and trust their own capacity to create change, you should always discuss the possibility with them that not all project goals turn out as initially planned, and if this happens, the important thing is to work collectively to find the best ways of addressing the problems your project faces.

LOOK FOR THOSE PEOPLE WHO MAY ALREADY BE CHAMPIONING ISSUES THAT YOUR PROJECT WANTS TO ADDRESS

TARGET FOR GROWTH AND PARTNER UP

Continuously grow your project by recruiting specific people, aim to collaborate with other communities and organisations relevant to your cause.

Explore every possible opportunity to grow your project from its original core community. Aim to have a more heterogeneous group of people engaged by the end than you did at the beginning. Look for those people who may already be championing issues that your project wants to address, and invite them in. Support their voices and skills so they can progressively join those of the original members. Try to also welcome external innovators who will not only be valuable as participants, but can also provide critical contributions to specific processes: for example, you might attract people who are good storytellers to help create better narratives for the general public (likewise photographers, filmmakers and media curators of all kinds). Never be afraid to use indirect forms of engagement, such as working with children to engage parents and teachers when it makes sense.

Keep an eye on similar projects to yours being carried out by FabLabs, hackerspaces or environmental groups and explore them, not only as a source of inspiration, but as potential partners for future collaborations. Consider the possibility of inclusive relationships between the people and organisations that comprise your community on one hand, and on the other hand, organisations such as local associations, political or issue-driven groups, universities and research bodies, local councils, neighbourhood businesses or larger companies. More often than not, you will discover that gaps in expertise or social and cultural representation within your community can easily be filled by reaching out to pre-established communities and organisations. These relationships will often offer the latitude to exchange views and consider new possibilities while allowing for competing and divergent ideas. As such, external collaboration should be encouraged, and will pay off in ways that help your project achieve its goals, or even devise new ones.

SOCIAL MEDIA HAS BECOME A POWERFUL TOOL THAT MAKES IT EASY FOR PEOPLE WITHIN THE PROJECT TO SHARE THEIR VIEWS AND ACTIVITIES

COMBINE ENGAGEMENT STRATEGIES

Make use of all physical and digital resources at your disposal to engage with people and increase participation and outreach.

Set up a wide range of resources for your participants which reflect their different ways of engaging with others. Some may be more at ease meeting face-to-face, while online communication may be the preferred choice for others. Do not assume that these two choices are necessarily disconnected: instead, explore how combining online and offline spaces can allow you to tackle resource constraints and maximise your efforts to make an impact. You might want to design a printed newsletter that can be disseminated at public events and in a local newspaper, but can also double as a blog post (and vice versa). Still, it is essential to understand how important online forms of communication can be as proven ways to help build communities. Social media has become a powerful tool that makes it easy for people within the project to share their views and activities with each other; it is also a highly efficient way of engaging with an extended audience beyond the project. You can easily expand your outreach by announcing and reporting your activities in a timely and targeted way. That said, never underestimate how physical events such as meetups, bootcamps, street-level interventions or political demonstrations can help bring more people into your community. Such events will not only help your community grow stronger, but they can also serve as a showcase for the wider public to see how active the project is and what its main achievements are.

ACCEPT THAT NOT EVERYONE HAS TO BE FULLY ENGAGED ALL THE TIME, AND THAT THIS WILL NOT COMPROMISE THE PROCESS

PLAN FOR INCLUSIVITY

Devise inclusion strategies which counteract cultural and knowledge imbalances affecting participation and community-building.

Never assume that most people can or will participate in the same way. Accept that not everyone has to be fully engaged all the time, and that this will not compromise the process if approached in a transparent and collaborative way. Some people only want to participate from time to time, while others prefer to engage at maximum capacity. This is perfectly normal, providing it does not interfere with the project's execution. Beyond participants' own interests and commitments to the project, personal and local circumstances can also affect their ability to remain actively engaged. Pay attention to differences in technical and social skills, work or family demands, or even how gender, ethnicity, economic and cultural backgrounds play into their identities inside the project. Account for, plan and promote moments for inclusion and learning that can help mitigate such differences. Design regular events with inclusivity in mind, and grant community members access to material, technical and methodological support, as well as educational resources. This type of consideration and provision will allow them to grow their own skills throughout the project. Other strategies for inclusivity might include considering meet-up places where your community is already getting together, for example, or creating financial support schemes to cover participation costs for people with lower incomes. You can decrease potential barriers for social interaction by scheduling meetings outside working hours or on weekends, or even partnering with other local events. Never underestimate how crucial respect for social difference is to relationship building inside the project.

