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Report and Assessment of Impact and Policy Outcomes Using Community Level Indicators

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Making Sense

Advances and experiments
in participatory sensing

REPORT AND ASSESSMENT OF IMPACT AND POLICY OUTCOMES USING COMMUNITY LEVEL INDICATORS

D5.5

DELIVERABLE

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Report and Assessment of Impact and Policy Outcomes Using Community Level Indicators

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1 INTRODUCTION

1.1 Making Sense: an introduction[1]

Making Sense is a European Commission H2020 funded project which aims at supporting participatory sensing initiatives that address environmental challenges in areas such as noise and air pollution.

The development of Making Sense was informed by previous research on a crowdfunded open source platform for environmental sensing, SmartCitizen.me, developed at the Fab Lab Barcelona. Insights from this research identified several deterrents for a wider uptake of participatory sensing initiatives due to social and technical matters. For example, the participants struggled with the lack of social interactions, a lack of consensus and shared purpose amongst the group, and a limited understanding of the relevance the data had in their daily lives (Balestrini et al., 2014; Balestrini et al., 2015). As such, Making Sense seeks to explore if open source hardware, open source software and and open design can be used to enhance data literacy and maker practices in participatory sensing. Further to this, Making Sense tests methodologies aimed at empowering individuals and communities through developing a greater understanding of their environments and by supporting a culture of grassroot initiatives for action and change.

To do this, Making Sense identified a need to underpin sensing with community building activities and develop strategies to inform and enable those participating in data collection with appropriate tools and skills. As Fetterman, Kaftarian and Wanderman (1996) state, citizens are empowered when they understand evaluation and connect it in a way that it has relevance to their lives. Therefore, this report examines the role that these activities have in participatory sensing. Specifically, we discuss the opportunities and challenges in using the concept of Community Level Indicators (CLIs), which are measurable and objective sources of information gathered to complement sensor data. We describe how CLIs are used to develop a more indepth understanding of the environmental problem at hand, and to record, monitor and evaluate the progress of change during initiatives. We propose that CLIs provide one way to move participatory sensing beyond a primarily technological practice and towards a social and environmental practice. This is achieved through an increased focus in the participants' interests and concerns, and with an emphasis on collective problem solving and action.

[1] A List of Terms can be found at the end of the introduction section
[2] For further information see www. making-sense.eu

We position our claims against the following four challenge areas in participatory sensing:

1) generating and communicating information and understanding (c.f. Loreto, 2017),
2) analysing and finding relevance in data (c.f. Becker et al., 2013),
3) building community around participatory sensing (c.f. Fraser et al., 2005), and
4) achieving or monitoring change and impact (c.f. Cheadle et al., 2000).

We discuss how the use of CLIs can tend to these challenges. Furthermore, we report and assess six ways in which CLIs can address these challenges and thereby support participatory sensing initiatives:

i. Accountability
ii. Community assessment
iii. Short-term evaluation
iv. Long-term evaluation
v. Policy change
vi. Capability

The report then returns to the challenge areas and reflects on the learnings and recommendations that are gleaned from three Making Sense case studies. Afterwhich, there is an exposition of approaches and tools developed by Making Sense for the purposes of advancing participatory sensing in this way. Lastly, the authors speak to some of the policy outcomes that have been realised as a result of this research.

1.2 Impact and Policy Outcomes in Participatory Sensing

Access to digital environmental sensors has allowed for participatory sensing to enter into our everyday lives. The distribution of off-the-shelf technology (e.g. AirCasting and Air Quality Egg) enables citizens to become more aware of their environments and associated challenges.

Participatory sensing is a bottom-up approach to data collection, and one which gives those with a shared concern access to the required digital technology to gather the information needed for their cause (Burke et al., 2006). However, much of the focus is on technology, and technology enabled communities of practice, and further research is needed into the dynamic social relationships and the collective capability of participants in sensing initiatives (Maisonnueve et al., 2016). Further to this, existing tools only go as far as gathering data and

there is a need to develop strategies for citizens to use the information gleaned to instigate change, or use the evidence to put pressure on local governments to initiate policy changes. Through the concept of CLIs, Making Sense has tested methods for citizens to collectively create solution driven goals and new approaches to help citizens make sense of the data they collect. Moreover, the project has seen developments in the way citizens collectively monitor the changes that result from an increased awareness on environmental issues, and any actions taken in tackling the issues. A key objective of using this approach is to move from collective awareness to collection action and impact. As combining complementary information and methods for collective sensing can help citizens evidence a need for action, and find their own pathways to tackle matters of concern.

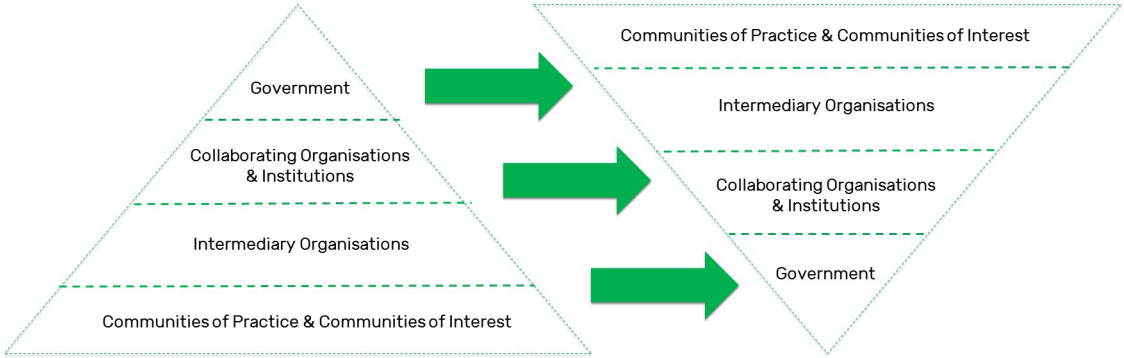


Figure 1. Perceived hierarchy of stakeholders to the ambition of participatory sensing in pilot programmes. Adapted from Making Sense D5.4 (2016).

The aim is shift in the perception on the flow of information and data to move between the stakeholders of a campaign [Figure 1]. As traditional viewpoints often consider few policy makers at the top and making decisions, participatory sensing looks to harness the collective efforts of citizens to become the influencers of change. Neither extreme represents true reality, however the visualisation is presented to express a key objective in participatory sensing. In Making Sense, emphasis is placed on the establishment of the communities of practice and the communities of interest within the area of concern, and the co-creation between these two groups of citizens to define the parameters and the objectives of the participatory sensing campaign. The aim is then to have the communities of practice and interest develop the strategies and methods for different approaches to data collection (both by the sensors and CLIs), enabling them with the tools and processes to form reciprocal information channels between them, the intermediary organisations (i.e. the Making Sense project organisers), collaborating organisations and institutions, and the government or municipalities. CLIs are intended to be part of this information and paired with the sensor data to drive and support action for change.

[3] http://aircasting.org/
[4] http://airqualityegg.com/

1.3 Structure of this Report

This report evaluates the use of CLIs, and discusses ways that it is used to address key challenges. We provide a section which examines how the concept has been applied in alternative fields, a definition of the term, and how it is been employed by Making Sense.

This report builds on earlier work conducted by Making Sense, which outlined the approach to using CLIs in participatory sensing (Making Sense D5.4, 2016). In this report we reiterate and develop key definitions and characteristics of CLIs. We also demonstrate concept development through three case studies: the first and second examine the use of CLIs in Barcelona over the course of two Making Sense pilots (Community Champions and Gracia Sounds), and the third, on the use of bio-indicators that were developed as part of the last pilot delivered in Kosovo (Season III). Using these case studies, this report evaluates the use of CLIs and indicators and the insights are used to provide guidelines for future work. Finally, we focus on how this concept has already been appropriated and applied in other research projects.

Section 1 covers the existing literature on CLIs that was outlined in Deliverable 5.4 and builds on this with information and insights that have been obtained since the previous report.

Section 2 examines the Making Sense approach to CLIs by defining the Making Sense Framework and methods for CLIs in this context.

Section 3 presents three case studies from Making Sense and looks at how CLIs and the collection of other indicators have been applied.

Section 4 posits how CLIs are developed for future use, and provides recommendations and guidelines for application.

Section 5 examines how the concept of CLIs, specifically in regards to policy and impact, are being used as a result of the Making Sense approach.

1.4 List of Terms

Bio-Indicator - the collection of data on a living organism which gives an indication of the well-being of a ecosystem.

Campaign - the public facing phase of a pilot, designed to achieve social innovation or change.

Citizen science - collection and evaluation of information on the natural world, with varying levels of collaboration between citizens and scientists.

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).

Community Level Indicators (CLIs) - measurable and objective information, complementary to sensor data and can assist in building awareness on a specific issue and shed light on long-term change as a result of actions or specific efforts.

Communities of practice - groups of individuals which come together by their shared expertise and passions, and collectively learn how to improve on their skills (Wenger, 2015; Wenger & Snyder, 2000).

Communities of interest - groups of individuals that are bound together in the context of specific projects, a shared concern, or shared enthusiasm for a specific subject and tend to be temporary or dissolve when a project ends (Fischer, 2001).

Crowdsourced - gathering information or resources from a large group of people, often achieved through an internet platform.

Data annotation - creating a set of comments, notes or explanations to inform numerical data sets, with the objective to form a better understanding of what that data means.

Data literacy - the combination of data annotation and data sensemaking, the ability to understand singular and collective sets of data.

Data sensemaking - the ability to evaluate and understand data and the relevance it has in daily life.

Fab Lab - a fabrication laboratory (also known as a "makerspace") is a small scale workshop which offers resources and knowledge for users to engage with personal digital fabrication technology, 3D printers, laser cutter, cnc machines, etc. (Troxler, 2011).

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

Indicator - a measure for which data are available to quantify outputs or outcomes (also referred to as a metric).

Initiative - a leading action, often in the form of a new project which introduces new activities and processes to tend to a social or environmental challenge.

Maker practices - derived from the "maker movement" which places emphasis on the human ability to be creative and produce objects themselves, often associated with personal digital fabrication technology.

Open source - making information publically available, often achieved through an internet platform.

Participatory sensing - a process by which groups of people collect and combine information into a database, often using mobile devices or other easily obtainable equipment for data collection.

Pilot - an experimental participatory sensing project with potential to be replicated, extended or scaled.

Social innovation - new strategies, solutions, ideas or tools that accrue value for a community or society rather than private individuals.

Tool - a physical object tied to an activity which supports the objectives of the pursuit (e.g. CLIs worksheet, Future Newspaper worksheet, and sensing journal).

