Citizen Science Roadmap for Local Government

A hands-on manual for citizen science,
by and for cities and towns

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Content

Preface

Proximity to citizens: that is what citizen science and local government have in common. Nevertheless, local governments often do not spontaneously think of citizen science as (part of) a solution for local issues. In essence, citizen science is about scientific research that is conducted - in whole or in part - by the general public. Therefore, at first glance, it seems to be something for scientists and citizens, but in many cases local government is also involved, for example when it comes to measurements and research that can reinforce local policy. Through citizen science projects, cities and towns gain access to an extensive network of locally engaged citizens, who are the ideal citizen scientists in such projects. Citizen science can provide new data and insights for a local government to back up supported policy choices. Therein lies great potential for the local policy level, whether it is a large city, a rural village or a single residential area.

In this roadmap, we outline what citizen science can mean for local government, explain how to get started and identify success factors. You will find lots of inspiring examples, and in the online version you will also find videos (in Dutch) related to the chapters of this roadmap.

This roadmap is an initiative of Flemish minister Bart Somers and Agentschap Binnenlands Bestuur of the Government of Flanders. The roadmap is the result of a close cooperation with all 13 Flemish central cities ('centrumsteden'), Vlaamse Gemeenschapscommissie, the towns of Aalter, Halle, Harelbeke and Zoersel, Vereniging van Vlaamse Steden en Gemeenten vzw, Kenniscentrum voor Vlaamse steden and the citizen science network of Scivil (the Flemish Knowledge Centre on Citizen Science). Insights and experiences were gathered through interviews and participatory workshops.

All involved parties hope you gain inspiration through this roadmap.

A roadmap made for Flanders translated to English

This roadmap was originally written in Dutch for a Flemish audience in a Flemish context. It has now been translated to English, for European and wider dissemination. This is why you will come across a lot of Flemish examples of citizen science, as well as referrals to Flemish and Belgian political, social and educational structures. Hyperlinks refer to an English webpage, if available. Dutch names of publications, projects and institutions are, by default, not translated. For the benefit of easy reading, we explain certain concepts and add a limited glossary below.

Explanations

Belgium and Flanders
Flanders refers to the Dutch-speaking region and community within the federal state of Belgium. It has its own regional parliament and government, responsible for a large number of policy domains, including - among others - education, culture, media, environment, agriculture, work and innovation. More info about the Government of Flanders.

City or town
Flanders consists of 300 municipalities ('gemeentes') across 5 provinces. Each municipality has its own local administration with elected representatives and officials. Since the term 'municipality' has a different meaning depending on the national context, in this roadmap, the dual term 'city or town' refers to any local governmental structure with its own administration and elected representatives and officials, be it a rural village or a large metropole.

Local administration and local government
In this roadmap, the terms 'local administration' and 'local government' both serve as an umbrella term for the democratically elected board and the civil services of a city or town. 'City council' exclusively refers to the democratically elected representatives of that city or town.

(Vocational) universities
In general, the Flemish higher education system is divided in two types of institutions: **'universiteiten'** providing in academic research and education on a bachelor's, master's and doctoral level; and **'hogescholen'** focusing on vocational education on a (pre)bachelor's degree and conducting applied research. The structure of the higher education system differs from country to country. In this roadmap, Flemish higher education institutions are referred to as '(vocational) universities'.

Glossary

Centrumstad (central city):
a larger city in Flanders that serves as the regional centre within its locality. Flanders has 13 centre cities.

Stadswachter (City guard):
a civil servant in Flanders with limited policing power, focusing on prevention, correction and service-providing in the public domain.

Intercommunale (intermunicipal company):
a partnership between multiple adjacent towns and cities in Flanders, in order to organize various community services.

OCMW (Public Centre for Social Welfare):
a public institution providing in social services for Belgian citizens. Each city or town in Belgium (and thus in Flanders) has its own OCMW.

Vereniging van Vlaamse Steden en Gemeenten vzw (Association of Flemish Cities and Municipalities): a member association, advocating on a policy level for the interests of cities and towns in Flanders.

Vlaams Agentschap (Flemish Agency):
a Flemish government organisation, responsible for policy implementation within one of the ten policy domains of the Government of Flanders.

Vlaamse Milieumaatschappij (Flemish Environmental Agency): an agency of the Government of Flanders working towards a better environment in Flanders, in the domains of water, air and the environment.

Vlaamse Gemeenschapscommissie (Flemish Community Commission): the government administration for Flemings living in the Brussels-Capital Region. The VGC is responsible for all communal policy domains: urban policy, culture, youth, education, formation, student affairs, well-being, health and family.

01.

Citizen science: what is it about?

The meaning of the term citizen science can vary quite a bit. In this chapter we will discuss the nature, the means and the underlying motives of citizen science in general. The specific applications and contexts for local government will be discussed in detail in later chapters.

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What is citizen science?

There are several definitions of citizen science. We use the following definition:

> " Citizen science involves scientific research conducted in whole or in part by non-scientists (citizens), often in collaboration with, or under the guidance of professional scientists."

Citizen science refers to research conducted (in part) by citizen scientists, volunteers who contribute to research in their free time. Citizen scientists often - but not always - collaborate with, or are supervised by domain experts, academics or governments.

For a more detailed framework, we refer to the Ten Principles of Citizen Science, developed by the European Citizen Science Association (ECSA).

In recent decades, citizen science has gained popularity across the world. In Flanders, widely known projects such as Waarnemingen.be, Airbezen, CurieuzeNeuzen, Straatvinken, Telraam and the various Luftdaten air quality measurements have also put citizen science on the map.

The most well-known examples of citizen science in Flanders perform(ed) research on biodiversity, mobility and air quality, but there are also successful applications in other domains, such as:

- genealogy (MamaMito)
- history
- archaeology
- palaeontology
- artistic research (Verrijk de kijk op Brugge)
- literature research (Straatpoëzie.nl)
- health (Isala)
- well-being (Researching Age-Friendly Cities)

75 Citizen science projects in Flanders
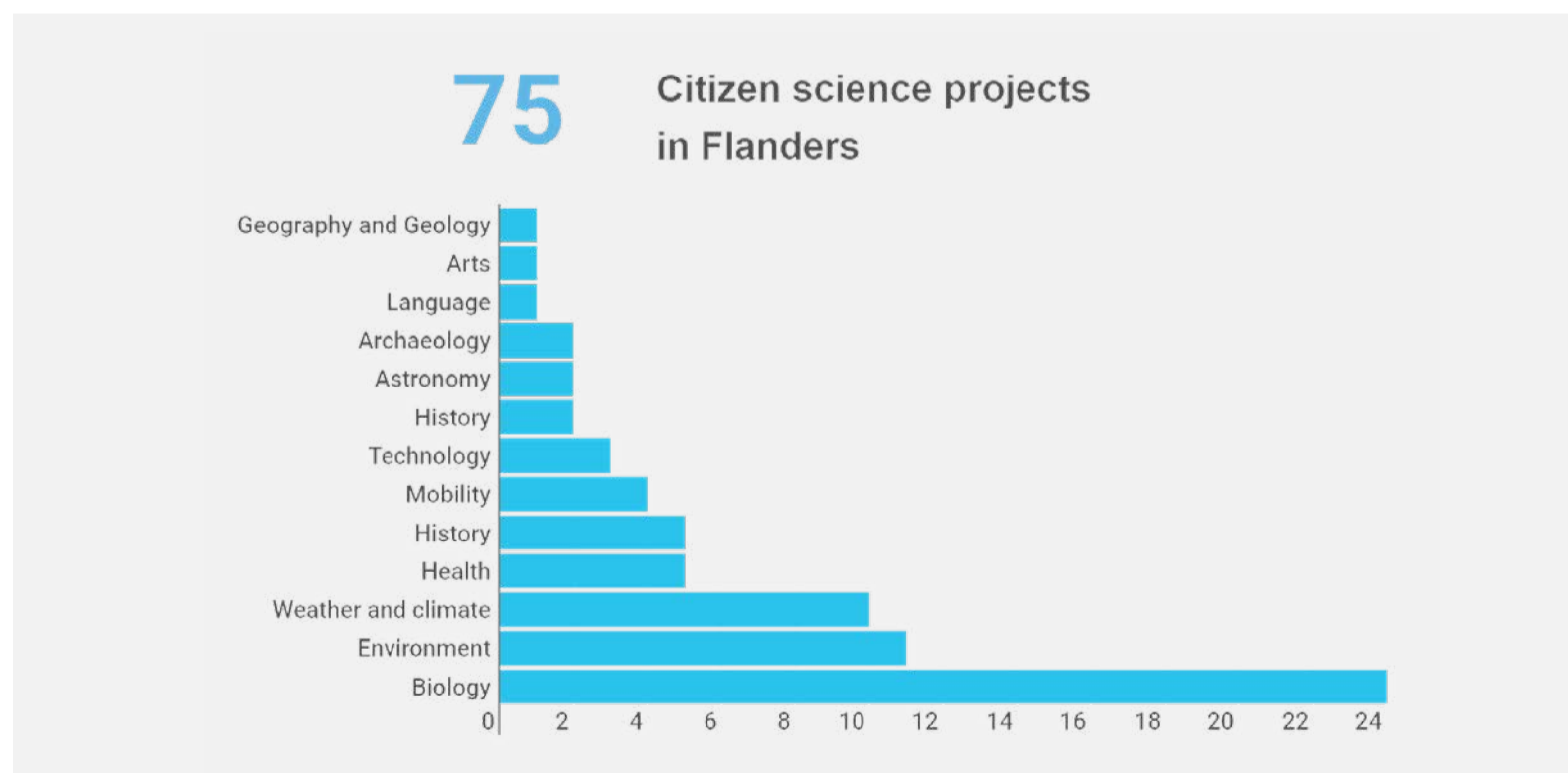
On this graph, we visualize citizen science projects in Flanders that were active in April 2021, and known to Scivil. We suspect that a large number of small-scale citizen science initiatives remain under Scivil's radar. It is therefore possible that a number of projects are not included in these counts.

How does citizen science work?

In the majority of citizen science projects, citizen scientists contribute to research by collecting data: They do this by:
- observing;
- counting;
- photographing;
- using sensors or devices;
- measuring;
- ...

or by analysing data:
- annotating;
- transcribing;
- interpreting;
- ...

However, citizen scientists can also be involved in other steps of the scientific process. For example, they can (help to) specify what should be investigated and what the research question will be, they can (help to) determine what protocols and methods they will use to conduct the research, and they can report on the research results.

Research and participation: two cornerstones of citizen science

Within and outside the citizen science community, discussions sometimes run high about which initiatives can or cannot be called citizen science. We want to avoid limiting citizen science too much with strict criteria and definitions, but there are two key questions that help to determine whether a project is citizen science or not:
- Is research being conducted?
- In what way do citizens participate in the research?

Without scientific research, we cannot speak of citizen science. Therefore, in a citizen science project, conducting research is essential. In this research, citizen scientists are involved; not as research objects, but as (co-)implementers of research tasks. This means that citizen scientists themselves collect or analyse research data and possibly also contribute to other aspects of the research.

As a result, research in which people participate in tests, give interviews, fill out surveys or attend focus groups is not called citizen science. If the participants themselves take an active role in organizing, conducting or processing these tests, interviews, surveys or focus groups, we do call it citizen science.

In the same sense, participation alone is not enough to speak of citizen science. Many participatory processes aim to actively involve citizens in policy or innovation. The methods used in these projects can also be applied in citizen science. If these methods do not provide data from which scientific conclusions can be drawn, it is not citizen science.

If we assess initiatives using these questions, we can distinguish citizen science from participatory projects. We would like to note that we do not grant the label citizen science as a quality label or value judgement. Citizen science is not a necessity, but a research method that cannot or should not always be applied.

Formulate a research question → Develop a method → Collect data → Analyse data → Report
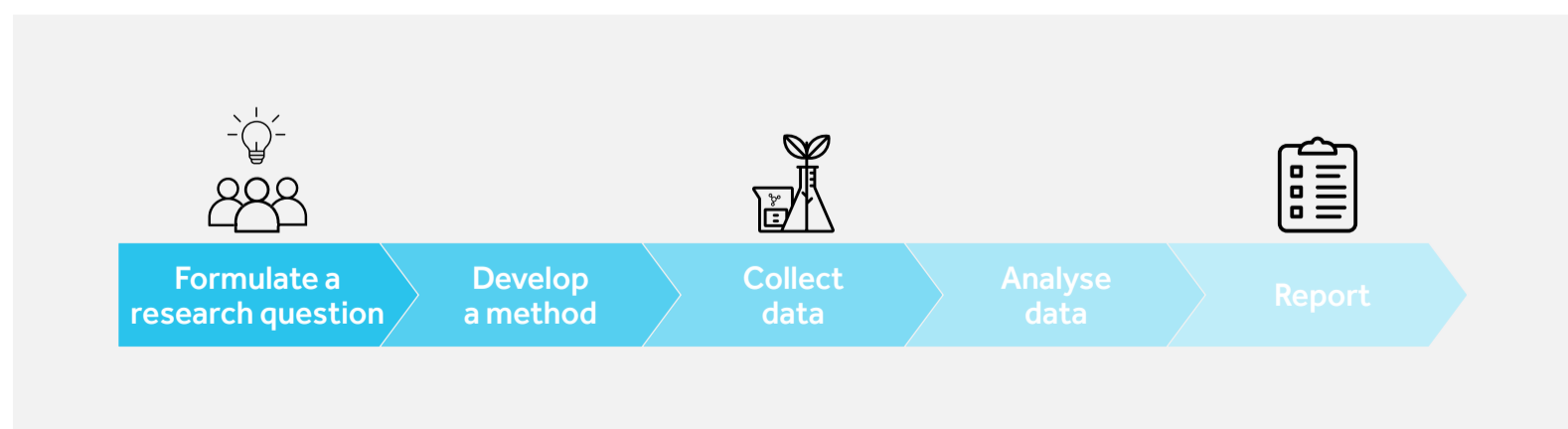
Citizen scientists are most often involved in data collection or analysis, but it is particularly valuable when they also contribute to other steps in the research process.

Is this citizen science or not?

On FixMyStreet, citizens can report incidents in public space (trash, damaged sidewalks, broken traffic lights, etc.) to their city or town. While volunteers often upload photos and observations to an application or online platform in citizen science, in FixMyStreet they are not uploaded to contribute to research. A very valuable initiative, but we do **not call it citizen science.**

The photos and observations of animals and plants uploaded to Waarnemingen.be, are collected in a large database available for research on biodiversity. This contribution to research is why we consider Waarnemingen.be to be **citizen science**.

The Gemeente-Stadsmonitor is a policy monitor that assesses the broad environment of a city or town using about 300 indicators or sets of figures. More than 100 of these come from a large-scale three-yearly citizen survey. In all 300 Flemish cities and towns, citizens are invited to fill in a questionnaire to evaluate how they experience living in their city or town. Although we can certainly call this citizen survey a research, the citizens only contribute by answering a questionnaire. Therefore, they are part of the research, but do not take an active role in it. It is large-scale research, but **not citizen science.**

Straatvinken engages citizen scientists to count traffic in their street once a year for one hour. The results of this count are analysed for the whole of Flanders by the University of Antwerp and KU Leuven, but they also give cities and towns insight into how traffic evolves year by year in their territory. The citizen scientists actively contribute to the collection of this research data: we are definitely talking about **citizen science** in this example.

# What are the underlying motives of citizen science?

The main reason to set up a citizen science initiative is to research something. Citizen science is a method of collecting scientific data that offers unique benefits. Here, for now, we will discuss in general terms the motivations for engaging in citizen science. In the next chapter, we will highlight specific benefits for local governments.

Research with more data and in new places

Citizen science can collect or process far more data with the help of a large group of citizen scientists than a small group of professional researchers could do on their own. Just think of large-scale projects like Waarnemingen.be, where thousands of observations and photos of Belgian plants and animals are added on daily base. Or consider the DoeDat platform, where thousands of volunteers annotate and transcribe photos and scans on their own computer.

A second advantage of citizen science is that it can provide access to places, people and insights that are less easily gauged by traditional methods. For example, Mijn Tuinlab was created because researchers wanted to gain insight into the biodiversity, water permeability and cooling effect of private gardens, which cover 9% of the surface in Flanders. In the Amsterdam (the Netherlands) neighbourhood of Slotermeer, the Dutch National Institute for Public Health and the Environment received little response to the health surveys they organized, until they began working with a diverse group of Slotermeer residents. They were trained on the one hand to take questionnaires from their neighbours and on the other hand to reflect together with them on what was needed to make the neighbourhood greener and healthier. (See Chapter 9 - Healthy Slotermeer)

Data collected through citizen science can be extremely valuable to cities and towns. Citizen science can be applied in all phases of the policy cycle. This aspect is discussed in detail in the second chapter of this manual.
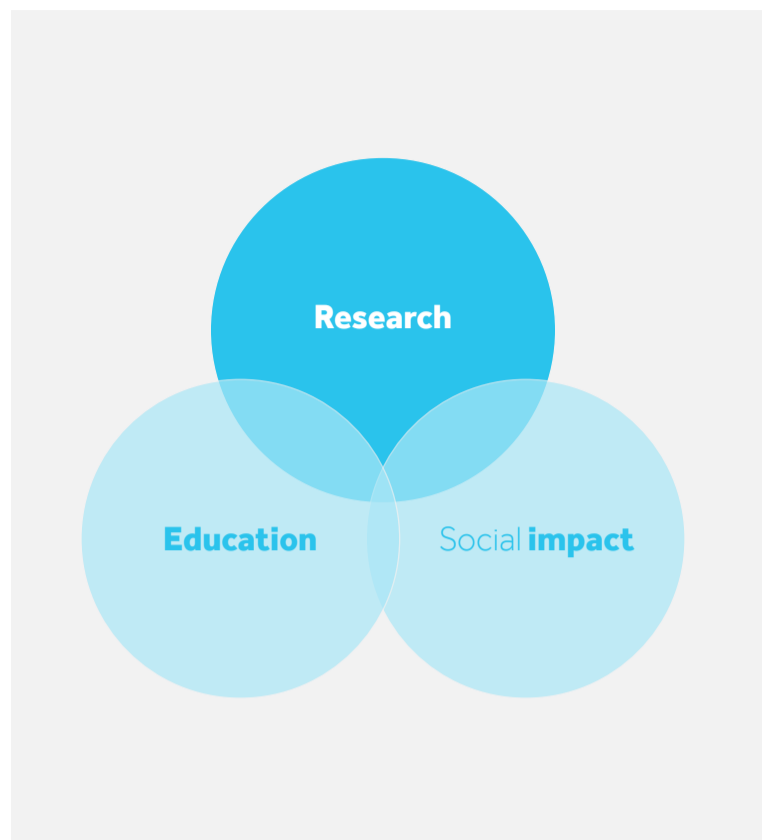
Research is the most important goal of citizen science, but education and impact are important side effects.

While the acquisition of new data and insights is central to citizen science, two other goals almost always come into play: education and impact.

Education and awareness

Citizen science projects are by their nature very educational. Since citizen scientists themselves get to work with a scientific method, they almost automatically learn a great deal about science. They not only learn about the content of what they are researching, but they also gain insight into the research process. This way, citizen science can strengthen the participants' confidence in the scientific method, sharpen their critical sense and raise a barrier against disinformation.

Of course, citizen science projects must invest heavily in training their citizen scientists. Projects that fail to do so will most likely see a rapid decline in the number of participants (who drop out of the research in frustration), but will also end up with incorrectly collected or inconsistent data, from which little valuable insight can be obtained.

Social impact

Projects conducting research on topics in the immediate vicinity of their citizen scientists often recruit new participants more easily. This is demonstrated in Flanders by the success of mobility measurements such as <u>Straatvinken</u> and <u>Telraam</u>, and the air quality measurements such as <u>CurieuzeNeuzen</u> and the <u>Luftdaten initiatives</u>. In these projects, citizen scientists not only contribute to a large-scale dataset, but they also gain insight into traffic and air pollution in their own street or neighbourhood.

However, this rule does not always hold true, as is proven by the enormous success of citizen science initiatives with less direct local impact, like <u>Zooniverse</u>, <u>VeleHanden</u> or <u>Doedat</u>.

Nevertheless, we notice that in addition to these large-scale projects, a lot of local and relatively small-scale measurement initiatives are emerging, often from a local concern. These may be local residents that are concerned about the <u>water quality in their rivers and canals</u>, that are bothered by a <u>foul smell</u> or that want to know more about the <u>air quality in their city</u>. With these measurements, citizens usually hope to convince authorities to take steps in addressing these concerns.

Requirements and tradeoffs in citizen science

Citizen science has been gaining a lot of interest in recent years, but we are convinced that a choice for citizen science must be well-considered and justified. Citizen science is enormously valuable when applied in the right way, but the method also requires a lot of resources and energy. There are several tradeoffs to be made. There are usually no wrong or right choices, but it is certainly useful to thoroughly consider the pros and cons when setting up a citizen science project.

1 Time and resources

It is sometimes uttered that citizen science is a cheap way to collect a lot of data, because the work is done by volunteers. This is a dangerous misconception. Citizen science initiatives set up from this rationale, are doomed to fail. The intensive collaboration with citizen scientists and various partner organizations requires great efforts in terms of communication and project management. These aspects should certainly not be underestimated when considering a citizen science project.

2 Sensors: quality or quantity?

Citizen science projects sometimes make use of sensors or measuring instruments. A project can choose to invest in a limited number of high quality and expensive sensors, or it can acquire a larger number of cheaper sensors. By applying statistics to a large dataset, less reliable data from these cheaper but more widely distributed sensors can still become valuable.

Price of sensor

Quality   Quantity
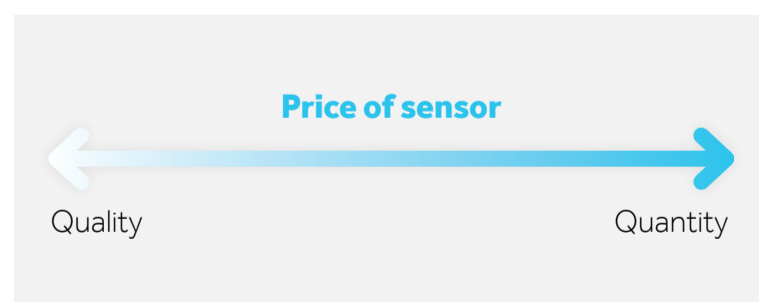
3 Autonomous citizen scientists or rigid protocols?

Allowing citizen scientists to determine when, where and how to collect or process data, will motivate them, and it is also very instructive. This is especially interesting for citizen science projects in education. This way, students not only learn something in terms of content, but they also learn to apply scientific research methods themselves.

On the other hand, citizen science projects want to avoid that the collected data contain errors or are too heterogeneous. They will therefore aim for an airtight method for data collection or processing by citizen scientists. However, excessive restrictions on when, where or in what way citizen scientists can contribute to the research, can be less instructive or even demotivating.

