MUV
in Amsterdam

MUV is a 3-year project funded by Horizon2020 which explores the relationship between mobility, data, technology, and community in 6 different European countries. In Amsterdam, the project mobilised communities of interest based on the mobility needs identified in different neighborhoods.

waag
technology & society

Buitenveldert

The project started in Buitenveldert with focus on the concept of mobility, game dynamics, data collection, and bringing elderly citizens into a technical co-creation project. How can we develop tech and a game that helps the elderly in their mobility needs?

The definition of 'mobility' was different here than in other cities. Mobility meant participating in social, active, and neighborhood life, so this was the starting point for this community.

This led us to hosting community walks and testing the game dynamic with elderly people who wanted opportunities for exercise and social interaction. The open process resonated – an app indeed could not solve these issues in Buitenveldert, but the co-creative process allowed the community to clarify its needs to the local government and identify practical ways forward, such as hosting more community walks hosted by local physiotherapists.

Buiksloterham, Zeeburgereiland, and Zuiderzeepark

A second phase of the project added the dynamic of citizen-sensing and air quality monitoring, in which people built and installed sensors in local areas of interest.

Communities in Buiksloterham, Zeeburgereiland, and Zuiderzeepark each engaged with the project based on concerns about the impact of development and mobility on the air quality in their own environment. The three neighborhoods had a sort of domino effect, with efforts in one community inspiring a neighboring citizen who then mobilized their own local citizen sensing community.

Data Commons, Participation, and Mobility Policy

The third and final phase of MUV focused on approaches to data commons, citizen participation, and mobility policy. Many types of data were explored over the course of the project – MUV game data, air quality data, and other external (open) datasets. How can these be brought together to influence policy? And what are the practical roles for citizens in this process?

Citizens, public servants, local business, organizations, and the MUV Amsterdam pilot team explored these issues in co-creation sessions and meetups hosted live and online. They created a value ladder and set of design principles for future mobility policy in Amsterdam, and provided insight on how to better involve citizens in an open process around data and mobility.

Some of the project's local highlights:

■ **Citizen Sensing**

Local Sensing Communities

10 Steps to Citizen Sensing

Smart Citizens in Amsterdam: An Alternative to the Smart City

■ **Tech**

Monitoring Stations and Sensors

The Bird

Asphyxia

Privacy and Data Anonymisation

■ **Data Visualization**

■ **Participation**

Smart Mobility in Amsterdam

Value Ladder and Design Principles for a 'Mobility Data Commons'

Citizen Insights

Insights and Recommendations on Participation

■ **Legacy**

The Smart Citizen Lab

Amsterdam smart mobility programme 2019-2025

Horizon2020

Citizen Sensing

Smart Citizens in Amsterdam: An Alternative to the Smart City

A chapter highlighting the smart citizen approach in Amsterdam was published as part of 'The Routledge Companion to Smart Cities'.

Get the book here

Local Communities

Local communities in Buitenveldert, Buiksloterham, Zeeburgereiland, and Zuiderzeepark formed the core of MUV in Amsterdam. For many of them, their citizen sensing continues beyond MUV.

10 Steps to Citizen Sensing

Our pilot team and community designed a citizen sensing approach which we are continuing to apply and develop in new projects
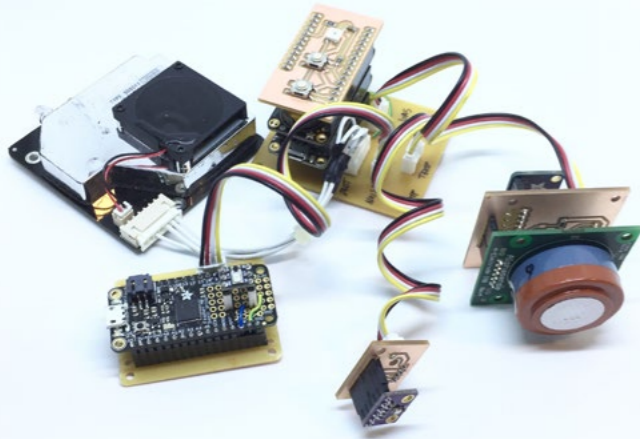
Read them here

Tech

Monitoring Stations and Sensors

Together with citizens in Waag's FabLab, MUV developed and built open source monitoring stations to measure air quality indicators.