2
COMMUNITY LEVEL INDICATORS

Devising and collecting community level indicators (CLIs) is a new evaluation approach for the Collective Awareness Platform for Sustainability and Social Innovation (CAPSSI) agenda outlined by the European Commission (EC).

The EC agenda seeks to provide "societally, environmentally and economically sustainable approaches and solutions to tackle societal challenges" which includes "collective decision-making tools and innovation mechanisms allowing and encouraging individual and community creativity, participation and situational awareness" (European Commission, 2012, p. 63, original emphasis). CLIs have been developed in direct response to this objective, and in an attempt to fill the other gaps discovered in early participatory sensing studies (as mentioned in the Introduction).

In Making Sense deliverable D5.4, Community Level Indicators, the concept of CLIs was presented. Drawing on its application in traditional fields of social health and well-being and developed to form a concept for specific use in participatory sensing.[5] This new conceptualisation of CLIs was formed due to a demand for participatory sensing and citizen science projects to document the long-term progress and impact the grassroots data collection (Conrad & Hilchey, 2010). In addition, the report outlined the knowledge and skills gaps of citizens in phases of sensing, awareness, participant engagement strategies and action. In response, a proposed methodology for employing CLIs as an approach to fill these gaps in environmentally driven participatory sensing initiatives was given (Making Sense D5.4, 2016). However, there is a need to build a common framework, which can be applied across the board, independent of which environmental (or indeed social) challenge being investigated. This report assesses how CLIs and indicators have been used in some specific cases in Making Sense, but also considers how the concept can be developed and applied to similar fields.

[5] Community Level Indicators see: http://making-sense.eu/publication_categories/toolkit/

2.1 What are Community Level Indicators?

Community Level Indicators (CLIs) are measurable and objective complementary information to sensor data. The concept assists in building awareness on a specific issue and help track short to mid-term activities geared towards long-term change, which is useful in time limited initiatives. CLIs also shed light on long-term change as a result of actions or specific efforts. As was outlined in the original report:

> *Community-level indicators seek to render the invisible visible, in the sense that the more abstract and immaterial outcomes of socially orientated 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. (Making Sense D5.4, 2016:16)*

Furthermore, it is not only the information captured but the bottom-up nature of creation which is valuable. The identification and collection of CLIs is a collaborative process and challenges the notion that information must be received through a top-down model or delivered by established institutions. This is why this approach has been appropriated by Making Sense and is a valuable method for CAPSSI projects. It is the notion of indicators, and indeed CLIs, that has evolved from a range of academic fields seeking to capture or evidence outcomes of initiatives that informs the Making Sense approach [Table 1].

TERM	DEFINITION	SOURCE	FIELD
Community-level indicators	"[M]easures 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	"[O]bservations of aspects of the community other than those associated with individuals ... to supplement individual-level measures in the evaluation of community-based programs."	Cheadle et al. (2000)	Health Education
Indicators	"[T]he ability to detect and/or predict trends in key variables of interest"	Fulton, Smith & Punt (2005)	Ecology
Indicators	"[E]vidence that outcomes have been achieved"	Kimbell (2014)	Design Sociology
Social Indicators	"[O]bjective measures which are known to influence life chances and satisfactions levels."	Berman & Phillips (2000)	Social Science
Impact Metrics	"[I]ndicators not only address reach and use, but also help ... assess connections with particular demgraphic 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 (Making Sense D5.4, 2016:15)

Building on existing definitions of CLIs and indicators, Making Sense has appropriated the term to fit within the field of participatory sensing and citizen science. Here, it is used as way to capture information which complements the sensor data and to better understand the sources and causes of environmental issues. The CLIs introduce a focus on a social or environmental issue or concern, it includes the co-creation of campaign objectives (or goals) and the identification of CLIs to inform further understanding into the matter and to boost collective awareness. In regards to the four challenge areas in participatory sensing:

1) generating and communicating information and understanding,
2) analysing and finding relevance in data,
3) building community around participatory sensing, and
4) achieving or monitoring change and impact.

We propose the concept of CLIs supports participatory sensing initiatives in six ways:

I. **Accountability**: Pairing sensor data with other types of data can reveal root causes of environmental issues. By identifying indicators participants can often recognise and challenge their assumptions on the cause and effect of environmental issues. It assists participants in understanding accountability, or in other words, that people become aware that they are both impacted by, and contributors to, the challenge at hand. For instance, in the case of noise pollution, mapping some of the causes and effects of noise and what is considered positive or negative to an individual, can instigate discussions regarding how everyone contributes to the creation of noise and how certain noises impact people in different ways. This can be a precursor for communities to plan what and how they will collect information to help them make sense of the data they capture on noise levels in a specific area.

II. **Community assessment:** CLIs can be used by participants to assist them in thinking about their shared community issues and discuss these challenges collectively. It also provides a platform for participants to collect the information needed to communicate the primary challenges to diverse-stakeholders in an accessible way. In addition, it provides the information about the effects of the campaign on the communities. If a community is concerned about the noise level caused by early deliveries in their neighborhood, they can each record the times in which trucks arrive and off-load goods, and compare this information to the sensor readings of noise levels. Co-creating a map of the locations and schedule of deliveries in combination with evidencing the high decibel readings give the community the information needed to discuss and make sense of the issue. This information can also be presented as a case for change to the shopkeepers association or municipalities.

III. **Short-term evaluation:** Monitoring CLIs during the period of a campaign can support evaluation by facilitating a process of iterative reflection on sensing and strategies. In addition to assessing whether actions help to immediately address environmental issues. If an initiative aims at monitoring noise pollution over time, a record of noise complaints in a certain area could support the information being captured with the sensors and illuminate whether there has been a reduction in complaints during the time of the campaign.

IV, **Long-term evaluation:** Continuous monitoring of CLIs supports the ability to evaluate the impact and legacy of initiatives, even after the conclusion of the project. Again, using the same example as above, capturing a record of noise complaints over a longer period of time, and after a campaign has taken place, could provide insight into whether the initiative has had a lasting impact on the issues of noise pollution.

V. **Policy change**: Identifying the root causes of environmental issues and combining this information gives citizens the evidence needed to deliver a powerful argument for change to local, national and international policymakers. It is also about redefining the relationship between citizens and government and creating new pathways for participation and co-creating actions. In sum, it is about giving citizens the approaches and tools to strengthen

their arguments and systematically change the decision making process. For example, a local government could provide a scheme in where citizens could test and calibrate their own air quality sensors to determine the reliability of the device. At the same time, citizens can monitor traffic on their local streets, collecting data on the peak times for congestion. If the government adds the citizen data to the city monitoring data repository, citizens could demonstrate the correlation of high traffic to poor air quality and present a case for policy change in traffic regulations in their neighborhood.

VI. **Capability**: Understanding the other indicators that decision makers use to consider environmental issues and develop policies may assist citizens in building their capability for data sensemaking and communicating their findings to instigate change. In the main, it is about looking for evidence and other types of data to create an awareness and understanding for developing an equal footing and building a culture of empowerment for citizens. For instance, if citizens recognise that there are social health challenges involved with environmental issues and they can collect personal informatics data using other accessible technology (i.e. fitbit, Apple Watch, Garmin watch) and other public available health figures to use as part of their campaign. This gives them further awareness into the issue and enhances their data literacy capabilities and develops their ability to plan pathways for action and change.

WAYS CLIS SUPPORT PARTICIPATORY SENSING	ADDRESSES CHALLENGE AREA:	EXAMPLES
Accountability	1. Generating and communicating information and understanding 2. Analysing and finding relevance in data 3. Building community around participatory sensing	• Personal feeling (positive / negative) • Counting (number of cars, bikes) • Mapping sources of issues
Community Assessment	1. Generating and communicating information and understanding 2. Analysing and finding relevance in data 3. Building community around participatory sensing	• Creating maps to visualise data • Creating time schedules of events • Co-producing data sets • Collaborative evaluation of data
Short-term evaluation	1. Generating and communicating information and understanding 2. Analysing and finding relevance in data	• Collectively identifying issues • Collecting complementary data sets • Sourcing public records for indicators
Long-term evaluation	1. Generating and communicating information and understanding 2. Analysing and finding relevance in data 4. Achieving or monitoring change and impact	• Creating long-term strategies • Maintaining long-term data sets • Comparison of data over long periods of time

Policy change	1. Generating and communicating information and understanding 2. Analysing and finding relevance in data 3. Building community around participatory sensing	• Contributing to national data sets • Finding indicators that relate to policy agendas • Create evidence-base for change
Capability	1. Generating and communicating information and understanding 2. Analysing and finding relevance in data 4. Achieving or monitoring change and impact	• Using other accessible technology • Pairing data sets • Sourcing public records for indicators

Table 2. Summary table of the key areas of support provided by CLIs in participatory sensing with cross reference to the four critical challenge areas and examples of practice.

These six areas assist in addressing the challenges that were identified at the start of this report. To more thoroughly understand how this concept is applied in Making Sense, the following section details the concept of CLIs and points to the phases in the Making Sense approach where CLIs can be useful.

2.2 Making Sense Approach to CLIs

More widely, CLIs are defined as measurable, objective outcomes that demonstrate related social change (KU Work Group, 2016; Cheadle et al., 2000).

For Making Sense, CLIs are used to complement sensor data and to better understand the contextual information around data gathering. Moreover, CLIs are guides collaboratively created by the participants for measuring and determining whether changes have occurred as a result of the campaign or intervention (Making Sense D5.4, 2016).

As part of the wider project, Making Sense developed a framework to articulate an approach to participatory sensing [Table 3]. The framework describes some cross-cutting principles and goals, such as, openness, co-creation, change-making and empowerment, that run throughout the entirety of each pilot. It also defines the phases of delivery within participatory sensing, as developed by Making Sense; scoping, community building, planning, sensing, awareness, action, reflection and legacy. For the research on CLIs, Making Sense sought to identify points within the framework where CLIs could support the aims and objectives of the phase and wider campaign. These areas are highlighted with in the Making Sense Framework, and discussed in more detail below.