Data

High quality, strict protocol   Autonomous participants, low data quality
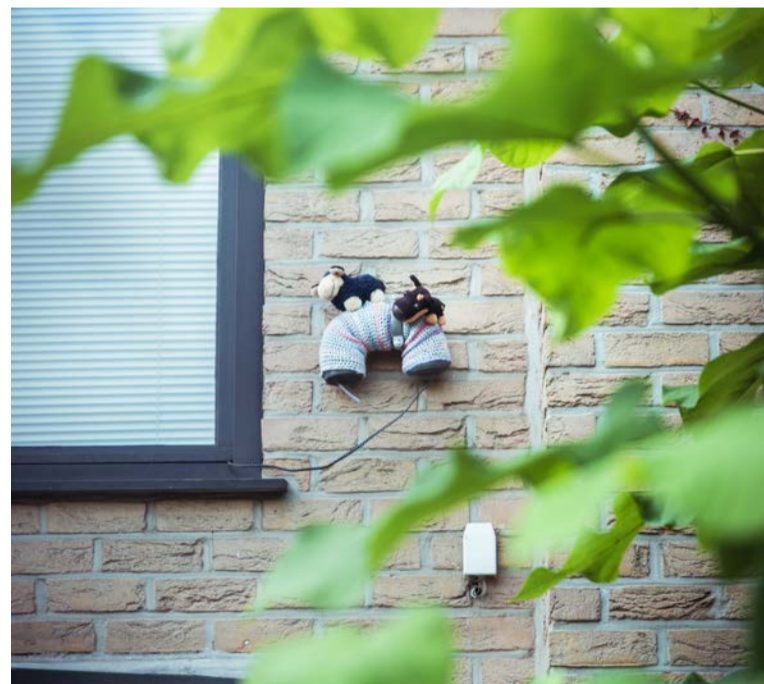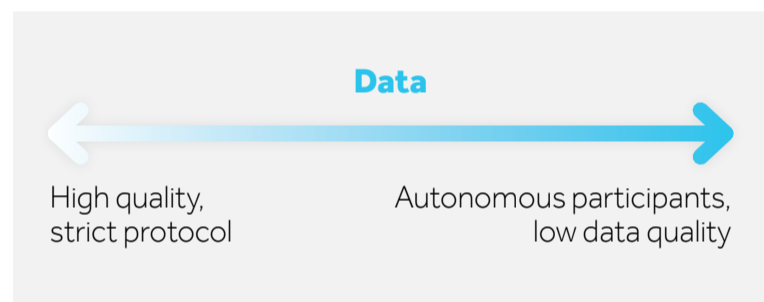
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4 Large numbers of participants, or intense co-creation?

Participation in citizen science is often depicted as a pyramid. At the bottom in the broad base, a very large group of citizen scientists perform a relatively simple and not very time-consuming task. Take for example installing a sensor or taking a one-time count of a particular species of animal or plant.

At the higher stages of the pyramid, citizen scientists will be more intensely involved in the project. For example, they will not only contribute to the data collection or processing, but they will also be involved in determining the research question or method, or in communicating the results. At the very top of the pyramid, we speak of co-creation, in which citizen scientists and project staff determine how the project will proceed on equal footing.

Obviously, the higher up a project is in the pyramid, the more intensive the involvement of citizen scientists in the research. This level of involvement requires a great deal of time and consultation, and will inevitably be carried out with a small group of citizen scientists. Projects at the lower stages of the pyramid, on the other hand, are able to involve much larger numbers of volunteers.

Co-creation

Cooperation

Contribution

Minimal involvement
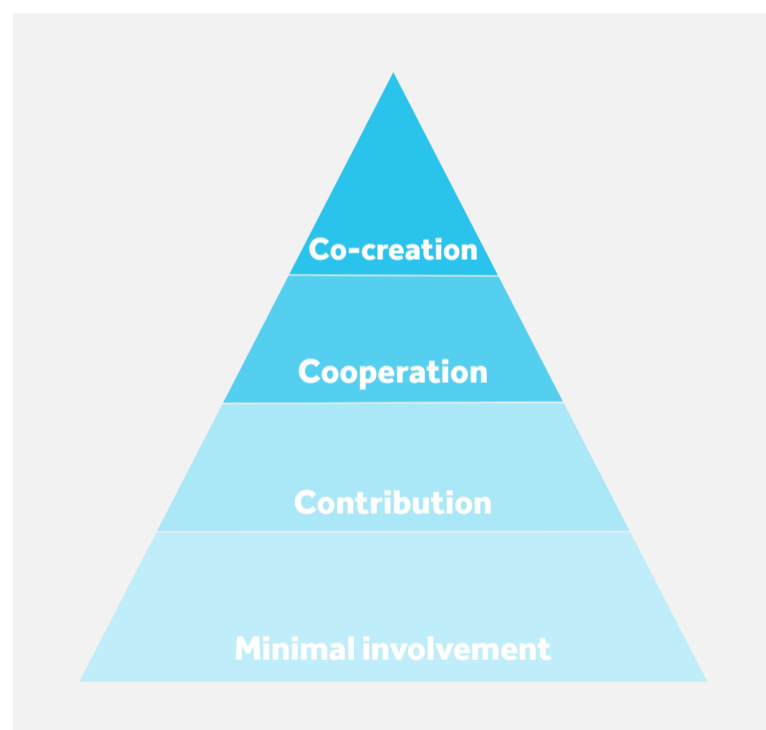
The citizen science participation pyramid. Based on the model presented at OpenScientist

Participation

Many participants
lower engagement

High engagement
fewer participants

Want to know more about citizen science? You can read more on the Scivil website and find referrals to more literature.

What are the benefits of citizen science for local government?

In recent years, citizen science has been gaining both attention among policymakers and recognition among the general public and research institutions. In this chapter we will elaborate on why it is worthwhile for cities and towns to engage in citizen science.

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The benefits of citizen science for local government are mainly situated in two areas:

1 **Gathering new data and insights** to inform, decide and follow up on policy choices;

2 **Increasing citizen involvement** in policy and important policy themes. For example, we now see that citizen science projects strengthen support for themes such as traffic safety, water quality, biodiversity, climate, health, etc.
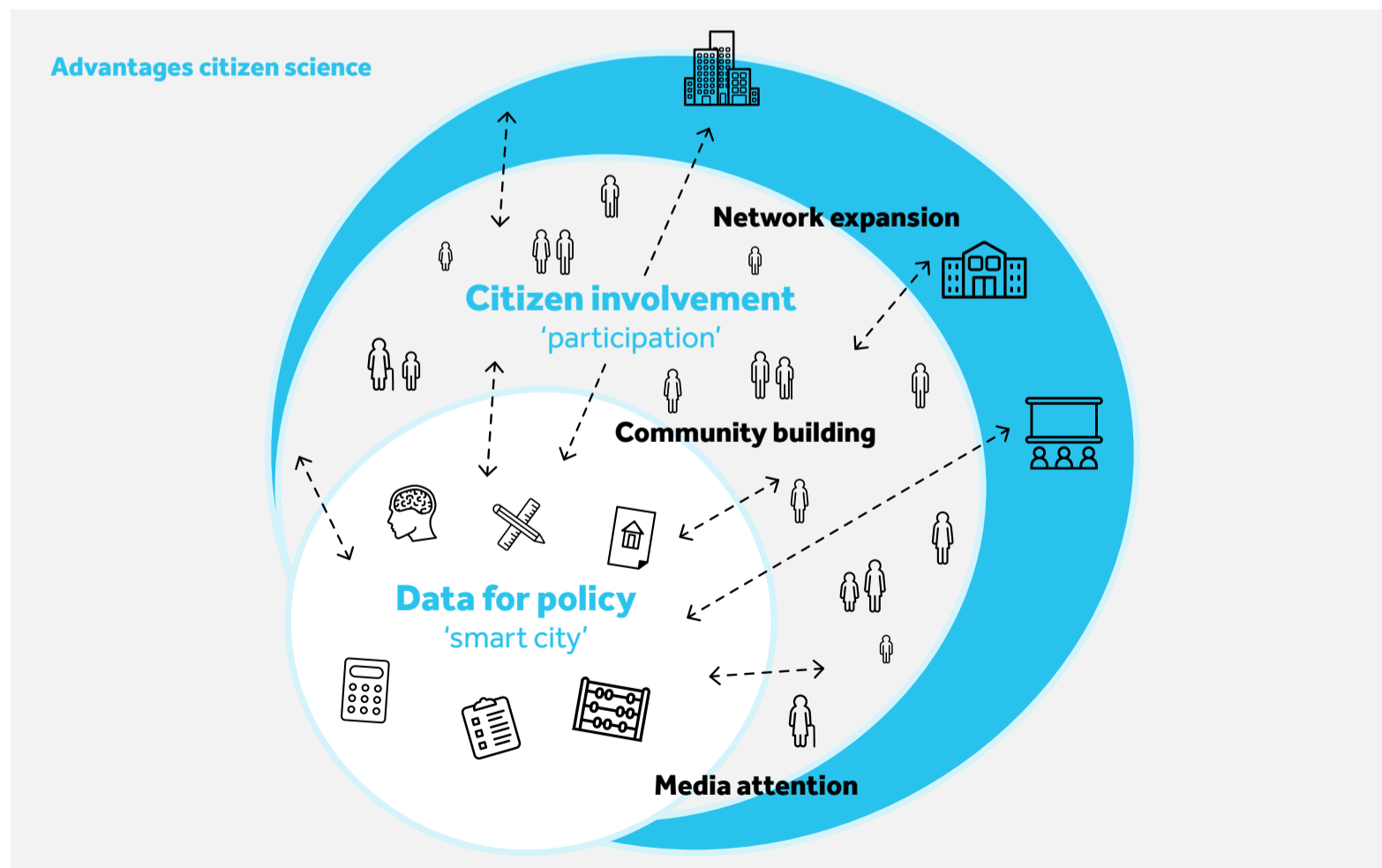
Additionally, citizen science also contributes to:

■ **Community building:** in citizen science projects, citizens work together and social cohesion is strengthened. The communities that emerge in citizen science projects can be considered as new associations;

■ **Network expansion:** in citizen science projects, local government cooperates with knowledge institutions ((vocational) universities, research institutions,...), civil society organizations (citizen movements, associations,...), companies, and external service providers (communication agencies, technology companies,...). These new partnerships enable local government to cooperate with these parties in other areas as well;

■ **Media coverage:** (the results of) citizen science projects are often in the spotlight. The administration's engagement in these projects ensures media attention for the local government and for the theme of the project.

These benefits can be visually presented in three circles. In a first circle, we see benefits for internal policymaking (additional data and insights for policy). The second circle refers to the strengthened relationship among citizens, and between citizens and the local government. The third circle concerns strengthened cooperation between local government and citizens, and other stakeholders inside and outside the city limits (knowledge institutions, social organizations, etc.).

Advantages citizen science

Network expansion

Citizen involvement
'participation'

Community building

Data for policy
'smart city'

Media attention

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## Added value 1: collecting new data and insights for policymaking

Through citizen science, a local administration can gather additional data and insights to substantiate policymaking. As part of the management and policy cycle, the Government of Flanders demands cities and towns to base their multiannual plan on an environmental analysis and to monitor their objectives using indicators. Not every theme has ready-to-use data to comply with these requirements. Data from citizen science are an interesting addition to existing data sources and often provide new knowledge and insights about the city or town.

In particular, citizen science makes it possible to gather a lot of data in a short time, to collect more detailed data, or to collect data that would otherwise remain hidden. The cost to the city or town is usually limited as the work is done primarily by volunteers.

We like to illustrate our point about detailed data collection with two examples:

- By installing "telramen" (sensors attached to windows), both citizens and the local administration get an in-depth picture of traffic in a neighbourhood. The end result is more detailed than a result based on a few counting loops or cameras installed by the administration;

- Local data on biodiversity is virtually non-existent. Via mijntuinlab.be, citizens and local government are able to gauge the fauna and flora at micro level, right down to private gardens. The evolution of biodiversity is also valuable policy information.

Citizen science facilitates the movement towards more data-driven policy. Based on reliable data, the local government can fully carry out its governing role: slowing down, stimulating, inspiring, etc. Just like other data types, results from citizen science can be used in every phase of the policy cycle, as explained in the blue box.

Policymaking

Policy preparation

Policy implementation

Policy evaluation
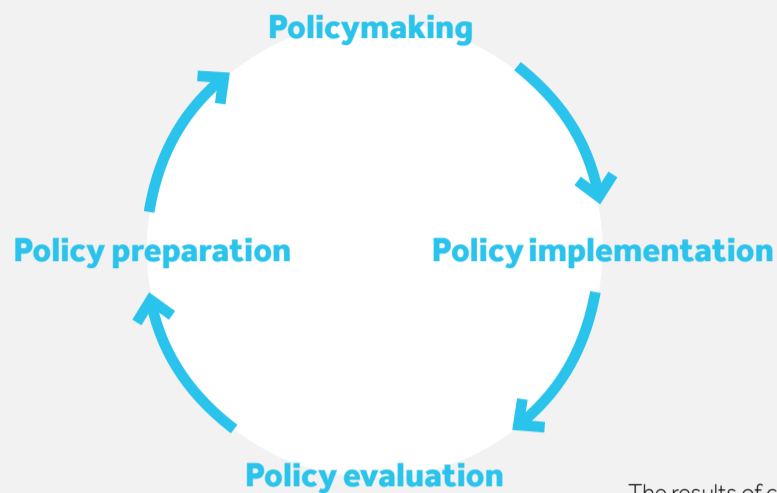
The results of citizen science can be used in every phase of the policy cycle.

Citizen science in the different phases of the policy cycle

Policy preparation: data from citizen science projects allow local government to monitor the changing environment and develop evidence-based dossiers. Some local administrations use citizen science data in the environmental analysis, or use data from Luftdaten to substantiate project proposals on mobility or climate.

Policymaking: policy decisions can be (additionally) substantiated by data from citizen science projects.

"We want to change the modal split in our city, namely cut car traffic in half and double bike traffic. Using the 'telramen' to assess traffic movements in the city, the local government makes informed decisions." — Interviewed civil servant

Policy implementation: are actions going as planned? Is the implementation on schedule? Using citizen science data, a local administration can assess the status of projects.

"We look at the CurieuzeNeuzen data multiple times per month, in order to formulate advice." — Interviewed civil servant

Policy evaluation: did our actions achieve our goals? Are we reaching the objectives from our multiannual plan? Using data from citizen science projects, a local administration can evaluate its policy and adjust it if needed. For example, citizen science projects investigating the heat island effect are used to monitor the impact of (local) climate policy.

Further reading
Would you like to read more about citizen science contributing to the policy cycle? In these European reports, you will learn how citizen science can contribute to environmental policies and various Sustainable Development Goals (SDGs).
- How citizen science can fill data gaps for the SDGs;
- Best Practices in Citizen Science for Environmental Monitoring.

Added value 2: increasing citizen involvement

A second important added value is increased involvement of citizens in policy and society. Through citizen science, local government can generate greater awareness of social issues, make more effective use of the skills and knowledge of citizens, and contribute to mutual understanding between government and citizens.

" The dialogue with citizens is at least as important as the accuracy of the data (…)." – Interviewed civil servant

Citizen science is a way to **generate awareness** on important social themes. Most projects in which schools participate, explicitly play out this form of sensitization or education.

" In general, we see an increase in knowledge, awareness and ability to act in schools regarding air quality thanks to the citizen science projects." – Interviewed civil servant

Furthermore, citizen science can also facilitate behavioural change. Examples include changing the way we move or disconnecting rainwater from the sewage system.

Citizen science is also a form of citizen **empowerment**. It helps communities bring certain needs or concerns into focus, and to the attention of local government. It is a way of utilizing the knowledge and skills of citizens, sometimes in areas where there is limited expertise within the local administration.

In doing so, citizens set the agenda and stimulate local authorities to take action. As a result of the findings of the CurieuzeNeuzen project, a number of local administrations set up their own network of sensors to get a deeper understanding of the issue.

" With the data from CurieuzeNeuzen, citizens approached politicians to divert a bus line in their street. As a result, a bus line was cancelled and the street was repaved." – Interviewed civil servant

Citizen science can also create a better dialogue and understanding between citizens and policymakers. Throughout a citizen science project, both parties get acquainted with each other's context. Citizens feel that they are heard and respected by their government, if attention is paid to their efforts in citizen science projects. Conversely, through their contacts with the administration, citizens gain insight in the whole context. Local governments have to take several interests into account when drawing up their policies.

Do not be caught off guard as a local government
By following up on citizen science projects in your city or town, you will stay informed and you will not be confronted with unexpected findings at the end of projects.

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Additional added values

In addition to the direct benefits (data collection, citizen engagement), citizen science also offers other potential added values.

Community building
Citizen science stimulates encounters and strengthens social cohesion within and between communities. In a sense, citizen science communities are new associations and enrich the socio-cultural fabric. Citizens use their leisure time in a meaningful way and obtain a sense of satisfaction and enjoyment throughout the process.

" Within citizen science projects, citizens listen to each other and learn to understand each other better: 'Oh, the trucks bother him, he has children and thinks it's a dangerous situation."   – Interviewed civil servant

Developing partnerships
Through citizen science, a local administration broadens its network. Since most citizen science projects involve important social organizations and scientific institutions, the local government broadens itself as a network organization. Sometimes there

are supralocal authorities or institutions involved like the Vlaamse Milieumaatschappij (VMM), the Instituut voor Natuur en Bos (INBO), provincial governments, … This way, a local administration establishes a better intergovernmental dynamic with other levels of government.

Via citizen science projects, the local government also builds relationships with (vocational) universities, Flemish administrations, Flemish research institutions (VITO, INBO, VLIZ,….), etc. These connections undoubtedly lead to interesting win-win situations in other fields. This network approach is consistent with the growing awareness among administrations that they are no longer able to provide answers to complex social problems on their own. Partnerships are necessary to tackle complex problems effectively.

Are you, as a member of a local administration, looking for partners, or would you like to sign up as a citizen science partner in Flanders (Belgium)? Go to the Scivil website and create a profile.

Media coverage
Citizen science projects and their results often easily attract attention. The administration's engagement in projects can provide additional media attention for the local government and the project's theme.

Tip: Collaborate with other local governments
Most social challenges do not stop at city borders (mobility, air quality,…). It is therefore interesting to also collect data outside the city limits. Collaborating with neighbouring towns on citizen science is most certainly an interesting idea. 'Intercommunales' can contribute to this kind of collaboration. For instance, the West-Flemish intercommunales WVI ('Smart Waterland') and Leiedal ('Telraam') were actively involved in citizen science projects for their member administrations.

How to start with citizen science as a local government?

As a local government engaging in citizen science, you have to appoint responsibilities, determine what you will (not) prioritize, which kind of support you will offer, which conditions you will set in partnerships, etc. In this chapter, we will outline a ten-step roadmap for developing a citizen science policy.

As a local government engaging in citizen science, you have to appoint responsibilities, determine what you will (not) prioritize, which kind of support you will offer, which conditions you will set in partnerships, etc. In this chapter, we will outline a ten-step roadmap for developing a citizen science policy.

Lots of cities and towns start with citizen science in an organic way: motivating citizens to participate in CurieuzeNeuzen, organizing a traffic count with Telraam, etc. This is an easy way to get familiarized with citizen science, but sooner or later key questions will arise about the role of the government or the extent of support for citizen science initiatives.

In this chapter, we will outline a ten-step roadmap for developing a citizen science policy, fully involving internal and external stakeholders. The steps follow a logical order, though this order is not predetermined. Some steps can come sooner or later in the process, depending on the specific context and the role of the local government.

A citizen science strategy for your city or town in ten steps

1 Appoint responsibilities within the local government and create a support base

2 Identify citizen science initiatives and stakeholders

3 Develop a project plan

4 Identify opportunities of citizen science for the local government

5 Determine the roles of the local government in citizen science

6 Determine which types of support the government will offer for citizen science initiatives

7 Determine requirements and standards that are important for the local government

8 Consolidate and communicate your local citizen science policy

9 Turn the policy into action

10 Evaluate the policy periodically

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Step 1: Appoint responsibilities within the local government and create a support base

Citizen science is a new theme and local administrations in Flanders are still relatively unacquainted with it. Therefore, the first question is: who will get the ball rolling within the local government?

We need process owners and ambassadors on two levels: on the general organization level, and on different department levels of the city or town.

■ On the general organizational level, the responsibility for citizen science is preferably appointed both administratively and politically. We have learnt from experience that citizen science is usually appointed to:
  • the staff member and alderman responsible for data and analysis;
  • the staff member and alderman responsible for participation.
Appointing this responsibility will ensure that there is a point of contact, and that you maintain an overview on the general organizational level: which initiatives are being undertaken within the city limits; how are data stored, etc.

■ It is also recommended that every department considers the possibilities of citizen science

in their respective policy domains. Ideally, the actual involvement of the city or town to a citizen science project lies within the department that is responsible for that theme. The traffic department could be involved in a citizen science project on mobility, while the environmental department could follow up a project on air quality.

If a local government is involved in multiple and complex projects, you could consider organising a working group on the general organizational level or the project level.

Creating support for a citizen science policy within a local government

■ Involve different city departments when developing a vision and strategy. Consult at regular intervals external stakeholders (knowledge institutions, citizen science initiatives, schools, social organizations).

■ Inspire staff members from different departments with good practices from this manual and/or from your own experience.

■ Test initiatives, start with easy projects (limited duration, limited investment).

■ Communicate about citizen science, both to the political level and to the civil servants. Use examples and highlight real-life applications for your organization.

Step 2: Identify citizen science initiatives and stakeholders

A survey among local governments shows that cities and towns generally have little insight into citizen science initiatives in their territory. Develop your citizen science policy, starting with a good inventory. Do not simply compose a list of completed, ongoing and planned projects within your city or town, but get to know the citizens and organizations involved, and ask about their plans, motivations, needs, etc.

In this introductory phase, you could consider organizing a meeting with all citizen science initiatives. This way, you get to know the initiatives better and you make clear that you value and hear the people behind the initiatives. Please note that not all citizen science initiatives will consider themselves as a citizen science project, e.g., local nature guides who keep track of certain animal species, local history societies, volunteers at archaeological excavations, etc.
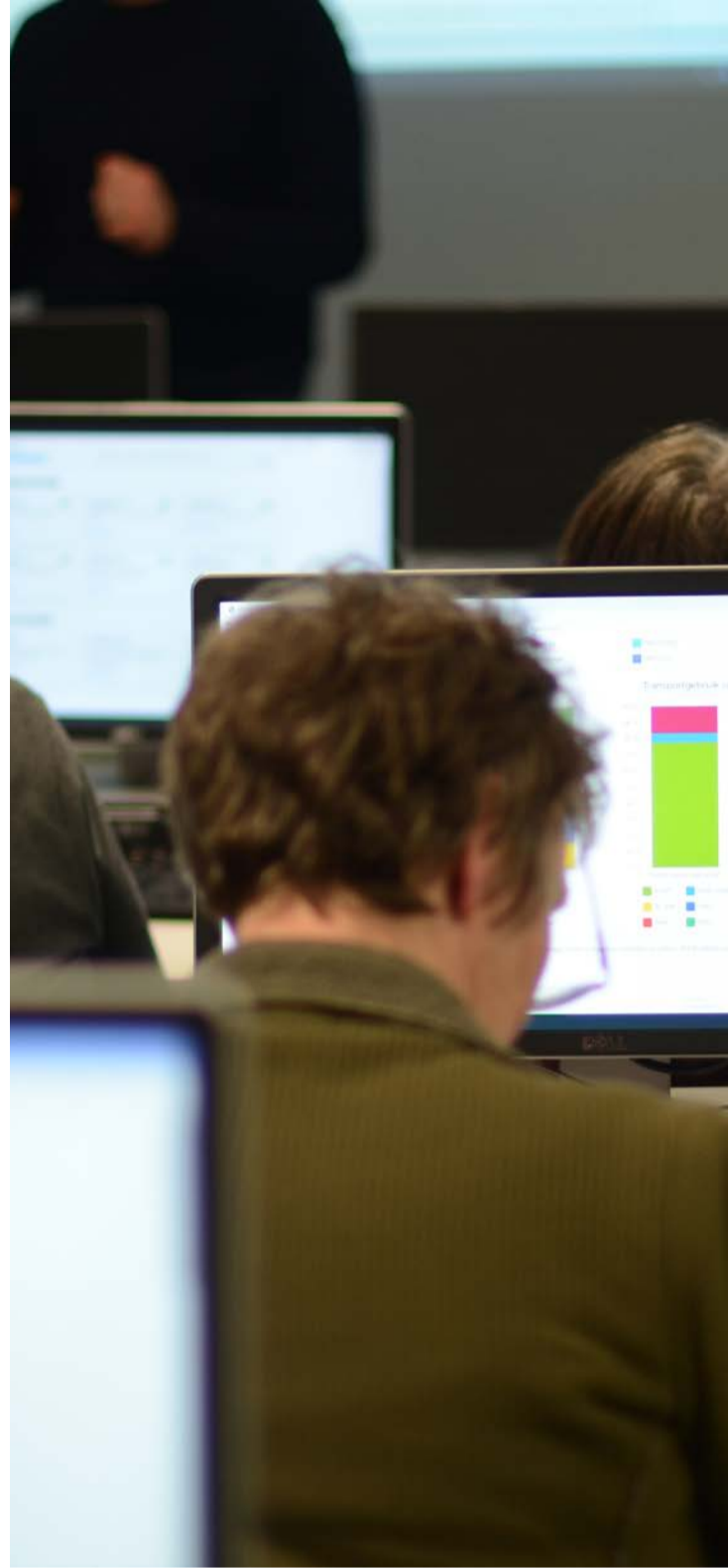
Step 3: Develop a project plan

You do not develop a citizen science policy on your own. You work together with employees from different departments, and you report to the city council, just like you would do with other actions and goals. It is important not to rush into this. Think carefully about how you approach and organize the development of your policy.

