



Making Sense

Advances and experiments
in participatory sensing

COMMUNITY LEVEL INDICATORS

D5.4



DELIVERABLE

PROJECT ACRONYM	GRANT AGREEMENT #	PROJECT TITLE
Making Sense	688620	Making Sense

DELIVERABLE REFERENCE NUMBER AND TITLE

D5.4 Community Level Indicators

Revision: v1.0

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Project co-funded by the European Commission within the Call H2020
ICT2015 Research and Innovation action

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- ✓ **P Public**
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REVISION HISTORY

REVISION	DATE	AUTHOR	ORG...	DESCRIPTION
v0.1	31-05-2016	Mel Woods	DUNDEE	Initial Scoping, References, Report Brief
v0.2	11-07-2016	Lily Bui	MIT	Outline, Report Structure and Section 1
v0.3	13-07-2016	Mel Woods	DUNDEE	Review and Edit
v0.4	16-07-2016	Lily Bui	MIT	Section 2 Design Tools
v0.5	21-07-2016	Mel Woods	DUNDEE	Review and Edit
v0.6	23-07-2016	Lily Bui	MIT	Full Draft and Figures
v0.7	25-07-2016	Frank Kresin	WAAG	Peer Review
v0.8	27-07-2016	Lily Bui	MIT	Integration of Review Comments
v0.9	28-05-2016	Drew Hemment	DUNDEE	Review and Additional References
v0.9.1	28-05-2016	Gui Seiz	IAAC	Design and Formatting
v1.0	30-05-2015	Mel Woods	DUNDEE	Final Edit, References and Proof Read

STATEMENT OF ORIGINALITY

This deliverable contains original unpublished work except where clearly indicated otherwise. Acknowledgement of previously published material and of the work of others has been made through appropriate citation, quotation or both.



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1

INTRODUCTION

Urban participatory science and citizen sensing aim to start from the needs of citizens in specific communities who are trying to understand environmental problems.

With the challenge of engaging citizens in processes spanning campaign roadmap design to data collection using DIY/DIT tools and technologies, comes yet another challenge of measuring the longer-term impact of these initiatives.

From among the informal networks of digital culture has emerged a sustained attempt – including in events and publications by FutureEverything and Waag Society – to shift the debate on the future of the Smart City towards “the central place of citizens, and of decentralised, open urban infrastructures” (Hemment & Townsend eds., 2013).

As suggested in the recent final report on Digital Social Innovation (Bria, et al., 2015), there is a growing motivation for citizens to engage in participatory sensing (also known as crowdsensing and citizen sensing) that stems from their acknowledgement that environmental issues, such as increasing levels of air and noise pollution have detrimental effects on their health and wellbeing.

Making Sense is such an initiative, and its focus is on open hardware and open design for social and environmental change. It seeks to position social innovation with a purpose by adopting a cooperative methodology that encourages participants to go from local to system awareness, from awareness to action, and from action to transformation.

To enable participation in Making Sense, an open call was launched through the FutureEverything Festival and Fab Lab Barcelona websites to identify potential users. The selection criteria were based on the level of technical skills and the topics of interests stated by the applicants (Making Sense D6.2, D4.1 2016).

Public funding for such multidisciplinary initiatives comes from the Horizon2020 CAPS Programme on “Collective Awareness Platforms for Sustainability and Social Innovation”, under the goal of supporting digital social platforms at larger scales towards the development of innovative solutions to societal challenges.



These challenges are shared by many within the field of social innovation, which seeks to produce systemic changes that challenge the status quo, allowing for “social learning and citizens’ involvement, empowerment, and participation” (Eijl et al. 2011, 73). Essentially, social innovation projects seek outcomes that possibly reshape society itself by changing “attitudes and values, strategies and policies, organisational structures and processes, delivery systems and services, methods and ways of working, responsibilities and tasks of institutions and linkages between them and different types of actors” (28).

Elsewhere within citizen science, scholars have called for “sound evidence of citizen scientists influencing positive environmental changes in the local systems they monitor” to document the progress and longer-term impacts of citizen-driven data collection (Conrad & Hilchey 2010).

So, in dealing with the complex nature of social problems, how does one approach the somewhat daunting task of measuring of social change within a project?

In the past, indicators have been used to measure different types of value for society, with Gross Domestic Product (GDP) being a commonly cited example. In other cases, indicators have been used to measure things like happiness and globalisation’s impact on environmental progress (OECD 2008; Ura, Alkire, & Zangmo 2012; European Commission 2015).

For more community-oriented work, some researchers have proposed methods of evaluation that lean on “community involvement to identify indicators to monitor progress towards sustainable development and environmental management goals” (Fraser, et al. 2006). As opposed to purely top-down methods of assessment that exclude target communities from weighing in, an approach that privileges community indicators roots the process of evaluation in an evidential paradigm built from the bottom-up.

The incorporation of participatory design and similar co-creation practices – putting citizens at the centre of inquiry, involving target communities of interest and practice in the making of questions, indicators – is paramount. Thus, we propose a community-level indicators approach to help assess the long-term impacts and measure near- to mid-term impacts along the way.

Community-level indicators (CLIs), discussed in much further detail in the following sections, are objective, measurable outcomes that point to related social changes. Using this approach in context also helps to address the challenge of reporting on findings and making meaning of results across such different cities and contexts.

CLIs are here understood as indicators that are defined by community participants themselves, at the level of the community rather than the individual. The attainment of indicators and outcomes are tracked by the community themselves, using designed tools and resources. CLI’s are framed within a Futures orientation, mapping the indicators of desired



outcomes for the community, supporting sensemaking and the development of productive communities.

CLIs can be used in participatory sensing projects to enable stakeholders and community participants to define and measure progress against the environmental issues that are important to them, they aim to address through sensing and making sense of data on their local environment. Examples include air quality both indoor and outdoor, noise and damp.

Every participatory sensing project – with its unique blend of community partners, participants, contexts, and tools – also comes with its own set of affordances, limitations, and particularities. Naturally, cities also can have a slightly different orientation toward which environmental problems to investigate and how to approach doing so, stemming either from local government initiatives, or from the constellation of actors and history of engagement in that locale.

We recognise a need to develop and share a common framework for pilot organizers and participants in order to create a baseline for change before the pilots begin, document progress toward commonly identified goals, and construct meaning around the findings in different cities. This report sets out to propose a community-level indicators approach to measuring social impact as a result of the Making Sense pilot interventions.



1.1 Arriving at community-level indicators collectively

The history of measurement in the city is undoubtedly connected to the history of various formulations of power and control. Within the “smart city” discourse, which often foregrounds technology rather than social challenges, city management focuses on concepts like “optimisation” and “efficiency” by way of surveillance and tracking.

For instance, Rio de Janeiro’s Centro de Operação Prefeitura is a hallmark example of city control rooms that illustrate and reproduce asymmetrical relations of power that exist between governments and citizens.

Likewise, in this version of the smart city, decision-making and problem solving are “usually left to experts, yet citizens know a huge amount about their cities” (Saunders & Baeck 2015).

We acknowledge and argue that sensors and sensor data alone cannot make sense of change (Greenfield 2013). We also note that participatory culture oftentimes empowers the already empowered, and “open source movements only care about who participates, not those who don’t” (Hemment and Townsend, 2013).

In opposition to this image of the smart city, a community-level approach proposes “rethinking smart cities from the ground up” and rather reimagines the smart city as one made up of smart citizens (Saunders and Baeck 2015). There arises the claim “that citizens can, and should, play a leading role in conceiving, designing, building, maintaining our cities of the future” (Hemment and Townsend, 2013). New digital tools further enable citizens to become involved with “policymaking, planning and budgeting, and this could help cities make smarter and more democratic decisions” (Saunders & Baeck 2015).

This poses profound questions about governance, where the question of who gathers evidence, on behalf of whom, and how, is of fundamental importance. This points “beyond a plea for wider public consultation in the planning process” to “a fundamental shift in the way we think about our cities and about urban development” (Hemment and Townsend, 2013).

Just as we advocate involving communities in defining matters of concern in each pilot, so too do we hope to propose creative, interactive ways for communities to be involved in reporting on key challenges and goals along the way.