See the source code

The Responsive Bird

The Responsive Bird is one example of an air quality case, created by Lotte Geraedts. Under good conditions, the bird sits happily; when NO2 levels are too high, the bird flips upside-down.

Make your own bird

Asphyxia

This was a prototype developed by students at the HvA in which a 'breathing' set of lungs changed color based upon AQ measurements.

Learn more about Asphyxia
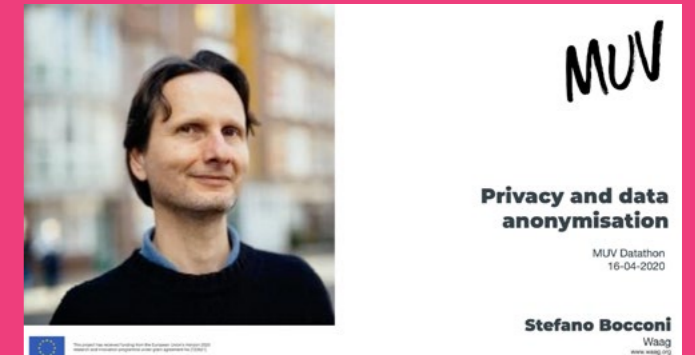
Privacy and Data Anonymisation

A presentation given by Waag's Stefano Bocconi covers GDPR, privacy by design, and anonymisation techniques.

Watch the lecture

Data Visualization

A data visualization was created with help from citizen user testing which displays MUV environmental data from the project's local citizen sensing network. The open source visualizations have been adapted and adopted by other citizen sensing initiatives.

Explore the visualization

Participation

In Amsterdam, pilot coordinators considered how to move citizens 'up' in levels of participation.
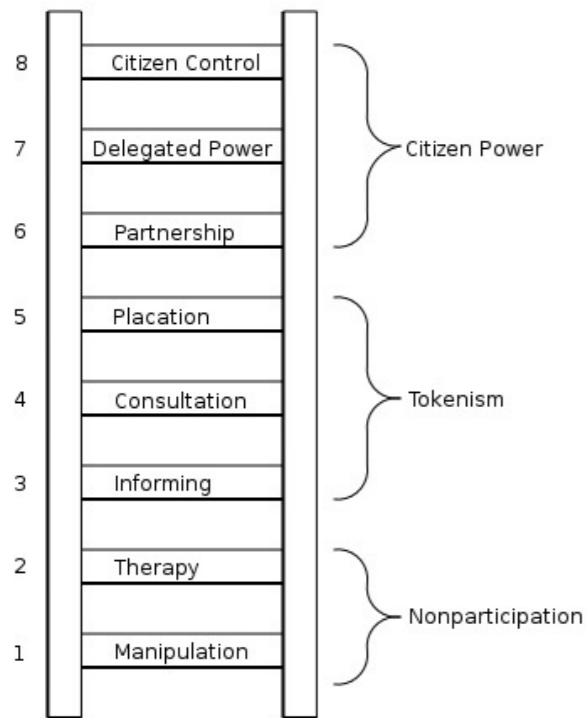
Sherry Arnstein's Ladder of Participation. Image from https://commons.wikimedia.org/wiki/File:Ladder_of_citizen_participation,_Sheey_Arnstein.tif CC BY 3.0

Smart Mobility in Amsterdam

Susanne van Gelder and Eduardo Green from the City of Amsterdam (Netherlands) share their knowledge about the Amsterdam smart mobility programme 2019-2025, looking at innovative mobility solutions and data and digitalization.