Develop a concrete project plan to introduce citizen science within your local government. In this plan, you should include among others:

- **the steps** you want to take. You can use our ten-step proposal as a basis;

- **the results** you want to achieve. The end result is an organization-wide vision and perhaps one or two concrete applications. Also determine

intermediate steps, such as the development of an opportunity map that summarizes the opportunities of citizen science for your local government (see chapter 2), a framework of agreements for dealing with data (see chapter 6), etc.;

- **the people** you want to involve (see chapter 5). As the person in charge, you can launch the plan yourself, but you should quickly involve colleagues from various departments in the process and form a small core group of enthusiasts. Together, you can reflect more deeply on the roles the local government will undertake, and on the forms of support (see step 6). Also provide one or two review moments in the trajectory with citizens, citizen science initiatives, schools and other stakeholders committed to citizen science;

- **the timeframe** you have in mind.

4

Step 4: Identify opportunities of citizen science for the local government

Creating a support base for citizen science (mentioned at step 1) is an ongoing process. It also implies identifying the concrete added values for the local government. If co-workers and managers see the advantages, you will motivate them more easily. Organize an interactive workshop on the subject with colleagues from various departments, and give attention to every domain. Environment or mobility are well-known themes for citizen science, but there are also interesting applications in culture, sports, health, welfare or public domain. Consider, for example:

- constructing the **history** of a town, based on photographs which citizens submit, classify and describe;

- **collaborating with citizens** to identify littered areas, analyse their characteristics and organize actions;

- identifying and analysing **gaps** in social services.

Citizen science does not always have to involve (new) data collection. You can also further analyse existing data, or organize discussion groups on the findings.

Identifying concrete opportunities does not imply that the local government itself has to take initiative. We strongly believe in embracing and encouraging bottom-up initiatives.

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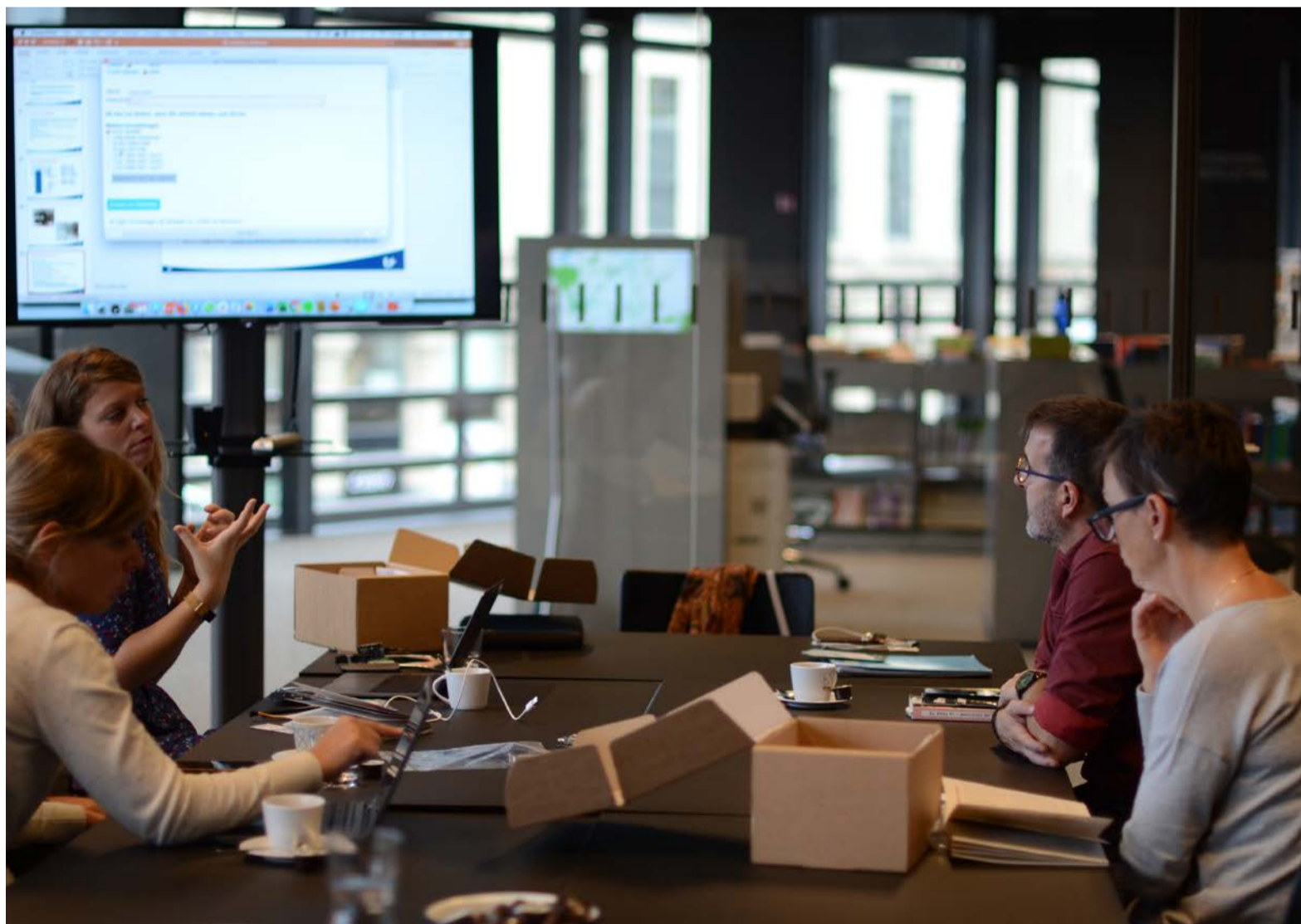
Specifying added value for the local government during an interactive workshop

Organize a workshop with employees of various departments to identify concrete opportunities. Provide several tables (or online: break-out rooms) in which the following questions are discussed:
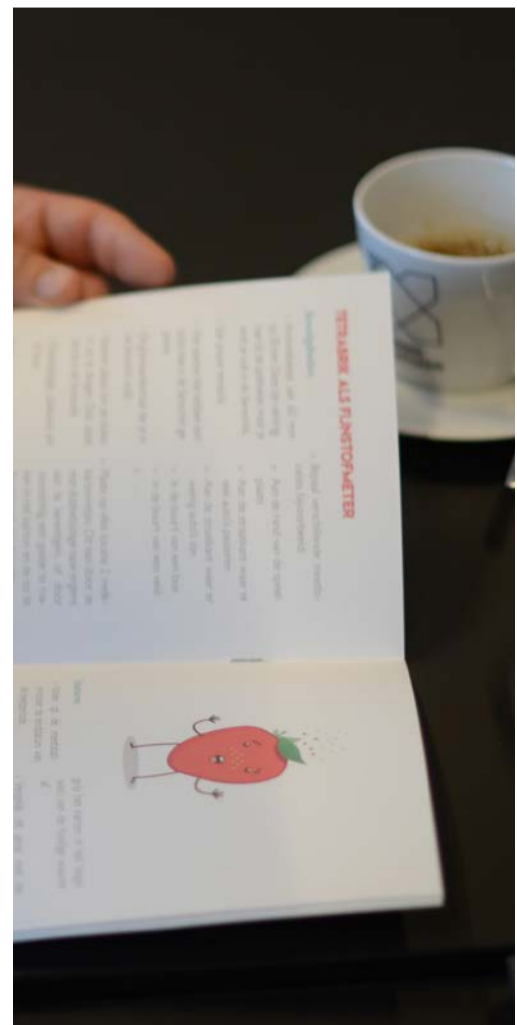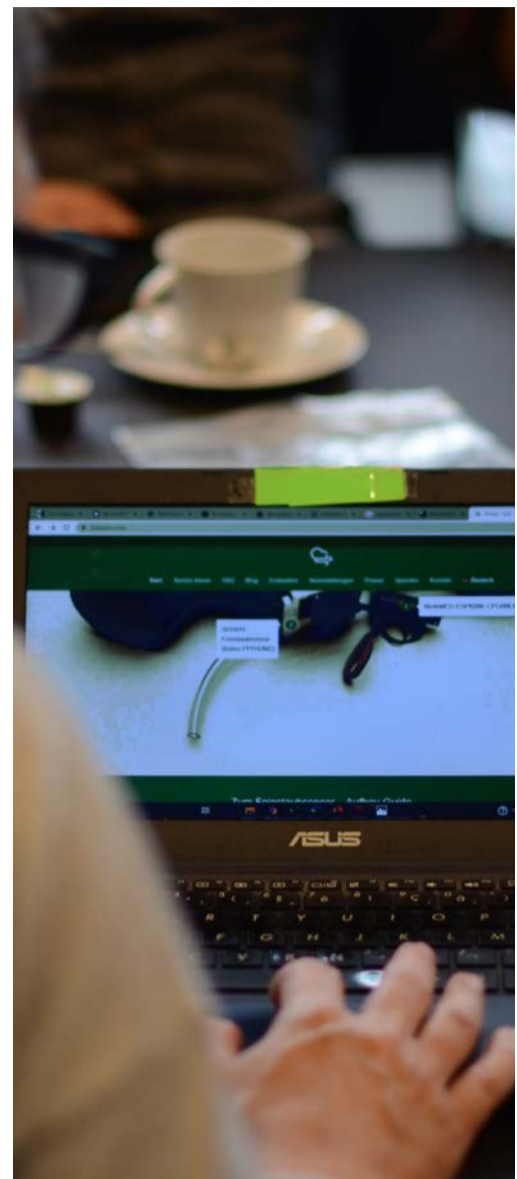
☐ which information needs are currently insufficiently met? Which trends or evolutions are underexplored?

☐ In which domains can citizen science involve citizens more strongly and/or raise awareness?

Let pairs brainstorm on post-its and rank them using the COCD box (see below). You can get to work immediately with the 'wow ideas' in the light blue quadrant.

The results of this exercise can be summarized in a persuasive opportunity map, that illustrates how citizen science brings added value to the local government.

What about spontaneous bottom-up initiatives?

Keep in mind that citizen science initiatives often emerge from society and are not often considered promising at first by the local government. In some cases, they will be in line with the ambitions of the administration, in other cases they will not. Sometimes they will seek contact with the local government themselves, in other cases they may want to keep a certain distance. The attitude of the local government or the degree of cooperation depends on the relevance and its possibilities, but in principle you should maintain an open attitude towards citizen initiatives.

COCD box for selecting ideas

	Common ideas	Original ideas
Not (yet) feasible		**'How' ideas** • Ideas for the future • Dreams and challenges • Wow ideas for tomorrow • Determining vision • Giving direction **HOW?**
Feasible	**'Now' ideas** • Easy to implement • Past examples available • Few risks involved • High acceptability • Low effort **NOW.**	**'Wow' ideas** • Innovative ideas • Breakthrough • Exciting ideas • Outstanding ideas • Energizing **WOW!**

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5

Step 5: Determine the roles of the local government

A city or town can be involved in citizen science in different ways. We distinguish seven different roles that in practice are often intertwined. A city can be a regulator, a partner in one project and a promoter in another project at the same time.

The choice of role of the administration is related to the importance it gives to citizen science. The position of the government can change across legislatures. Furthermore, the role of the government also depends on current events, for example if there is bottom-up pressure regarding the construction of a new ring road or a traffic accident. These events can lead you to switch to a more active role. Regardless of the role chosen, it is important that the entire administration is well informed. This way, everyone knows where the support or responsibility starts or stops, when you are approached by a citizen science initiative.

When considering these roles, we recommend an interactive work session with a smaller core group of colleagues. In doing so, you take into account the capacity and resources of the local government. The very active roles also require the necessary personnel.

1 **Regulator:** this role sets out the rules for citizen science activities, for example, deciding where sensors can be placed in public spaces, any rules that must be observed in terms of traffic safety, etc.

2 **Listener:** citizen science initiatives often arise from a concern in society. Groups collect data to make their concerns evidence-based ('to measure is to know'). Even if the project goal, the data or the research method do not entirely fit the policy agenda of the local government, it is important that these initiatives are not ignored. By entering

a dialogue with citizen scientists, the government may also succeed in aligning the research with its own expectations and agenda.

3 **Initiator:** in this role, the local government itself initiates a citizen science initiative. This can be a new initiative, but one can also tap into an existing initiative and roll it out more broadly within the city or town. For example:

> " We contacted Telraam - there are a number of streets whose traffic we want to assess, for the purpose of the mobility plan.
> We purchased and distributed about 50 'telramen'. Next week, there will be a call to recruit another 40 residents in the suburbs."
>
> – Interviewed civil servant

4 **Coordinator:** the city or town is in charge of the project coordination of a citizen science project. Evidently, this does not mean that the administration has to do everything, because then it would no longer be citizen science. In its role as coordinator, the administration maintains a bird's eye view on the project, maintains the network and the cooperation, and ensures that the intended results are achieved.

5 **Partner:** the government is an active partner in a citizen science project.

6 **Broker:** in this role, the government brings parties together and facilitates citizen science communities.

7 **Promoter:** as a promoter, the government supports and encourages citizen science initiatives through grants, logistics (communication, infrastructure), staff deployment, etc. The different forms of possible support are described in the next step.

6

Step 6: Determine which types of support the government will offer

A city or town can support citizen science projects in different ways. This choice depends on the vision and possibilities of the local government. It is important to make choices beforehand, and to communicate consistently, both internally and externally.

Expectation management is important
When a local government lends its support or cooperation to a citizen science project, citizen scientists often consider this to be a 'commitment for change'. The local government must be careful not to create expectations among citizen scientists that it cannot meet. Therefore, communicate clearly about which commitments you can make as a local government and which you cannot, in terms of project support, but certainly also in relation to the results and findings of the projects.

Also be open about the possibilities and the time needed to turn research results into policy and actual changes in the city.

Supporting communication
In terms of communication, a city or town can provide real added value for citizen science projects. Think of announcements for recruiting participants, announcing results or celebrating an initiative. In a survey conducted for this roadmap, citizen science initiatives indicated that they particularly appreciate the governmental support in the area of communication. Moreover, communication involves more than printed media and online communication. It also concerns organizing contact moments or developing targeted communication through advisory boards.

" The participation officer helped with the recruitment of volunteers. He used the city's online participation platform for this. A lot of citizens are registered there, so there has been a lot of response." – Interviewed civil servant

Logistics
Local governments can also facilitate financially in the purchase of equipment, for example sensors or do-it-yourself kits for sensors. In the case of 'Telraam', for example, we see that this is often the case. The financial resources usually come from the budgets of the departments involved, for example the mobility department when it comes to traffic safety. During discussions, there was an idea of a lending post or library for measuring instruments, although we have not yet found any concrete examples.

Personnel support
It is not uncommon for civil servants to lend a hand in citizen science projects. Current examples of personnel support include:

- management of a citizen science project;
- participation in meetings and thinking along with the initiators and participants of the citizen science projects;
- making personnel available for various tasks within the citizen science projects: collecting samples, maintenance of sensors, communication, etc.

Community building

The local government can also help create citizen science partnerships. The government can bring together knowledge institutions, civil society organizations, companies and citizens, or citizens themselves. The administration can use the broad network of organizations with which it is involved. We give a number of examples of this brokerage role below:

- The city of Bruges has a Facebook group on the theme of climate. By regularly posting relevant news and calls, the city builds a community committed to this theme. For citizen science projects on climate, volunteers can be recruited within this group.
- The city of Genk has, in the context of Stiemerlab, approached local associations (e.g., sports clubs) to participate. This has led to the introduction of a lot of new faces who perhaps would not quickly participate on their own.
- In the city of Ghent, the district director of the Meulestede - De Muide neighborhood motivated and brought together residents to count traffic on the Muide bridge.

Financial support

A local government can directly or indirectly facilitate the search for financial resources for citizen science projects:

- by helping citizen science initiatives to find financial resources: identify grant opportunities, and if necessary, support the development of grant applications;
- by launching a grant for citizen science initiatives or by opening up existing grants to citizen science projects. Examples are the subsidies for neighbourhood projects in Ghent (Wijkbudget) or the thematic call for subsidies for climate projects

in Mechelen. In both cases, these calls are also open to citizen science.

Local funding can certainly make a significant difference for small and local initiatives. Large citizen science projects, often launched by an academic institution, are more likely to aim for supralocal funding and larger grants.

Just about all projects - large or small - indicate that funding does not account for long term projects. Usually, funding channels are temporarily accessible, while initiatives often have the ambition to collect data over a longer period of time.

Should you, as a local government, support every citizen science initiative?

As a government, you don't have to support every citizen science initiative. With an open attitude and respect for citizen initiatives, you are already taking an important step. As a government, you can also refer to other partners. Initiatives that you support as an administration should first and foremost fit in with your own ambitions and the current multiannual plan. Make your needs known as a local government; this could lead to the joint development of a new project.

Managing, analysing and disseminating data

Depending on the capacity and knowledge within the local government, the city can also support citizen science projects that do not have knowledge of, or partners in data collection and analysis. In some cases, local governments turn to an external service provider.

7

Step 7: Determine requirements and standards

If the local administration participates in, or supports a citizen science project, it can also formulate boundary conditions. This is certainly a legitimate demand, if there is a strong commitment from the administration. At the same time, the administration should always be aware of the fact that they are dealing with voluntary initiatives that should not be deterred by excessively high requirements.

Requirements from the local government can relate to:

- the quality of data and measurements. Both objective (measurements) and subjective (opinions) data must be collected in a substantiated way. Therefore, you could offer citizen scientists professional training;
- making data available to the government and making data publicly available (open source);
- the openness of the citizen science initiative to all citizens.

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8

Step 8: Consolidate and communicate your local citizen science policy

When a local government has completely determined how it wants to deal with citizen science in the coming years, it is time to summarize the vision in a document. This will provide guidance for stakeholders.

Publish the vision on the local government's website, so citizens and associations can take note of it.

What comes first: vision or practice?
In an ideal world, a vision precedes concrete actions. However, this sets a high bar and threshold. You can also get involved with citizen science from a bottom-up approach, through concrete projects and collaborations. This way, a vision can gradually emerge, based on insights from experiences.

9

Step 9: Turn the policy into action

A vision for citizen science is important, but the real added value lies, of course, in its implementation and in the projects.

The ideas that were identified as "wow ideas" during step 4 can now be put into practice.

Many of the steps in the vision development are now turning into permanent tasks. Examples are taking stock of citizen science initiatives, sensitizing and inspiring departments, and supporting citizen science initiatives.

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Step 10: Evaluate the policy periodically

Like any policy plan, a citizen science policy is never finished. Over the years, needs change, new opportunities arise and we learn from experience. Periodically re-examine the vision on citizen science and make adjustments. Also involve citizen scientists in this evaluation.
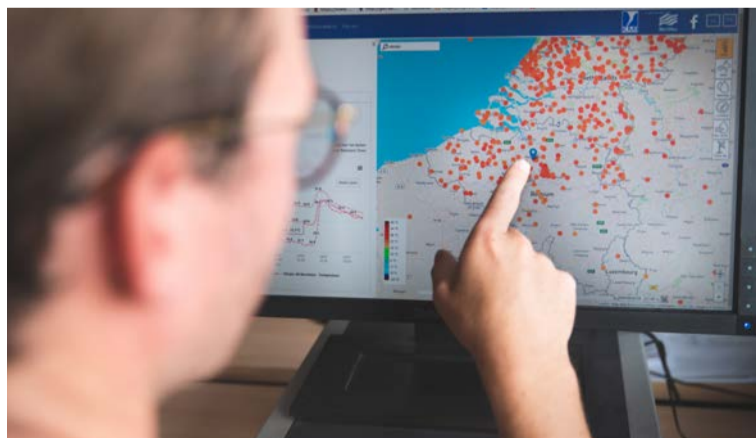
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As a local government, how do you deal with a citizen science project that takes on an "opposing" position?
Though rare, there is a chance that citizen science communities turn against the local administration and contest policy. If such a scenario unfolds, the following tips can help:

- ☐ establish a dialogue with an attitude of mutual respect;
- ☐ take note of the findings of the citizen science initiative, evaluate the findings and the way they were established;
- ☐ explain why you as a government can or cannot meet certain expectations. If necessary, ask for time to examine certain issues more closely;
- ☐ make agreements about future contact so that any difference in views does not escalate further.

04.

A roadmap for a citizen science project

In this chapter, you will find a step-by-step plan to get started with a citizen science project. The roadmap covers activities before, during and after setting up (your own) initiatives. Before starting a project using this roadmap, it is recommended that the local government already has a vision and policy on citizen science.

In this chapter, you will find a step-by-step plan to get started with a citizen science project. The roadmap covers activities before, during and after setting up (your own) initiatives. Before starting a project using this roadmap, it is recommended that the local government already has a vision and policy on citizen science.

How to use this roadmap

This roadmap provides a detailed overview of all activities involved in setting up and carrying out a citizen science project. It provides a manual for the project from inception to finalization. Depending on the role of the local government as well as the project's objective, you will go through this step-by-step plan in a different way.

The role of the local government
The role(s) that you as a local government wish to take (see chapter 3), determines how you will go through this step-by-step plan. If you as a local government are the 'initiator' of a project, you will take the lead in several activities. In more passive roles, such as 'the broker' or 'the regulator', you will be involved in one or a limited number of activities. Also, as the initiator of a project, you do not have to bear full responsibility for all activities: after all, citizen science is something you do together with others.

Furthermore, as a local government you can also choose to outsource certain activities to external providers, such as consultants, or you can assign them to project partners. This can be a suitable solution for local governments that do not have sufficient in-house capacity or resources.

If a citizen science project is started by citizens or a citizens' association, the local government may play a limited role, or it may even not be involved at all. Then, it is mainly a matter of finding out in which phase(s) the local government can set up a cooperation and possibly offer support. Have a look at the internal vision statement on citizen science of your local government (see chapter 3). This vision paper helps to define the role and form of support of a local government within a citizen science project.

The project's objective
The extent to which you follow this roadmap also depends on the project's objective (see Chapter 1). For a project that focuses primarily on data collection, the focus will be on the first phases of the project. If there is more emphasis on raising awareness, the focus will lie in the last phases of the project.

You can also use this roadmap to set up a small-scale project or experiment. Such a small-scale project can serve as a pilot study for a larger citizen science project in the future.

Tip: Experiment with citizen science
In order to build experience with citizen science, we recommend that you get started with this roadmap and start experimenting. Simple, short-term initiatives help overcome cold feet. This way, you can build your first experience with participation and data collection.

The roadmap consists of 22 steps, divided in six phases. You can also consult the roadmap interactively via the following link (in Dutch). This roadmap was developed in collaboration with local administrations and citizen science initiatives, and based on the manual by Tweddle et al. (2012).[1]

Phase 0: Consider

1. Define the problem statement
2. Is citizen science a suitable method?

Phase 1: Define

3. Define the project objectives
4. Find resources or funds
5. Assemble the project team
6. Identify your participants and get to know them
7. Take into account privacy and ethics

Phase 2: Develop

8. Determine the data protocol
9. Determine data requirements
10. Determine technological requirements
11. Develop support materials
12. Develop a communication and engagement plan
13. Conduct a pilot test

Phase 3: Launch

14. Promote and publicize your project
15. Receive data and provide feedback
16. Communicate and maintain engagement

Phase 4: Analyse

17. Analyse and interpret the data
18. Report the results
19. Share your data
20. Evaluate your project

Phase 5: Valorise

21. Translate insights into policy actions
22. Develop a long-term plan

[1] Tweddle, J.C., Robinson, L.D., Pocock, M.J.O. & Roy, H.E (2012). Manual to citizen science: developing, implementing and evaluating citizen science to study biodiversity and the environment in the UK. Natural History Museum and NERC Centre for Ecology & Hydrology for UK-EOF. **Available online**

Phase 0: Consider

Before you get started on a citizen science project, you should consider whether this approach fits the issue at hand.