CROSS-CUTTING MAKING SENSE PRINCIPLES & GOALS
(OPENNESS, CO-CREATION, CHANGE-MAKING, EMPOWERMENT)

PHASE	PROCESS DEFINITION
Scoping	Mapping, identifying and framing issues Identifying communities of interest & practice and stakeholders Defining internal organisational process Research and literature review (Academic, grey, prior organisational knowledge) Understanding context & motivations
Community building	Community recruitment Starting engagement process with communities of interest & practice Identifying skills available in community to address gaps Fostering community cohesion & communication Management and governance Instilling principles Documentation protocol
Planning	Fostering and enabling new skills Making or learning about sensors Data literacy ***Mapping indicators*** ***Sensing strategy and protocol*** Sensor calibration ***Goals*** Tools - Selecting, Acquiring, Building, Developing o Sensors (tech) o Methods (design)
Sensing	***Measurement of environment*** ***Collecting individual observations*** Questionnaires with citizens Uploading and accessing data Feedback
Awareness	Sharing and (optionally) visualizing of data ***Interpreting & understanding of data*** ***Understanding environmental and health impact*** ***Identifying potential for change***
Action	***Impact (Policy, social/cultural, public discourse)*** Action by citizens/communities Interventions (artistic, protest etc)

Reflection	Sustainability of the pilot/community
	Iteration of process/method/protocols/technology
	Accountability and evaluation
	Critical reflection and lessons learned
Legacy	Change in the world
	External impacts for issue e.g. policy change
	Fostering external appropriation
	Sustainability of project tools
	Writing publications
	Uptake of toolkit/approach by others

Table 3. Making Sense Framework (Making Sense D5.5 + D4.3, 2017). Highlighted sections identify points for CLIs to be embedded within the process.

In addition to identifying the points within the Making Sense Framework where CLIs could potentially add value to the participatory sensing process, a series of questions were formed and proposed in relation to the phases of the Making Sense Framework [Table 4]. These questions were considered as prompts and progress guides for the intermediary organisation facilitating the participatory sensing campaign. The intent is to use the questions to support both the intermediary organisations and participants in considering the application of CLIs during certain phases within the Making Sense Framework.

GOALS (PLANNING)	PROCESS (SENSING)	OUTCOMES (AWARENESS)	IMPACT (ACTION)	FUTURES (LEGACY)
What are the questions that community members are asking, and how do they propose answering them? What skills or knowledge do participants want to achieve or build upon by being involved? How many people are community members now, and how many people are needed for critical mass? What kind of measurements are necessary to investigate the environmental issue of concern?	What are the biggest challenges and concerns in carrying out the work to achieve the community's goals? What kinds of measurements were taken toward environmental monitoring, and is this information sufficient to construct meaning around the issue? Should participants modify their expectations or goals?	Have the participants picked up new skills and knowledge? Can these skills and knowledge be passed to others? Is there evidence that entities outside of the community have become more aware of the issue? Is there a sense of pride within the community as a result of the their involvement? Have behaviours or attitudes within and outside of the community changed?	Have participants developed their abilities in data literacy? What findings from the data can be linked to understandable impact on daily lives? Can connections be made between the insights from the data and realistic actions for change? What can be done to change the status quo? How can an achievable project plan be put in place?	What longer-term changes would indicate that the campaign has been successful? What do future headlines look like with regard to the environmental issue of concern? What indicators should be monitored in order to assess the progression of the work or community toward this long-term goal?

Table 4. Questions to help identify community-level indicators during different parts of the campaign timeline, adapted from Making Sense D5.4 (2016)

For each phase, where these questions are posed, Making Sense also developed a range of methods to support the collection and use of CLIs in the campaign:

Planning

The goals are preferably set before the campaign by participants, with support from the intermediary organisations. Goals are collectively devised through brainstorming sessions, action and sensing strategies and research into the environmental challenge at hand. It is also the phase that indicators are mapped and initial plans for collection are laid out.

- Methods: Goalposts and Signposts Workshops help form and collectively decide on the community goals and identify the relevant indicators for each goal (c.f. Making Sense D5.4, 2016).

Sensing

This phase is where information on the environment is collected. In addition to this, so are the measurements of things that may affect or be affected by environmental changes (i.e. CLIs). This can be included as part the campaign, such as: the number of participants for certain activities, levels of media coverage, or the activities delivered as part. It can otherwise include things being investigated during the campaign, like: health records, numbers of cars on the road.

- Methods: Progress Tracker Workshop helps to determine if the indicator monitoring methods are accurately measuring inline with the original goals. It is also an opportunity to check if the goals and subsequent indicators are positioned correctly or need to be altered or changed (c.f. Making Sense D5.4, 2016).

Awareness

Here, the aim is to capture and reflect on the campaigns, monitor the results of actions and stages within the campaign. This is the phase which intended to capture the occurrences and changes that have happened as a direct result of the campaign, such as a policy change or behavioural change in the participants, communities, collaborators or government.

- Methods: Hindsight Workshop to define the long-term change that the community wants beyond the timeline of the campaign, and identify the indicators that may assist in monitoring that change (c.f. Making Sense D5.4, 2016).

Action

Action draws on the information and insights gleaned from sensing and awareness and has participants consider new and different pathways. Be it behavioural change, protests, public intervention, this phase connects the sensor information to the CLIs and examines what actions or changes can be made for long-term improvements.

- Methods: Visioning Workshop to identify the long-term changes the communities want to see beyond the timeline of the campaign and devise indicators that might demonstrate that change (c.f. Making Sense D5.4, 2016).

Legacy

This is the phase where the final information as a result of the campaign is considered in a futures context. This can can be reflective of the goals that were developed at the forefront of the pilot, or examining the progress of change and action since the beginning of the campaign.

The methods and framing above were drawn from the Making Sense Deliverable 5.4 (2016). These conceptions have evolved throughout the Making Sense project, along with the Making Sense Framework. The authors have aligned this development of theory and practice, both for CLIs and the wider Making Sense process, and have identified the key points at which CLIs support a campaign.

To give further evidence to this concept, the following is a presentation of three case studies, which explore the use of CLIs in Making Sense. The authors note that, in practice, the way in which these approaches were delivered changed according to the context within which they were delivered in. Therefore, the terminology in the case studies below give an account of methods and tools with the adapted language or interpretation.

3
CASE STUDIES

This report presents three case studies in how Making Sense has used the concept of indicators the sensing projects.

Specifically, we examine the use and development of CLIs in two campaigns in Barcelona, Spain, delivered by IAAC, and the use of bio-indicators in a campaign delivered by PEN in Kosovo. These approaches are evaluated and insights from each are presented at the end of each case study, with an overview of learnings offered at the end of the section.

3.1 Barcelona

3.1.1 Context

In Europe more than 30% of the population is exposed to noise levels exceeding what is deemed healthy limits. At night, recorded levels can exceed 55 db(A), which is 15 db(A) over the recommended maximum (WHO, 2017).

This is the equivalent to overhearing a constant conversation, but in urban areas can actually be a combination of low-quality environmental sounds (i.e. cooling systems, household machines, people on street, etc.). Research shows that continuous exposure to noise can have detrimental effects on human health including:

> **illness or fatigue from sleep deprivation, and increase in blood pressure and decreased capacity for creativity and learning caused by stress from exposure to high levels of noise (European Commission, 2015).**

Noise pollution is a real but very complex environmental challenge as the increasingly levels of sound are an outcome of contemporary living. It is an aspect of urban living but understanding this dynamic social context is an essential step in understanding actions and motivations to better the environment. These issues are only recently coming to the forefront of political debate, but citizens in the main still are not aware of the potential impact on their lives and health, or how to resolve this complex problem.

Figure 2. Residents hang flags from a building which indicate negative feelings towards the effects of tourism in Barcelona. Photograph was taken in the area of Gracia, known for having major issues with noise pollution, and 50 metres away from Plaça del Sol, the location of the third pilot delivered in Barcelona, Gracia Sounds. Photo by Saskia Coulson for MakingSenseEU.

For the city of Barcelona, noise pollution is a real cause for concern. Traffic and tourism are cited as the main sources of the high levels of noise. Government studies point to traffic as the primary cause of noise pollution and claim that 61% of citizens have to endure higher noise levels than what's deemed healthy by legislation (Bausells, 2016). Whereas many citizens see people (specifically tourists) as a root cause; some residents take action against this type of noise pollution by hanging flags in their balconies with strong warning messages [Figure 2]. The issue of noise pollution was cemented during an initial scoping workshop at IAAC in Barcelona, in which 100 participants joined and expressed noise as the critical environmental challenge in Barcelona.

The following two case studies examine how CLIs were used in the first pilot, Community Champions, and the third pilot, Gracia Sounds. Focus is given to the use of methods and tools in each pilot. CLIs are particularly relevant in these cases as noise pollution is a complex social issue, it is a cause of urban living but can also be disruptive and have severe health implications on those inflicted by it. Therefore, the concept of CLIs were brought into the forefront of each pilot, to assist participants in collectively discussing this complicated matter and question their assumptions around noise. Furthermore, having participants collectively consider CLIs helped to empower them and shift their understanding in how to instigate change.

Example

3.1.2 Case Study 1. Community Champions

The Community Champions pilot was the first delivered by Making Sense in Barcelona and was considered an opportunity to test methodologies and technologies for the following two pilots in the city, and wider participatory sensing initiatives.

Due to this overarching objective for the pilot it was often referred to as the "beta pilot" and it brought together a community of people both driven by their interest in maker practices (community of practice) and those who were driven by the issue, noise pollution (community of interest). The Community Champions pilot provided an excellent testbed for the CLIs methods and tools to be prototyped and trialled with the pilot group.

During the second event of the Community Champions pilot, the Issue Onboarding workshop (part of the Making Sense "planning" phase), the community champions (n=18) were introduced to the underpinning principles of the pilot, including ideas around participatory sensing and data collection.[6] They then engaged in a series of activities that assisted them in understanding the complex issue of noise pollution, helped them collectively define the main goals of the pilot, and consider some of the CLIs that could be collected.

Figure 3. Noise Timeline method: participants map, on a timeline, the noises they had heard throughout the day before developing a parallel timeline with noises they had made themselves. Photograph by Gui Seiz for MakingSenseEU.

[6] In addition to the community champions, Making Sense Barcelona and Dundee team members were also present at this event (n=8).

Worksheets showing two 24 hour timelines were given to groups of between three and five Community Champions with five groups in total [Figure 3]. Each group populated the timelines with the noises they heard on one timeline, and the noises they made on the other. In addition to the timeline worksheet, small and large icons and colored paper shapes were given to the group to help them populate the timelines. The participants were also asked to use red and green dots to identify what sounds they considered as positive and negative. This method was effective in creating participant awareness on the subjectivity of noise. Specifically, how it relates to personal perceptions and that the issue is indeed a complex and socially constructed one.

After the Noise Timeline each group discussed and wrote down two goals or objectives for the pilot. These goals reflected collective aims of what they wished to achieve through the actions of the campaign. The groups devised ten goals in total [Table 4] and each community champion was given two votes each to select which of the goals they thought were the most appropriate for the pilot. "Relate noise levels to stress" was considered the most favorable with 12 votes and "How could we reduce traffic noise?" followed with 10 votes. Another goal, "to identify which noises are avoidable and which are not" also received a high number of votes, with a total of nine. All other goals received under five votes each. It was decided that the two which had the highest number of votes would be taken forward as the collective goals.