Figure 1. Rio de Janeiro's Centro de Operações Prefeitura. (Photo credit: www.rio.rj.gov.br)

It is important, too, that collecting indicator measurements involve a diversity of tools that capture various aspects of the campaign – both quantitative and qualitative – in order to evaluate pilots.

Ultimately, we want campaigns to lay the groundwork to affect long-term policy and/or behaviour change in their respective cities. In order to achieve this, we must enable both pilot organisers and involved communities to effectively create a baseline, identify common goals, document progress, and report on results.



Figure 1. Rio de Janeiro's Centro de Operações Prefeitura. (Photo credit: www.rio.rj.gov.br)



1.2 Why evaluate community initiatives?

The ability to evaluate a community initiative allows for determining the overall value of the work completed. Using CLIs to determine the impact that a campaign has on its target community provides feedback for what went well, what went not so well, and what could be improved upon for future endeavors.

Whereas direct feedback may be possible to collect in a more immediate, short-term setting, the challenge of measuring long-term change lies in navigating the nebulous, complex factors that indicate meaningful social change.

Not only does a community-level indicators approach support evaluation before and after a campaign, but it also involves evaluation in medias res while the campaign is taking place. This is a form of “action research,” which Reason and Bradbury (2001) describe as a “participatory, democratic process concerned with developing practical knowing in pursuit of worthwhile human purposes, seeking to bring together action and reflection, theory and practice” (1).

This enables campaign managers and community members to collect feedback about their work, draw conclusions from it, and choose (if necessary) whether to change course or to continue in the same direction as before.

Without community-level indicators, the process of extracting meaning from these disparate yet connected campaigns would belabor the manifold possibilities for outcomes in each pilot. CLIs, at the very least, provide a common framework from which to evaluate what kind of change these campaigns seek to affect, and to what extent the campaigns are successful in doing so.



1.3 Tactical, short-term outcomes to measurable, long-term change

Crowdsensing has the potential to change the life in the city, even creating social change in their respective communities. We believe that in order to move projects from the realm of activism and civic engagement into long-term policy changes, there must be a way to evaluate how those changes have taken, or can take, place over time.

While it is true that a short term project cannot by its very nature measure long-term change, a shared framework for projecting what long-term changes might be would help campaign organisers understand and foster the potential changes or map key stages towards long term change, which lay in the near future. In the event that a campaign does not achieve what it set out to do during its inception, looking at community-level indicators for project evaluation might help provide insight as to why not.

Finally, in an increasingly diverse landscape of community-based research around the world, citizen sensing initiatives such as those implicated in H2020 ICT Collective Awareness Platforms can enhance the impact of their work by documenting what is happening using community-level indicators and learn consistently from their consequences.

The use of a framework and indicators, we hope, will bridge the gap between citizens, scientists and decision-makers. This may spur further innovation in the field, moving existing attempts at communicating change using open hardware, open software and participatory design forward.



1.4 Scope of this report

This report maps how community-level indicators have been used across other disciplines for the evaluation of various initiatives, and it also proposes how to situate participatory sensing projects within the wider ecology of initiatives that use indicators.

To be clear, this report does not expect to arrive at specific indicators for participatory sensing projects in general, or for campaigns within Making Sense. In these cases the communities of interest, communities of practice, and campaign organisers for each city will rightly define them. However, this report will suggest preliminary ways to conceptualise, at a categorical level, what some potential community-level indicators might be.

The framework presented in this report can potentially be applied in participatory sensing projects, as well as citizen sensing projects within H2020 ICT Collective Awareness Platforms. The latter sections of the report are designed to be implemented within H2020 ICT CAPS Making Sense EU campaigns in particular.

SECTION 1 introduces an overview of how indicators are used as a metric for evaluation and argued for the importance of evaluation community initiatives.

SECTION 2 provides a literature review of extant scholarship and knowledge about community-level indicators across a variety of disciplines, spanning health to environmental monitoring to media.

It situates participatory sensing within this ecology of indicators-related work and proposes how projects might see themselves in relation to how other fields have used CLIs. It also points to precedents of CLIs for campaigns focusing on environmental pollution.

SECTIONS 3, 4, and 5 propose a practical framework for participatory workshops that involve Making Sense pilot organisers and community members toward evaluating the progress of pilot campaigns. It suggests a curated collection of existing tools that might be used in order to create a baseline, track progress, and report on results.



2

LITERATURE REVIEW

Community-level indicators provide a means of looking at long-term, social change in the aggregate, as a result of specific efforts.

At the same time, by actively engaging in clarifying the results, a community and its organisers may be able to set out the process leading to the desired effects in a more focused and effective way. Still, the concept of community-level indicators itself is not new.

2.1 A brief history of CLIs

Social indicators appeared as early as the 1830s in Belgium, France, England, and the United States when they were applied to social and health reform issues (Rethoret 2013; Cobb & Rixford 1998).

Physicians and statisticians hoping to understand urban disease epidemics began to look at the social components of Census data, which eventually led them to formulate models linking disease with poverty and other social conditions.

The 1800s saw the formation of agencies like the Massachusetts Bureau of Statistics and Labor and the U.S. Bureau of Labour, which provided some of the first “officially gathered” social statistics (Cobb & Rixford 1998). The next watershed moment for social indicators research was in the year 1910, during which the Russell Sage Foundation¹ developed local surveys for measuring industrial, educational, recreational, and other aspects of living in the United States (Sheldon & Freeman 1970).

Previously, economic measures such as the gross domestic product (GDP) were used to estimate social trends. Still, these early reports did little to influence social reform, although they did raise greater awareness of social problems (Rethoret 2013; Cobb & Rixford 1998). Social researchers quickly realised the need and opportunity to develop more robust theoretical framing to measure progress toward social goals as opposed to economic ones

1 www.russellsage.org



(Sheldon & Freeman 1970; Andrews 1989; Cobb & Rixford 1998; Berman & Phillips 1999; Gahin & Paterson 2001; Crothers 2011). This moment in social research moved toward gathering “descriptive data, then [developing] the categories that would allow meaningful generalisation and eventually work toward analysis of social change” (Sheldon & Freeman 1970, 103-5).

Academics and researchers began to experiment with economic and social indicators at local levels, producing community problems, citizen surveys, and socioeconomic data. Much of the experimentation at this stage of indicators research focused on drawing conclusions about the impact of social conditions on health (Gahin & Paterson 2001; Rethoret 2013).

During the 1960s and 1970s, a growing interest in social indicator reporting fueled the establishment of governmental infrastructure for development of social indicators in countries across Europe. The Social Indicators Research Journal was launched in 1974 and continues to be published to this day (Rethoret 2013).

Social indicators research experienced a lull until the late 1980s, when both national governments and publics began to demand more “evidence based policy” and outcome-oriented measurement toward local decision-making (Rethoret 2013). Within the research community, a growing consciousness of the relationship between economics, social conditions, and the natural environment led to the growth of sustainability indicators, which showed how these relationships work (Meadows 1988).

Today, the use of indicators for evaluation still maintains its rootedness in the social sciences, though their use has been adapted across a multitude of fields, with each field developing its own conceptualisation of the term.



2.2 Defining Community-Level Indicators

A close look at how community-level indicators are defined across disciplines and fields quickly reveals a relatively uneven landscape of how the terms are used.

The table below illustrates how “community-level indicators” or “indicators” is used in fields such as health, ecology, design, sociology, social science, resilience studies and media studies (Gahin & Paterson 2001; Cutter, Burton, & Emrich 2010; NCME 2013; Rethoret 2013).

The use of a framework and indicators, we hope, will bridge the gap between citizens, scientists and decision-makers. This may spur further innovation in the field, moving existing attempts at communicating change using open hardware, open software and participatory design forward.

TERM	DEFINITION	SOURCE	FIELD
Community-level indicators	“measures that refer to population groups rather than individuals...[they] offer objective measures of outcomes”	(KU Work Group for Community Health and Development 2016)	Health
Community-level indicators	“observations of aspects of the community other than those associated with individuals... to supplement individual-level measures in the evaluation of community-based programs”	(Cheadle 2000)	Health education
Indicators	“the ability to detect and/or predict trends in key variables of interest”	(Fulton, Smith, & Punt 2005)	Ecology
Indicators	“evidence that outcomes have been achieved”	(Kimbell 2014)	Design, sociology
Social indicators	“objective measures which are known to influence life chances and satisfaction levels”	(Berman & Phillips 1999)	Social science
Impact metrics	“indicators not only address reach and use, but also help...assess connections with particular demographic groups, their penetration of specific geographic communities, and the loyalty of various audience segments to their services”	(NCME 2013)	Media studies



Table 1. Various definitions of the meaning and use of indicators across disciplines.