Watch the presentation

Value Ladder and Design Principles for a 'Mobility Data Commons'

Stakeholders in a MUV co-creation session considered data governance for mobility data. A 'value ladder' was created showing what values ought to be reflected in mobility policy. In addition, a set of (concrete) design principles were formulated that can help to ensure each of the 5 values are taken up in practice. These values are now being technically implemented into mobility projects by the Amsterdam CTO.

Learn more about developing the value ladder
See the design principles

Citizen Insights

A series of meetups between local citizens and public servants in Spring 2020 in Amsterdam gave citizens the floor to share their insights on participation, mobility policy, and data collection.

At the final session, we reflected on the process of participating in MUV and with Amsterdam's mobility data and policy more generally.

Read the citizen insights

The full documentation of citizen input at these events can be found in D5.5 'Documentation on Engagement Activities in Amsterdam - Final Release' at https://www.muv2020.eu/resources/

Insights and Recommendations for Participation

The pilot team gathered and summarized insights and recommendations regarding citizen participation, co-creation, and mobility data governance

Read our insights and recommendations

Legacy

MUV is closing, but a strong network of local initiatives are continuing to do important work in citizen sensing, data commoning, mobility and citizen participation in and around Amsterdam.

The Smart Citizens Lab

Through various pilots, citizen measurements and events, we map out the living environment of our province and convert it into action together.

Hollandse Luchten uses experimental technology and investigates the value of new sensor technology for residents of North Holland.

Amsterdam Sounds is a platform for measuring noise nuisance in Amsterdam.

GammaSense is a platform for the measurement of radioactive radiation. It enables citizens to measure gamma radiations with an open hardware solution and visualises their measurements on an interactive map.

Learn more about the Smart Citizens Lab

Amsterdam smart mobility programme 2019-2025

The Innovation Centre for Mobility Management will be the Municipality's test centre where research and pilots for new mobility concepts and mobility management will be performed. The lab intends to involve citizens in identifying use cases, testing solutions and scenarios, and producing webinars and e-lectures in which citizens will be asked to share and partner with pilots and projects.

MobiLab pulls data from across mobility providers, public transport and digital information services and collates this into usable formats. Initially it will only be for researchers, but the municipality will provide an online environment in which citizens will be asked to supply research area's/questions and the opportunity to be involved in (3rd-party) collaborative teams as solutions are explored.

eHubs Pushes the shared mobility agenda by providing neighbourhoods with multiple shared options such as electric bikes, electric scooters and electric cars all of which is for communal use by all residents in the neighbourhood. It serves to provide alternatives to car ownership and in doing so make citizens assess their own mobility behaviour.

Horizon2020

European projects will continue to explore the links between issues like mobility, liveability, data, and citizen participation in Amsterdam.

Urbanite explores how big data and artificial intelligence can support the public sector and citizens to improve the mobility issues and foster urban transformation in their cities.

Atelier is a five-year project funded by the European Commission that focuses on shaping energy-positive neighborhoods. Residents, local stakeholders and companies will work together in these districts on a local energy system for energy that the residents have generated sustainably.

10 Steps to Citizen Sensing

1. Identify and prioritize issues facing your community

This is the first stage in any citizen sensing project. Here, a community comes together and identifies what problems they are facing. This process may start very open ended, and will ideally converge on tangible, measurable issues within the community. Examples may include issues with traffic, pollution, noise, or other environmental factors that may present a general issue to a wider community.

After identifying multiple issues facing their community, these issues will have to be prioritized. Using voting or discussion methods can help in this process. The goal of this step is to identify one or a few shared concerns within the community that will be the focus of the next steps. It is of course also possible that there is already a feeling of urgency on a specific topic. The starting point of the project will be less open ended when a strong feeling of urgency is already present within the community.

2. Identify what, where, and when your community wants to measure

Is it possible to measure the community's prioritized issue? To help narrow in on this question, it may help to focus on the sub-questions of measuring: what, where, and when to measure. To formulate an answer to all these questions and design your sensing strategy, you can use co-creative methods to make this a collaborative effort within the community.

Inspiration for co-creative methods can be found on the co-creation navigator and inspiration for methodologies on citizen sensing are shared in the Making Sense Toolkit.