	GOALS	VOTES
1	Traffic	1
2	Refuse collection (schedule, vehicular)	1
3	Collect noise data you can control	1
4	Self-awareness about the noise we can generate	1
5	***How we can reduce traffic noise?***	***10***
6	How could we make people aware of the healthy level of listening to music?	4
7	Percentage of noise in urban transport, hours of noise	0
8	Monitor the noise, understand where it comes from	1
9	***Relate noise levels to stress***	***12***
10	Identify which noises are avoidable and which are not (and educate people about the problem)	9

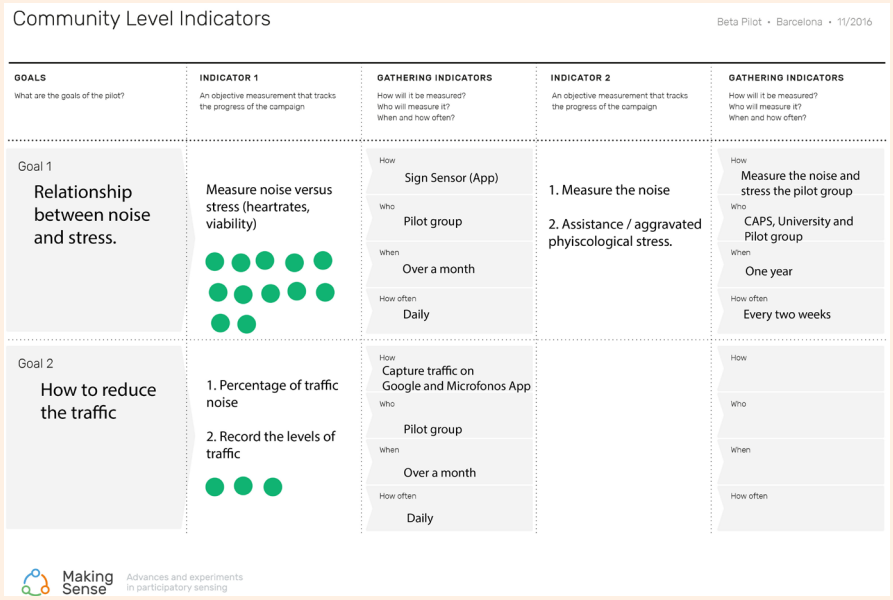
Table 4. Beta Pilot Barcelona Community Champion Co-Created Goals

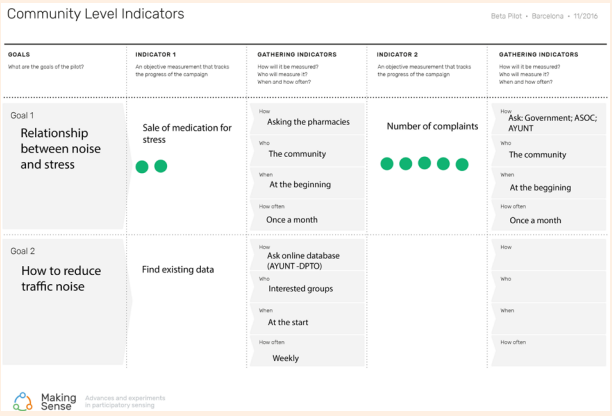
Taking the two goals that were considered the most favorable, the groups used these goals as premise for considering what CLIs could be used as a way to track progress and complement the sensor data during the pilot [Figure 4 & Figure 5].

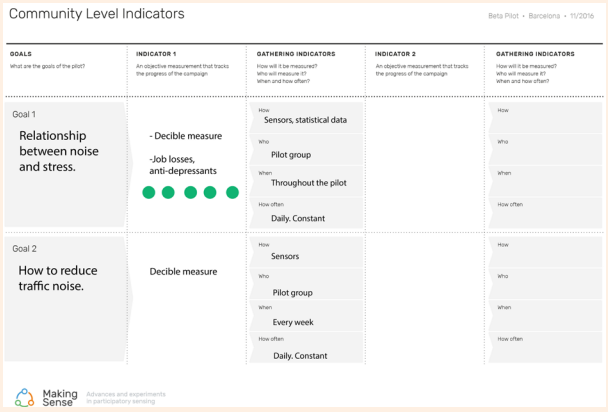
Figure 4. Community Level Indicator Tool. Photograph by Gui Seiz for MakingSenseEu.

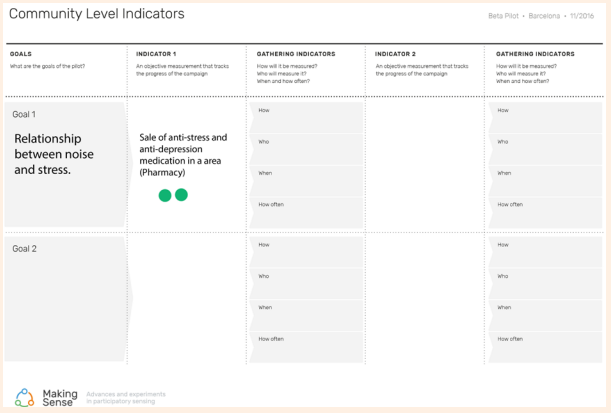
During this activity it was observed that some community champions found the leap between co-creating collective goals and identifying indicators to match those goals a difficult one. One remarked that they could not grasp the concept, due to the complexity of the CLI tool and to the fact that this concept was introduced at the very start of the pilot, as some community champions were only just being introduced to the technology and fundamental concepts of participatory sensing.

However, other community champions were able to quickly identify other types of indicators and ways to capture this information. One group [top of Figure 5] considering using other types of technology to monitor the stress levels of the participants during the pilot and to capture information on traffic levels in the city. This variance could be related to the knowledge and experiences of each community champion. As mentioned previously, there was wide diversity amongst the participants. Those with the knowledge of technology and science (communities of practice) were able to identify CLIs at this early stage in the pilot. Whereas those who were driven by the issue of noise (communities of interest) did not yet have the knowledge base to consider other types of indicators to complement the sensor data.









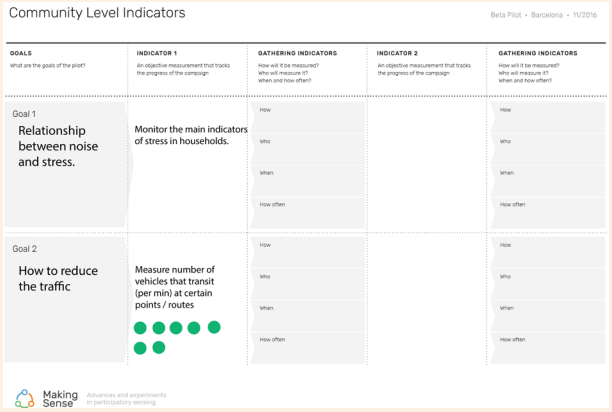


Figure 5. Completed CLI Tool v1.0 from Onboarding Workshop with Community Champions. Documentation has been translated, transcribe and typed onto CLI tool.

After the group activity for the CLI session was complete, groups presented back and then there was an opportunity for individuals to cast a vote on which of the CLIs they would like to take forward, including:

- Measure noise versus stress (heart rates, viability) (12 votes).
- Measure the number of vehicles that transit (per min) at certain points / routes (7 votes).
- Measure the number of noise complaints (5 votes).

Following this workshop, and throughout the rest of the pilot, the Community Champions did not collect CLIs. However, while the community champions did not systematically collect the CLI data, the approach had an impact on the pilot in regards to their awareness of the problem. In later discussions, the group often would refer back to the observations made during this event, and to CLIs, particularly in regards to physiological responses to noise. For instance, one community champion noted that their lack of sleep was due to a trash collection truck that would pick up trash nightly on their street. This level of understanding and follow through with the concept of CLIs was to be expected during this pilot, as the purpose was to test methods and tools in order to build the infrastructure to support future participants in collecting CLIs.

3.1.3 Discussion

The Making Sense team and the community champions had the opportunity to reflect on the design and delivery of the CLIs methods and tools at the end of the Community Champion pilot. From the community champions' perspective, the CLI session was considered to be interesting and useful in thinking about noise pollution. Practically, they suggested that this session was delivered further into the pilot and that more time was given to the worksheet and thinking about CLIs. Making Sense team members also reflected on the delivery of the CLI workshop, and agreed that the delivery of the concept was too complex for the time allocated to it. It was suggested that further iterations be more accessible (perhaps not using the term CLIs) and the tools be easier and quicker to complete.

This feedback was taken onboard by the Making Sense team in Barcelona and embedded into the third pilot. As the second pilot focused on working with children over a period of a week, CLIs were considered outwith the scope and capacity of the participants and therefore not included.

Example

3.1.4 Case Study 2. Gracia Sounds

Gracia Sounds grew from the Community Champions pilot, where the Making Sense team wanted to build on the knowledge from the first pilot, and further develop the structure, methods and experience of participatory sensing. For this pilot, the emphasis was placed on collecting useful data, and bringing participatory sensing to a group of citizens brought together through a shared concern of noise pollution. It aimed to do so by targeting a group of people brought together by the location where they live and a shared concern over the levels of noise in their neighborhood, who were residents of Plaça del Sol in the area of Gracia. A subsequent objective of this pilot was to provide a platform for the community champions from the first pilot with an opportunity of more leadership responsibilities and help manage and direct this pilot.

However, as this was a pilot tending to real-world problems, the real challenge of delivering this pilot was that the local residents joined because of ongoing issues they were facing with noise levels in the Plaça del Sol, an open plaza which is renowned for loiterers, buskers and people gathering en masse to sit and drink in the square. The residents wanted action, and some were less concerned about the activities which would support them in developing the skills around participatory sensing. It was an objective of the Making Sense IAAC team to demonstrate the value of participatory sensing, and how data sensemaking, building a community around the issue and collective action could assist them in their cause for a resolution.

As suggested in the feedback from the Community Champions pilot, the notion of CLIs was brought into the discussion at a later point into the pilot to allow for participants to be introduced to the sensors and fundamental information before being introduced to more complex concepts. It was still incorporated into the “planning” phase but followed other workshops that introduced the participants to complex ideas more incrementally. Prior to the workshop on CLIs, a previous workshop engaged the local residents in a noise timeline activity, but also had them consider sensing strategies for deploying the sensors during the Gracia Sounds pilot. These strategies were voted on and the three most favorable were selected to bring to the session on indicators [Figure 6]:

- Inside/outside deployment
- Around the plaza
- Certain apartment levels

Figure 6. Sensing Strategies. The worksheets used during a previous session where residents collectively decided on the sensing strategy for the pilot. Photograph by Gui Siez for MakingSenseEU.