Step 1: Define the problem statement

The very first step is to formulate a problem statement: what do you want to investigate? A problem statement describes a challenge or issue that you want to solve and forms the basis of your project. If the problem statement is not properly formulated, you may run into problems as the project unfolds. Make sure your problem statement is not too narrowly or too broadly defined and that it can be answered within a certain time frame.

By answering the questions below, you can determine your problem statement:
- Is your problem statement linked to a policy issue?
- Is your problem statement linked to a citizen concern?
- How much data do you need to find an answer?
- How can participants contribute to the project?
- What is the geographic scale of the problem statement?
- Are there already similar projects?

A problem statement can also be formulated by a citizen science initiative. Citizen science initiatives often arise out of a concern within society. Depending on the role of the local government, you can choose to define the problem together.

We recommend that you present the formulated problem to the person responsible for citizen science, and we also recommend that you perform an internal check (see chapter 3). Is there support within the local government for developing the problem statement? Which departments should be involved?

Traffic nuisance - a problem statement:
There have been citizen complaints about traffic nuisance in a particular neighbourhood in your city or town. A possible problem statement here is to collect insights about the degree of nuisance in cooperation with citizens, by monitoring the number and type of vehicles passing through the neighbourhood. This way, you can determine whether there really is a nuisance. A second problem statement could address the way this nuisance can be solved.

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Step 2: Is citizen science a suitable method?

In this step, you consider whether a citizen science approach fits your **problem statement.** It may well be that citizen science does not fit your problem statement at all, and that other methods of data collection (such as databases or questionnaires) or participatory methods (such as citizen panels or discussion forums) may lead to better results. There are a number of rules of thumb that can help you make this choice.

First of all, you will choose a citizen science project if you want to **support research and participation.** A powerful way to achieve this is by having citizens play an active role. Initiatives can be set up by citizens or a citizens' association themselves, or you let citizens actively participate in your project. An active way of participation, for example collecting ideas or data, will strengthen involvement in a particular topic. Building a dense network of sensors with the help of citizens is also possible. Make sure that citizens do not only place a sensor, but are also actively involved in the whole process, so that they also know why you are doing this. This way, citizen science acts as a participatory method to engage citizens.

A second important rule of thumb is the **complexity of the data protocol.** A data protocol defines the way participants are asked to collect data. How much time does it take for a participant to collect data? Is training required? The easier it is to participate, the better a citizen science approach will fit. Research shows that user-friendly data protocols that were applied to a large group of participants are more likely to be used for policymaking [2]. Thus, the more data that is collected in a simple way, the more it benefits both the local government and the participants.

Additionally, there are some other questions that can help you decide whether or not to engage in citizen science [3]. Answers at the right end of the spectrum justify a citizen science approach:

Do you have a clear and well-defined goal in mind?

Rather a vague idea	Clear research question

Can you engage citizens in a meaningful way?

One-way communication	Engagement is important

How many participants do you need to reach your goal?

Few participants	Many participants

How user-friendly is the data protocol?

Complex	Simple

Do you have sufficient resources to support participants?

No resources	Many resources

How clear are the motivations for participation?

No clear motivations	Clear motivations

Using these questions and tips, a local government can also give advice to citizens or citizen associations on whether or not to adopt a citizen science approach to the formulated problem statement.

Tip
The following publication, including a decision tree, can further help you to consider citizen science as a method for your project idea.

[2] Turbé, A, et al. 2019. Understanding the Citizen Science Landscape for European Environmental Policy: An Assessment and Recommendations. Citizen Science: Theory and Practice, 4(1): 34, pp. 1–16. **DOI**

[3] Pocock, M.J.O., Chapman, D.S., Sheppard, L.J. & Roy, H.E. (2014). Choosing and Using Citizen Science: a manual to when and how to use citizen science to monitor biodiversity and the environment. Centre for Ecology & Hydrology

Phase 1: Define

If citizen science fits as a method for your problem statement, then start by defining the first building blocks of your project.

Step 3: Define the project objectives

Citizen science projects generally aim for three different objectives (see Chapter 1). Link these objectives to your problem statement (see Step 1):

Objectives for a citizen science project
- contribute to research: collecting data;
- educate and raise awareness: increasing knowledge about a particular theme or issue, increasing understanding and support;
- create social impact: strong locally embedded projects in which people seek a solution to social issues.

Consider carefully which outcome(s) you are aiming for as a local government. You can combine several objectives, or have one primary objective. For example: if you choose to collect data, you also need to decide whether you are actually going to use, change or prove something with the data. You may choose, as your primary objective, to focus mainly on data collection and less or not at all on social impact. Of course, you can combine both objectives, this being the most ideal scenario. It is important that you clearly communicate these objectives to the participants: is it an experiment, a short-term intervention, or inspiration for a better city or town in the long run?

It is possible that the project's objective is already determined by the citizen science initiative and that it does not fit with the policy agenda of the local administration. In that case, you can try to enter a dialogue and align the research. If the objective is not yet defined, then you can link it to policy plans, your organization or policy issues.

The local government may also recognize the importance of taking on a new challenge that presents itself through the citizen science initiative.

In order to further shape your project objective, you can create a use case. A use case describes what you as a local government actually want to achieve with the project.

> " As a city you have to present a valuable use case to your citizens. Why are we investigating? What do we want to know? What are the measures? Is it for climate, health? For what age group? Why should the public be concerned about this? You have to have a cause and an approach."
>
> – Interviewed civil servant

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The template below can help you create a use case:

The project
(describe the problem statement and the challenge that you are addressing):

Objective
(describe the intended result):

Added value
(describe the potential benefits to the local administration):

Current and desired situation
(describe the current approach including existing practices, and the desired situation):

Logistical and financial support
(describe what resources you will need in order to carry out the project):

Risks
(describe potential failure factors and risks):

Involved departments of local government
(describe internal collaborations and responsibilities):

Involved target groups
(describe the target groups and their possible motivation):

Step 4: Find resources or funds

After defining the project objectives, you make a financial estimate of the project.

Via citizen science, you can collect a lot of research data in a short period of time. However, citizen science is not free of charge. The total cost will depend to a great extent on what role you take on as a local government, what costs your partners will finance and what type of support you will provide. This includes both staffing costs and material costs. Depending on the estimate, you may want to seek an external source of funding. Most costs will be made in the development phase of your project. Also keep in mind that the cost of a citizen science project will increase proportionally with the number of participants.

Citizen science initiatives may also ask a local government for financial support for their project. In this role as "promoter", you can provide material support, for example by making meeting rooms available, or personnel support, for example in promoting the project. As a local government, you can also support a project through a grant.

More information about financing citizen science can be found in chapter 7.

Step 5: Assemble the project team

Citizen science is about working together. In this step, you determine who is going to do what exactly. Will you take on a responsibility as a local government yourself? When is it better to outsource? Who are you going to outsource to? Or will you rather bring parties together?

Constituting a project team can be done on the basis of time management and expertise.

If you as a local government are the initiator of the project, then it is important to compose a balanced team. As initiator, it is your job to determine what competencies are needed for the project to be successful. You can find these competencies internally in the local government, outsource to an external service provider, or choose a project partner. The activities with the most impact on the project results are best part of a shared responsibility or taken on by you as a local government. For example, formulating a problem statement or project

objectives can be done in consultation with civil society. This way, you immediately set up a project in a co-creative manner. It is better to choose one person responsible for sharing data and following guidelines on privacy and ethics. When choosing the project team, you should also consider involving neutral partners. For example, knowledge or research institutions can be of added value in developing the data protocol and analysing data. They have the expertise and can analyse the results in a scientific way. This also generates public trust.

If you as a local government take on a 'broker' role, then you can propose a number of organizations that can be part of the project. You pass on a number of contacts to the citizen science initiative, and you could even introduce these parties to each other. Here, the government takes on a facilitating role by bringing different parties together.

Chapter 5 discusses collaborations in citizen science projects in more detail.

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Step 6: Identify your participants and get to know them

Do you want to reach the general public, active citizen scientists, passively involved sympathizers, people that would like to think constructively about a topic, or niche experts? The better you define the target group, the better you will be able to assess how to collaborate effectively. Citizen scientists have their own motivations and aspirations. Not knowing your potential target group and not knowing how to stimulate that group is a potential pitfall in citizen science.

It is therefore important to list your target groups and think about their profile and possible level of involvement in the project:

- **Primary target groups:** a primary target group consists of people who will be most involved in your project, and for whom your project objective has the greatest impact. This is the target group that will contribute the most to your project.
- **Secondary target groups:** a secondary target group refers to the people who will be informed about your project, but who are not directly involved. This can change in a later phase of the project, when a secondary target group becomes a primary target group.
- **Intermediary target groups:** an intermediary target group is a group or person through which you can communicate about your project.

Local governments can play an important role in defining and bringing communities together, without actively contributing to the project. In the "broker" role, you then focus primarily on bringing parties together.

Tip
You can find more info on this activity in the manual "Communication in citizen science. A practical guide to communication and engagement in citizen science".

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Step 7: Take into account privacy and ethics

Citizen science can pose challenges in terms of privacy and ethics. The Citizen Science Data Charter includes a number of guidelines on privacy and ethics:

- Pay active attention to privacy and ensure knowledge sharing: provide a basic information kit about privacy, rights and obligations, and integrity in data processing. Designate a data manager.
- Comply with the GDPR guidelines.
- Communicate clearly about intellectual property and copyrights: do so for the data collection and dissemination of the results.
- Carefully trade off your data quality and quantity against ethics, feasibility and project objectives.
- Watch out for undesirable ethical side effects when releasing your data.
- Adopt a respectful, equal attitude toward citizen scientists.

If you as a local government are an initiator or partner in the project, you will follow up on these guidelines. In more passive roles, such as the regulator, you may advise and pass these guidelines on to citizen science initiatives.

Click here for a detailed explanation of the citizen science privacy and ethics guidelines.

Phase 2: Develop

In this phase of the citizen science project, you make all preparations before the project kicks off.

Step 8: Determine the data protocol

In this step you determine the data protocol, this is the way participants collect data. To determine the data protocol, you will consider the following questions:
- What type of data do you need? Does it involve objective or subjective measurements? Do you focus on one or more parameters?
- Does it involve creating a new dataset or adding to an existing dataset?
- What is the geographical and temporal scope of the project?
- Do you need a representative sample?
- How will participants have to collect the data: via one or several measuring instruments?

In general, it is best to develop a simple data protocol. The easier participants can collect data, the more likely you will collect qualitative data over time.

If the data protocol is too difficult, participants might drop out quickly or you might exclude certain groups.

As a local government, you can also let experts, such as informed citizens or scientists, determine the data protocol. It can also be a shared responsibility in the implementation of a project.

Tip
Match your data protocol with the skills and knowledge of your participants.

The hackAIR project uses different instruments to measure air quality. There is a mobile application where you can take a picture of the sky to get an indication of the local air quality. For participants with more technical knowledge, there are building kits for mobile and fixed air quality sensors. By combining possible measurement tools, you enable participants to grow in knowledge and skills throughout your project, and you will appeal to a more diverse audience.

Step 9: Determine data requirements

When determining the data requirements, you consider the following questions:

- How do I obtain reliable data?
- What are possible mistakes that participants can make?
- What are possible validation mechanisms?
- What are possible verification mechanisms?
- Who is responsible for data management within the team?
- How will I store data, analyse it and make it accessible?

We recommend writing down the answers to these questions in a data management plan (DMP). In the DMP, you describe how you ensure - during and after completion of a project - that all data have a reliable quality, are stored securely and are made optimally findable, accessible, reusable and linkable. We recommend having the DMP prepared by a permanent project partner. This will usually be the partner who will physically store and manage the data.

Chapter 6 goes more into detail on how to obtain reliable data. Further, there is also the Citizen Science Data Charter for setting up a DMP for a citizen science project.voor een citizen-scienceproject.

Verification in the "Oog voor Diabetes" project

In the "Oog voor Diabetes" (Eye for Diabetes) project, citizens annotate abnormalities on retinal images. In doing so, they help build a reference database of annotated images that can be used to train an intelligent computer model to eventually recognize diabetic retinopathy by itself. As a built-in verification mechanism, each retinal image is analysed ten times by different citizen scientists, so that errors can be averaged out easily.
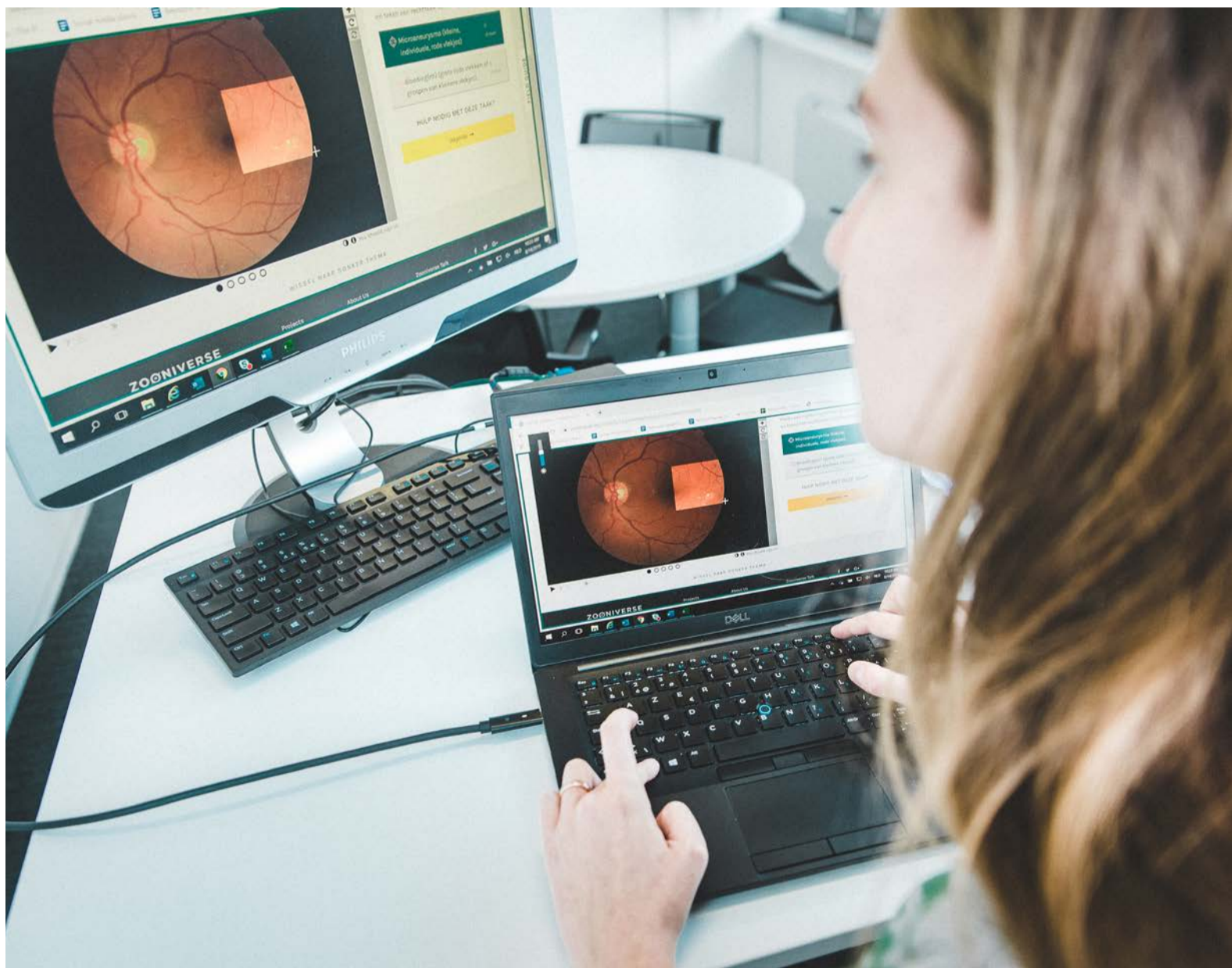
Step 10: Determine technological requirements

In addition to determining the data requirements, you also have to consider the technological requirements of your measuring instruments. The following questions can help:

- Am I going to use a mobile application to collect data?
- Am I going to use open-source software or develop something myself?
- Am I going to use a web-based technology?
- Am I going to connect with citizen scientists online and how am I going to set this up?
- Am I going to bundle all content on one project website?
- What sensors will I choose? Where will I install these?
- Do I distribute off-the-shelf sensors, have participants build their own, or distribute a pre-made sensor kit?
- Would I like to share the results on a public display in my city or town?

Local governments are often approached by citizen science projects to discuss certain technological requirements. Usually, this concerns location determination of sensors and permission to install them. In the 'regulator' role, the government can determine where sensors will be placed in the public space and provide staff to install them. You can also give advice on which measuring instruments to choose, if you would like to use certain data yourself for formulating policy actions.

When choosing measuring instruments, it is important to consider a number of factors.

First and foremost, there are the lifetime and quality of the measuring instruments to consider. Low-cost sensors can be purchased in large quantities. For example, an air quality sensor from Luftdaten costs about 50 euros. However, the lifetime and quality of these measuring instruments are not that good. Be transparent about this to participants and colleagues within the local government. Explain that the data come with a certain margin of error and that after a number of years the sensor will no longer measure as well as it did at the start.

Furthermore, it is also important to match the measuring instruments to the target group. A choice for a certain technology will always implicitly appeal to a certain target group. For example, sensors in a do-it-yourself kit will appeal to a more technical audience. Make sure you do not exclude certain groups. Possible solutions are providing guidance, giving sensors on loan and/or working with a socially favorable rate.

Muide Meulestede Morgen

Measuring instruments do not have to be high-tech. You can just as easily collect traffic data using only pen and paper. This method of pegging was applied in the 'Muide Muilestede Morgen' project. This urban renewal project has an eye for sustainable mobility. A number of residents raised the issue of the excess amount of through traffic at the Muidepoort.

Step 11: Develop support materials

In this step, we emphasize providing support materials for citizen scientists. Who can they turn to with their questions? Who will answer these questions and in what timeframe? Make sure you have a general info@yourcitizenscienceproject.com address to handle incoming questions from participants. Appoint a person to centralize these questions and gather all necessary information from the different project partners.

Participants in your citizen science project need good support to carry out the data collection or analysis correctly. There are a number of possibilities:
- Video clips
- Step-by-step instruction manuals
- A list of frequently asked questions
- Training workshops
- Organizing a webinar with the opportunity to ask questions to an expert. This can also motivate participants who want to gain more in-depth knowledge on the topic.
- "Train the trainer" modules: you provide training to a number of participants in your project, who in turn will help other participants. This is a (cost-)efficient way to support a large group of participants.

This responsibility is best taken on by a partner who has the necessary expertise and capacity to continuously support participants. As a local authority, you can also work with ambassadors.

An ambassador for your project

In the project "Luchtpijp", the organization Beweging.net works with volunteers to build sensor kits. The volunteers put these kits together and think about how the sensor can be optimized. These volunteers have become ambassadors of the project. They help other participants with technical problems with their sensor. For example, they go to people's homes to provide on-site support.

Step 12: Develop a communication and engagement plan

Communication is an essential component of citizen science. This is how you recruit, engage and motivate participants. Communication is also necessary to disseminate the results of the research or to raise awareness among the general public. You should not underestimate the time invested in communication with the citizens involved and to the general public. It has become something of a cliché that 90% of your time in a citizen science project is attributed to communication.

In your communication plan, you can consider (public) moments when you communicate about the project. In addition to a launch event organized by the local government, you can also attract some media attention during and after the project.

> **Tip**
> Learn more about developing a communication and engagement plan in the manual "Communication in citizen science. A practical guide to communication and engagement in citizen science".

Step 13: Conduct a pilot test

This activity is not a necessary step in your project, but it is definitely recommended. Before you launch and promote the project, test all materials with a small group of participants, preferably co-workers, friends or acquaintances for whom it is okay to make a mistake.

You will test the entire course of the project: do the participants understand the project objectives? Do they know where to find the measuring instruments? Do the collected data end up on the server?

Evaluate with the project team and adjust if necessary.

Phase 3: Launch

In this phase, you launch the project to the general public. This is the phase where data are collected and you generate and maintain engagement with participants.

Step 14: Promote and publicize your project

In this step, you launch and promote the project to the general public. The prepared communication and engagement plan, in which you identified target groups and communication channels, will now be carried out.

The local government can take charge of the launch and promotion of a citizen science project, if it is the initiator of the project. If you do not have the resources or capabilities to do so, you can outsource this step to a project partner or service provider such as a communications agency.

However, a local government is ideally placed to create initial outreach. You can use the regular communication channels to promote the project, such as the website of the city or town. Furthermore, 'stadswachters' can flyer and you can launch a call through a city magazine or district newspaper,

social media, digital screens, etc. The local government can also make targeted contact with associations to address specific profiles, such as youth clubs or social services. Knowledge institutions and bottom-up initiatives often turn to local governments for this type of communicative support.

In order to facilitate continuous participation of citizens and manage the community, we recommend working through organized groups and networks. Consider, for example, a civic association or network, or a university's science communication department. These organizations have the necessary expertise to connect with participants on a regular basis.

> **Tip: Make optimal use of the power of the media**
> You can highlight your project using a press release. Make a list of journalists in advance and contact them. Also write to them regularly about the status of your project. You might also consider appointing media personalities as endorsers of the project. Also do not forget the local newspapers and TV stations.

Step 15: Receive data and provide feedback

Once you launched your project, participants will get to work. This is when data or metrics are collected and submitted. Monitor the chosen measuring instruments, and regularly check for technical problems in receiving the data. At this stage of the project, you will also hand out support materials. Share instructional videos or make sure someone is available to answer questions.

In addition to monitoring the incoming data, you can also monitor the number of participants. How many participants are registered? How many times has a mobile application been downloaded? If you are working with sensors, you can also check how many sensors have been distributed and how many sensors are actually connected to the network and the platform. If you notice a drop in the number of participants or amount of data submitted, additional recruitment may be required.

Also make sure that, at this stage, you are able to provide quick feedback. This will help motivate participants. If you will be working with data submissions, you can send out an automated thank-you email. For more extensive feedback, you can use a recurring newsletter or intermediate physical meetings. When giving feedback, do not make too much use of personal communication, but bundle your messages and communicate through generic channels.

Step 16: Communicate and maintain engagement

In line with the previous activity, in this step you think about maintaining high involvement among participants. This is one of the main difficulties in a citizen science project: how do you ensure that participants do not drop out and that they stay involved in the long run?

Be aware that the number of participants who drop out is highest at the first contact with the project, or just after. The reasons why they choose not to participate anymore, are diverse, such as too much jargon used, a complex data protocol, but also a perceived lack of appreciation or openness about the results. To keep participants involved in the long run, it is important to regularly give a token of appreciation:

"Provide appreciation: pastry or a reception, a thank-you email, or a goodie bag." – Interviewed civil servant

"As a thank you, there was an excursion to the Netherlands, where there was a partner meeting with a dinner. The participants enjoyed talking to locals about water measurements." – Quote from a citizen science initiative

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Phase 4: Analyse

In this phase of the project, you analyse the collected data

Step 17: Analyse and interpret the data

The tasks of the city or town in this activity depends very much on the project and on the chosen role. If a project was not initiated by the local government, it obviously does not have to be responsible for the interpretation or conclusions. However, it is important to be involved in the analysis phase, if the local administration wants to draw conclusions for policy.