Some definitions for indicators refer to the scale of a group or community rather than an individual. We see this in the definition from KU Work Group for Community Health and Development (2016) as well as in Cheadle (2000). Other definitions do not specify a scale but instead focus on measuring particular trends or outcomes such as in Fulton, Smith, & Punt (2005), Kimbell (2014), Berman & Phillips (1999), and NCME (2013).

While nuanced in their differences, these conceptualisations of indicators share a common core in that they treat indicators as something (or many things) to watch in order to determine whether or not something else is changing due to some sort of intervention – be it a campaign, policy, or another variable.

Community-level indicators seek to render visible the invisible, in the sense that the more abstract and immaterial outcomes of socially oriented campaigns (e.g. awareness, loyalty, and so on) tend to be difficult to capture on their own. An approach that leans on indicators as objective, observable proxies provides a means to creating more reliable scientific evidence for more abstract outcomes and changes.

2.3 Looking at key community-level indicators for progress

We look to establish community-level indicators that will serve as key metrics to track participatory sensing projects for CAPS ICT H2020 broadly, and Making Sense EU specifically.

In a general sense, community-level indicators are objective measures of outcomes that reflect the concerns of a specific community. Because they are based on observations of the community environment rather than individual reporting, CLIs “provide a way of measuring environmental changes--often an intermediate goal of community-based programs” (Cheadle 2000). An example might be monitoring smoking through the community-level indicator of cigarette sales in a city, rather than polling individuals to find out how many cigarettes they smoke daily.

Because CLIs focus on a different scale (a community, rather than individual), it is important that community-level indicators reflect the following characteristics:

- Relevant
- Usable in practice
- Statistically measureable



- Logically or scientifically defensible
- Reliable
- Policy-relevant

While CLIs do seem to emphasise more quantitative measures toward evidence-based decision making, these indicators ultimately represent more qualitative, abstract societal changes. CLIs offer a way of obtaining feedback from communities to determine progress in a campaign that aims to affect social change (KU Work Group for Community Health and Development 2016).

Community-level indicators can be useful in four key ways:

[1] Community assessment

CLIs can be used for community assessment by helping to identify community issues and problems and providing information about the effects of the campaign on the communities themselves. For example, a reduction in number of hospital check-ins for substance abuse may indicate that a substance abuse prevention program is working.

[2] Accountability

CLIs can help maintain accountability for campaigns by offering pilot organisers a set of consistent metrics to track throughout the course of the campaign. A campaign that focuses on measuring air pollution might make a point to track carbon dioxide levels near public spaces before, during, and after a campaign takes place in order to see whether pollution from vehicle emissions and industrial exhaust might have varied over a period of time.

[3] Evaluation

CLIs can be used to measure progress toward campaign goals. If a campaign aims to track community perception of noise pollution over time, it might look at how many noise complaints there are in a city before and after some sort of campaign intervention.

[4] Policy change

CLIs can help determine whether policy change is needed, and/or whether a change in policy has affected change in any way. For instance, if a grassroots air quality monitoring initiative in a city whose government historically does not provide air quality information reveals a demand and need for this type of information, it may warrant a policy change to enact the proper infrastructure to collect and disseminate this information to citizens.

While there may be no such thing as a “one size fits all” method of capturing the impact of all the pilots for all their unique challenges and affordances, an approach that involves defining key community-level indicators to watch across the pilots helps guide the process of evaluation of each individual campaign in relation to the overarching goals of Making Sense.



3

COMMUNITY-LEVEL INDICATORS FOR MAKING SENSE EU

In order to begin thinking about key community-level indicators for participatory sensing, we must first come to an understanding about some key terms and definitions.

First, what constitutes a community at a practical level? One common MacQueen, et al. 2001 of community is “a group of people with diverse characteristics who are linked by social ties, share common perspectives, and engage in joint action” (MacQueen, et al. 2001, 12). It is important to acknowledge, too, that while not all communities need to be co-located geographically (e.g. a community of researchers around the globe), in the case of local communities, a shared geography does add to the level of cohesion around a social group, issue, or concern.

To further nuance the meaning of community, we distinguish between communities of practice and communities of interest. A community of interest may be connected through their interest or concern in a topic, such as air quality in Amsterdam or noise pollution Barcelona. A community of practice might share the same types of skills and can provide additional expertise or knowledge about the issue but is more concerned with technical or scientific advancement, regardless of its application or issue. This definition can also extend to those interested in the advancement of science, or in this case citizen science in general.

Communities can be active, dormant, or somewhere in between. For instance, Barcelona’s Making Sense pilot engages with a pre-existing community of practice that was connected through SmartCitizen, an environmental sensing community based in Fab Lab Barcelona. While the community had become less involved – and thus dormant – with regard to maintaining their sensors over time, the prospect of applying the same tool to a Making Sense campaign reactivated interest among community members (Bui 2016). In Prishtina’s pilot, hosted by the Peer Educators Network (PEN), the organisers recruited their communities of interest and practice from a previous citizen science campaign with which many of them had been involved.

In both cases, one might interpret that citizens can be “off-duty scientists” that might be



called upon to contribute time and effort toward community investigations.

Second, we may look to existing toolkits and frameworks for evaluation in other contexts. As discussed in Section 2, other disciplines and fields have developed ways of measuring CLIs across health studies, ecology, sociology, media, and so on. Relevant existing resources include Lucy Kimbell’s Social Innovation Handbook toolkit (2014); One Global Economy’s Digital Inclusion Impact Evaluation Toolkit (2013); Rabinowitz’s methods for evaluating community initiatives (2016); and the Community Toolbox (2016). Each of these endeavors to use community-level indicators reporting as a basis for reporting on goal setting, progress, and impact of a campaign. (See Appendix for more examples.)

Third, in this report, we distinguish between “pilots” and “campaigns” for participatory sensing. We use the term “pilot” to more broadly refer to participatory sensing programmes with the potential to be replicated, extended, or scaled (Making Sense D5.1 2016).

Many citizen science projects use the term “campaign” to describe the engagement, awareness and invitation to citizen scientists to contribute to scientific research. We will move beyond the most common concept of campaigns as awareness raising and citizens as contributors, as this fails to recognise the huge potential of greater participation in question definition, local and situation-specific knowledge, and more complex analyses as well as in decision making (Science Communication Unit, 2013). Campaigns are designed to achieve social innovation and change leading to policy outcomes.

The table below provides a look at other frequently-used terms in this report and their respective meanings.



3.1 Definitions of Terms

Community

A group of people with diverse characteristics who are linked by social ties, share common perspectives, and engage in joint action (MacQueen, et al. 2001)

Communities of practice

Current or potential participants with high interest and variable technological skills.

Impact

Long-term measurable change that occurs due to specific efforts, often shown by community-level indicators.

Framework

A theoretical structure that describes an approach for managing a measurement effort.

Evaluation

A process designed to articulate how activities are intended to achieve a set of outcomes, specify indicators to measure progress toward those outcomes, and collect and analyze data on those indicators.

Social innovation

New strategies, solutions, ideas, or tools that accrue value for a community or society rather than private individuals.

Communities of interest

Current or potential participants with high interest and variable technological skills.

Outcomes

Changes that follow as a result of program implementation.

Metric

A measure for which data are available to quantify outputs or outcomes (also referred to as an indicator).

Tool

A measurement instrument that can be used by pilot organisers or participants for evaluation or data collection.

Social change

An observable shift in the status quo (with respect to an established baseline) in social behaviour, policy, institutions, relationships, welfare, quality of life, or environmental health.

Pilot: A test participatory sensing programme with potential to be replicated, extended or scaled.

Campaign

The public facing phase of a pilot, designed to achieve social change or innovation



3.2 Examples of community-level indicators

Here we will examine a few examples and point out some general types of community-level indicators for environmental campaigns that could be used as starting points.