For this workshop there were local residents (n=12) and community champions (n=7), in addition to the Making Sense team from Barcelona and Dundee (n=5). It is important to note that the participating residents were also representing other residents who were unable to attend the meetings. During the launch of Gracia Sounds, some of the local residents expressed a desire to host a sensor but an inability to attend the meetings. In addition, the group that did attend the workshops was not always comprised of the same residents. This variance continued throughout the full pilot and had implications on the CLIs as it meant that developing an ongoing dialogue and discussion on data and indicators could not be formalised.

For this event, however, the first activity was a mapping exercise. A large map had been printed and was laid out on the table at Kubik. Local residents were invited to add information about where they lived and where they could deploy the sensors. One local resident brought a list of other residents, so that further locations for sensor deployment could be added [Figure 7]. This information included the geographic location of the residents home, and also the floor which they lived on so that the group could plan the data collection for the various strategies that had been agreed on in the previous workshop.

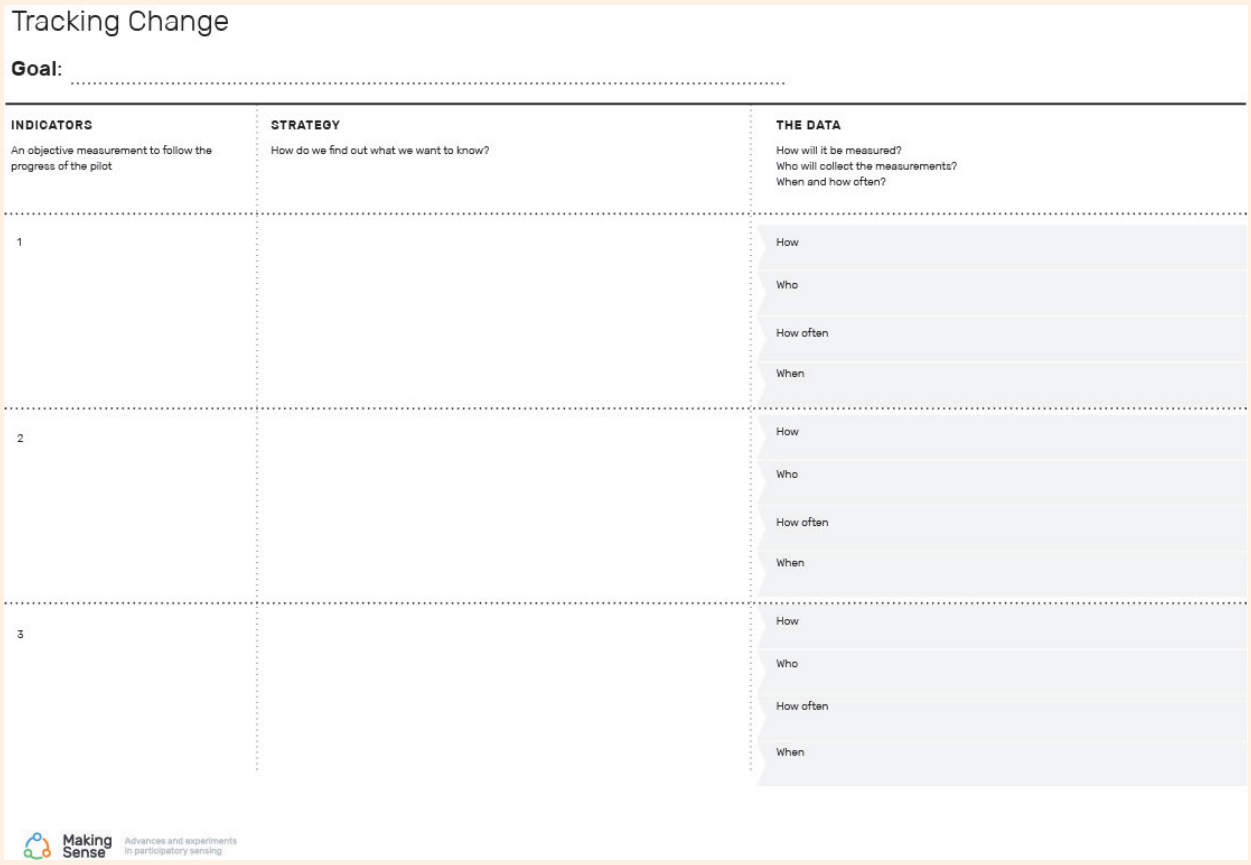
Figure 7. CLIs for Gracia Sounds. The residents consider other types of data that can complement the sensors and help them track their areas of concern during the pilot. Photographs by Saskia Coulson for MakingSenseEU.

Local participants split into three groups, each taking one strategy for capturing sensor information. Using the tool, the strategy for sensor deployment was considered the primary tool in collecting data on noise levels. The groups were asked to come up with one or two other indicators that could be used for data annotation with the predetermined strategies.

The CLI activity succeeded in having the groups think about the problem of noise pollution differently [Figure 8]. Some considered how the materials and the physical elements of the buildings they lived in had an effect on the noise that they were hearing. By finding out at the start of the campaign which materials their apartments were built from, and details such as the year of construction, they wished to find out if there was a relationship between this information at the noise decibels recorded on the sensors.

Another group sought to know more about the causes of noise from within the apartments by having all the residents track their schedules of when they were in and out of their homes. As part of the the Gracia Sounds pilot, each participant was given a sensor for both the exterior and interior of their apartment. By annotating the data with the times when residents were home, they sought to understand the noise that was created from inside, and if that would affect the readings of the noise coming through from the outside plaza.

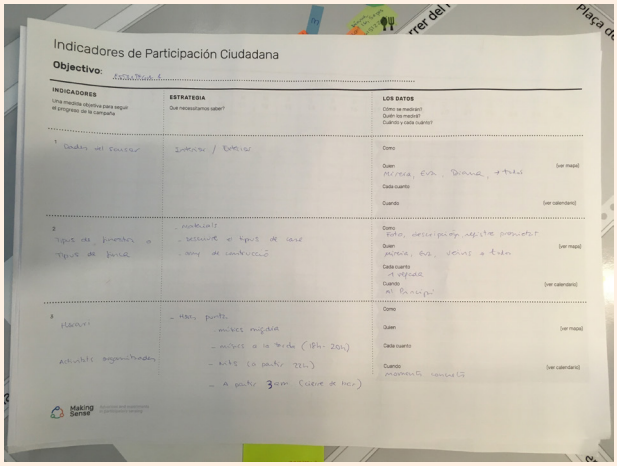
Moreover, one group sought track the people in Plaça del Sol by following their movements throughout the plaza in relationship to the light from the sun throughout the day. The aspiration was to compare this information to the sensors and examine distance between the two, to examine whether there was a correlation to the people in the square and the location of the sensor. This was discussed because some residents had noticed that people in the plaza moved to chase the sunlight, and they want to examine whether the noise decibels would increase on those sensors closest to the people.


Tracking Change

Goal: .....

INDICATORS An objective measurement to follow the progress of the pilot	STRATEGY How do we find out what we want to know?	THE DATA How will it be measured? Who will collect the measurements? When and how often?
1		How Who How often When
2		How Who How often When
3		How Who How often When

Making Sense Advances and experiments in participatory sensing



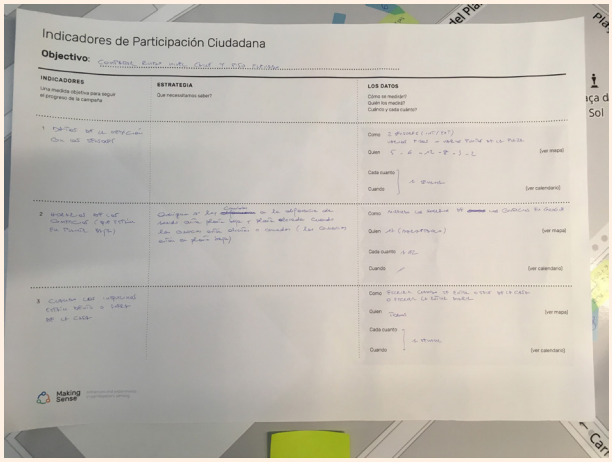


Figure 8. CLI Tool v2.0. An image of the CLIs worksheet used during the session with the residents of Plaça del Sol. Photographs of two completed worksheets from the session. Photographs by Chiara Dall'Olio for MakingSenseEU.

One key observation taken during the CLI workshop, was that it honed the residents energy to discuss the issue of noise. Prior to the activity, the tension in the room was increasing

with debate and expressions of discontent over the challenges faced by the residents in dealing with the issue of noise. However, this debate was not about proposing resolutions but obsessing about the problem. When given the opportunity to break out into smaller groups and discuss CLIs and strategies to make sense of the sensor data, the group honed their collective energy to discuss and plan approaches to building on the data sets gathered by the sensors that would reveal insights into the data. The groups started unpacking the issue of noise pollution in a more tangible way, and were able to think about what they needed to know to create strategies for action and change. This was a critical point in the pilot when the residents moved from a culture of blame to seeing the possibilities of contributive participation. This activity revealed opportunities to take action into their own hand, in the pilot evaluation they reflected on this and commented that it made them feel "useful" and "empowered".

Gracia Sounds: final event

At the end of the Gracia Sounds pilot, the residents and Making Sense team decided to stage a public intervention in Plaça del Sol [Figure 9]. Participants at the public intervention demonstrated a lot of interest in knowing how the process was going to move forward and how they would get proposals for policy action to the city council, and indeed, what those proposals would be.

Figure 9. Gracia Sounds final public intervention. The local residents set up a forum to discuss the issue of noise in Plaça del Sol in the square itself. Creating silhouettes that represented the residents and setting out tables for discussion. Photographs by Saskia Coulson for MakingSenseEU.

The residents led discussions, and invited those sitting in the square to take part. At one table the participants agreed on the effects of noise on health: sleep disturbance, hearing loss, heart disease, stress and depression. In order to provide evidence of this, they proposed to study the relationship between noise and health by comparing data from the sensors and other significant data, like pharmacy sales or data generated by personal devices that could measure sleep patterns. This was initially discussed during the CLIs activity at the

start of the pilot, as one resident was keen to track their sleep patterns with a fitness tracker device. However, this was never recorded during the Gracia Sounds pilot. The reiteration of this additional data on health and well being in relationship to the noise pollution that was occurring demonstrates a desire for work on CLIs to continue alongside any continuation of participatory sensing activity. In fact, the residents have been successful with a funding application to continue this type of work in partnership with the health department of the district of Gracia.