Data analysis and interpretation are best carried out in cooperation with knowledge institutions and citizens. A knowledge institution has the necessary experience in scientific data analysis and interpretation, and they give legitimacy to the results. By involving citizens, you increase co-ownership, ensure that the interpretation is not too one-sided, and generate broad support for the conclusions. Analysing and interpreting data together can also facilitate a healthy dialogue and corresponding visions.

" Having a scientific partner, or a citizens' association linked to a knowledge institution is crucial. We don't have the in-house knowledge to carry out the interpretation of the data, to determine the data structure or to draw scientific conclusions. It is not in the DNA of a city to carry out these tasks. But this is the good thing about citizen science projects: you have to do it together with other parties. You can't do it alone: it's a quadruple helix model." – Interviewed civil servant

When analysing and interpreting data, you need to take the following aspects into consideration:

- How reliable is the data? Is it necessary to clean up the data?
- How do we visualize the results? Do we use a dashboard, graphs, infographics, etc.?
- Is there qualitative feedback we should take into account?

Verrijk de kijk op Brugge

In the citizen science project 'Verrijk de kijk op Brugge' (Enrich your view of Bruges), participants help to describe images from the city archives, the public library and 'Musea Brugge'. Participants are asked to look at the images and describe what they see. Which people can you identify? What buildings do you recognize? Do you recognize Bruges or a borough? Participants complete an instructional form and then transmit the information to the registrars. The finalized information is shared through this website.

Step 18: Report the results

In this step, you communicate the research results. You share the results with your primary and secondary target groups, as well as relevant partners and the political administration. We recommend presenting the results tailored to the target group. You can opt for a more accessible infographic for the general public, while an in-depth report can be sent to a more professional audience. You can also disseminate the results through the press, or through a personal contact moment with the participants. This offers an additional opportunity for dialogue and discussion about the results. You also share the results internally with other departments and the political administration. This communication must include a clear outcome, so that the resources invested are justified.

Reporting the results is an important communication milestone in your project. If your project has no follow-up, this will in most cases be the last physical (or online) contact moment with the participants.

Step 19: Share your data

After analysis and interpretation, you can start sharing your data. This is a key trademark of a citizen science project. The data and metadata are made publicly available and the results, if possible, are published in open access. Sharing data takes place during or after the project, unless this is not possible for security or privacy reasons.

If you as a local government have not collected the data yourself, then you can determine together with the initiative whether they can be published on the platform of the city or town.

You can read about sharing data correctly in the Citizen Science Data Charter and in the Open Data Charter.
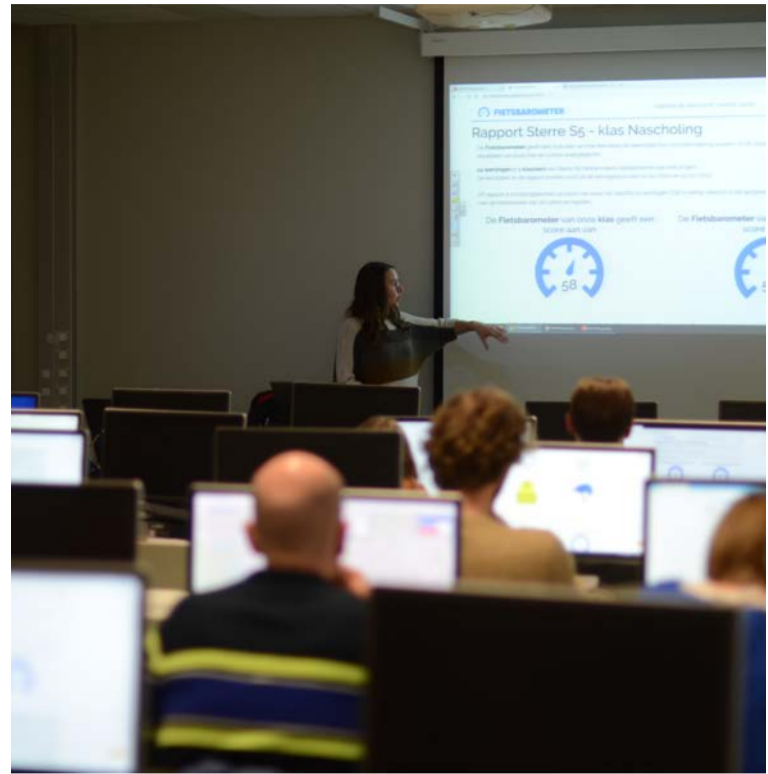
Step 20: Evaluate your project

In this step, you revisit the initial use case that you described at the start of the project. In doing so, you evaluate the success factors and pitfalls that you encountered along the way: what went well, what could be improved?

It is best to do an evaluation with the entire project team. Involve everyone and reflect on the project objectives and the results achieved. You can also draw up a number of indicators that you will test. These can be both qualitative and quantitative indicators. For example: how many people did we reach with the project? How much data did we collect? If your objective was to raise awareness, you can also look at the actual impact in terms of knowledge or behaviour about a particular theme.

Citizen science by and with local governments is still an emerging practice. Your project-based and research-based conclusions are extremely valuable to share with others.

Tip

Learn more about project evaluation citizen science, in the manual "Communication in Citizen Science. A practical manual to communication and engagement in citizen science".

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Phase 5: Valorise

This is a final, crucial phase for local governments. In this phase, the results are translated into concrete policy actions.

Step 21: Translate insights into policy action

If your citizen science project aimed to use the collected data for policy, this is the phase where the local administration moves forward with concrete action. Based on the results, the local administration will actively use the data for advice, adjustments to policy, or evaluation of measures and implementations. If you do this right, then you can speak of a data-driven policy. Ideally, the local government also reuses or combines data for other use cases. Indeed, experience shows that data can be useful for different services or challenges, even where one does not expect it.

Some examples where citizen science data can lead to concrete policy actions:
- adjusting circulation plans in certain neighbourhoods, based on traffic counts;
- adjusting plans for public space and planting additional trees, based on data from local monitoring stations and data on heat stress;
- adjusting the mobility plan by building a bicycle street, based on air quality measurements;
- using citizen science data to shape future policy plans, such as cutting car traffic in half and doubling bicycle traffic, and to support arguments in doing so.

Tip
If you as a local government collaborate with a knowledge institution for data analysis, we recommend discussing this step with them. Together, you can assess whether or not the data can be used for policy actions. "To measure is to know", but using data for policy needs requires the right framework and a foundation in data.

Step 22: Develop a long-term plan

If the local government is eager to develop a long-term vision for a citizen science project, you will now consider the following questions:
- Will we repeat this project annually?
- Should we develop a follow-up project with a different focus?
- How can we keep the project alive within the community?
- Can we link the project to other projects?
- Who will take on future maintenance of the sensors?

It is not necessary to write a long-term plan for a citizen science project. A one-off initiative can be sufficient. The advantage of writing out a vision for the long term is that projects are better aligned, expertise from multiple services is bundled and there is a constructive collaboration between knowledge institutions and citizens.

Meet Mee Mechelen
"Meet mee Mechelen" was coordinated in 2016-2017 by the research institution VITO through a H2020 grant. The project focused on air quality measurements and noise measurements. Afterwards, the project was taken up by the citizens' association "Klimaan", who now have a constructive relationship with the City of Mechelen.

05.

Citizen science equals collaboration

Citizen science involves, without exception, collaboration. In this chapter, we will elaborate on how to find partners and set up collaborations.

Who is involved in citizen science projects?

In citizen science projects, we often see collaboration between actors from the 'social pentagon'. The following examples of organizations were collected during the workshops we held with local governments and citizen science projects.

■ **Civil society:** these are citizens, action groups, civic associations and other (voluntary) societies where citizen science actors can be recruited through a membership base. For example: Stadslab 2050, Gents Milieufront, Filter Café Filtré, Beweging.net, Histories vzw, VELT vzw, Avansa, Mintus, ...;

■ **Knowledge institutions:** these are research and science institutions, schools, (vocational) universities and educational associations. For example: Ghent University, Luca School of Arts, Plantentuin Meise, Instituut voor Natuur- en Bosonderzoek (INBO), VITO, imec, ...;

■ **Governments:** these are local and supra-local authorities, and other public organizations.

For example: local governments, the provincial government, Intercommunale Leiedal, the Vlaamse Milieumaatschappij (VMM), the Government of Flanders, Geopunt Vlaanderen, ...;

■ **Industry:** these are private companies with expertise in certain types of sensors, in building platforms, legal or judicial advice, data management, communication and media, ... For example: District09, Digipolis Antwerpen, Bits of Love, law firm De Groote - De Man, Breeze Technologies, EOS Wetenschap, Voices that Count, De Standaard, Cronos, ...;

■ **Financial world:** there are Flemish, national or European institutions that provide funding or launch grant calls for citizen science. For example: the Flemish Department of Economics, Science and Innovation (EWI), the Fonds Wetenschappelijk Onderzoek (FWO), European Commission - Horizon Europe, ...;

However, this categorization is not exclusive. Certain organizations can fall under several categories. Research institutions can, at the same time, be governmental bodies, such as the Flemish Institute for the Sea (VLIZ). Likewise, a voluntary association can also commit to educational tasks, like Natuurpunt does. Similarly, the social services of a local government can help search for specific groups of participants.

The social pentagon
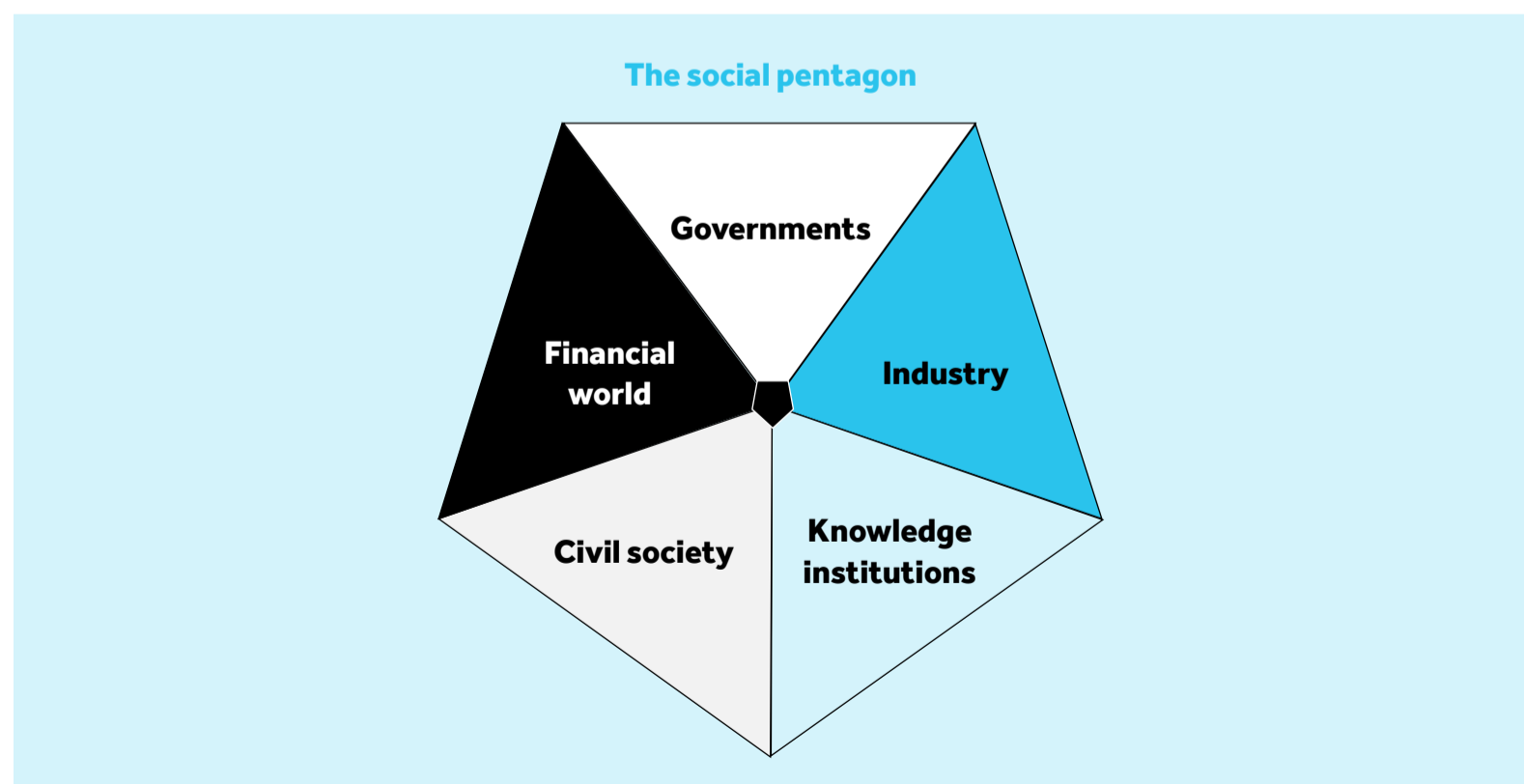
Who does what?

In a citizen science project, you can compose a project team based on several elements. First of all, you can opt for an interdisciplinary team. You can combine different scientific disciplines, like various research groups from different faculties, but you can also work together with different actors from the social pentagon. Furthermore, you could consider the required competencies, the range in target groups and the win-win situation you aim to create for each group.

Considering the required competencies, you can address specific actors. You can look for these competencies within your local government, outsource them to a company or choose a project partner from civil society such as a volunteer association. The activities with the most influence on the project results are best set up in a shared responsibility with civil society or, when you are the initiator of a project, taken on by the government itself. For example, formulating a problem statement can be done in consultation with civil society. This way, you can set up the project co-creatively from the outset. For sharing data and monitoring privacy and ethical guidelines, it is better to appoint one responsible person.

> **"**We must get rid of the idea that we, as a local government, must do everything ourselves; we do not have the capacity nor the resources. Citizens can do something themselves in their garden and then you can include this. Citizens can do more than you think."   – Interviewed civil servant

If you as a local government take on the role of a 'broker', then you can suggest a number of partner organizations. You pass on a number of contacts to the citizen science initiative, and you could also introduce these parties to each other.

Here, the government has a facilitating role in bringing different parties together.

Possible competencies that can be useful in a citizen science project:
- **Project coordination:** monitoring the project plan, formulating a problem statement, logistical support, …;
- **Formulating the problem statement:** formulating the research question or collecting ideas or challenges;
- **Communication:** recruiting participants, publicizing the project, engaging volunteers, valorising the results, …;
- **Ethical and legal advice:** guidelines on data and ethics in citizen science;
- **Research:** defining the research method, analysis and interpretation of the data, …;
- **Technology:** determining data and technological requirements, such as sensors, measuring devices, platforms, …;
- etc.

As we learn from experience, actors find each other mainly through informal contacts or through intermediaries. The Scivil network can be a good starting point.

Tip: Take a look outside the specific field of expertise
It can be useful to involve partners outside the expertise domain. For example, for the "Grote Schelpenteldag" (Big Shell Counting Day), in which participants are asked to count shells on the beach, the VLIZ chose to collaborate with the 'cel Kusterfgoed' (Coastal Heritage Unit). Beforehand, they were not involved with shells at all, but they do make paper beach flowers, from a heritage point of view. In exchange for the shells, participants receive a paper beach flower. Such a partner contributes to valorisation, by bringing a different focus to your project.

Tip: Should a professional scientist always be involved to ensure reliability?
Scientists are not a necessary prerequisite, but they are extremely valuable for determining and monitoring the methodology. They can also ensure that data and findings are generated in a scientific manner. It is also recommended that scientists partner up with citizens in these projects, so that the methodology and protocols remain accessible. This way, you also prevent a (growing) gap between scientists and volunteers.

A successful partnership

In order to have a successful partnership, there has to be added value for the various actors involved. The following points of interest can help you set up a successful partnership:

- **Communicate clearly and openly:** make clear agreements about the collaboration and create clear expectations among partners and citizen scientists. Even if you as a local government are not involved in the citizen science project, it is important that you maintain respectful communication. Communicate regularly about the project's findings and show appreciation for participants' contributions;
- **Ready-made materials,** such as platforms, methods, lesson plans, conclusions, etc. are more likely to be taken up and communicated more widely by partners;
- **Innovation versus predictability:** in long-term projects it helps to keep participants and the press engaged by incorporating innovation in the project. On the other hand, it also helps to work with a fixed format: this way, partners and participants know exactly what is expected of them every year;
- **Long-term thinking:** do not only make agreements about activities during your project, but also on how you can successfully conclude the project or keep it viable;
- **Think about the added value for each party involved.**

The 'Grote Schelpenteldag'

VLIZ's 'Grote Schelpenteldag' (Big Shell Counting Day) is an annual event involving 10 coastal cities and towns. They know what is expected of them each year, how it is organized and what the project is about. Communications regarding this event are prepared in advance by VLIZ, so that the cities and towns can distribute the right information via their newsletters or local magazines in a timely manner and so that communication is streamlined. For coastal mayors it is attractive to support a beach project, on the one hand because it can attract more tourists to the coast, and on the other hand because it can bring more awareness to the people about the importance of the sea and sea life, for our daily lives.


Stiemerlab in Genk

For a city administration or a project partner, it is a great advantage if a citizen science project is part of a larger whole. For the city of Genk, the Stiemerlab project is not only a 'measuring project of the scientific partners', but it is also a shared project supported by the whole city. The project aligns with the city's wish to restore the health of the Stiemerbeek river and to stimulate a sense of belonging among the citizens. Such a framework helps a project to grow in the future.

Tip: Make a connection with your local government

When a citizen science initiative wants to collaborate with a local government, it helps to look at the multiannual plan of the city or town to connect with the project. You can find the multiannual plan for each local government on their website.
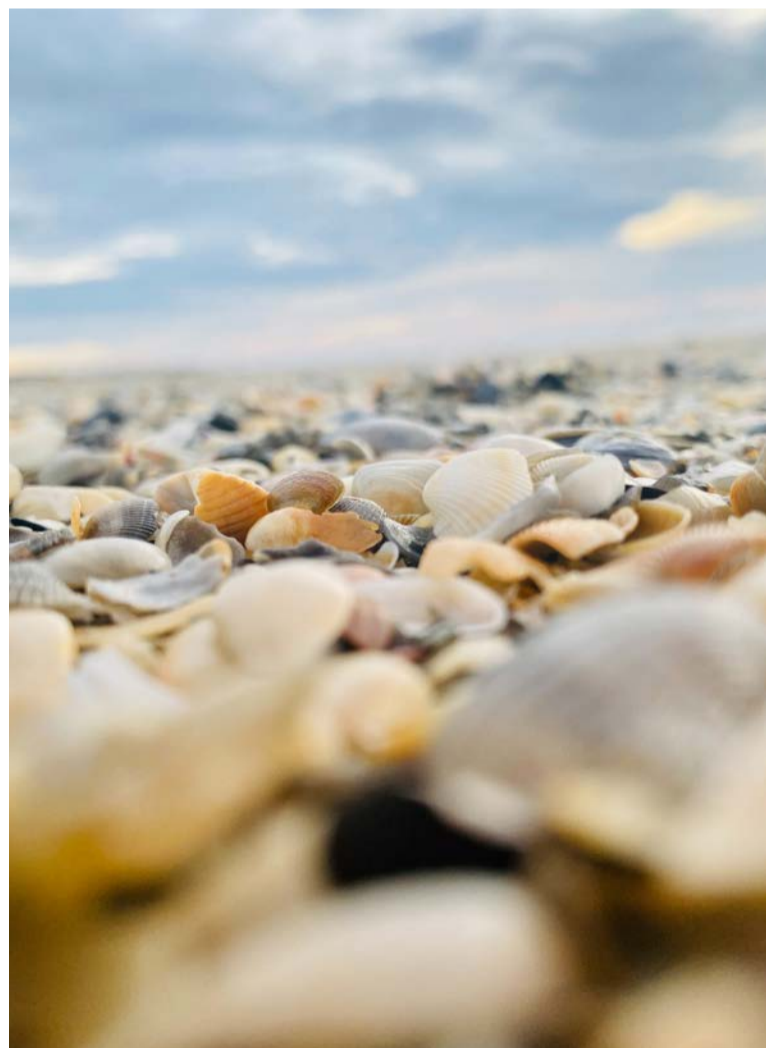
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Inclusion in citizen science

Participants in citizen science projects are not always representative for general society. The typical citizen scientist is white, middle-aged, highly educated, male, and has a keen interest in science and research. It should not come as a surprise that this profile is strongly represented in citizen science projects. They are motivated and also have the time, the resources and the expertise to participate in scientific research.

Involving disadvantaged groups from low socio-economic classes and ethnic-cultural minorities in policy and research, is a special point of interest in citizen science. If you want to work inclusively, you need to make explicit choices during your project design.

We list a number of recommendations:
- At the start of your project, think about how you can facilitate equal participation opportunities within your project. Framing the problem as a local issue can help to involve citizens, if they feel connected to their locality;
- Establish some inclusion criteria for yourself at the start of the project, based on gender and social class;
- Search for relevant intermediaries. Contact socio-cultural institutions or welfare organizations. Think of the OCMW, poverty associations, youth organizations or community centres. Do not forget to also approach more local, informal organizations and individuals. They are often trusted by the local community - more so than formal institutions;
- Use consultation moments with these institutions and confidants to map out the best channels of communication. Can an announcement be made via Facebook or is personal contact needed?
- Also be sure to think about the wording of your message. Match the language used to your target group and avoid jargon;
- When you want to bring people together to inform, convince, train or put them to work, consider organizing these meetings at a place and time when your target group usually convenes;
- Try to use different forms of participation and moments to contribute to the project. It is important to indicate that you want to involve participants not only for collecting info or data, but also for analysis and involvement.

Other points of interest in collaboration

- Be clear about the expected commitment from participants: which activities can you participate in? How much time does it take? When does the activity start and stop?
- Give enthusiastic feedback about the results to participants, so they feel that their contribution matters.
- Keep in touch with participants through a newsletter, social media, current news items, blogs, …
- Some participants will drop out as your project progresses. Make sure you have continuous recruitment whereby you motivate new participants, so that there is always enthusiasm for the project.
- Announce activities well in advance and don't change your approach too often.
- Apart from a steady format, remain open to innovation, so that the project stays interesting for participants, partners and the public. However, it is best to keep the methodology constant, so that the collected information remains comparable over time.
- Provide ready-made materials for the participants, such as fixed templates that can be used, or fully developed teaching modules for teachers.
- Think carefully about any difficulties that may arise, also in the long run, and make agreements about this in advance. For example: who will take care of the maintenance of the sensors?

A tale for techies? Data and measuring instruments

Citizen science also has a "technical" dimension. In this chapter, we will talk about data (protocols) and measurement equipment.

Citizen science also has a "technical" dimension. In this chapter we will talk about data (protocols) and measurement equipment.

Data

An important advantage of citizen science is the amount of new data you can collect. 'To measure is to know' and citizens can be a great help. It allows you to take measurements on private property, or in places where specific professions or hobbyists go, like fishermen. You can also save a lot of time if citizens collect the data themselves.

However, the same data can also be the cause of worry. The collection, analysis and interpretation of data can sometimes go wrong. With appropriate planning and actions, you can solve many

uncertainties and avoid pitfalls, so that your citizen science project is truly valuable.

Questions and doubts about data

Sometimes, suspicions arise regarding citizen science data. Are citizen scientists reliable or can they intentionally or unintentionally influence the results of a study? What exactly is being measured and has this been carried out correctly? Are the data processed and interpreted correctly? What do you do with multiple conflicting interpretations?

Both research institutions and local administrations face these questions, but they can be resolved with appropriate measures. In this chapter, we provide guidelines for dealing with data appropriately. Reliable data are ultimately the core of a good citizen science project.

"We have a database of statistical data. When you receive a question from a colleague, you sometimes notice that not everyone looks at a figure in the same way. What exactly is the definition? You can very quickly draw wrong conclusions. An alderman could have interpreted it differently." – Interviewed civil servant

Making agreements about data

Do you want to make agreements about data? Then several aspects need to be taken into account: quality, ownership, privacy, public availability, exchangeability (also called 'interoperability*', meaning that data from projects can be easily linked), etc.