Environmental pollution can threaten both wildlife and human health. The state of the natural and built environments contributes to the quality of life (or degradation thereof) within a community. While open spaces like parks and plazas provide opportunities for exercise, socialising, fresh air, and so on, polluted air, noisy streets, and rundown buildings can also negatively influence those living in the area.

Some examples of community-level indicators to assess the environment's impact on human health might include (but are not restricted to):

- The amount and condition of open space in the community (including public parks, conservation land and other protected areas, wildlife refuges, state forest, farmland, and protected or unprotected wild areas)
- Amount of protected land in the community
- Efforts to preserve and restore historic buildings, monuments, spaces, etc.
- The quality and adequacy of drinking water in the community (measurable pollutants, threats to or problems with the water source, size of the water supply and its ability to meet future needs, etc.)
- Air quality in the community
- Efforts by local government to reduce its effect on the environment (e.g., mandated use of low-emissions vehicles on government business, low-emissions or electric vehicles used for public transportation and garbage pickup)
- Availability and ease of recycling of paper, plastic, hazardous waste, and metal for both households and business/industry
- Level of regulation and enforcement of environmental standards for business and industry
- Local sponsorship of or support for public art (e.g., sculpture in public spaces, murals painted by teenagers in neighborhoods)



Many of these indicators are most useful when compared to past figures or figures from other similar communities, when monitored over time, or when looked at as a percentage or proportion of the population. In that way, the figures can be reasonably compared with those of communities of any size, and the figures will also be more succinct when addressing an audience of policymakers or decision makers.

One of the intended outcomes of participatory sensing is an enhanced feeling of empowerment and stewardship toward the environment, as well as new connections and skills. For this reason, it is also important to note more tacit impacts such as level of participation among members in a campaign, new skills learned, attitudes, behaviours, and connections. These more internal factors, discussed in further detail in the following chapter, can be assessed by self-reporting methods such as surveys, focus groups, journaling, and so on.

CASE STUDY

Barcelona and noise pollution



Figure 2. “No more terraces” and “No more noise” flags in Barcelona. (Photo credit: Lily Bui)

In the city of Barcelona, noise pollution is a problem for local residents of the city. The sources of noise can vary: traffic, major transportation facilities like airports or train stations, leisure activities, shopping areas, industrial activity, people, and animals.



However, the exponential rise in tourism over the years, leading back to the 1992 Olympic Games in Barcelona, has inadvertently transformed previously quiet neighborhoods into overcrowded, loud ones; raised property values for local residents; and posed a cultural threat to the Barcelona way of life (Duran 1992).

Neighborhoods such as the Gothic District, Born District, and Barceloneta have experienced rapid development and commercialisation in recent years, attracting increasing numbers of tourists. Additionally, with tourism on the rise also comes an increasing demand for hotels and lodging for tourists (Burgen 2015; Colau 2014).

In order to express their discontent, some local residents use their balconies as a medium for protest and activism against the massification of tourism in their neighborhoods. By hanging flags with messages against tourism, residents signal disapproval of current conditions in the city. Grassroots groups like Guanyem Barcelona (which translates to “take back Barcelona”) have emerged to support more regulation of tourism in noisy areas as well.

The municipality of Barcelona has responded to these complaints by releasing “noise control service” resources through the city website and related channels. However, the challenge in addressing noise pollution, and specifically noise pollution in relation to tourism, is that noise is relative and mostly a matter of interpretation. It can also vary depending on the time of day, a person’s mood, and more (Ajuntament Barcelona 2016).

At the time of writing, the city has mostly created recommendations for citizens as individuals to reduce noise pollution in their own environments as opposed to suggesting wider community-level actions. However, the city has taken the initiative to begin mapping noise pollution with a limited network of sensors to better understand how noise is distributed across the city (Barcelona Strategic Noise Map 2016). Also, future development campaigns like the 22@ urban plan scheme for Barcelona places emphasis on creating public shared spaces for local residents as well as incorporation of natural environment into built environment for reduction of air and noise pollution.

In this case, we can look to possible community-level indicators that may allude to the social perception of noise and the steps toward change that might be taken.

Some possible indicators may be as follows:

- Noise levels (in decibels) across different types of areas (residential, commercial, industrial, public, institutional, etc.)
- Number of major transport facilities (airports, train stations, fire stations) nearby
- Number of flags protesting noise pollution in the city
- Volume of traffic near residential areas
- Property values near noisy areas vs. quieter ones



- Rating of well-being
- Symptom profiles
- Use of psychoactive drugs and sleeping pills
- Mental-hospital admission rates

Community-level indicators for environmental issues must deal with the complex problem that environmental issues are often also social, economic, and political ones. Therefore, the act of measuring the extent of environmental issues necessarily involves a broad understanding of their human impacts.

In the next section, we will move toward proposing a practical toolkit that draws on existing resources, designed for participatory sensing pilots to collaboratively identify community-level indicators for urban environmental problems.



4

DESIGNING EVALUATION APPROACHES AND TOOLS

Each participatory sensing pilot takes place in its own particular context and is inevitably concerned with different indicators for social and technological change.

Not to mention, each city will run a series of pilots dealing with different aspects of the environment. Consequently, any indicators that are relevant to the first pilots may be subject to change for subsequent ones.

This approach is deliberately flexible in order to accommodate the needs of the concerned communities and the potential changes of those needs as the campaigns move forward.

This section of the report aims to propose a practical framework for evaluating the progress of pilot campaign. It will also suggest a curated collection of existing tools that may be used to achieve this. The intended audience are the organisers, participants, and fablabs involved in participatory sensing pilots.

It is our ambition that this framework is flexible enough to accommodate the varied contexts in which the campaigns are taking place, and that it is broad enough to be adaptable to different phases of the pilot campaigns. We envisage that the tools presented here can be used in collaborative workshop settings in order to stimulate dialogue among stakeholders and to set, track, and make decisions based on shared goals.



4.1 When to evaluate

Suggested timeframes for assessment of CLIs

While we do not propose specific CLIs for these pilots or future ones, we have identified practical categories for types of CLIs to begin with.

Campaign timelines can often be broken down into a before, during, and after period during which evaluation is crucial to understand how the campaign is progressing, and whether the intervention is effective or not.

Likewise, there are three key parts to a monitoring system from which CLIs can be derived to capture different parts of the campaign timeline:

- Goals
- Process
- Outcomes
- Futures

Goals

Reflect the before period of a campaign, during which most planning and coordination takes place among partners, campaign managers, and community members. This is not to say that new goals cannot also be set after the campaign has begun. However, much heavy lifting happens during this before stage, and social changes can occur early on in these early days as a community begins to form around the campaign.

During this period, pilot organisers and participants might document crucial elements that are co-created in order to set the path for the campaign. These might include (but are not limited to) materials from brainstorm sessions, co-designed road maps and action plans, recruitment and promotional materials to garner participation, contextual research for the environmental matter of concern, meeting minutes, number of community members in attendance, communication channels, and more.

Process

Measurements are meant to capture feedback for everything else in between, with a sharp focus on CLIs that signal whether or not a campaign has been effective up until that point. Possible categories for measurement of participation might be the number of members who attend events at each stage or event, their frequency of attendance, and the turnover rate. Planning products such as written objectives, by-laws, or committees that form can be documented as well. Here too media coverage (e.g. television, radio, print media, social



media), financial resources (e.g. grants, donations, in-kind services), services provided (e.g. classes, lectures, workshops held), and community actions (e.g. petitions, protests, rallies) can be recorded.

Outcomes

Reflect the after period of campaigns, or they may reflect the results of certain stages within a campaign. They may be measured by observing changes in programmes, such as a new or modified service or programmes; changes in policies, such as a new or modified policy; changes in practices, such as a new or modified practice; or changes in behaviour.

Futures

Beyond the timeline of a particular campaign they are also deserving of their own indicators. These indicators describe what a community believes would constitute the overall success should the environmental issue at the heart of a campaign, be resolved. This could overlap with any of the outcomes listed above but looks toward longer-term change instead of the immediate future that is limited within the scope of a campaign. Here, change is defined as social change, social innovation and ultimately transformation.