Discussions also looked towards a resolution and some groups proposed to organise a calendar of silent events (i.e. yoga sessions, open air cinema, etc.) by contacting different associations operating in the area. They imagined occupying part of the square with fixed elements for silent activities aimed at different age groups (a playground, a petanque field), as well as deploying mobile urban furniture (benches, seats, planters, parasols, etc.) in order to use them only on specific occasions. From replacing the stone floor with sound absorbing materials, to creating moss vertical gardens [Figure 10] in order to protect the facades of the residential buildings, participants had plenty of suggestions for improving the square.

Figure 10. A Community Champion proposes an idea for noise reduction in the Plaça del Sol at the final public event of the Gracia Sounds pilot. These images capture the individual's sensing journal in where they captured the data on noise levels in Plaça del Sol. They also present a sample of moss, which they believe has sound reducing abilities and could be installed in the square to assist with the noise problem. Photographs by Saskia Coulson for MakingSenseEU.

One idea came from a community champion, who had been involved since the beginning of the first pilot. They had been collecting data on the noise levels recorded by the sensors in Plaça del Sol during the Gracia Sounds pilot. They had also been investigating into materials that could absorb the sound and had discovered that certain types of moss had noise reducing abilities. Equipped with this information, they attended the final event to propose a modular structure made from panels containing mosses that could be installed onto the sides of buildings.

Not only was this an approach to reducing noise, but could become a feature or sculpture, and be more aesthetically pleasing than some of the other ideas for absorbing noise.

Insight

3.1.5 Plaça del Sol Resident

For one resident, the issue of noise was a long-standing one. She had lived in Plaça del Sol for nine years. When she moved in, noise was already a problem but she believes it has become worse. She has several children and the family struggles to sleep, and she finds it very stressful.

Prior to the Gracia Sounds pilot she had been active in trying to resolve the problem. She had been working with neighbors and speaking to the local council for over a year. She understands that it is a difficult situation for the city council to deal with however because they do not want to do anything that infringes on the rights of the public. As the square is a public space, it is difficult for anyone to decide what can and cannot be done in the space. She contends that the main cause of noise is down to the people sitting in the square:

> We are sure that the noise comes from the people. There is so little we can do, the huge problem is the people. A lot of people here is the square drinking and talking [...] singing also and sometimes playing instruments.

She spoke about how she wanted to track the movement of people according to the pathway of the sunshine. However, she reflected that this would only be something that could be achieved during the Winter and Spring months, as during the summertime the sun was too hot for people to sit in direct sunlight, and very few people sit in Plaça del Sol when the sun is beating down on it.

She did not use the sensing journal, as she found she did not notice things that should be recorded. Some of the other residents who were at home more frequently were able to note down some of the causes of noise. However, she would only take note of it at night when she would put on the television and realise that she had to turn the volume up very high in order to hear the sound. She had a sensor deployed on the inside and and one on the outside of her apartment, the one inside recorded the level of noise from the television. It also captured other noises, like her children shouting, but still maintains that highest levels of noise come from outside on the square.

In addition to using the Smart Citizen Kit, she captured the issue by taking photos on her phone of the Plaça del Sol at night when it is busy [Figure 11].

Figure 11. Capturing the issue of noise pollution. A resident of Plaça del Sol shows one of the many images of the square at night she has taken on her phone. They have been doing this prior to the Making Sense pilot, but continued to do so throughout as a way to capture evidence of the issue beyond the recording of sensor data. Photograph by Saskia Coulson for MakingSenseEU.

She usually takes photos every two days, or several times a week and is prompted to photograph the square when she hears a lot of noise coming from street level. When going back through her photographs she does not see too many patterns, just that there is always a lot of people sitting in the square.

> Always the picture looks the same, but it's not. You can see that there are some differences, but days look the same more or less.

Photographs she has been taking can be considered the collection of indicators, which complement the sensor information. She has shares the photographs through the community whatsapp group, where residents upload information that they collectively "measure". She uses the photographs to communicate to others and the government about the issue. Reaction from those who see the photographs is described as shock:

> They are surprised because they don't realise that this is happening. They know it because I have showed these photos one year ago when we had the first meeting. At first, they were very surprised but come on, we have this everyday.

She cites one of the main sources of the problem are bodegas which sell carry-out alcohol. She states that the local council has given permission to a bodega to open at Plaça del Sol. It is actually illegal to drink in the streets of Barcelona, but the bodega challenges this law and citizens respect of it.

> They permit these kinds of shops but you cannot go there and buy bread, it's just cold drinks. This is it, if you want to change something you have to start by not giving this kind of [permit]. They are open until 11 o'clock.

However, she believes that taking part in Making Sense has helped in activating change:

> We have the information, we have the data. We knew in the past that these noises were not normal that it was high. We knew that we had to stand up because it's not a normal level but we have the evidence and we have that data that states the decibels we have here so we should do something.

She wants to continue working on reduce the noise pollution in Plaça del Sol with the other residents. However, she believes that they should think about many different solutions, not just relying on the police to remove people. She understands that people want to gather and socialise, but wants to create awareness that Plaça del Sol is a residential area and wants there to be alternative places for people to go.

For her, Making Sense has opened the doors to the government and also brought recognition from the press which has forced the government to take note and to react. As an outcome of Gracia Sounds, the residents have started a petition, and the government will have to respond to this. She believes that the local residents now feel motivated and ready to keep going:

> We are on, going, moving, so we'll keep moving and not leave it. If we leave it and don't say anything else, if we don't complain the council will forget us.

As a result, the city council has change the time in which they clean Plaça del Sol. This has resulted in a marked reduction in noise levels. In addition, the council has launched a campaign for reducing noise pollution and have distributed signs all around the plaza and surrounding area.

3.1.3 Discussion

The Gracia Sounds pilot provided an opportunity to test the concept of CLIs with a community of people galvanised through a shared matter of concern.

The conditions for which this pilot was delivered was different to the Community Champions pilot, as there was a stronger focus on applying participatory sensing to a real-life challenge and with those who were directly affected by noise pollution.

Furthermore, there were other differences in working with a group driven by a longstanding environmental challenge. Namely, the development of trust and working relationship that was nurtured by the Making Sense IAAC team, the community champions and the residents of Plaça del Sol. Few of the residents joined the pilot due to an interest in participatory sensing or had the knowledge or skills, nor the aspiration to develop these skills. It was some of these gaps that were the reason for delivering the Community Champions pilot previously. The community champions consisted of those who were interested in the technology, and importantly, became connectors between the delivery team and the residents as some of them already had connections to the people living in Plaça del Sol or could demonstrate how from a citizen's point of view, participatory sensing could be valuable to the residents.

A direct comparison on the development and use of CLIs between the first and third pilot a systematic comparison is not feasible due to the variants in pilot delivery. However, the reflections from the community champions did help to evolve the workshop and tools used for the CLIs of the Gracia Sounds pilot. As an activity, it was found to be more accessible to the participants and was delivered at a more appropriate point within the pilot. It helped to build consensus amongst the group, change the way residents viewed the problem and provided them with direction towards change.

Participants of the Gracia Sounds pilot used sensing journals provided by Making Sense for data annotation during the sensing phase of the pilot, one resident even completed two of the sensing journals provided. In addition, some residents, like the one described in the Insight section, collected and kept other types of information, like the photographs of the square during peak times. However, during the interview it became apparent that this resident had a limited understanding of the concept of CLIs, or indeed indicators, although the images that they were collecting on their phone could be defined as CLIs. From this, the authors posit that there is scope for further investigation into making the concept even more accessible and understandable to citizens.

In addition, the residents formed a shared history of Plaça del Sol by collecting and showing pictures of it and creating an evolution timeline. Through this they discussed how the

developments of the plaza contributed to the increased noise pollution. They also collected present day images to support campaigns launched by the city council and aimed at reducing noise pollution. However, it was observed that residents did not follow through with the tracking and monitoring of indicators that were co-created as part of the CLIs workshop throughout the campaign. Even though many of the ideas reemerged in subsequent discussions and participants continued to express interest in gathering evidence that could help them with a powerful case for change, as was expressed during the final event at Plaça del Sol. This leads the authors to believe that more could be done in regards to building and supporting residents with methods and tools for collecting CLIs during a participatory sensing initiative.

Through reflection from the Making Sense team, it proposed that once the CLIs have been agreed on, the entire pilot needs to focus on following that direction. Moreover, the Making Sense team in Barcelona found that citizens in the main have very limited time in their day-to-day to dedicate to meticulous data collection. There is a need to rely on local community champions and to streamline the process. In the future, CLIs could be used as the pillar of the pilot, ensuring that the subsequent phases build on them. Yet, without orchestration and guidance data collection can becomes a hurdle.

3.2 Prishtina

3.2.1 Context

The World Bank (2013)[7] states that "the cost of outdoor air pollution in urban areas, with the most significant health effects caused by particulates which are responsible for increases in cardiopulmonary and lung cancer mortality from long-term exposure and for chronic bronchitis and respiratory diseases, has the highest impact with estimated damage costs ranging from €38 million to €163 million per year (0.90-3.88 percent of GDP).

Air pollution is estimated to cause 852 premature deaths, 318 new cases of chronic bronchitis, 605 hospital admissions and 11,900 emergency visits each year". However, the World Bank has been accused for "supporting a new coal plant that would modernise Kosovo's creaking energy infrastructure, but also lock the young nation into a future powered by a regressive fossil fuel" (Mathiesen, 2016).[8] Another investigation by Prishtina Insight and ClimateHome reveals the involvement of World Bank and its contribution "to the suffering of hundreds of Kosovans (living in the polluted periphery of the country's capital city) who were forced from their homes to make way for a coalmine, a leaked report reveals" (Xharra & Mathiesen, 2016).[9] Moreover, European Union Progress Reports (2014; 2015; 2016) criticize Kosovo's Government, particularly its Ministry of Environment and Kosovo Environmental Protection Agency, on the lack of air monitoring system and the lack of maintenance and calibration of their existing air pollution monitoring tools.

The third Making Sense campaign in Kosovo ran from May to June 2017, implemented by Peer Educators Network (PEN) and Science for Change Movement in Kosovo (SfCK), sought to build the capacities of young people and empower them in participatory sensing and action around the subject of air pollution. In the first two pilots they collected data on air quality across the whole of Kosovo, then honed in on Prishtina. The third pilot expanded again to including Obilic, Fushe Kosova, Krushevc and Plemetina. These were chosen due to their proximity to coal-powered plants. It continued to use targeted measures as a means to monitor a strategic shift in awareness and results from the heavy campaigning from the participants. The pilot brought together an intersection of themes: grassroots and co-created citizen science methods and approaches, campaigning and actions, data collection and interpretation, radical democracy, and a variety of digital sensors and non-digital devices. It also brought together a wide range of people, from youth activists to scientists, from institutional health experts to citizens, and formed committees within PEN and SfCK to execute the measurement of air pollution and devise strategies for action and awareness against this growing problem.