In order to introduce initiators of citizen science projects to these aspects, the Scivil Data Working Group drew up a Flemish charter for data in citizen science. This charter is non-binding, but highly recommended. It consists of 26 principles divided into five categories:

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* Products, systems or organizations are interoperable if they can work together without restrictions. To achieve this, standards, protocols and procedures are required. We distinguish 'semantic' (definitions of data concepts), 'technical' (technical guidelines), 'organizational' and 'legal' interoperability. (Definition according to **Wikipedia** and **VLOCA**).

Summary of the contents of the Data Charter for citizen science

Open attitude: if you follow these principles, your data will be made available to the outside world in an (ethically and legally) correct way. For local governments, the new PSI guideline (Public Service Information guideline, also called Open-Data guideline) will play a central role in these principles (see below).

Privacy and ethics: since you will be working with people in citizen science, it is best to take into account the basic rules of privacy and ethics from the start.

Data hygiene: the principles in this chapter will help you through a number of steps to properly structure and document your data so that, afterwards, others can understand it more easily or can link it to other data.

Data standards and formats: by using the right names or codes for everything you measure, and by providing the data files in a file format that everyone can 'read', you ensure that data from different projects can be linked together in the future, if necessary.

Metadata: data are described by 'metadata': that is, data about the data. Assigning metadata also involves a set of rules, which will make your data easier to find.

Data Charter for citizen science
The 26 basic principles

Open attitude

1. Aim to publish your data openly on the web, or give a clear and justifiable reason when this is not possible
2. Publish your data under an open license from a concise, recommended list
3. Publish your research results and findings in 'Gold Open Access Journals' where possible
4. Where possible, also publish the software you develop under open licenses
5. Actively search for existing open data
6. Ask for advice from support services

Privacy & Ethics

7. Pay attention to privacy and ensure knowledge sharing
8. Meet GDPR guidelines in your project
9. Communicate clearly on intellectual property and copyrights
10. Carefully weigh your data quality and quantity against ethics, feasibility, and project goals
11. Watch out for ethically undesirable side effects of releasing your data
12. Take a respectful, equal stance with citizen scientistsrs

Data Hygiene

13. Develop a data management plan (DMP)
14. Take into account the cumulative potential of data: 'Treat a small data set like a large one'
15. Take extra care of data quality
16. Develop a conceptual data model for your project

Data standards and formats

17. Build on existing data standards relevant to your project
18. Make use of machine-readable, open formats
19. Assign globally unique and persistent identifiers to your data
20. Incorporate your project data into the network of Linked Open Data

Metadata

21. Provide your data with metadata that are as rich and accurate as possible
22. Consider capturing the metadata as close to the source as possible
23. Assign a globally unique and persistent identifier to your metadata set
24. Use the appropriate standard for your metadata
25. Make your metadata, and therefore your datasets and research results, findable by registering them on a searchable portal
26. Make your citizen science project findable for colleagues and volunteers

The charter not only makes recommendations, but also comes with an extensive manual with tips and practical examples to make it easier to apply the 26 principles.

We will elaborate on the most important principles from the charter, using the concept 'data quality'.

With this concept, we refer to the reliability of data, but we also consider how correctly they are shared, both on the technical level and in terms of ownership. These aspects are particularly important in the context of citizen science.

Quality: are data from citizen science initiatives reliable?

Strictly speaking, 'quality' refers to the correctness, accuracy and completeness of data. This is addressed in principle 15 of the citizen science Data Charter. In a broader sense, the term 'quality' also covers matters such as the correct organization, storage and release of your data, both technically and legally. These aspects are also covered in the charter, and are briefly explained below, because they are of great importance in citizen science.

Requirements?

In general, the quality of your data should at least allow you to answer the research question of your project in a statistically significant way. Ideally, your data are also well documented and technically arranged so that they can be linked to other project data (see section 'Findable and combinable').

How?

The reliability of information and data is crucial to the credibility of citizen science. There are different ways to achieve this, but you will always have to make a conscious trade-off between different methods: do you want a large number of participants or rather a small number of highly specialized participants? Do you invest extra time to train them better or do you provide simplified measurement methods ('protocols') that you can distribute more widely?

In order to make that choice, it is best to take into account the context and the overarching objectives of your project: how important is data quality to you compared to, for example, the educational content of your project? In any case, you will always have to find a balance between individual data quality on the one hand, and scaling up to larger amounts of observations/measurements on the other.

In any case, make sure you have **well-tuned methods** or protocols: try to assess in advance, via a small pilot study, what the possible errors could be, so that you can anticipate these errors in your protocol. To do this, it is best to take into account the background

of your (intended) participants and their knowledge about the subject. The data must be interesting, but the measurement or sampling methods must also be practicable for the participants.

In general, you can focus on the following aspects:

You pay extra **attention to training** the citizen scientists, so that they can make more accurate observations or work more independently. For example, you can provide extra manuals, an extensive website or a teaching package, multiple contact moments or extra guidance by 'ambassadors' from your field (see chapter 4). For example, in the MamaMito project, in which participants reconstructed a family tree along their mother's line, they put a lot of effort in training citizen scientists through workshops and an online guide. To this end, a collaboration was set up with Familiekunde Vlaanderen, Davidsfonds, and a number of small local historical societies.

You invest in data validation: you work together with scientists or with the aforementioned 'ambassadors', so that they can check and validate the work of citizen scientists. On the DoeDat platform of the Plantentuin Meise, the scientists themselves validate the data that are entered, and they still consider this way of working to be more efficient than when they make their observations without the help of citizens.

You ensure a very **large number** of samples, measurements or observations by involving a large number of participants in your project. In doing so, you can either choose for a maximum number of participants or a smaller group doing multiple observations or measurements. The advantage of a large number of participants is that you collect a large amount of data on which you can make statistical corrections afterwards.

Another advantage of 'large numbers' is that different participants can **double (duplicate)** certain observations, measurements or analyses, thus checking the accuracy of their results.

In a project like CurieuzeNeuzen (Curious Noses), which mapped the NO_2 concentrations* in Flanders for the month of May 2019, there is a clear choice for the power of numbers: 20,000 participants provided a particularly large number of measuring points. On the other hand, detailed measurements with sensors were not possible for all those participants, for reasons of feasibility. However, the NO_2 was measured twice for each participant, via two measuring tubes that were installed at the same time. If those measurements did not match, then one of the two was definitely wrong, and the entire sample (i.e., the two values) was excluded from the final data set, because it was 'not sufficiently reliable'.

In a similar way, many projects on the citizen science platform Zooniverse.org duplicate observations. One example is the Radio Meteor Zoo project of the Belgian Instituut voor Ruimte Aeronomie (BIRA). In this project, participants are asked to draw rectangles as small as possible around signals indicating the presence of meteors (usually visible as a vertical line) on a spectrogram. In a preliminary study, 35 people were asked to draw rectangles on at least 12 different spectrograms. They were allowed to draw intentionally incorrect rectangles. Afterwards, a check was carried out to see how much the rectangles of the different participants differed in size and position. It was decided that each spectrogram would be analysed by 10 different people, and that all "space" indicated by at least four participants would be used as the "smallest frame" of a meteor signal.

⊞ Apart from these methods, it is also best to carefully select the citizens that will participate in your project and/or to select the areas or time periods in which they will make observations. It is often necessary to **systematically divide an area into segments**, so that global statements can be made. Likewise, you need to make a conscious decision whether to limit your observations to, for instance, a season or the entire year.

Spinicornis, the Belgian working group for woodlice, wanted to map the distribution of woodlice in Belgium. To do this, they divided the territory of Belgium into segments of 10x10 kilometres, where

they organized field trips to each of those segments for more than a year. The Spinicornis volunteers made observations in different habitats (e.g., in a forest, in a residential area, near a river) and over the course of a whole year, in order to systematically cover all seasons.

Who is responsible?
As a local government, you do not always have in-house experts to guarantee reliable data quality for all citizen science projects you participate in, or to determine the technical requirements of the software and hardware you use (e.g., sensors) (see Chapter 4). Moreover, this also depends on the role that you as a government take within a project (see chapter 3). Make sure that you always have a project partner with specialists in the field to help monitor the correctness of the methodology. These do not necessarily have to be professional scientists, but they should be people with a thorough knowledge of the research field and methods. It is necessary, however, that these experts remain in contact with citizens, in order to monitor the accessibility of the protocols.

In the Leuven.cool project, weather stations were placed in public spaces and private gardens to study the urban heat island effect. This was done in collaboration with KU Leuven and the Royal Meteorological Institute (RMI). There is also a link with the citizen science platform 'Mijn Tuinlab'.

If you, as a local government, want to support a project indirectly, you can opt to include quality conditions in a bilateral contract, based on the principles of the Data Charter of Scivil. This charter is not binding, but can be a good guideline for evaluating external offers.

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*NO_2 or nitrogen dioxide is a gas that is released into the atmosphere from all kinds of combustion processes, such as in a car engine, in boilers, in industry or in power plants. 61% of NO_2 emissions in Flanders come from traffic, one of the biggest causes of air pollution. This makes NO2 an important indicator of air pollution from traffic. (Definition taken from **CurieuzeNeuzen**).

Ownership & public availability: from and for whom are the data?

Before the start of your project, you should already think about the conditions under which you will make the data available to third parties. Communicate clearly about possible intellectual property rights (see Principle 9 in the Scivil Data Charter) and possible conditions under which third parties may reuse the project data.

In general, the goal is to publish project data as openly as possible. Most citizen science projects do this under a Creative Commons license or an Open Data Commons license (see Principle 2 of the Scivil Data Charter).

For each project, do check beforehand whether the data does not fall under the Public Sector Information directive: in that case, use either a CC0 declaration, or the Model License 'Gratis Hergebruik', or the Model License 'Hergebruik tegen Vergoeding'. More information about the Open Data Directive can be found on the website of Digitaal Vlaanderen.

## Findable and linkable: avoid double work by joining forces

International research policy and the European and Flemish governments are strongly committed to making data findable, sharable and interoperable. You have to go through a number of logical steps to achieve this. First, your data must be 'open'

(see 'Ownership & Public Availability') and published online. Preferably, you choose a data format that is open and machine-readable. In other words: do not choose a format that can only be read by a limited number of programs or apps, such as .XLSX for Microsoft Excel, or .SHP for ESRI geodata. You choose formats that can be universally imported by any program, such as .CSV instead of .XLSX, or .GML for spatial data (see also principle 18 in the Data Charter).

For those with knowledge of data management, we recommend reading and applying the technical section of the Data Charter (principle 17 and following) for citizen science. The Government of Flanders provides a series of data standards for different domains, which, in combination with data standards from the scientific world, can form a perfect set for your project. The most important data standards, such as those of OSLO, are mentioned in the Scivil Data Charter. For the topics 'water in the city' and 'mobility - mobipoints', standards were also agreed upon as part of the VLOCA initiative. Extensive information about data standards for the culture and heritage sector is available through Meemoo's cultural standards toolbox (CEST). Have you checked these sources and do you still have questions? Do not hesitate to contact the Digitaal Vlaanderen 1700 contact center or Scivil (info@scivil.be) for referrals to the most relevant domain specialists.
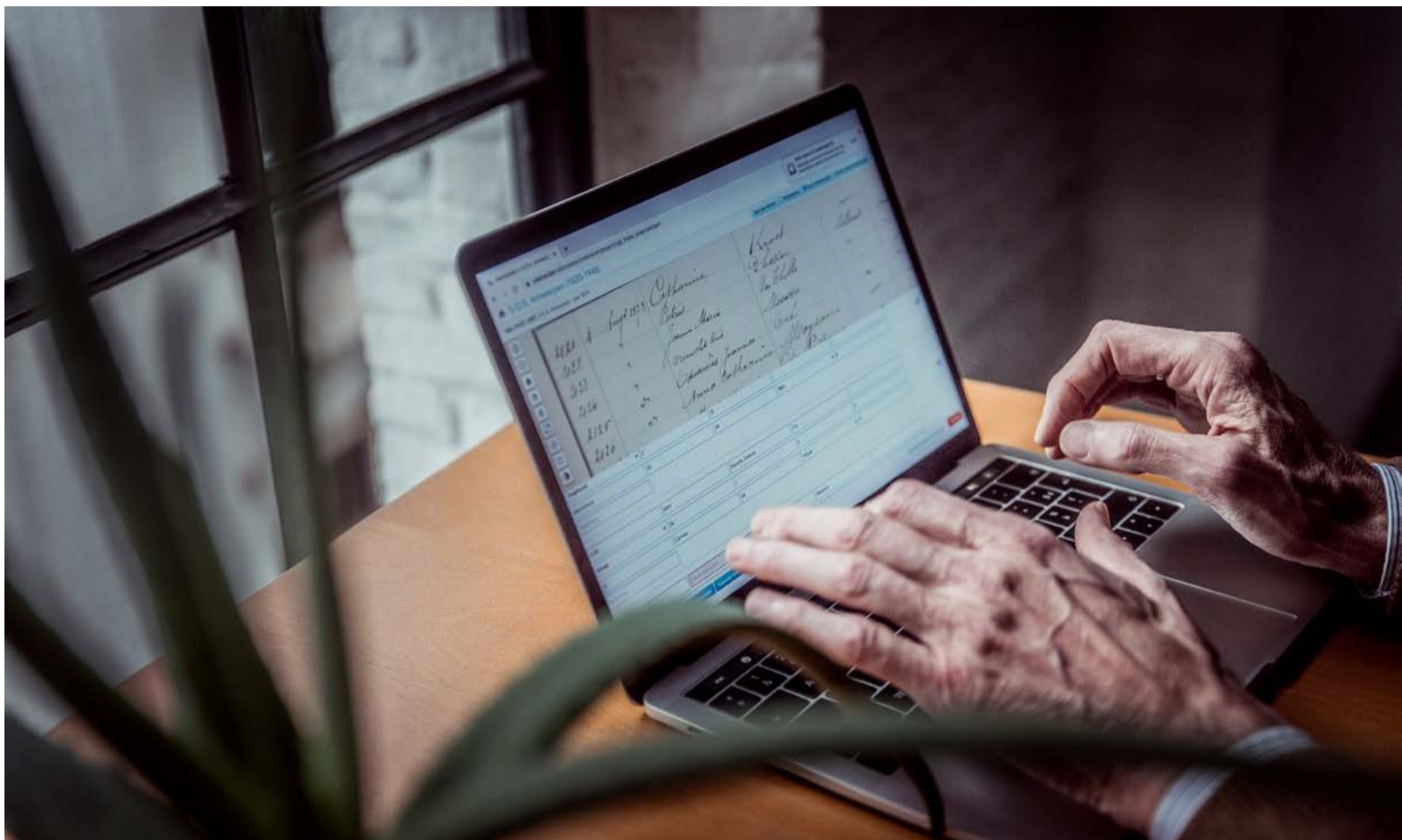
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You preferably structure your data in a UML class diagram, and provide them with a globally unique identification code (URIs). To make your data easier to find, you should also provide rich metadata, which in turn should also conform to (meta)data standards. Assign a globally unique identification code to both your dataset and your metadata set, and register your metadata in a portal such as the metadata portal and/or the FRIS research portal of the Government of Flanders. Finally, also make your project known to the public via Iedereenwetenschapper.be or (internationally) via the European citizen science platform EU-Citizen.Science.

Tip
If it is well structured and documented, a seemingly 'small' data set with only a few observations can in time grow into a scientifically interesting database. So, pay sufficient attention to the way you structure, store and release data from a citizen science project.

The Open Data Portal of the City of Ghent
The City of Ghent has its own Open Data Portal with extensive information for users.

Who is responsible? In Ghent, the technicity of data storage is largely outsourced to the Autonoom Gemeentelijk Bedrijf (AGB) District09, where some 200 employees work to support the ICT of the City of Ghent, including the development of the City's Open Data Portal.

Communicating ownership: The City of Ghent is very clear on its Open Data Platform about who is the publisher of the datasets released on the platform, and which license is used.

Findable and linkable: Again, the City of Ghent shows good example in its Open Data Portal, offering data in .CSV, .JSON and GeoJSON formats, among others.

Tools

Managing data in a citizen science project can be divided into several steps: data collection, storage, processing, and visualization. We highlight some of the tools that are related to these steps.

Data collection: new data

When citizens help in the data collection phase, they directly provide new data. This can be done via sensors, an app or even using pen and paper. The latter method can sometimes be the best solution, for example, when automated observations pose privacy concerns. Think about registering vehicles and passersby on a street.

Some citizen science initiatives use apps to make it easier for their participants: ObsIdentify allows users to take pictures of organisms, such as plants, animals and fungi, which the application then automatically recognizes and adds to the Waarnemingen.be database. Another example of such a citizen science application is the (international) Marine Debris tracker app, in which you can enter every piece of litter you come across.

> ### Tip
> If you want to build (or have built) an application or platform yourself, you should not underestimate the costs. Several online tools allow you to make a rough calculation of development costs for mobile apps: App Development Cost, Buildfire, Digitalya.
>
> You can also build a citizen science application using these online tools:
> - Citsci
> - Natural Apptitude
> - Open Data Kit
> - Siftr
> - Spotteron
> - Arcgis Developers

The most advanced measurement technology involves sensors: there are hundreds of different types available and it is often difficult to see the wood for the trees. There are sensors in all price ranges, from simple devices costing a few euros to professional setups costing thousands of euros. So, it is best to first ask yourself what a sensor must be able to measure - and with what precision and accuracy - in order to solve your scientific problem. Again, you have to weigh up data quality, price, feasibility and data quantity. Various institutes, such as imec and VMM, are working on methods to calibrate low-cost sensors using professional measuring equipment. The Telraam project recently tested the performance of the sensors against a police sensor and found a 10% margin of error.

For an extensive list of sensors for citizen science projects, we refer to the PWC study on the subject. Do not forget to pay attention to the durability of a sensor, the required weather resistance and maintenance efforts, after the sensor is installed.

> ### Tip: measuring air quality
> For measuring air quality, the online tool Hoemeetiklucht.eu introduces you to the various measurement methods. You can also use this tool in your communication to citizen science participants. Via this tool (see sensors for particulates, and sensors for NO₂) you can also find the results of the research that the Vlaamse Milieumaatschappij (VMM) conducted into the quality of various sensors. For a complete overview, you can also go directly to the website of the LifeVACUUMS project. The VMM also allows citizen science projects to use the official air quality monitoring stations to calibrate (test) low-cost sensors. It is also worth taking a look at the sensor.community network, an international open network of air quality measurements performed by citizen scientists, to which the Leuvenair and HasselAir projects, among others, are connected.

Reusing data: data sources

It is not necessary to collect all data by yourself: more and more data are available online under an open license. On the metadata portal of Digitaal Vlaanderen, you can search for data that is relevant to you. You can combine several parameters (e.g., 'data provider' or 'type of license' or 'year') to quickly find the dataset that is useful to you.

Are you looking for information on a specific research domain? Then have a look at the FRIS research portal: here you can find out which research is carried out by whom and which publications result from it. Soon, information on scientific datasets (open or otherwise) will also be available here.

Besides the metadata portals you can also go directly to Vlaams Open Dataportaal to look for data. On Geopunt-Vlaanderen, you can easily see all available (open) data in a map environment. Research institutions such as Instituut voor Natuur- en Bosonderzoek (INBO) link their open data to Geopunt and feed the portal. Local governments sometimes also offer open data, such as the City of Ghent or the City of Kortrijk. At the federal level, there are the portals of the Belgian Open Data Initiative, and the geoportal Geo.be, which includes data on air quality.

You might sometimes get lost in the "maze of data". Platforms to assemble and view data are expensive, especially when it comes to real-time data. Combining data from different tools is also a challenge, in which most governments are still finding their way. An important piece of advice is that even if your city or town does not yet have its own data platform, you should still look up what data standards and formats are appropriate and feasible for your project. The more your data comply with the principles of the Scivil Data Charter, the easier it will be in the future to link your datasets to datasets and databases of larger cities and towns, and those of Digitaal Vlaanderen.

You will save a lot of money and effort, if you collaborate with other cities and towns in setting up technical structures such as a (real-time) data platform. The cities of Leuven, Roeselare and Bruges recently joined forces to launch a public contract to select a Smart City Data platform. Bruges wants to market this as a procurement hub. The City of Hasselt also showed interest as a possible user.

'Intercommunales' can also play a supporting role, especially for smaller administrations, by centralizing sensor purchases or offering a joint web service with a common API. For example, Intercommunale Leiedal supported its 13 cities and towns in the implementation of the Telraam project. Governments or projects that developed their own data platform used the DCAT application protocol to enable links with the Flemish databases. It is advisable, however, to provide systematic funding within the government for data infrastructures, so that their maintenance and use does not stop when a citizen science project comes to an end.
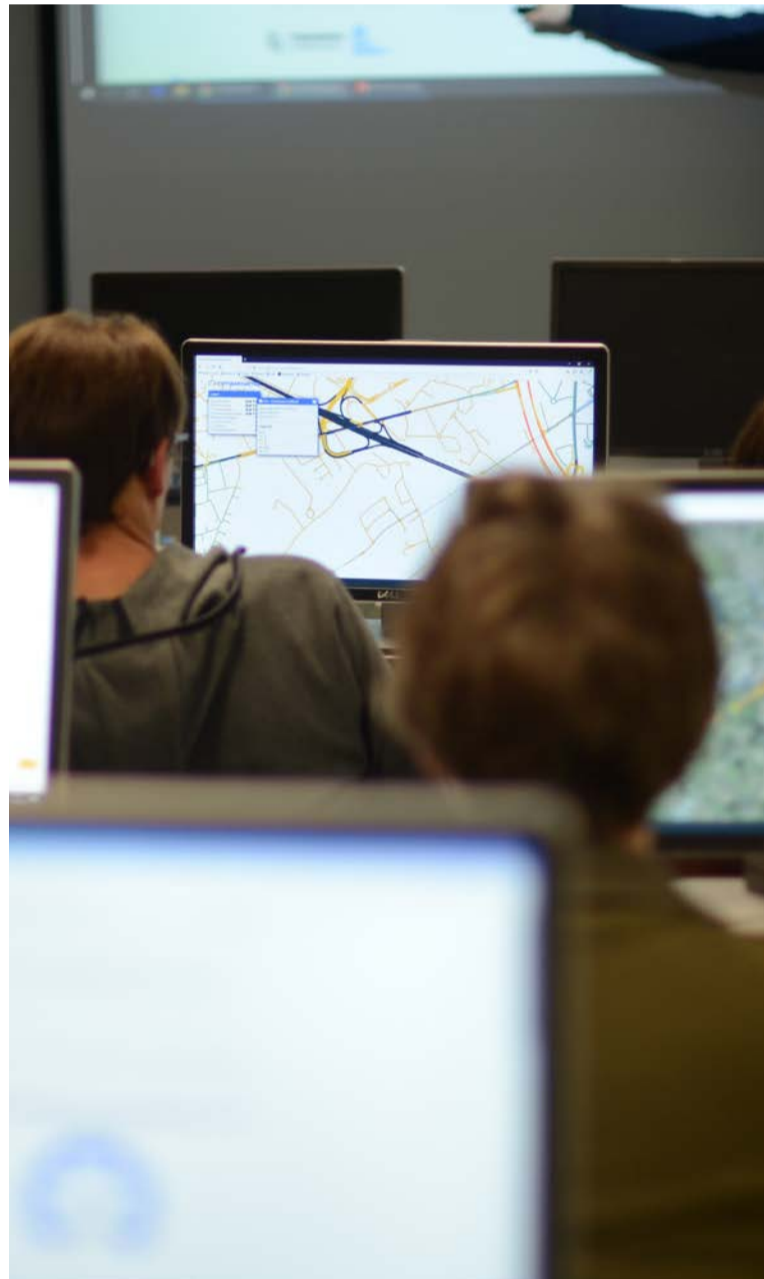
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Data processing by citizens

Not all citizen science projects rely on direct observations or sensor data. A large proportion of projects, such as those on the platforms Zooniverse and Velehanden.nl, offer a range of raw data and ask citizens to analyse those data. This often involves analysing images or texts. Examples of such projects are Radio Meteor Zoo, Oog voor Diabetes, and S.O.S. Antwerpen. With online tools like these, you make use of the software behind the platforms. You offer your collection or data and remain the owner of those data afterwards. The results of the analyses of citizen scientists are then delivered to you by these platforms in an open format (e.g. .CSV). It is then up to you what you do with it afterwards. However, in the description of your project you should clearly state who is processing the data, how this is done, and what precautions you are taking to comply with GDPR rules.