What

Consider the prioritized issue from step 1. Can it be measured? Often, there is more than one way to measure an issue. Take traffic as an example. There are multiple indicators that may be relevant to measure if traffic is a concern: noise levels, the frequency or density of cars, or the air quality near a highly trafficked area. The community will need to decide which (combinations of) factors they want to measure, and if and how these factors can be measured together.

In MUV, all pilot communities were interested in air quality. Like traffic, there are many ways to measure air quality. Ultimately, it was decided to measure PM2.5, PM10, NO2, O3, temperature and humidity, taking into account World Health Organization guidelines as well as feasibility and cost of measuring. These guidelines are recommended reading for those interested in deciding how to measure various aspects of air quality, and can be found at https://www.who.int/phe/health_topics/outdoorair/outdoorair_aqg/en/.

Where

There are two levels of 'where' to consider. Firstly, a community will want to identify the macro level they want to measure. This could be noise levels within a particular neighborhood, or pollution levels near a major highway. The limits and definitions on the area and place where something is measured should be related to the initial issue that was identified by the community. Co-creative methods like collaborative mapping exercises can help the community to identify the places that will be most relevant for them.

The second consideration of 'where' to measure regards the individual or micro level. Different sensors will come with different requirements, such as whether a power source is necessary, whether the sensor needs to stay dry, whether the sensor is sensitive to electrical currents, and even where a sensor can legally or practically be placed. The specifics of these considerations will be made more clear once a community has decided precisely which sensors to use.

Of course, availability and practicality will also play a role in the placement of monitoring stations. Ultimately, the decision of 'where' to place a monitoring station will be dependent on a number of factors, including available places, interested hosts, available power sources, and even geographical distribution within the pilot area, to name a few.

When

Finally, it is important to identify 'when' a measurement will take place. Considerations in this regard may be both short term and long term: for example, measurements concerning traffic may be gathered during both peak traffic hours and low traffic hours so as to make a comparison. In another example, if a community is interested in measuring noise levels in a town square, they may want to consider measuring on weeknights and weekends, or perhaps in both summer and winter, in order to better understand the impact that days of the week or seasons of the year have on noise levels. In a final example, if a town is interested

in measuring their general air quality, they may want to plan for an entire year of measuring in order to understand how the seasons, precipitation, and temperature affect air quality measurements.

In each case, the time during which measuring will take place is greatly dependent on what the community wants to measure and why they want to measure it.

3. Identify what your community wants to do with the data

The question of 'what to do with the data' will likely last a long time, and may even change throughout the project. Nonetheless, it is important to have a plan early on regarding why these measurements are taking place: What will we do with the data?

One way to approach this question is by considering the position of different stakeholder groups within the community. As an individual citizen, what can I do with this data? As a group or network, what can we do with the data? In collaboration with official government bodies, what could be done with the data? The answers to these questions often depend on the political context just as much as they depend upon a group's level of knowledge, expertise, and time.

There may be several options for how to apply the data, involving goals such as educating citizens, raising awareness, inciting a behavioral change, or influencing governmental policies and decision-making. During this step, it is helpful to involve relevant stakeholders—civil servants, universities, research centers, environmental organizations, data experts, etc.—to help identify the possibilities and limits of follow-up actions.

4. Set Up Your Network

Citizen sensing often takes place within a network of various factors. Individual people may have a sensor, for example, that is part of a network of other citizen sensors. Perhaps the data from these sensors will be stored in a common shared place, or visualized online.

Setting up a citizen sensing network requires an architectural understanding of the dependencies between the hardware, software and network (of people, data, hardware and software) in a citizen sensing monitoring station. This step will almost always require help from outside specialists. The whole stack must be integrated. The particular ways in which the stack is integrated will depend on the goals of the community, like what they want to measure and what they want to do with that data. In MUV, these dependencies of the sensing network are generally as follows:

Each sensor (is connected to) » Internet (via Wi-Fi/LoRa, and connects to) » a server with a formatted data base (which sends data to) » an API (connected to) » web visualization.