ACKNOWLEDGE THAT EVERYBODY DESERVES THE OPPORTUNITY TO INTERPRET THE PROBLEMS YOU ARE FACING

AGGREGATE DIVERSE KNOWLEDGE

Combine non-expert knowledge with expert contributions to boost the value of your bottom-up experiences and ensure wider impact.

Not all forms of knowledge inside a citizen sensing project are considered to be on an equal footing. Most of the time, expert views are favoured over others, and participants' unique knowledge about their neighbourhoods, local problems and needs are downplayed or ignored entirely. Acknowledge that everybody deserves the opportunity to interpret the problems you are facing and come up with potentially achievable solutions. Incorporate as many sources of knowledge as you can into your project, and turn it into a truly inclusive and transdisciplinary venture. Let people bring their own know-how at all times, either to build their own tools or to evaluate the impact of the project itself via a community-based task. That said, also consider the added value of including professionals from diverse areas of expertise such as design, computer science, the social and economic sciences, environmental sciences, and so on. This usually helps to create strong collaborations within a project between individuals and groups with different backgrounds and contributions. It can ultimately improve the project's problem-solving approach, allowing your community to tackle concrete issues in a more precise way. External expertise can also help yield higher levels of quality and legitimacy, especially when dealing with data. In turn, this will help you to open new channels for dialogue with traditional science and technology institutions or public and governmental organisations, thereby achieving more widespread impact.

EVERYTHING YOUR COMMUNITY PRODUCES SHOULD BE AS EASY AS POSSIBLE FOR OTHERS WITH VARYING COMPETENCIES TO INTERPRET

GENERATE ROBUST AND OPEN DATA

Co-create strong data collection and validation strategies, and make use of open methodologies so others can benefit from your results.

The usefulness of your data should always be a fundamental concern, regardless of how intensive your project's approach is to collecting, visualising, interpreting or using it. Everything your community produces should be as easy as possible for others with varying competencies to interpret and apply wherever and whenever possible. Start by establishing processes for data validation before conducting your sensor deployments so that these are embedded from the outset. Plan informal workshop events geared around sensor calibration, which will enable more participants to learn the process and understand its critical role in the project. Make sure your community has access to the most reliable and authoritative datasets for comparison, and approach organisations or specialists that can help you with these processes.

Collaboration with experts is especially important when data is being gathered by large numbers of people with different competencies, or when using low-cost tools that are too often judged as unreliable or not sufficiently accurate. If you want your results to be valuable to others, endeavour to legitimise your data by corroborating it with as many highly-regarded sources as possible. As a result, your data will also be more easily accepted as a lever for action and change. Never be afraid to revisit your data collection strategies and experiment with how you present and use the data. It is worth remembering, however, that standardisation often helps to build your case by ensuring results can be shared with similar projects, or with research and governmental institutions capable of extending the reach of your results. Always use open standards and open licenses to enable others to read, verify and use your results.

YOU SHOULD ALWAYS AIM TO MAKE IT SIMPLE FOR COMMUNITIES TO CONTINUE SUSTAINABLY WITHOUT YOUR SUPPORT AFTER A WHILE

PROMOTE COMMUNITY OWNERSHIP

Encourage community members to appropriate resources, tools and results using solid, targeted support and techniques for building trust.