Tip: take a look at these platforms:

- **DoeDat** is a platform for analysis and transcription of images. Though managed by Plantentuin Meise, it is also open to projects outside this organization.
- **DigiVol** is the Australian platform on which DoeDat is based.
- **VeleHanden** is a Dutch crowdsourcing platform for annotating or transcribing historical source material.
- **Zooniverse** is perhaps the best-known platform for annotating images with the help of citizen scientists. Zooniverse reaches a community of nearly 2 million citizen scientists with various projects. Most projects are in English, but a test version of the translation feature is currently available.

Data interpretation

In order to process data in a statistically correct way and to interpret project results, you best consult a professional. This does not always have to be an academic, but involving scientists can be a great advantage. Local governments or citizen science projects often collaborate with nearby (vocational) universities. Some cities or towns see it as their task to do the interpretation of the data themselves in projects they initiate or lead themselves. Nevertheless, it remains advisable to involve other actors (such as scientists and citizens) in this step of your project as well. This can also have advantages for clear, neutral communication. Do not be afraid to link the data back to the citizens themselves in this phase: they have their own perspective or context from which they can contribute, and it can also encourage them to engage more or in the long term. The city of Mechelen (Meet Mee Mechelen) provides a good example of interaction with citizens in terms of the measurement data on their website.

Data visualization

Most citizen science projects provide their participants with the results of the project. Good examples include the platform of Fietsbarometer and Vespa-Watch. Most citizen science projects that display their data in a map, use the open software Open Street Map.

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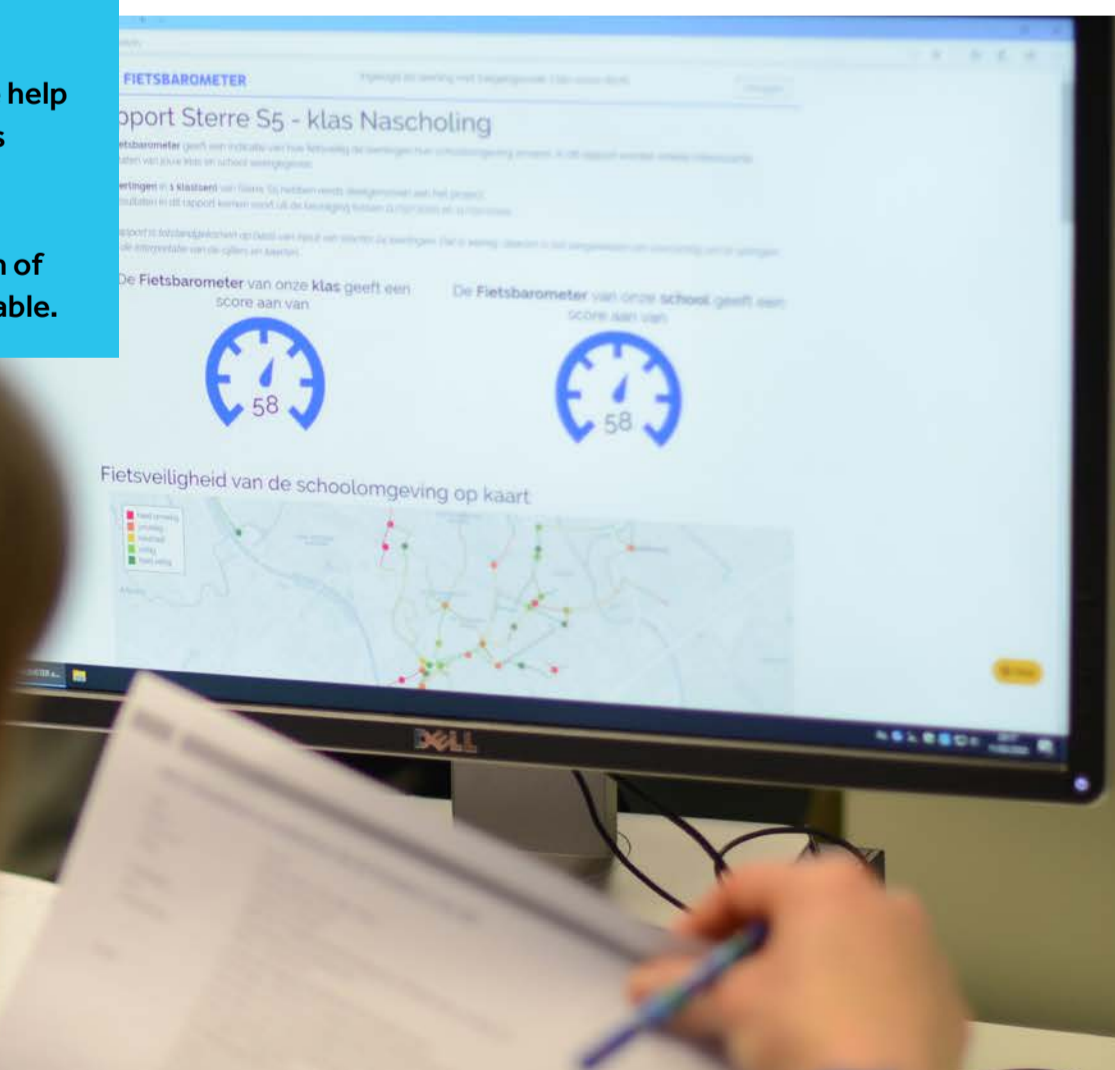
Sharing data

You can share your data on Geopunt-Vlaanderen (see also 'Reusing data'), where you can also find a large number of (open) data. If you cannot place your citizen science data in a spatial context, then you can describe your data properly (via metadata) and link them to the metadata portal of Digitaal Vlaanderen. This way, they can still be found by anyone who wants to build on your research. For the arts and heritage sector, check out all the information on the website of Meemoo.

Tip

The citizen science project Mijn Tuinlab added its website to the list of apps in this portal. By entering 'citizen' as the target group in the metadata, the results of this project can also be found more quickly by the general public.

Whether or not it is the **responsibility of a local government** to provide open and linked data, depends a lot on the government and the project itself. Is the city or town the initiator of the project? Then it seems logical that the government provides in a data infrastructure. Does the initiative come from partners, or do partners already have an existing data infrastructure? Then you can consult and make clear agreements in advance about who will take on what role. Also bear in mind that sometimes data cannot be shared for legal reasons.

Before you decide as a city council to capture data, you should ask yourself how interesting or necessary the project is, and how easy it is to get hold of the data if you do not store it in your own infrastructure. Also, when jointly purchasing sensors, it is best to agree in advance who, for example, will do the maintenance of the sensors, if something goes wrong or when the sensors need to be replaced.

Finally, it is worth to stay informed about the Flemish government's Open Data Policy. Through the Open Data Action Plan (2020-2024), the government is taking actions to maximize the findability and interoperability of data in Flanders.

07. **The financial side**

What is the cost of citizen science? How much
funding should a government set aside?
Or through what channels can you raise
additional funds for these projects?

What is the cost of citizen science? How much funding should a government set aside? Or through what channels can you raise additional funds for these projects? We will tackle these questions in this chapter.

Is citizen science expensive?

The cost of citizen science varies from project to project. **Personnel costs** are usually not too high, as most projects rely on volunteer work, or rely on staff funded through other channels (researchers, teachers, etc.). If civil servants assist, this does translate into a cost for the government. On the other hand, the time and energy spent on project coordination, communication, possible training, workshops and actively following-up on a citizen science partnership should not be underestimated.

Material costs are diverse, from communication to measuring instruments. Especially costs for the latter can be high, although this does not always have to be the case. In citizen science, you would usually choose very accessible measuring instruments. These may be less accurate, but they can be widely distributed and used. Within the project 'Smart Waterland', for example, the West Flemish intermunicipal company WVI purchased a 3D printer with which schools can print their own rain gauges in a cheap way. To this end, they submitted a project in the 'Slim in de stad' (smart city) prize. There are also many entry-level options for applications and platforms (see Chapter 6). If you want to develop a new application or platform yourself, the costs can rapidly increase. Most costs are linked to the start of the project, when you are developing support materials, considering the purchase of technology, etc.

Financial and material support from cities and towns

In addition to material support (communication, staffing,...), cities and towns can also offer financial help in citizen science. We have not yet seen examples of subsidy lines that are exclusive for citizen science projects, but there are examples of existing subsidy lines with which citizen science projects are funded. Here are a few examples:

- Local citizen science initiatives are supported from the Ghent district budget;
- In the city of Mechelen, a citizen science project is supported by a budget line for climate projects and circular economy.

Small-scale and local citizen science initiatives in particular will greatly appreciate financial support from a city or town. From a survey among these initiatives, we know that even small budgets can boost a project. The initiators also indicate that when funding is allocated, sufficient attention must be paid to the long term (and scaling-up possibilities). With short-term 'flashpoint funding', you risk that the project will diminish quickly.

Flemish and European funding

Citizen science also receives support from the Government of Flanders and the European Commission, sometimes directly (as illustrated by the EWI calls below), usually as part of a larger project.

- **Calls from the Department of Economics, Science and Innovation (EWI).** Between 2017 and 2021, the Department of Economics, Science and Innovation of the Government of Flanders supported 20 citizen science projects for a total budget of € 2.900.000:
  - Following a call in December 2017, Minister Muyters supported seven citizen science projects for € 1,000,000 in May 2018 and six additional projects for € 900,000 in a second wave.
  - In 2019, there was a second call for citizen science projects from the EWI Department. Seven projects were supported for a total of € 1,000,000.

- **European funds.** The European priorities for the coming years are summarized in the Green Deal. Europe is going for an innovative economy, climate neutrality and social justice. The European funds are dedicated to projects that contribute to these ambitions. Citizen science can take an important place in these projects and contribute both educationally and scientifically, in terms of awareness-raising or as an added value for policy.

In the past, INTERREG Europe, INTERREG North Sea Region and ERASMUS+ have already been successfully used for citizen science. HORIZON is also funding research projects on citizen science.

Here are some examples of citizen science projects funded by Europe:
- Example on waste in oceans
- Example on water levels
- Example on sustainable development
- Example on heritage

More general information about support from the European Commission to citizen science can be found here.

Tips for finding financial resources

1. Identify links with existing grant lines in the different social domains (mobility, climate, health, nature, etc.).

2. Look for sponsors, or raise funds from a wide audience through crowdfunding. Read more about crowdfunding on the website of Agentschap voor Innoveren en Ondernemen.

3. Have participants cover a portion of the costs for analysis. Communicate about this correctly and tell what participants will get in return. If you are transparent about the costs and if the intrinsic motivation to participate is high, participants are often willing to contribute financially. However, do not forget financially vulnerable groups.

4. Build a partnership around your project. That way, not only the efforts but also the costs are shared.

5. Save costs by using open-source software and freely available applications. Developing equipment yourself is very time consuming and costly.

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08.

Success factors and points of interest

We highlight a number of general points of interest for successfully supporting or participating in citizen science in your city or town. Looking at the interviews and workshops we held with local governments and citizen science projects, the following insights stood out.

We highlight a number of general points of interest for successfully supporting or participating in citizen science in your city or town. Looking at the interviews and workshops we held with local governments and citizen science projects, the following insights stood out.

Scientific backing

While collaboration with a scientific institution is not an absolute must for citizen science, it often adds significant value to the research. The scientific partners inject expert knowledge of the researched domain and know the most reliable ways to collect or interpret certain data. If the project team does not yet have this expertise on board, the obvious solution is to approach a (vocational) university or research institute.

Scientists can also take on the role of neutral, objective partner in a citizen science project and this can certainly help to win the citizens' trust for the project.

A partnership can only be successful if there is a win-win situation for all partners involved. This is no different in citizen science and scientific institutions. Chapter 5 provides more information on what a partnership in a citizen science project may entail.

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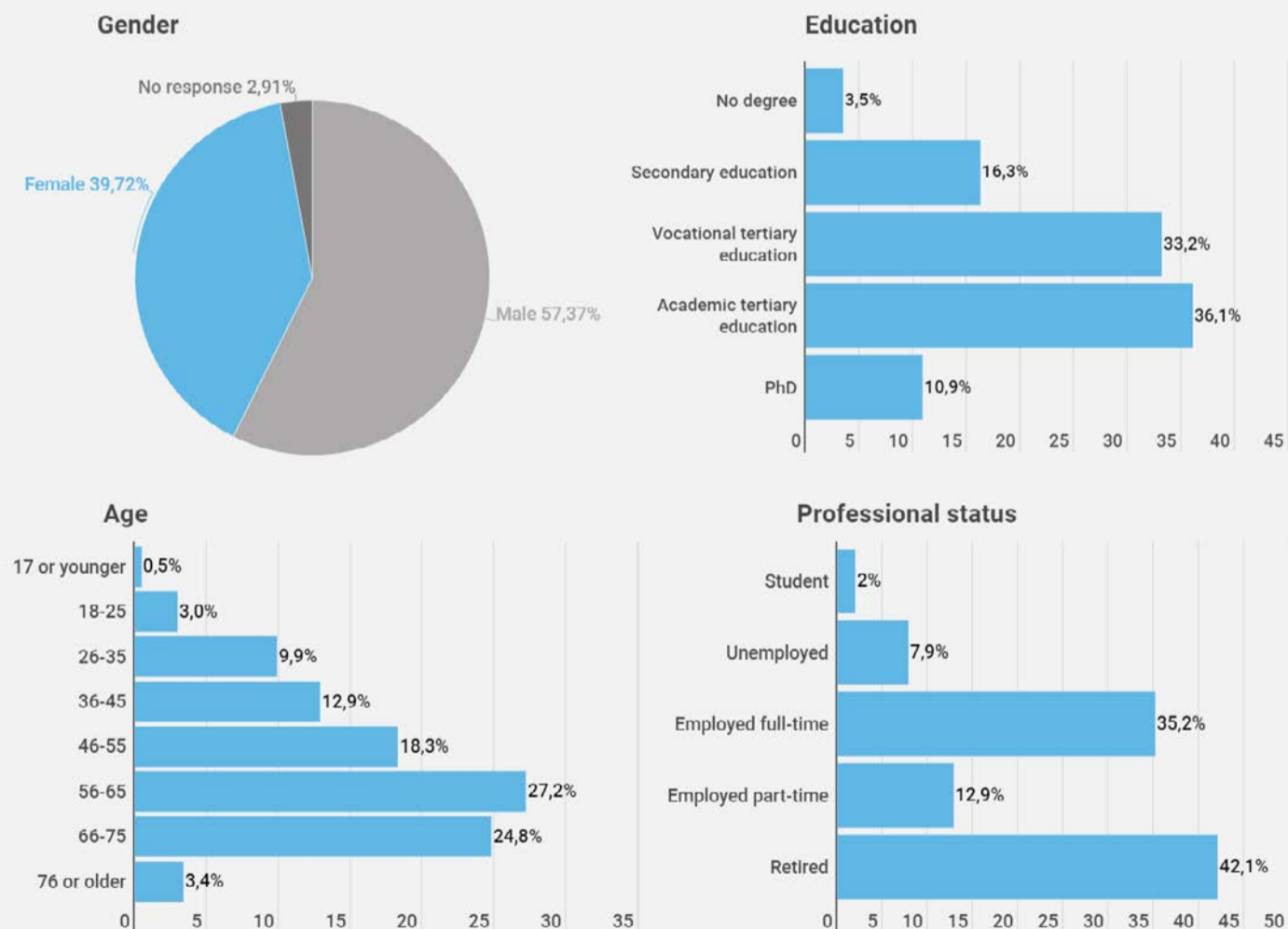
Activating and engaging citizens

Local governments are considered to be ideal partners in citizen science initiatives, because they have close ties with citizens, local associations and key persons that can play a crucial role in recruiting and keeping citizen scientists engaged. Seek out groups of citizens who are already committed to the topic, and involve them in the project. A club of sport fishermen may want to contribute to the water quality. A social media page where people exchange tips on ecological gardening, can quickly gather enthusiastic participants for greening gardens. The local heritage society will be very interested in research on heritage within its community.

Most citizen science initiatives tend to attract a homogeneous group of participants: the participants are predominantly over fifty and are highly educated. Sometimes the participants are also mostly male, although this is not true for every project. A survey of 300 Flemish citizen scientists confirmed these trends.

Who are the Flemish citizen scientists?

Survey by Scivil among 300 Flemish citizen scientists in 2020

Gender

- No response 2,91%
- Female 39,72%
- Male 57,37%

Education

No degree	3,5%
Secondary education	16,3%
Vocational tertiary education	33,2%
Academic tertiary education	36,1%
PhD	10,9%

Age

17 or younger	0,5%
18-25	3,0%
26-35	9,9%
36-45	12,9%
46-55	18,3%
56-65	27,2%
66-75	24,8%
76 or older	3,4%

Professional status

Student	2%
Unemployed	7,9%
Employed full-time	35,2%
Employed part-time	12,9%
Retired	42,1%

Keep in mind that citizen science most easily reaches a certain target group and that this may have implications for the representativeness of the data you want to collect. For example, if you want to map air pollution, you don't want to do this only in the neighbourhoods and streets where older, highly educated people live.

Target groups that do not automatically find their way to a citizen science project will have to be actively approached. This is best done via ambassadors or organizations that know these target groups well. They can spread the news about the research among their network. Concrete tips and tricks are provided in chapter 5.

In the Scivil communication guide, you will find guidelines and tips for developing a communication strategy in citizen science.

Expectation management

When a local government commits to a citizen science initiative, it sends a signal to citizen scientists that the government takes the research seriously. Among citizen scientists, this will create expectations that the local government will also take action if this seems necessary or desirable according to the research.

The residents of a city or town are not always fully aware of how their government works. Therefore, the government should clearly communicate the extent of its commitment during and after the project.

- In terms of **time**: it can take some time for a decision to pass through the entire policy cycle. If actions by the government take a while as a result, it may seem to citizen scientists that the government disregarded the results of the research. Therefore, keep them regularly informed of what is being done with the research results.
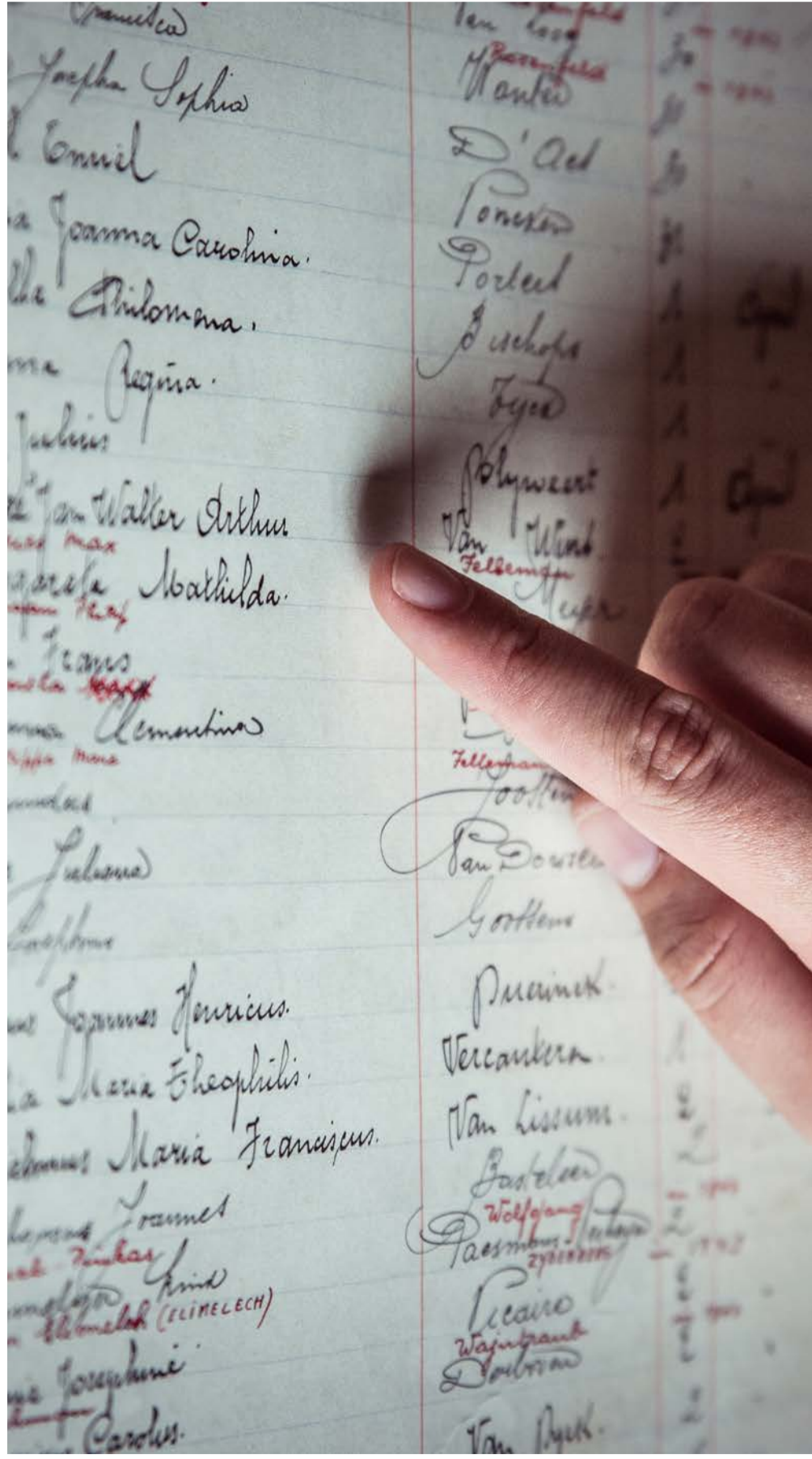
- In terms of **scale**: a local government does not have unlimited resources and it cannot carry out every action that the citizen (scientist) requests. Again, it is important for the government to explain from the beginning what commitments for change it can make. Be sure to keep citizen scientists informed of what does happen with the research results.

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Sustainability

Long-term projects can provide very valuable insights, because the data reveal trends in the long run. But the long duration of these projects comes with additional risks and challenges.

Most citizen science projects see a large spike in participation by citizen scientists at the beginning of the project. In turn, keeping large numbers of citizen scientists engaged throughout a long-term project is a challenge in itself, requiring a specific communication and participation strategy. To this end, you can find tips and tricks in the Scivil communication guide.

Especially in citizen science projects initiated by the citizen community itself, the continuation of the project often depends on one or a few enthusiastic initiators. If they eventually drop out, the project might come to a complete standstill. To cope with this, the local administration can develop a 'citizen science community', in which different projects and organizations are interconnected.

Conversely, the initiators and collaborators of various citizen science projects indicated during interviews that interest and support for their research by local government did not remain constant either.

Sometimes, there was a lot of enthusiasm to support the project at its inception, and that interest waned after a while. Sometimes, it was just the opposite and there was suddenly more interest in the research from local government. It was not always clear for the projects what caused this change in support: a change in personnel that prevented the official, who held the project in high esteem, from continuing its support? The news value of the project that suddenly increased or decreased? A new alderman or mayor who attached more or less value to citizen participation?

An established policy on citizen science in a city or town can cope with these peaks and troughs in interest for citizen science. Read more about it in chapter 3.

Control

A local government can never fully control or manage citizen science. A government may choose not to support a citizen science project, but that does not mean that the research will be discontinued. On the other hand, not every citizen science initiative wants to maintain a close partnership with their local government.

Even when a city or town does contribute to citizen science, unexpected and perhaps undesirable results may emerge from the research. That possibility should certainly be considered before a government commits to citizen science.