5. Order Parts

There may be tradeoffs to consider between cost, accuracy, ease of use, and other factors to consider when ordering sensor parts. To help narrow the field of options, it is recommended to consult with an expert. There are also a number of existing resources that can help to evaluate the multiple sensor options that exist. Note that the field of citizen sensing is developing rapidly, so the availability, price, and quality of sensors is subject to change from year to year.

Resources that may be helpful in selecting air quality sensors include:

- https://www.epa.gov/air-sensor-toolbox/evaluation-emerging-air-pollution-sensor-performance – an evaluation of various air quality sensors compiled by the United States Environmental Protection Agency
- http://explorables.cmucreatelab.org/explorables/air-quality-monitor-tests/ – low cost air quality sensor review by the Carnegie Melon University Create Lab.
- https://www.samenmeten-aanluchtkwaliteit.nl/sensoren-voor-fijn-stof-pm25pm10#nova-fitness-sds011 – a discussion of various dust particle sensors from the Dutch RIVM (Royal Institute for People's Health and Environment).
- https://www.samenmeten-aanluchtkwaliteit.nl/sensoren-voor-no2 - a discussion of various NO2 particle sensors from the Dutch RIVM (Royal Institute for People's Health and Environment).

When multiple sensors are put together, it is important to have an overview of the needs and special considerations for each sensor: whole stations should balance the needs of each component. For example, access can be a problem—all parts of the kit need to be accessible, particularly those which may require updates or changing. Some sensors may require calibration more often or for a longer period than other sensors. Certain sensors may also require deliberate positioning (for example, placing a microphone in a certain direction, or making sure that a particle sensor receives proper airflow).

6. Build and calibrate with your community
Building

There are different levels of building in citizen sensing projects. Some projects may design and build sensors from scratch, while others may only involve basic assembly of existing parts. Activities like soldering and programming will require working in a FabLab or similar setting with the proper tools and experts at hand. Assembling parts may be done in more informal spaces, and naturally requires less oversight and instruction. The level of building that takes place will largely depend on the goals of the project (i.e., learning how sensors work vs. wanting simply to gather data) as well as upon the types of sensors used and the complexity of the monitoring station (for example, if more than one sensor is contained in the unit).

Calibrating

Many sensors — particularly gas sensors — require calibration before measuring begins. Some sensors may need to be recalibrated after some time to demonstrate the quality of the original calibration and indicate the level of accuracy of your readings, or to indicate how much the calibration has deteriorated over time.

Calibration usually involves placing DIY sensors next to official sensors for a designated period of time. There are also other calibration methods that do not require physical proximity, but instead rely on making simultaneous measurements during a time of low or stable background levels of the measured factor, doing so repeatedly over time. In each case, a reading from a DIY sensor is compared with the reading from an official monitoring station or sensor.

Because calibration requires some level of cooperation or coordination with an official measuring institute, the pro-cess can be an opportunity for community building and education. For example, installing DIY sensors next to official stations can be done as a co-creative event including both citizens of the community and environmental experts.

7. Install and Measure

Once calibrated, sensors can be installed and measuring can commence. The amount of time that will be dedicated to measuring depends on the phenomenon being measured, and what types of insights the community aims to gather. With regard to air quality, a year is a good benchmark to get a general understanding of an area, covering all of the seasons and going through natural cycles of heat and humidity.

There are practical considerations regarding where, when, and how to install a sensor. These will largely depend on the specifics of the sensor or monitoring station itself.

Installation and measurement can be part of a larger social process. In cases where sensors are placed in homes or other private areas, they may still be contributing to a larger network of data created by a community of practitioners. In other cases, monitoring stations may be in a public space like a park or city square. In a public setting, monitoring stations can serve as an ambassador for the project by being interactive, informative, or experiential.

8. Understand the Data

There are multiple levels of understanding to consider with regard to citizen sensing data. As part of understanding the data, there will need to be a platform where the data can be checked and accessed.