[7] http://documents.worldbank.org/curated/en/282361468047686579/pdf/750290ESW0P1310LIC00Kosovo0CEA0Rprt.pdf
[8] https://www.theguardian.com/environment/2016/jul/20/kosovo-coal-plant-power-world-bank-investment-dirty-technology
[9] https://www.theguardian.com/environment/2016/nov/14/world-bank-broke-own-rules-as-coalmine-left-kosovo-village-in-limbo

Example

3.2.2 Case Study 3. Bio-indicators

Over and above the usual measurements executed by the committee members, a student of Environmental Science at the University of Prishtina, and member of the Monitoring and Research Committee as part of PED and SfCK within Making Sense, measured the relationship between air pollution and bio-indicators.

The protocol and scientific guides for the collection of bio-indicators was based on an existing study titled, European Guidelines for Mapping Lichen as an Indicator of Environmental Stress (Asta et al., 2002). The committee member who lead this strategy produced a research proposal and presented it at the Making Sense (Kosovo) General Assembly to the committee for review and approval. For this, they produced a map which illustrated the area covered by the measurements, and a brief strategy document [Figure 12]. The proposal demonstrated how the researcher would monitor air quality through bio-indicators, specifically, lichens as indicators of air quality. The proposal identified the places where diversity research could be conducted on lichen in relation to the monitoring of air contaminants NOx, SO2 and Air Casting (pm 2.5). In these areas will also be defined the concentration of heavy metals in the swamps that have the ability to accumulate heavy metals, determination of heavy metals will be done through ghost wipes.[10]

LOCATION	TUBE SO2	TUBE NOX	GHOST WIPES	AIR CASTING
Prishtina	13	20	15	1
Fushe Kosove	13	15	15	1
Obiliq	13	13	15	1
Drenas	13	13	10	1
Lipjan	13	13	10	1
Total	74	74	65	

Figure 12. Map and equipment protocol for the measurement of bio-indicators in relation to air quality monitors. Source: research proposal from committee member, internal Making Sense document.

[10] Ghost Wipes sample metals on rough surfaces and dissolve completely for maximum recovery of target analyte(s). The wipes are effective at collecting antimony, beryllium, cadmium, chromium, cobalt, copper, iron, lead, manganese, molybdenum, nickel, vanadium, and zinc. (SKC) http://www.skcinc.com/catalog/index.php?cPath=600000000_601000000_601000100

As this study was also part of the lead researcher's Master's project, they received support and guidance on scientific matters from a professor at the Department of Environmental Science, University of Prishtina, who assisted with the fieldwork and collection of bio-indicator measurements. They received additional support from two to four Making Sense committee members.

The study identified seven to eight SO2 indicator species, which were recorded by location and timestamp as recommended by the original guideline document. Furthermore, the collection covered an approximately 30km area, where samples were taken from six trees at 5km positions over the gridded boundary, as seen in the map [Figure 12]. Trees with a circumference of under 50cm were chosen, the latitude was recorded in addition to the species and coverage of lichens using a sample definer on each cardinal direction of the tree [Figure 13]. An axe was used to remove a section of bark (approximately 5cm x 10xm in size) and collected for a laboratory study into the comparative herbaria of the samples.

Figure 13. Documentation of collection of bio-indicators. Researcher selects tree and collects data on the lichen and mosses living on tree. Photographs by Mel Woods for MakingSenseEU.

The evaluation of the measurements and bio-indicators had not been completed by the time of writing this report. However, this was described by a project leader as a success for PEN and SfCK in the Making Sense pilot as it demonstrated the ability to directly support the communities in being self-directed. Future data analysis will use additional computational software to bring all the data together. After which, it will be possible to compare by the diffusion tubes or by comparison points. Early findings reveal that in the two municipalities close to the power plant the lichen and moss diversity is lower, and way lower than low areas. The lead researcher and his professor are considering publishing a scientific paper, which is why the data are undergoing a rigorous and lengthy evaluation. The data from this project will be included in future Making Sense events in Kosovo.

3.2.3 Discussion

Although the findings from the data set on bio-indicators were still being analysed at the time of writing this report, there are several insights that can be drawn from the process and the use of bio-indicators in Kosovo. The proposal to study bio-indicators came from within the committee and was approved through a democratic process, which demonstrated a proactive approach to learning more about the relationship between the pollutants in the air and its effects on living organisms (beside human health).

However, there was already a level and interest from the lead researcher in collecting this type of data, as they are a student Environmental Science at the University of Prishtina and therefore has a foundation of knowledge and skills in the collection of data. The researcher also received direct support from a specialist outside the Making Sense team, a professor at the university, who provided the expertise to help the researcher in forming and conducting this study. Yet the researcher also employed the help of his fellow committee members from the Making Sense project.

4

IMPACT AND REFLECTIONS IN THE USE OF CLIS

Using the insights from the case studies, this section returns to the four challenge areas and the six ways the CLIs support participatory sensing. We consider how the events and learnings from the Making Sense project further inform the concept of CLIs.

Table 5 pairs the areas of support to the challenge area that is address and pulls in examples from the Making Sense case studies above.

WAYS CLIS SUPPORT PARTICIPATORY SENSING	ADDRESSES CHALLENGE AREA:	EXAMPLES
Accountability	1. Generating and communicating information and understanding 2. Analysing and finding relevance in data 3. Building community around participatory sensing	• Noise Timeline (CC) • Personal feelings - positive / negative (CC) • Recording personal activities in sensing journal (GS)
Community Assessment	1. Generating and communicating information and understanding 2. Analysing and finding relevance in data 3. Building community around participatory sensing	• Co-creation of goals (CC) • Collective voting on CLIs (CC) • CLI Tool to form dialogue between residents (GS) • Democratic voting on proposal (BI)
Short-term evaluation	1. Generating and communicating information and understanding 2. Analysing and finding relevance in data	• Sensor deployment strategy and CLIs (GS) • Mapping people in plaza with distance to sensor (GS) • Collecting lichen in relation to distance to power plants (BI)

Long-term evaluation	1. Generating and communicating information and understanding 2. Analysing and finding relevance in data 4. Achieving or monitoring change and impact	• Documenting people in plaza with photographs (GS) • Collecting health records and personal informatics with sensor data (GS) • Using existing study to reexamine lichen diversity (BI)
Policy change	1. Generating and communicating information and understanding 2. Analysing and finding relevance in data 3. Building community around participatory sensing	• Using photographs in addition to sensor data to communicate issues to the government (GS) • Government working with citizens to resolve noise pollution issues (GS)
Capability	1. Generating and communicating information and understanding 2. Analysing and finding relevance in data 4. Achieving or monitoring change and impact	• Using CLI Tool to enhance understanding of noise pollution (CC/GS) • Understand to sensor deploy in relation to physical factors - like building materials (GS) • Developing personal knowledge and skills with support of experts (BI)

Abbreviations Key:
Community Champions (CC)
Gracia Sounds (GS)
Bio-indicators / Kosovo Season III (BI)

Table 5. Summary table of the key areas of support provided by CLIs in participatory sensing with cross reference to the four critical challenge areas and examples of practice, examples from case studies included.

In the sections below, we explain our insights in more detail. Focus is first given to the six areas of support and evidences these with an example from the case studies. Then we examine the four challenge areas and give recommendations for participatory sensing initiatives as a result from the insights gleaned as part of Making Sense.

4.1 Use of Community Level Indicators in Making Sense

To evaluate the use of CLIs and other indicators in the activities of Making Sense, this section examines the six ways in which CLIs can support participatory sensing initiatives outline at the start of this report, and considers them through examples from the case studies.

Accountability:
Accountability is an process of understanding the complexity of the environmental challenge at hand. It is a deepening of awareness with those engaged in the participatory sensing, by tracing to the root cause of the issue. In addition to a fuller understanding into the matters of concern, CLIs enlighten participants in understanding that environmental problems are not something they are inflicted by but also that they are contributors to. For example, the Noise Timeline had the community champions think about the noises they made compared to the noises they heard throughout the day. This allowed them to think about the complexity of noise, and the varying associations that humans can have with the noises they hear. It engaged the community champions in discussions around the multifaceted nature of noise.

Community assessment:
The way in which the community gathers this information on indicators is also a strategy to bring individuals together, and build a community through a shared interest. The intent is to create a platform by which people can share their concerns, knowledge and information on pertinent matters. Focusing on the subject of CLIs in building this community intends to help shape and form the community and direct their discussion towards understanding the complexity of the problem. In the instance of the Gracia Sounds pilot, the CLIs workshop allowed the group to focus on their shared concerns and how to capture and monitor those issues in a tangible way. For instance, by monitoring the number of people in Plaça del Sol and tracking movements, the residents sought to examine the relationship between those in the square and the levels of noise decibels recorded on the sensors.

Short-term evaluation:
Our study has observed that monitoring indicators during the period of a campaign can build awareness around the environmental factors. During the third pilot in Kosovo, the researcher examining bio-indicators was interested in the relationship between air pollution and lichens and mosses growing in the proximity of several active power plants in specific areas around the country. Collecting bio-indicators allowed for the committee members to understand the relationship between air quality and living organisms.

Long-term evaluation:
We suggest that continuous monitoring of CLIs supports the ability to evaluate the impact and legacy of initiatives, even after the conclusion of the project. In the case of Gracia Sounds, this would be the continuous tracking of people using Plaça del Sol. If the residents continue to campaign and collect data on the noise levels, this additional data could provide insight into whether their efforts have had an effect or whether it is the cause of people that are making the majority of noise.

Policy change:
Having access and collecting the right data to present a case for change to policy makers is key to the developments of Making Sense. Deploying the sensors in Plaça del Sol allowed residents to collect the information they needed to build a case for change. Pairing this with the images caught by a smartphone by one of the local residents helped to add a visual narrative to the issue.

Capability:
Understanding the other indicators that decision makers use to consider environmental issues and develop policies may assist citizens in building their capability for data sensemaking and communicating their findings to instigate change. Primarily, it is about developing the ability to identify and collect evidence and other types of data to create an awareness and understanding. In addition to creating an equal footing and building a culture of empowerment for citizens. The residents of Gracia Sounds felt empowered by their campaign and able to speak to government officials to make their evidence-based case for change.

4.2 Learning and Recommendations

To discuss the productiveness of the CLI approach and consider areas for future development of concept, we return to the four challenges in participatory sensing presented at the start of this report. These areas are:

1) generating and communicating information and understanding,
2) analysing and finding relevance in data,
3) building community around participatory sensing, and
4) achieving or monitoring change and impact.