Questions to help identify community-level indicators during different parts of campaign timeline

GOALS (Before)	PROCESS (During)	OUTCOMES (After)	FUTURES (Beyond)
What are the questions that community members are asking, and how do they propose answering them?	What are the biggest challenges and concerns in carrying out the work to achieve the community's goals?	Have participants picked up new skills and knowledge? Can these skills and knowledge be passed on to others?	What longer-term changes would indicate that the campaign has been successful?
What skills or knowledge do participants want to achieve or build upon by being involved?	What kinds of measurements were taken toward environmental monitoring, and is this information sufficient to construct meaning around the issue?	Is there evidence that entities outside of the community have become more aware of the issue?	What do future headlines look like with regard to the environmental issue of concern?
How many people are community members now, and how many people are needed for a critical mass?	Should participants modify their expectations or goals?	Is there a sense of pride within the community as a result of their involvement?	What indicators are necessary to track in order to assess the progression of the work or community toward this long-term goal?
What kind of measurements are necessary to investigate the environmental issue of concern?		Have behaviours or attitudes within and outside of the community changed?	

Within each of these categories may be myriad opportunities to create CLIs to watch as campaigns progress. For example, if a campaign is focused on encouraging more people to bike to work, one community-level indicator for behaviour change may be to watch the number of cyclists who pass through an intersection during workdays before, during, and after the campaign.



4.2 Internal and external indicators

Another way to consider indicator types is to categorise them as internal or external.

4.2.1 External Indicators

External indicators describe changes that can be observed outside of the communities of interest and practice themselves.

For instance, these indicators might answer the following questions: Has the community been able to raise awareness about an issue out in the world among other stakeholders? Has the initiative attracted others to become engaged with the work? Have there been policy changes as a result of the intervention?

In order to document this kind of external impact, pilot organizers might collect media clippings that mention the campaign; compare the number of participants before, during, and after the campaign has begun; acknowledge the number of partners and collaborators that are involved before and after the campaign; take note of any shifts in policy or decision making; and so on.

The Prishtina pilot organisers have designed their pilots based on seasonal timeframes for air quality measurement. Each season brings forth concerns for different pollutants; hence, the pilot will focus on different pollutants for each cycle. With the measurements, the team hopes to run public campaigns based on the data collected in order to raise awareness about environmental issues. The team also hopes to use gateway activities such as educational workshops and trainings to teach community members how to use sensing tools. Some external indicators for this specific case might include looking at how much traction the public campaigns gain beyond the community itself, as well as whether the workshops and trainings attract new participants.

The pilot organisers emphasise that whether or not the campaigns set out to affect a policy change depends on some key factors: namely, whether or not a community actually wants a policy change and whether the outcomes warrant a policy change. That said, in these specific cases, policy change is certainly an ambition but not necessarily a goal of the pilots, an attitude that reflects the collaborative and grassroots nature of the wider Making Sense agenda.

4.2.2 Internal Indicators

Internal indicators describe aspects of social change that happen within the community and among community members.

They might answer the following questions: Have we been able to create a community? Do people want to continue taking action? Do people feel as though they have learned new skills?

Pilot organizers might track these indicators by surveying participants about their sense of community and willingness to take action on urban environmental issues before, during, and after a campaign; leading focus groups to stimulate discussion about new skills learned; and so on.

For the Waag Society’s first pilot, the University of Dundee with the organisers conducted a survey with 15-16 participants about what environmental problems they considered most important (i.e. noise, air, soil, etc.) This survey helped determine the direction of the pilot, which focuses on air quality at street level, and at the same time, it provided a baseline for the Dundee and WAAG team’s assessment of the pilot. The Dundee team plans to distribute a second questionnaire, with some identical sections after the environmental sensing has been completed to gauge whether attitudes, behaviours or issues have changed throughout the course of the work.

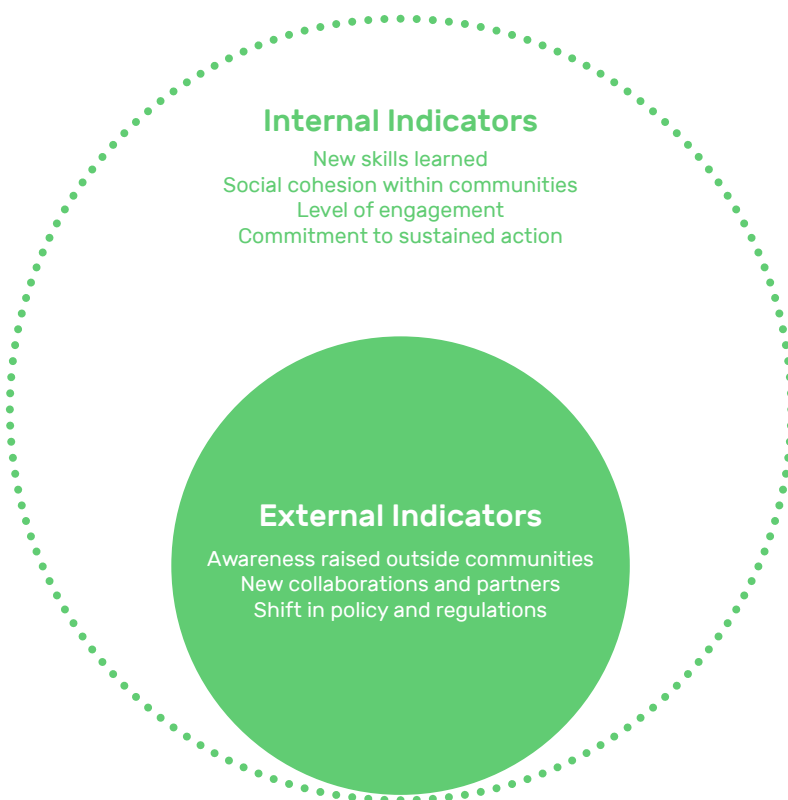


Figure 3. Internal and external community-level indicators. (Image credit: Lily Bui)



Tracking both of these types of indicators arguably provide insight on the evolution of a campaign, its value for the implicated communities, and whether or not a community initiative will be sustainable after the campaign has run its course.

4.3 Identifying and engaging with stakeholders

The process of identifying stakeholders for each pilot is essential for setting the agenda for environmental sensing initiatives, but it is also highly variable across contexts.

However, there are categorical levels of stakeholders that can prove useful in targeting which groups to engage. These stakeholders can be part of, advise, or oversee the process of identifying relevant community-level indicators to track.

The model below suggests a hierarchy of stakeholders. Among all the pilot campaigns, the communities of practice and interest make up the foundation of stakeholders, constituting the largest collective.

Then, there is the organisational partner for the funded project (i.e. H2020's pilot organisations Waag Society, SmartCitizen, PEN) that oversee the communities of practice and interest. Alongside this additional organisational partners lead the research and other agenda.

Following the organisational partner for the funded projects are the various organisations and institutions that are willing to work collaboratively with the organisational partner to carry out the campaign. This can include universities and educational institutions, science institutes, non-governmental organisations (NGOs), community-based organisations and embassies,

At the very top would be the municipality, which comprises policy makers, political leaders, environmental agencies, and others in positions of authority over environmental regulation within the city of concern.

It is worth noting the considerable overlap that can exist between communities of interest and practice, collaborating organisations, the municipality, and partners in funded projects.