Initially, it is important that people have an understanding of the values' context: for example, provide references for comparison or indications of which levels (PM, NO2, noise, etc.) are normal and which are unsafe. Through the co-creative process of building and deve-loping the sensors up to this point, people will ideally also have an understanding of the mechanical and physical aspects of what is being measured and how the technology works.

On a more macro level and following initial measuring, the data from the network of sensors can also be understood collaboratively. It is important that people who are gathering the data are also informed about the larger trends to be inferred from networked data gathered over a period of time. Groups like governmental institutes, universities, and research centers can be helpful in analysing this data as well. An accessible and open means for exploring the data (like a high-quality data visualization), in combination with a community educated on the subject, can allow for further individual exploration of the data.

Finally, consider that the data gathered sits within a public context of the community's interest. It is important that, in addition to the gathering and understanding of quantitative data, the people involved are also able to share, explore, and define how the data affects and informs their livelihood.

9. Share the Data

As mentioned above, the data requires a platform. It is good to make this platform open and shareable. Data is often more informative when considered in combination with other data—an open platform can allow people to compare sensor kits together. With a network of data, for example, it is possible to see movements and direction, gaining a better sense of flow, cause, and effect. In some cases, it may be possible for this data to contribute to an existing dataset from other public datasets, for example from citizen sensing or governmental initiatives.

In addition to sharing with the measuring community and other groups, it is also important to share the data with the wider public. When the data is open and accessible, anyone who might be interested in looking at the data can do so.

10. Act (lobby, raise awareness, change habits)

In addition to sharing the data, it is also important to share the message behind that data. Does the data clarify a problem or issue? Does it indicate that some sort of change is warranted?

There are many ways that action can take form in a citizen sensing project. This could range from raising an informational campaign about behavioral change to protesting and lobbying officials to make a legislative change. By this point in a citizen sensing project, a community will ideally be well equipped to know what actions ought to be taken, and they will also have knowledge of the institutions, experts, and public officials who may help them to make that change possible.

Design Principles for a 'Mobility Data Commons'

Stakeholders in a MUV co-creation session consi-dered data governance approaches to mobility data. A 'value ladder' was created showing what values ought to be reflected in mobility policy. In addition, a set of (concrete) design principles were formulated that can help to ensure each of the 5 values are taken up in practice. These values are now being technically implemented into mobility projects by the Amsterdam CTO.

The design principles as follows:

1. Design principles for societal interest
- As the organizer of the data commons, you make clear that there is added value for the user. This is possible with a membership model. Allow participation. It would be nice if you built in these resources in the structure of the data commons.

2. Design principles for a level playing field
- Ensure that your entry into the data commons is only possible if it contributes to explicit social interests.
- Reporting is obligatory

3. Design principles for transparency
- Show who is entering, extracting and using data (traceability).

4. Design principles for accessibility
- Take care that the needs of a large group are addressed
- Ensure that no prior knowledge is assumed, so that you do not have to be an expert to partici-pate
- Make sure you know who the commons are for: target group
- Make sure it is clear how to enter/join and how to leave the commons

5. Design principles for sovereignty
- There are people who organize the data com-mons and people who contribute to it. It is important that both parties have influence.
- Ensure that you put humanity first.
- Breaking down and commercializing business models from large platforms
- Digital identity is very important

The City of Amsterdam is applying these values and design principles as a framework for the data platform MobiLab that they are building.

More about the process of developing design princi-ples for a data commons can be found in our report (PDF link, Dutch language).

Citizen Insights

A series of meetups between local citizens and public servants in Spring 2020 in Amsterdam gave citizens the floor to share their insights on participation, mobility policy, and data collection.