In both cases, it is recommended that the government does not disregard citizen science, but that it openly communicates why it may or may not commit to action. We provide concrete tips for dealing with this in Chapter 3.

> " I sense quite a bit of distrust and fear of data. We're often asked: "So will everyone get access to that?", "Will it be proactively communicated?" Officials often have concerns about that as well. Maybe they're afraid of the administration's reaction afterwards." – Interviewed civil servant

How can local governments help citizen science projects?

The online survey we conducted with citizen science initiators showed that they value local governments as partners in their project. Their experiences with local administrations are generally positive.

How do citizen science projects experience contact with local governments?

Survey by Scivil among Flemish citizen science projects in 2020.

- Very negative 0,00%
- Somewhat negative 6,10%
- Neutral 12,10%
- Somewhat positive 33,30%
- Very positive 15,20%
- Not applicable 33,30%
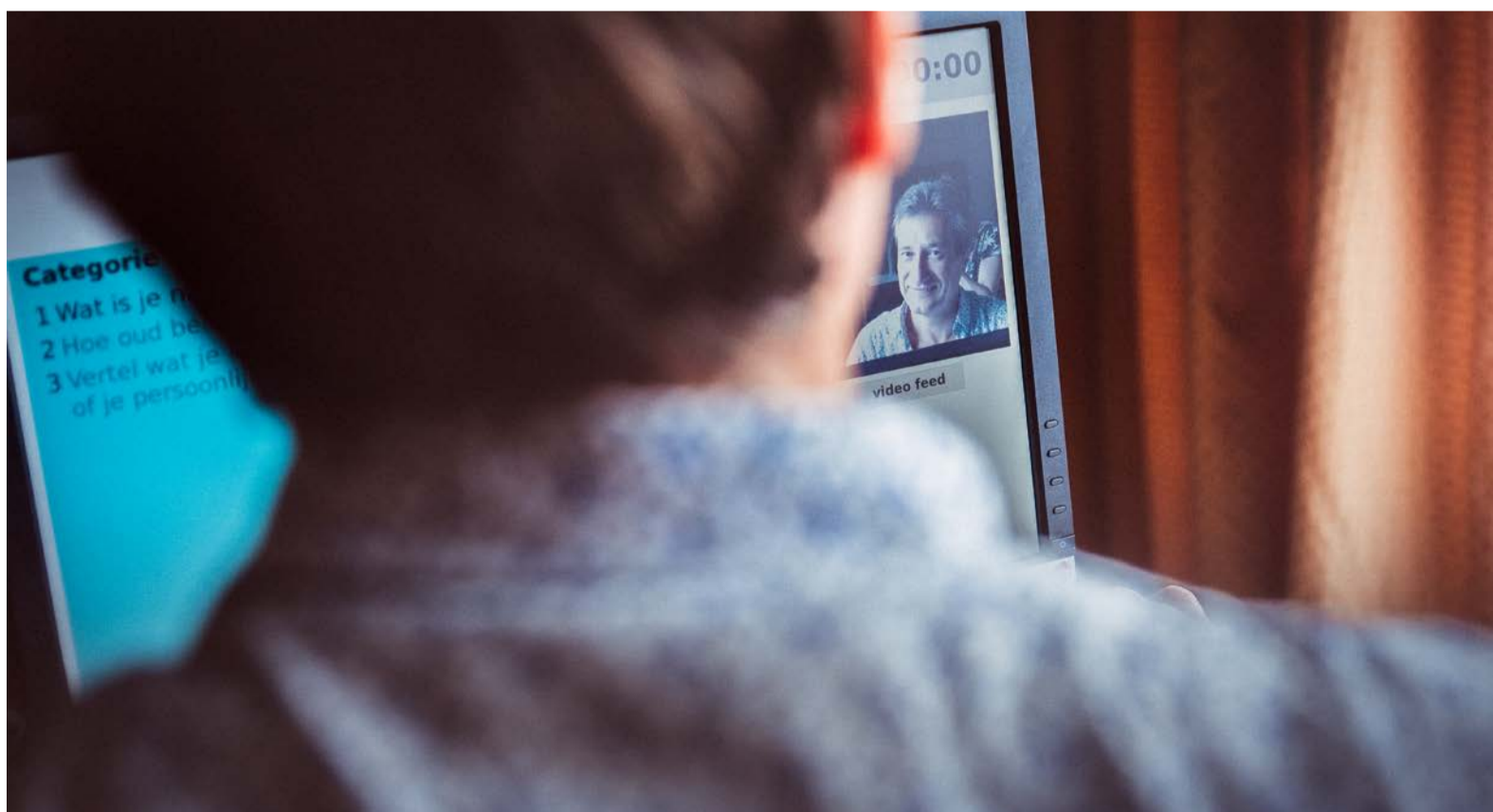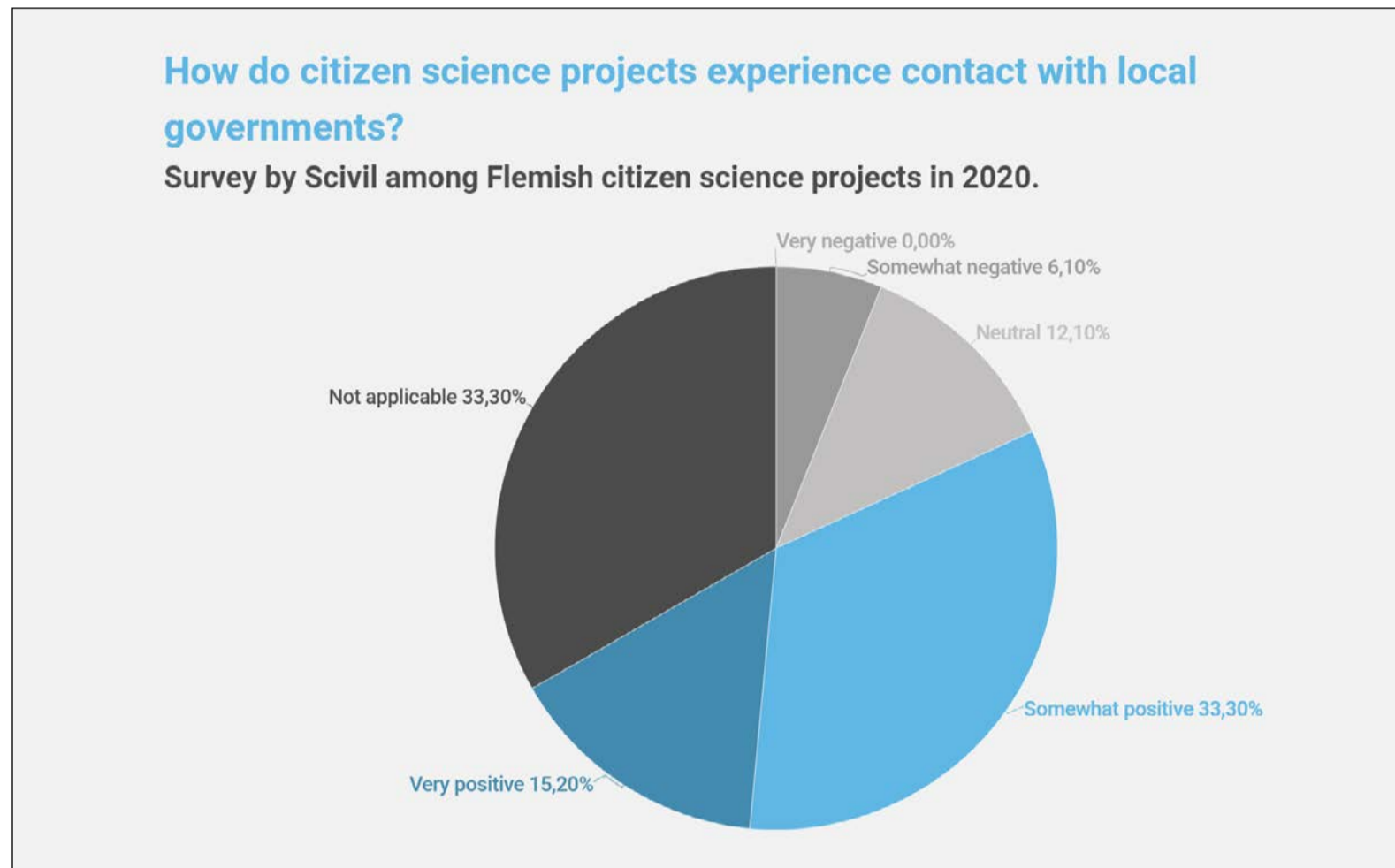
During the preparation of this roadmap, we organized workshops and conducted interviews with representatives of local governments and citizen science projects. From the input of citizen science project staff, we developed this wish list relative to local governments.

What kind of support do projects desire?

- Trust
- Network
- Continuity
- Impact
- Appreciation
- Funding
- Communication
- Logistics & technology

1 Gaining the **trust** of local government. Recognize that what citizen scientists do, is done in a scientifically sound way and that this data can be valuable to governance and policy.

2 The research can create **impact** in the city or town. Measures or adjustments are made by or with the support of the local administration to meet the research findings. Even if this sometimes requires a lot of time.

3 Using the extensive **network** of the local government to find partners or participants for these efforts are recognized.

4 Citizen scientists want to be **appreciated** for the work they do. Citizen science is usually set up to make the world a better place and it is nice when these efforts are recognized.

5 **Communicate** news about the citizen science project through the channels of the city or town.

This can be a message in the newsletter at the launch of the project, or spreading the research results via an interactive screen in front of the town hall.

6 Citizen science projects sometimes experience that interest or support from local government for their research is temporary. They would certainly welcome a policy strategy that could guarantee some **continuity**.

7 More resources are welcome. Small-scale and local citizen science projects indicate that limited **funding** from the city or town could already help a lot.

8 A local government can also help citizen science in kind, by offering **logistical and technical support**, like providing a venue for activities, offering data infrastructure or technical support in building or maintaining sensors.

09. Inspiration: further reading and contacts

In this chapter, you will find inspiring practices of citizen science across Europe.

Gezond Slotermeer

Project title	Gezond Slotermeer
Country	The Netherlands (Amsterdam-Slotermeer)
Start and end date	2014 - 2015
Project initiator	The team of Gezond Slotermeer consisted of: Eigenwijks Foundation, Dietician Practice De Zoete Appel, HVA BOOT Nieuw-West, HVA Domein Sport, Bewegen en Voeding, GGD Amsterdam. The RIVM provided scientific support. The project plan was written by bureau Ahorn. But the main role was played by the Health Ambassadors themselves. Gezond Slotermeer has been commissioned by City District Nieuw West.
Domain	Social Sciences (Citizen Social Science) & Health
URL	Read more about the method of health ambassadors here.

Health connects Amsterdam-Slotermeer

In 2014 and 2015, a group of Slotermeer residents attended a training to become Health Ambassadors. These residents interviewed their neighbours about how healthy they think Slotermeer is in terms of litter, exercise and sports, child-friendliness, greenery in the neighbourhood, ambiance, traffic and transportation, etc. They collected this information from local residents and, in turn, gave them advice on certain topics, such as moisture problems at home.

The ambassadors learned how to interview, gained additional knowledge and started to think more positively about the health of Slotermeer. Moreover, the interviewers came into contact with people outside their direct network. This way, talking about health served a connecting function, crossing cultural differences.

The results were presented during a health festival for local residents and other interested parties. They will also be used to complement existing scientific insights and to better align policy with practice. A total of 221 interviews were conducted by 22 ambassadors.

Tip
- Read how you can shape policy together with citizens by collecting problems through interviews.
- An inspiring example where citizens were motivated and trained to become researchers themselves ("health ambassadors").

Plastic spotter

Project title	Plastic spotter
Country	The Netherlands (Leiden)
Start and end date	2019 – ...
Project initiator	This project came at the request of residents in Leiden. This project was set up partly thanks to the financial support of the Leiden University and the City of Leiden.
Domain	Waste - floating waste in canals and moats
URL	Plastic spotter

"Leiden's canals: a reflection of society"

The mobile app "CrowdWater" allows citizens to enter observations about floating plastic waste. This data is displayed on a map, identifying hotspots of waste in Leiden's canals. In cooperation with "drift waste fishermen", the plastic waste is cleaned up by volunteers with a canoe. Every Sunday at 11 am they go out on the water to pick up plastic waste. Afterwards an analysis is made of the collected material: which categories of waste are observed and what is the source? This way, they want to remove and prevent floating debris.

You can watch an online report from "Vroege Vogels" (BNN Vara) about Drift Waste Fishermen.

Tip

- ☐ Where are the hotspots of floating waste in urban canals or ditches? With the help of volunteers, these locations are mapped using the CrowdWater app, and then removed.

- ☐ Watch the video and see how small practical changes, such as advice on additional garbage cans, can be made using the collected data.

- ☐ Other projects on plastic pollution include Canal it up: a similar initiative on floating litter in Brussels, OpenLitter map: an open dataset on global plastic pollution, and Plastic Pirates: an educational clean-up campaign aimed at schools on litter in rivers in Germany, Portugal and Slovenia. On their website, you can find videos and educational materials to set up a scientific study on waste.

StadtWildTiere

Project title	StadtWildTiere
Country	Germany, Switzerland and Austria (in the cities of Berlin, Bern, Chur, Luzern, Sankt Gallen, Vienna, Winterthur and Zürich)
Start and end date	2013 - ...
Project initiator	StadtNatur
Domain	Biodiversity – Animals in the city
URL	StadtWildTiere

Animals in the wild - looking for tracks in your city

Green and open spaces play an important role in the quality of life in cities. With increasing population density in cities, these areas and thus the habitats for urban wildlife are increasingly coming under pressure. Through the project "StadtWildTiere", residents from urban areas are asked to share observations via photographic material of animals or their tracks on an online platform. Volunteers can also rent a camera trap to make observations. StadtWildTiere works with ambassadors, where each ambassador is responsible for observations of 1 square kilometre of the city. The ambassadors are asked to take regular walks and to talk to residents of their area. A specific training to recognize animal tracks is offered by the institute StadtNatur. The data are used for scientific studies by a team of biologists and ecologists from the StadtNatur team.

Tip
- Are there certain animal species in your city or town that are endangered? Look at the example of StadtWildTiere to make observations about wild animals living in an urban context.
- Using ambassadors, you can make systematic observations. Click here for more info on how they do that.

Rainfall observers

Project title	Rainfall observers
Country	Scotland
Start and end date	2016 - …
Project initiator	Met Office, SEPA (Scottish Environment Agency)
Domain	Flooding and rainfall
URL	Rainfall observers

Install a rain gauge and measure rainfall!

The Scottish Environment Protection Agency (SEPA) collaborates with the Met Office of the United Kingdom to support a network of volunteer rain observers in Scotland. As of 2016, this network of volunteers has been collecting data on rainfall for the national rain archive. To this end, rain gauges are placed in gardens, which the volunteers purchase or assemble themselves. Every day, the volunteers make an observation and they share this report on SEPA's platform. The rain archive is used by government agencies, industry and researchers for a number of purposes, including managing Scotland's water resources, planning sustainable economic development, climate research and developing flood management measures.

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Tip
- Observe how the Met Office uses two specific standards, an A and B standard, for data quality regarding precipitation. Volunteers who meet the criteria of an A standard observer can contribute to the national precipitation archive.
- Thanks to the network of volunteers, data has been collected since the 1960s, with one volunteer making rainfall observations by family tradition since 1898. These historical data are very valuable for rain modelling by the National Meteorological Institute.

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Active ageing

Project title	Age-friendly cities
Country	United Kingdom
Start and end date	2014- 2015
Project initiator	◼ Manchester Institute for Collaborative Research on Ageing (MICRA) ◼ Age-friendly Manchester ◼ Whalley Range Community Forum ◼ Chorlton Good Neighbours
Domain	Health – Social Sciences
URL	Age-friendly cities

'Active ageing' in the city

The "Manchester Aging Study" is an investigation in the ways elderlies experience life in the city. The project aimed to contribute to what the World Health Organization (WHO) defines as 'active ageing', namely continued participation in all aspects of social, economic, cultural, spiritual and community life. The study involved elderlies, not only as target population of the study, but also as experts and actors in the planning, design, development and implementation of the study. A diverse group of eighteen elderly residents, between the ages of 58 and 74, were trained as co-researchers. The co-researchers conducted 68 interviews with elderlies who were experiencing social exclusion, isolation, poverty, or health problems. Through the interviews, they sought ways to improve the quality of life of elderlies in urban communities. The insights from the interviews and input from the co-researchers were used for the redesign of a local park and the renewal of public transport.

Tip
◼ More information on how to involve elderly people in citizen science research concerning urban planning, can be found in this manual.
◼ A 15-minute video was also made, highlighting the research.

Smartwaterland

Project title	Smartwaterland
Country	Belgium (Roeselare)
Start and end date	2020-2022
Project initiator	The city of Roeselare In cooperation with WVI, the province of West-Flanders, Aquafin, Quicksand, Vives, Simaqua/KU Leuven and secondary schools
Domain	Water management
URL	Smartwaterland

Smartwaterland

The city of Roeselare does not escape the changes in our climate. Both floods and droughts are becoming more frequent. The city is therefore working on an integrated approach including a smart water management system. An important instrument in this approach is a dense network of digital rain gauges. These meters are made in schools by 3D printers and are set up by students at home. Involving schools, and thus families, in the entire project is an important added value in terms of awareness, but it also ensures a large number of measuring points throughout the city and region. The data of the measuring points are collected on an online data platform. The platform not only captures rainfall, but also the water levels in rivers, sewers and wells. The combination of all those data allows to implement a fast and efficient water management policy and, among other things, allows to prevent heavy flooding in the city. The project received € 290,000 in financial support from the Government of Flanders (Team Stedenbeleid, ABB) within the call 'Slim in de Stad' (smart city) 2019.

Tip
- Consider involving different parties from the social pentagon, such as governments, companies, knowledge institutions and citizens.
- The involvement of children and families through the schools ensures a strong awareness of both data and climate. The children are also introduced to new technology by 3D printing rain gauges in the classrooms.
- Through the partnership, it is possible to scale up the results, both intermunicipal (through WVI), provincial (through the province of West Flanders) and Flemish (through Aquafin).

Stiemerlab

Project title	Stiemerlab
Country	Belgium (Genk)
Start and end date	2020-...
Project initiator	LUCA School of Arts in cooperation with VITO, UHasselt (Centre for Environmental Sciences), the City of Genk and Vlaamse Milieumaatschappij (VMM).
Domain	Environment
URL	Stiemerlab

Stiemerlab

The sewage system and the increasing urban expansion in Genk have a negative impact on the water quality (pollution, algae formation) and biodiversity of the brook Stiemerbeek (16 km long) and Stiemerbeek Valley. The citizen science project 'Stiemerlab' starts from the premise that citizens of Genk citizens, local residents and local organizations can actively contribute to assess and address the water quality issues. The project wants to actively involve citizens, for example by training them as citizen scientists to collect data on the water quality in the Stiemerbeek using sensors. In addition, citizens can also assess biological water quality by taking water samples at various locations in the Stiemer Valley.

The results will then be visualized in an accessible way to a large audience in public spaces and on an open online platform. The aim of this project is, on the one hand, to monitor the water quality of the Stiemerbeek over a long period of time and, on the other hand, to gain insight into the recovering power of the brook after overflows from sewers.

For the project, a unique partnership was formed between LUCA School of Arts, VITO, UHasselt (Centre for Environmental Sciences), the City of Genk

and Vlaamse Milieumaatschappij (VMM). The project received support from the Government of Flanders, Department of Economy, Science and Innovation (Call for citizen science projects in 2019).

Tip
- One of the partnership's strengths is that it brought together expertise, not only on water and the environment, but also on citizen participation (LUCA).
- Do not forget to pay tribute to the volunteers from time to time. In the Stiemerlab they do this with cookies made in the Stiemer valley. A Facebook page and a newsletter keep the network around the Stiemerbeek alive.

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Examples of citizen science

- **Agilas** (archaeology)
- **Airbezen** (air quality)
- **CurieuzeNeuzen** (air quality research 2018)
- **CurieuzeNeuzen in de Tuin** (garden research, heat stress)
- **De Grote Schelpenteldag** (biodiversity)
- **D-Noses** (measuring scents)
- **DoeDat platform** (various domains)
- **Gezond Slotermeer** (health)
- **InfluencAir** (air quality)
- **Isala** (health)
- **Luftdaten** (air quality)
- **MamaMito** (genealogy)
- **Mijn Tuinlab** (garden research, health, biodiversity, sustainability)
- **Paleontologica Belgica** (palaeontology)
- **Radio Meteor Zoo** (meteorology)
- **Researching Age-Friendly Cities** (health and wellbeing)
- **S.O.S. Antwerpen** (social injustice in mortality)
- **Straatpoëzie.nl** (literature research)
- **Straatvinken** (traffic counts)
- **Telraam** (traffic counts)
- **VeleHanden** (heritage)
- **Verrijk de kijk op Brugge** (artistic research)
- **Waarnemingen.be** (nature observations)
- **Waterland vzw** (healthy rivers)
- **Zooniverse** (various domains)

Other websites

The following websites may offer further inspiration on examples of citizen science:
- **www.iedereenwetenschapper.be:** This website lists citizen science projects in Belgium and the Netherlands. You can also advertise your project here to find volunteers.
- Inspiring examples of citizen science in Austria can be found **here** (German/English). This website is managed by the Citizen Science Network in Austria (CSNA). You can search by different domains (weather, mobility, culture, language, etc.) and by type of volunteer tasks.
- **Hoemeetiklucht.be:** Here you can find information about measuring air quality through citizen science. There is an extensive list of possible sensors that you can use for specific parameters.
- **Funding opportunities.**
- **Movies** that link to the different chapters in this roadmap (in Dutch).
- **Citizen science event calendar**
- **Further reading**

The authors

imec-SMIT, Vrije Universiteit Brussel

The research group SMIT (Studies in Media, Information & Technology) is part of the Vrije Universiteit Brussel and imec, and is specialized in socio-economic research in the field of digital innovation and media. Within the 'data, communities & governance' unit of SMIT, expertise has been built on the recruitment and engagement of citizens in research, as well as the organization of impact measurement and evaluation of citizen science tools. SMIT is a partner in the following citizen science projects: hackAIR, FloodCitiSense, Oog voor Diabetes, the SBO project Flamenco, Climate Stories and the amai!-project.

Carina Veeckman (senior researcher, Bachelor & Master Communication Sciences, researcher at SMIT) is a member of the working group 'Communication and Participation' and of the steering committee of Scivil. Carina coordinated the development of this roadmap.

Nils Walravens (senior researcher, PhD in Communication Sciences) coordinated the Smart Flanders program and was the promotor of this project.

IDEA Consult

The IDEA team is a partner of public and semi-public organizations that go for sustainable development and impact. They provide new insights, concepts, strategies and instruments to innovate our economy and labour market (new economy), increase the vitality of cities and regions (vibrant places) and introduce more effective governance practices (modern governance). They deploy their expertise in a multidisciplinary manner. This project on citizen science is a good illustration of that.

Bart Van Herck is senior expert and managing director of IDEA Consult. From his experience with local government in Flanders, he worked on a strategy to integrate citizen science more strongly into the daily practice of cities and towns.

Marieke Carpentier is a researcher at IDEA and conducted in-depth interviews with the pilot cities in the project. These good practices were integrated in this roadmap.

Scivil

In 2018, the Department of Economy, Science & Innovation (EWI) of the Government of Flanders launched a project call on citizen science. In response to that call, the EWI Department commissioned RVO Society to establish a citizen science knowledge centre. Scivil was founded in January 2019 as the Flemish Centre of Expertise for Citizen Science, aiming to bundle and strengthen the expertise on citizen science in Flanders as a network organization.

Mieke Sterken en Jef Van Laer are citizen science advisors at Scivil. Mieke coordinated the Scivil working group 'Data and citizen science' in collaboration with Informatie Vlaanderen and published the Flemish Data Charter for Citizen Science. Jef organized a series of surveys, interviews and focus groups in 2019 and 2020 to map the Flemish citizen science field.