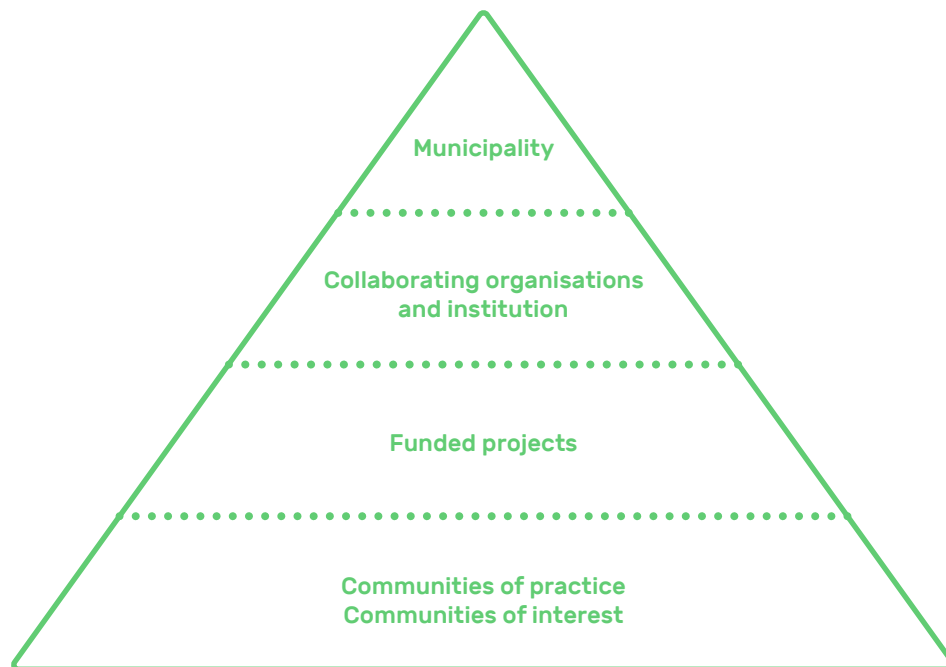


Figure 4. Hierarchy of stakeholders in pilot programs. (Image credit: Lily Bui)

We argue that stakeholder engagement should begin first with establishing where the communities of practice and communities of interest are, who belongs to them, and also how and why they have formed (Making Sense D5.1 2016).

Once that has been done, funded projects can then situate themselves among the community and determine what its role might be in the work. From there, organisers should begin engaging with potential collaborators in peripheral organisations and institutions, and if it is desired by the community, with the municipality to explore the campaign’s possible impacts on policy.

For instance, PEN in Prishtina began by identifying a pre-existing community of practice from a previous citizen science campaign, consisting of activists, ecologists, and makers who had connected through shared environmental concerns. Within this community were even smaller groups that wished to achieve slightly different goals. Organisers at PEN then decided that it might be best to offer trainings in how to use tools, how to run public awareness campaigns, etc. based on these different goals. At the time of writing, the organisation is in the process of working with community organisations and institutions to calibrate tools, generate educational resources, and more. Ultimately, the team plans to engage with policymakers, but the nature of that engagement will largely depend on the outcomes of the environmental measurements that the team is currently producing.



Evaluations that involve as many stakeholders as opposed to few have their advantages and disadvantages. One positive result is that evaluations involving many stakeholders are more likely to be more representative of the community's needs, and they are likely to bring more awareness of shared concerns to involved stakeholders.

On the other hand, bringing multiple stakeholders to the table can also lengthen the process of evaluation due to logistical factors. More importantly, partners may have different goals and aims, as well as different cultures, attitudes, and personal aspirations – all of which make negotiating quite a difficult task.

We argue that this diversity of stakeholders not only promotes knowledge exchange and builds trust, essential in community building, but generates resources for communities of interest and practice to take action. In addition it promotes awareness among other local organisations that the campaign is taking place, and also creates the infrastructure for that action to resonate across different spheres.

4.4 Setting, rating, and monitoring community goals collaboratively

Organisers play a key role in facilitating the dialogue among community members and other stakeholders.

While communities of interest and communities of practice are likely already connected by shared concerns, organisers make it possible for these groups to engage with other stakeholders that might be involved with addressing the same concerns in other ways.

For pilot campaigns, it is the organisers' role to bring all stakeholders to the table, both literally and figuratively, to identify common goals. We suggest that organisers, community members, and all collaborating stakeholders should aim to set goals together in a workshop setting. During these workshops, all stakeholders should plan to brainstorm indicators that can be tracked in order to understand the progress of the work.

Both goals and indicators should also be rated, meaning that involved stakeholders should decide which goals and indicators should be prioritised over others. This process is a way to discover what a community believes is feasible, and what is most important. Goals can span a change in behaviour, policy, attitude, level of engagement, and so on, that might have an impact on the issue of concern. Related indicators should be objective measures of the extent to which the goals are achieved.



This should all happen *before* the campaign action plans are carried out so that all stakeholders engage in dialogue about the main goals of the work and are able to weigh in on how this takes place. It is important also that all stakeholders have an opportunity to weigh in on which indicators are important to track throughout the campaign.

Organisers should think carefully about the evaluation process in relation to the campaign's key goals, and how this may vary across stakeholder groups, namely:

- What indicators will tell you whether change is taking place?
- What is it that you want to know?
- Why are you interested in knowing this?
- Is the issue specific to the community?
- What kinds of changes does the community want ultimately, possibly beyond the timeframe of the funded campaign?

The answer to each of these and other questions helps to define what it is the campaign aims to accomplish and, by extension, how to accomplish it.

Once indicators have been set, they should be monitored *during* the course of the campaign with whichever observational system(s) the community and its stakeholders have decided is best. Thus, in this same setting, stakeholders should also collaboratively design observational systems that describe how to consistently collect information about indicators over time, who will do it, and how often. This will ensure that progress is monitored throughout the campaign.

Below, we propose a set of workshops that organisers can conduct with pilot communities and stakeholders in order to identify key goals and corresponding indicators for progress.

These workshops can be combined and held in the same day, or if this is not possible, the workshops can be divided among separate days. However, we suggest the former so that attendees can more easily recall the materials produced from previous workshops.



VISIONING WORKSHOP

Purpose:

To articulate the long-term changes that a community wants to see beyond the timeline of the campaign, and to chart out the indicators that may help get to that change.

When to run this workshop:

Before any formal action plans have been established, at the beginning of project timeline once a community has crystallised around an environmental issue or concern.

What you'll need

- A space that comfortably fits all participants
- Writing space, such as a table or desks
- Post-its, large sheets of paper
- Writing materials, such as markers, pens, pencils, or crayons
- A facilitator
- A documenter to photograph or take notes on results

Time involved

60 minutes

Who should be involved

To the extent that it is possible, all stakeholders and involved participants 10 - 15 people (suggested)

To start every workshop: Attendees should introduce themselves to the organisers and to each other.

Storyboard: 15 minutes

What does success look like for this campaign?

In smaller groups of 2-3 people, attendees should discuss the following questions about the potential of the work beyond the timeline of the campaign, not just in the near future. Each group should choose to focus primarily on one of these questions, and organisers should ensure that the questions are appropriately distributed so that all questions are covered by at



least one group.

- What do future headlines look like for this issue in your city?
- What will have changed from the beginning of the campaign, and how will we know?
- What new stakeholders will exist, and what role(s) would they play?

Groups should document their responses on post-its or even create a newspaper headline of their preferred futures. Participants should be encouraged to submit their responses in creative ways (text, drawings, comics, graphs, charts, etc.).

Share: 10 - 15 minutes

All groups should reconvene and briefly share their responses with all attendees, one group at a time.

Chart: 15 minutes

All responses should be posted somewhere visible by the whole group, either in the middle of a table or on a wall. Organisers should then facilitate a discussion focused on which indicators would point to the campaign's success.

Sort: 10 minutes

Organisers and attendees should also try to arrange the indicators in chronological order, thinking critically about which indicators should come before or after others. The end result is a map of indicators that lead to a "success story" of the campaign.

Document: Make sure to record the results of each stage of the workshop so that the process is documented for future reference. These results should be shared with participants of the workshop.



GOAL POSTS AND SIGN POSTS WORKSHOP

Purpose

To identify and rate community goals for and decide upon relevant “signs” or indicators related to each goal.

When to run this workshop:

After the Visioning Workshop is held, when organisers and community members are ready to start collaboratively creating an action plan for a campaign.

What you’ll need

- Materials produced in the Visioning Workshop
- A space that comfortably fits participants
- Writing space, such as a table or desks
- Post-its, large sheets of paper
- Writing materials, such as markers, pens, pencils, or crayons
- A facilitator
- A documenter to photograph or take notes on results

Time involved

Preparation, 15–20 minutes

Workshop 70 minutes

Who should be involved

To the extent that it is possible, all stakeholders and involved participants. 10–15 people (suggested)

Review: 5 minutes

Spend the beginning of this workshop reviewing the results from Visioning Workshop in order to make sure that all attendees have familiarized themselves with the key goals and corresponding indicators.

Listen: 10 minutes

Organisers may begin the workshop with any relevant contextual information about the environmental concern at hand by offering brief presentations or lectures, educational



materials, and so on to attendees. Additionally, attendees should have an opportunity to introduce themselves to the organisers and to each other.