Start by involving your community in every process, right from the very first day of your project. That is not to say that bringing people in at later stages might not be helpful in some circumstances, and even necessary or desirable if your campaign strategy calls for wider outreach. Either way, where possible, open all your activities at the beginning of the project, and keep them open until the end. Promote tools and techniques that everyone can use, hack and reinvent themselves, voicing frequently how much you trust your community with these tools with the aim of fully empowering them. If done right, this usually allows your community members to acquire new skills: this, in turn, will strengthen their autonomy; enhance their sense of ownership; promote more sustained engagement; and allow for new autonomous activities. To consolidate this sense of empowerment, consider assigning community members parts of your budget to manage by themselves. You might also consider granting them extended decision-making powers, even if this means simplifying or slowing down activities you had already planned. This might be achieved using transparent voting or resolution processes that allow all choices to be discussed, or simply by establishing more participatory communication and feedback channels. Encourage people to join your project, supporting them to 'fork' or 'spin-of' parts of it. As an end goal, you should always aim to make it simple for communities to continue sustainably without your support after a while. Once a project has learned how to fly on its own, you'll see how rewarding it is to see it growing way beyond the original nest. And this is when you can start thinking about joining, supporting or building new adventures!

GLOSSARY

Actions/Activities/Interventions: *a community-led response that builds on and amplifies findings from the sensor data.*

API: *Application Programming Interface. A set of functions that allows two software programs to communicate with each other.*

Appropriate: *in this context, we use this verb to mean 'to harness'.*

Arduino: *an open-source electronics platform that includes a hardware board, a programming language and software. Designed to be easy to use and to create things with.*

Community Members: *a group of any size whose members share one or more of the following: social ties, interests or practices. They often have a common perspective, and are engaged in social action in a local setting.*

Community Organiser: *a person who builds relationships, recruits people and organises cooperative work to promote the interests of their community as well as create change through collective action.*

Calibration: *setting or correcting of a measuring device or base level, usually by adjusting it to match or conform to a reliably known and unvarying control measurement.*

Citizen Sensing: *a socio-technical process in which citizens use lightweight and accessible sensor-technologies to collectively monitor the environment by performing a number of tasks that typically involve collecting, sharing and/or interpreting data.*

Co-production: *communities and researchers producing findings and outputs together.*

Collaborative Inquiry: *communities and researchers working together as co-researchers to identify issues, challenges and understand previous work.*

Community Champion: *a member of the community who has experience or knowledge of the citizen sensing process and can pass that knowledge onto other community members.*

Community Level Indicator: *information chosen by the community that accompanies and gives context to sensor data.*

Fablabs: *small scale workshops where anyone can use the digital fabrication tools that are available, they are part of the Fab Foundation.*

Forking a project: *copying parts or the entirety of a project in order to start a new one with experiments and modifications based on or inspired by the original project's concepts, methods, tools, designs, code, etc.*

Github: *an online repository for code, includes public repositories can be accessed and downloaded by anyone.*

Hackerspace: *a place where people interested in technology can collaborate to work on projects. Evolved from the concept of computer programmers coming together to make technology work in ways it wasn't necessarily intended.*

Iteration: *the process of doing something over and over to improve it.*

Makerspace: *a place, referred to frequently in computing or technology, where people can come together to work on projects and share ideas, equipment and knowledge It is similar to a Fablab but not part of the Fab Foundation.*

Open innovation: *a term coined by Henry Chesbrough in 2003. It is a distributed, participatory, decentralised approach to innovation, and is associated with technology developed through collaborative means e.g. in workshops or hackathons.*

Open vs Open-source: *Open-source is where the code or software is freely available to anyone to use and modify, whereas open is a more general concept that promotes more direct and transparent practices, and is seen in education, science, innovation and data.*

Participatory design: *multiple stakeholders are actively involved throughout the design and decision-making for a specific technological and organisational output.*

Project Team: *an interdependent group of individuals (whose members can belong to different organisations) who work together and have responsibility towards a common goal or project.*

Protocol: *an established procedure within pilots for accomplishing a purpose.*

Scoping questions: *the range of topics and issues you are interested in, they link to issues that communities have identified as matters of concern.*

Sensing activity: *the period of time when sensors are collecting data.*

Smart Citizen Kit: *a platform consisting of integrated Arduino-compatible sensing devices, a database for storing the sensor data, a publicly available website, a data visualisation API, and a mobile app.*

Social Innovation: *a way to create an environment for change and empower people to become agents of that change using new approaches to address social needs.*

Targeted measurements: *sensing around a particular location or time of day, that has been specified and chosen for measurement.*

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