At the final session, we reflected on the process of participating in MUV and with Amsterdam's mobility data and policy more generally. We introduced Arnstein's Ladder of Participation [pictured below] and facilitated a conversation around it. Here's what some citizens had to say:

Where do you see yourselves on this ladder?
- A lot is poured onto Zeeburgereiland with lots of information that is well intended but ineffective. It goes over the heads of residents. No feedback mechanisms. Position of informing. You don't see any effort from the neighborhood covered off or controlled.
- It's counter-productive to nag citizens about this. More consistency would be created if the municipality would explain the information more in layman's terms so that one could review objectively what the (data) approach could be. Especially informing, via Facebook, for which the municipality could be more involved.
- Participation: the municipality makes it seem that everything is still possible, while a number of things are already fixed. That's frustrating. Clarify the contours and limits of participation. We are going to build together, that's certain, but regarding some aspects, we're asked to think about things we're not supposed to be discussing. Make it clear what you can talk about and what not.

Where would you like to be?
- We want to advise at an early stage in order to bring ideas regarding longer term topics. Citizens can also participate in the decision-making process. As the moment of implementation approaches, the degree of participation should be increased.
- Municipality must act according to their responsibilities and to do the job. You cannot ask the citizens. Government has the final word.
- If you explain more clearly to citizens why certain choices are being made, you will become more equal with each other.
- Citizens should participate in matters that affect them directly, and if there are various options to choose from, then they need to make a decision. If the municipality already has a plan, then as a government you just have to do your job.

How can we make this happen? How do you ideally see your participation as a citizen?
- Leave it to the government. Show what can be done with it and build citizen enthusiasm through it.
- Data collection of residents will lead to more input from residents regarding specific issues.
- The most important thing is that something happens with the data. Like providing information about good cycling facilities. Would I like to live-stream my location to the municipality? This is not necessary if there is a site where you can provide the information. This must be done by municipalities however, not a private company.
- Thinking about the conditions under which the municipality collects data is a fundamental thing, so it's important to not think about small things, but the frameworks within which my data is being collected.
- Data should be collected for optimization of the road and transport networks. It doesn't need to be for any more extent than that.

What would you find to be an interesting use case study for future projects about mobility data?
- Safety
- Transport shame
- Privacy: Where does the data go and how it is handled?
- Crowd management
- Quality bicycle facilities

Insights and Recommendations for Participation

These recommendations are based on insights from the MUV pilot team in Amsterdam, and are generally intended for those involved in organisations, projects, and initiatives taking a participatory approach to mobility and data.

Consider what participation would look like on different levels.

Informing

Informing is about frameworks and big picture items, not small details.

Challenge: In Amsterdam, citizens often feel they do not know how much data is collected about them, and for what purpose.

Recommendation: Share demonstrations of how citizen data is used and outputs of data collection. It should be visible (clear and transparent) how the data leads to decisions, infrastructure, etc. A design question at this stage could be 'How do we make our work and team as easy to access and understand as possible?'

Recommendation: Continue to involve citizens as much as possible in co-developing mobility solutions in Amsterdam, particularly when developing rules, values, and guidelines for data collection and application.

Consultation

Consultation can help to scope the boundaries of a design question, a target community, or an issue to be addressed. Consultation is a 'step higher' than Informing, but still falls short of citizens' and policymakers' ultimate ambitions.

Challenge: In Amsterdam, citizens feel there is a lack of feedback mechanisms that go beyond mere "informing". They do want to raise their level of participation but expressed there needs to be more clarity on which groups of citizens need to be involved in which mobility issues.

Recommendation: More equality would be created by having better communications mechanisms and options for 'levels of participation' to actually choose from: Provide multiple avenues for these various levels of participation.

Partnership

Partnership is the type of sustainable, long-term involvement advocated for by citizens, public servants, and others in the field with whom we spoke.

Challenge: The municipality is lacking a clear "data approach" which details how they want to involve citizens. There are unclear boundaries surrounding what citizens are able to influence and what they cannot.

Recommendation: Clarify (with the core project team and with citizens) what the limits, boundaries, and mandate of the participation are. (Example from MUV)

Recommendation: Involve citizens as early in the process as possible in order to be part of the decision making process - involvement should increase as the scope increases.

Recommendation: Host collaborative sessions that bring in multiple stakeholders, placing citizen needs as a central problem.