Discuss and collaborate: 20 minutes:

What are the goals of the campaign? In what ways do participants and stakeholders want to make an impact on the environmental issue of concern? Which indicators can be used to track change as it happens over time?

Organisers should lead the discussion with the questions above, including any other relevant ones to the community or topic at hand.

Attendees of the workshop should be given writing materials (i.e. post-its, paper, markers, etc.) to respond to the questions prompts. Each person should submit at least one response to each question by posting it either in the middle of the table or on a wall where responses are visible by everyone.

For every goal that is identified, participants must be sure to also identify a related indicator that can be used to measure progress.

For example, if someone has a goal to “raise media awareness about air pollution in the city,” a relevant indicator might be “the number of news articles about air pollution before, during, and after the campaign.”

This exercise can be done one question at a time, or if there is enough wall or table space to host responses to all questions at once, organisers can choose to proceed as they see most suitable.

Rate: 15 minutes

Which goals seem most feasible? Which indicators can be tracked most consistently?

Once all goals and indicators have been submitted, organisers should prompt attendees to appraise the goals by level of importance to the group.

There are several ways to order the goals, based on the responses to them:

- *Must Do:* These are goals the community thinks are important and feasible. You will want to pursue these right away.
- *Important to Try:* These are goals the community thinks are important, but will be difficult to accomplish. You should try to do these, but keep in mind these goals will require extra effort to accomplish.
- *Easy to Do:* These are goals that the community thinks are easy to accomplish, but are also are not all that important. You should do these if you need to increase your group’s credibility.



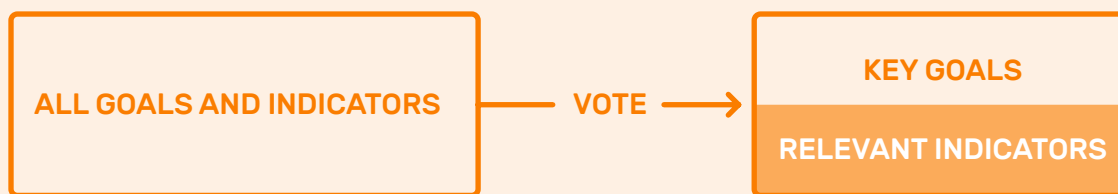
- *Last Resort:* These goals are of low importance to your community, and are difficult to do. The only time you would want to do these is if you know something the community doesn't; because you won't get much support and even if you do succeed it may not matter.

(Adapted from Community Toolbox)

Take a vote: 20 minutes,

By a show of hands, about which goals fall into which category. The group should narrow down goals to a list of key goals that the group would like to achieve based on these features, and the corresponding indicators the group would like to measure.

Both organisers and attendees should actively discuss whether goals and indicators identified seem appropriately related.



Document

Make sure to record the results of each stage of the workshop so that the process is documented for future reference. These results should be shared with participants of the workshop.



PROGRESS TRACKER WORKSHOP

Purpose:

To collaboratively determine observational systems to monitor identified key indicators for measuring the progress of the campaign

When to run this workshop:

After the Goal Posts and Sign Posts Workshop

What you'll need:

- Materials produced in the Visioning Workshop
- A space that comfortably fits participants
- Writing space, such as a table or desks
- Post-its, large sheets of paper
- Writing materials, such as markers, pens, pencils, or crayons
- A facilitator
- A documenter to photograph or take notes on results

Time involved:

60 minutes

Who should be involved:

To the extent that it is possible, all stakeholders and involved participants, particularly those involved in the Visioning Workshop
10-15 people (suggested)

Review: 10 minutes

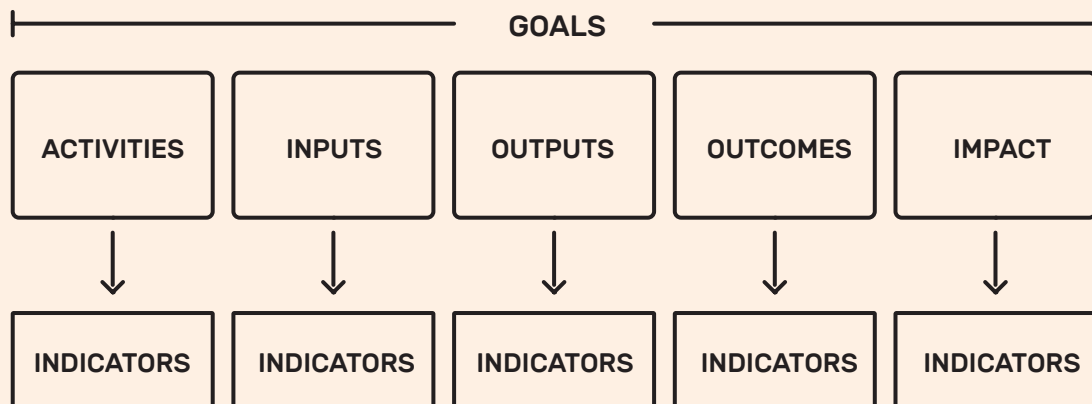
Spend the beginning of this workshop reviewing the results from the Goal Posts and Sign Posts Workshop in order to make sure that all attendees have familiarized themselves with the key goals and corresponding indicators.

Zoom in: 30 minutes

Attendees should take a more granular look at each individual goal. Draw out the goals table below. Attendees can decide on what inputs, activities, outputs, outcomes, and impact that



each goal might entail, and which indicators might be involved in measuring the progress of these steps. Because this will likely be happening before the campaign begins, some of the indicators for these steps may be speculative at this point in time, but may nevertheless be useful to anticipate ahead of time what might be measurable for later stages of the work.



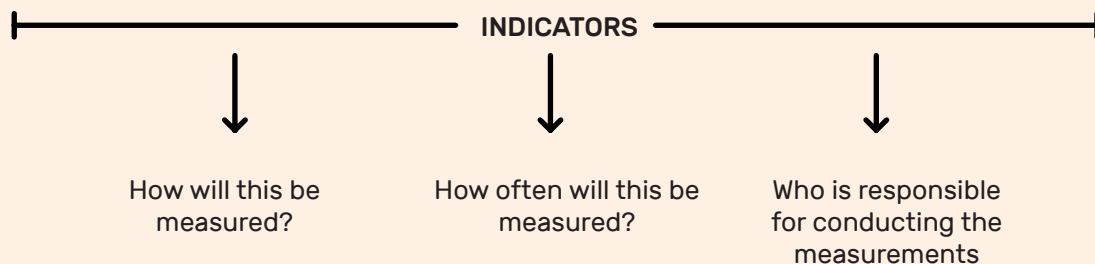
Adapted from Gertler, Martinez, et al. (2011). Impact Evaluation in Practice. The World Bank.

Decide: 20 minutes

Attendees should decide how observations of all of the above indicators would be conducted. Is it direct observation, participant observation, self-reporting, electronic/mechanical observation, public records, or otherwise? Document the “how” next to each indicator with post-its or on paper.

Finally, as a group, decide who is responsible for making these observations. Will it be the pilot organisational partner? Will it be a volunteer community member? Will it come from outside of the community? Include the “who” next to the other factors.

Particularly for this last point, it is important to involve as many stakeholders in this workshop as possible so that implicated parties may have a way to provide feedback on how responsibility for indicators might be shared.



Document

Make sure to record the results of each stage of the workshop so that the process is documented for future reference. These results should be shared with participants of the workshop.



4.5 Understanding results and improving initiatives

After campaigns have ended and all responsible parties have collected information about indicators, it is imperative to share the results and extract meaning from them in order to evaluate what changes, if any, have occurred as a result of the campaign's intervention.

Organisers and community members should collaboratively assess to what extent goals have been attained after campaigns have ended and decide what actionable steps could and should follow.

Here, we propose a series of steps that organisers and community members can take in order to revisit goals and indicators that were defined early on in the campaign's inception.

HINDSIGHT WORKSHOP

Purpose

To articulate the long-term changes that a community wants to see beyond the timeline of the campaign, and to chart out the indicators that may help get to that change.

When to run this workshop:

About a week or two after a participatory sensing campaign has come to a close

What you'll need

- Materials produced in all previous workshops
- Data and information collected during the course of campaign
- New participants who have joined campaign since its launch
- A space that comfortably fits participants
- Writing space, such as a table or desks
- Post-its, large sheets of paper



- Writing materials, such as markers, pens, pencils, or crayons
- A facilitator
- A documenter to photograph or take notes on results

Time involved

45 minutes

Who should be involved

To the extent that it is possible, all stakeholders and involved participants

1. Write down all goals and indicators.

Simply write down all of the goals that you defined in the first three workshops. Use any appropriate documentation of your goals and indicators for reference. This exercise will give you a better sense of where you have already been in terms of completeness, and also where you still need to go.

2. Identify which goals have been completed, and which indicators show they have been completed.

After writing down your goals and indicators, identify which goals have been reached by the campaign's end. Note any important indicators that point to a change since the campaign's launch.

3. Determine which goals have not been completed and identify reasons why this might be the case.

Constructively look at which goals have not yet been reached. Discuss and document why this may be the case, making note of which indicators point to lack of change since the project's launch.

4. Discuss what new goals have arisen since the start of the work.

Asking questions almost inevitably leads to asking more questions. Allot some time toward discussing what new questions or goals have arisen since the beginning of the campaign. Document these too.



5. Decide how to communicate results

Discuss and identify what potential audiences for this information might be. Is it policymakers? The community itself? The media? Other organisations?

This data can provide valuable insight into the work the community has done. It will also point to work that still needs to be done and opportunities for further investigation in the future.

If the report highlights weaknesses, that is certainly understandable. In fact, that is the main purpose of this step of the evaluation process. If, after completing the report, your group draws some conclusions that will help strengthen your action plan, then it is worthwhile. In other words, low numbers should inspire positive change, and hopefully not just dissatisfaction.

6. Divide the work

Will multiple people be responsible for putting together content for the report, a designated individual, the organiser, a third party, or otherwise? Finally, decide who is responsible for what aspect of reporting out this information and divide the work appropriately.



5

DISCUSSION

A community-level indicators approach to assessing social and technological change, while a promising and practical approach for decision makers and stakeholders with positions of authority, deserves a body of criticism around it so that the approach can become more nuanced, more inclusive, and more representative of the affected communities over time.

We do believe that the value proposition of a common approach to community-level indicators: giving the potential to compare and share results across pilots. Without a common approach, the challenge of reconciling the particularities presented by each pilot would make results almost impossible to understand across contexts. In this way, providing a common practical framework for generating indicators allows us to test this proposal in practice. It also gives pilot cities the opportunity to participate in the same mode of evaluating the progress of their campaigns at different stages.

Still, there are some shared challenges among pilot organisers that are worth highlighting and in some ways illustrate the limitations of looking at indicators alone, empirically, to understand the overall impact of a campaign.

First, all participatory sensing initiatives confront the challenge of bringing together communities of interest and communities of practice, a difficult but necessary effort to undertake. We argue that bridging these two communities is what enables sustainable engagement and action in response to environmental concerns at the grassroots level.

While communities of practice comprise groups of makers and technologists that underpin the development of grassroots sensing, communities of interest comprise the larger category of concerned citizens who may not necessarily have technological training. The combination of these two groups often results in differences in goals and therefore a need, on behalf of pilot organisers, to manage expectations among the different groups. Much of this has been mitigated by the fact that organisers have recognised these differences in goals and have offered a diversity of ways in which to participate – whether by attending lectures, workshops, troubleshooting sessions, or otherwise.

Still, despite having commonly identified goals among stakeholders and communities of



practice, the initiatives have largely been led by communities of practice to advance the technologies involves in environmental sensing. A question that our team struggles with is this: to what extent is it possible to affect both technological and social change with this approach? Then, within the context of community-level indicators, to what extent is it possible to capture this in the evaluation of these initiatives both for internal documentation and external storytelling?

We draw an analogy between DIY sensors and virtual reality in the sense that both technologies, upon their introduction, experienced a spike in interest among various audiences, followed by a dip in interest, and now followed by a steep uptake, again, while cheap and powerful devices are introduced to the market.

Linden & Fenn (2003) describe this phenomenon as part of Garner’s hype cycle, a model that establishes the “expectation that most technologies will inevitably progress through the pattern of overenthusiasm and disillusionment” (5). We anticipate a dip in interest for DIY technology and criticism forthcoming from those disillusioned by initial efforts and campaigns. However, our position is that the dip may have occurred within communities of practice, but communities of interest may invigorate a new wave of progress in the uses, applications, and gratifications of DIY technology.

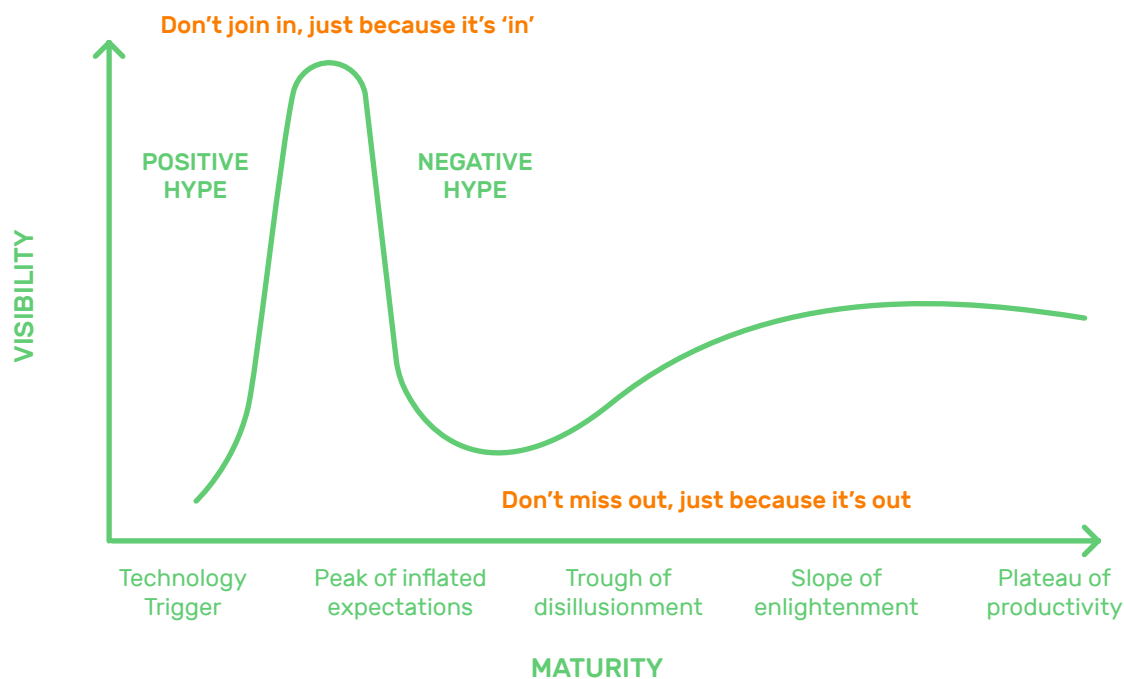


Figure 5. Gartner’s Hype Curve. (Image credit: Gartner Research, May 2003)

Regardless of the direction of the curve, we believe that DIY technologies should be forwarded nevertheless, and Making Sense urges similar communities to push the agenda for grassroots sensing initiatives.



6

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APPENDIX

Existing tools and resources

Development, Impact, & You (DIY) Toolkit
Practical tools to trigger & support social innovation
<http://diytoolkit.org/tools/>

Community Toolbox
(With particular attention to Chapters 37 and 38)
<http://ctb.ku.edu/en>


Charities Evaluation Services
(With particular attention to Appendix B)
<http://www.ces-vol.org.uk/Resources/CharitiesEvaluationServices/Documents/assessingchange-740-748.pdf>

The Service Innovation Handbook
(With particular attention to Methods 7, 8, and 13)
Available at: <https://serviceinnovationhandbook.org/methods/>

and

The Social Design Methods Menu
Available at: http://www.lucykimbell.com/stuff/Fieldstudio_SocialDesignMethodsMenu.pdf

Three Horizons
A futures framework for thinking about longer term social change
Available at: <http://www.internationalfuturesforum.com/three-horizons>



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