Below we discuss each and the insights we have gleaned from our work, and propose these as recommendations for future participatory sensing initiatives.

Generating and communicating information and understanding:
We recommend that CLIs is a form of data annotation which provides supplementary information to the sensor data, and that this contextual information helps to form a wider understanding of environmental issues. We found through our studies that the concept of CLIs and indicators assist in helping participants think more deeply about the issues when considering ways to annotate the sensor information. However, we also recognise that there is still a gap in understanding what can be collected to complement the sensor information and collect additional information. In the case of Gracia Sounds, there was a need for stronger links to be made between the sensor data and supplementary information for the participants to understand the relationship and to support them in making the connections themselves.

Analysing and finding relevance in data:
CLIs support data sensemaking through understanding how to analyse the data and find the relevance of that information in participants daily lives and in addressing environmental issues. However, the learning process of data sensemaking, in the main, came from the assistance of experts in the case studies. In the case of Barcelona, the Making Sense team did the majority of data analysis and presenting it to the residents during the Gracia Sound pilot. For the bio-indicators, the researcher and team received support from the professor at the University to make sense of the data they were collecting. Also, the researcher was a student of environmental studies and therefore had previous experience in this type of analysis.

Building community around participatory sensing:
Through a collaborative approach, we sought to build CLIs in the community building engagement strategies around participatory sensing. By bringing people together through physical connections that are enabled by smart thing technology, CLIs are considered

a concept to be shared and developed by multiple perspectives. It is through these engagement strategies that we move towards a “click and bricks” model, a term which implies citizens coming together for actionable change through technology platforms (Gore, 2017).

Achieving or monitoring change and impact:
This report has put forth an argument for CLIs to be considered key in devising pathways for achieving change and monitoring the progress of change. From the study and collection of data in the Making Sense, the authors contend to this as there has been expressions of need for this type of supplementary information. However, as Making Sense is limited to a two-year time frame, the assessment and ability to evaluate long-term impact and action is limited. This is an area for further review and research in following projects.

4.3 Community Level Indictors: approaches and tools

Examining the Making Sense Framework which has been developed through a reflective practice approach as part of the project (Making Sense D5.2 + D4.3, 2017), there are key areas in which CLIs can be introduced and the methods and tools that have been used and evaluated in this process [Table 5].

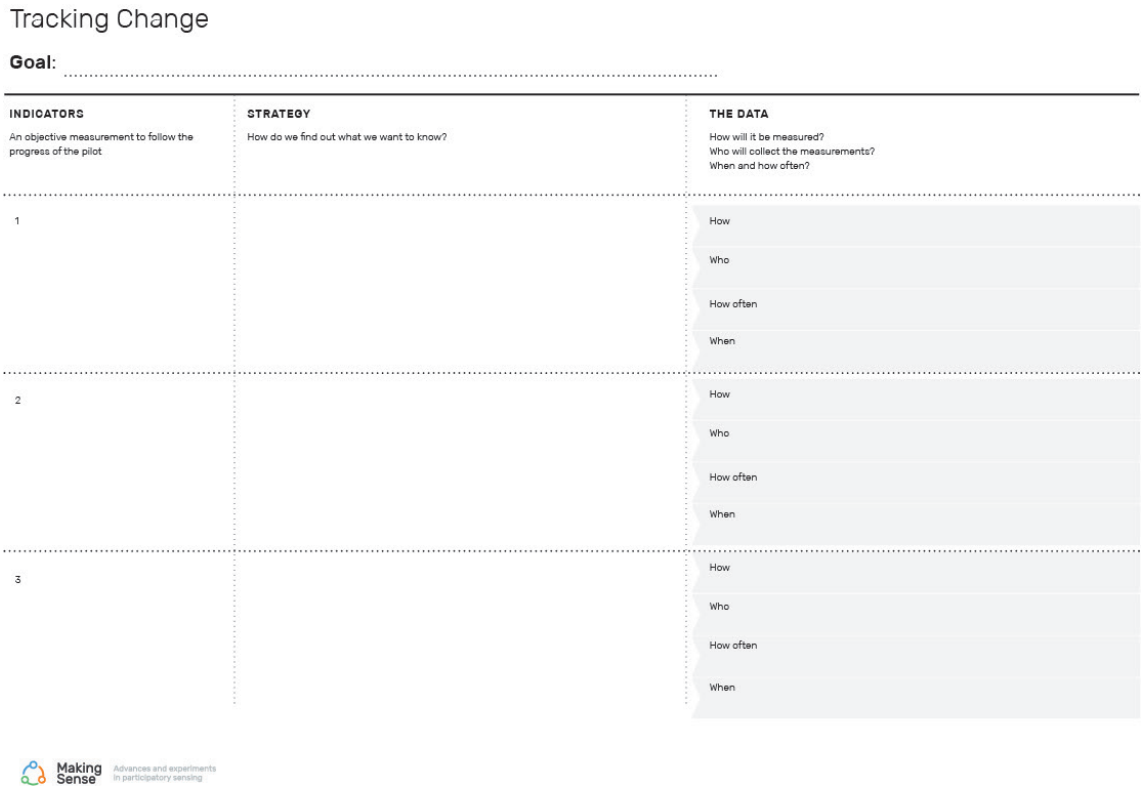
The methods within the table draw from the Making Sense 5.4 Community Level Indicator deliverable, reflecting on practical elements, like the inclusion of particular stakeholders and specific areas of knowledge which should be considered in the various phases. Due to the developments of ideas from the initial report, the authors advise that this document be read in conjunction with the original.

PHASE	DESCRIPTION	METHOS	TOOL
Scoping	• Identification of internal indicators for campaign delivery (achieed through questions formulation0		• Noise Timeline (CC) • Personal feelings - positive / negative (CC) • Recording personal activities in sensing journal (GS)

Community Building			
Planning	• Mapping indicators • Sensing strategy protocols • Goals	• Goal post / Sign post workshop	• Noise Timeline • Sensing strategy • CLIs Tool
Sensing	• Measuring the environment • Collecting individual observations	• Progress tracker workshop	• Sensing journals
Awareness	• Interpreting and understanding data • Understanding environment and health • Indentifying potential for change	• Hindsight workshop	• Future Newspaper or other future projecting activity to understanding how the information to the legacy of the campaingn
Action			
Reflection	• Use of indicators to reflect on actions and change		
Legacy	• External impact, e.g. policy • Writing publications		

In the original report, it was suggested that the Visioning Workshop and Future Newspaper tool be included as part of the Community Building and Planning phases. This was intended to enable the long-term aims (or goals) of the community to drive a short to mid-term pathway, and allow members to monitor progress towards larger objectives. Thereby, encouraging participants to take ownership when the pilot ended. However, during studies in Barcelona, the participants used the tool after data had been used to form awareness on the challenge at hand. The Future Newspaper tool was then used to co-create a strategy for change after new insights had been gained.

Several new tools were developed by Making Sense in order to achieve the objectives laid out for the project. The first was the CLIs tool [Figure 14] which has been created and iterated upon through an investigation into its use and effectiveness during two pilots in Barcelona.



Tracking Change

Goal: .....

INDICATORS An objective measurement to follow the progress of the pilot	STRATEGY How do we find out what we want to know?	THE DATA How will it be measured? Who will collect the measurements? When and how often?
1		How Who How often When
2		How Who How often When
3		How Who How often When

Making Sense Advances and experiments in participatory sensing

Figure 14. CLIs Tool v3.0.

This tool is designed for new communities during the Planning phase to consider what other types of indicators can be gathered as part of the participatory sensing initiative. For this the key participants would be those involved in the data collection, as this activity helps them define and decide which indicators to capture, and they would go about this.

Further to this, a sensing journal [see Annex] has been developed sensing participants to annotate the sensor data and track other types of information and data.

5
POLICY OUTCOMES

CLIs are developed in Making Sense as one way to enable the move from collective awareness to collection action and impact, including policy impact.

CLIs are furthermore presented as a resource and framework for future use, including recommendations and guidelines for application. The potential is for CLIs to be taken forward and integrated in both citizen and policy domains.

Section 5 reflects on the concrete outcomes and impact that demonstrate pathways to policy change, specifically in the context of Barcelona's ongoing challenges with noise pollution. We discuss the way in which CLIs have fed into the pilot outputs, including; shaping actions or interventions and providing evidence to support discussions with government officials. There is further discussion on the uptake and corresponding impact outside of the Making Sense project, building on Section 4 which reflects on the impact of the use of CLIs within Making Sense. It examines how the concept of CLIs, and the framework developed in Making Sense, have been appropriated and employed as a result of this project in regards to policy and impact. This demonstrates scope for further uptake beyond Making Sense, which was the ambition described in the original report (Making Sense D5.4, 2016).

5.1 Impact and Policy Outcomes in Barcelona

The case studies into the theory and practice of CLIs in the context of Barcelona, demonstrates instances where the Making Sense approach not only provides the contextual information needed for data sensemaking. It also demonstrates tangible examples of real impact and how this approach supports policy change.

For the participants of the Barcelona pilots, Community Champions and Gracia Sounds, the CLIs were instrumental in forming a collective understanding around noise. It helped participants to map and understand the landscape and impact of noise pollution. It assisted the residents in deciding which action was to be taken as a direct result of their sensing strategy. By collectively building on their knowledge of the problem, the residents felt empowered and were able to publically speak out. As many of them did when they were interviewed by national Spanish media outlets as a result of the Gracia Sounds pilot.[11] Furthermore, the residents capability to facilitate discussions around the issue of noise was demonstrated during their final event in Plaça del Sol when they led on debates as part of the intervention in the plaza.

For the Gracia Sounds pilot CLIs supported the residents in building a case for change. Specifically, in the case of the photographs which complemented the sensor data when the residents presented information to government officials. It gave the residents the additional context and information so that they could evidence that the high readings from the noise sensors were a result of people in the square. Other data annotation archived in the sensing journals also helped to give further insight into this challenge. As a result, the city council have changed the times at which they clean the plaza, resulting in a noted reduction of noise. In addition, they have launched a campaign against noise pollution and have installed signage for this all around Plaça del Sol.

The residents from the Gracia Sounds pilot are also looking to continue this initiative. Having already formed a partnership with the local health board, the next step is to collect information on the impact noise pollution has on their health. This was discussed during the final event, and was an idea that came up frequently, even during the Community Champions pilot. Making Sense in Barcelona have also secured a partnership with the DECODE project, which provides the tools for individuals to control their own data and manage how they share that data.[12]

[11] For examples, see: http://www.ara.cat/societat/veins-sarmen-dades-desmentir-ladministracio_0_1850814902.html; http://www.naciodigital.cat/noticia/133576/placa/sol/gracia/zona/zero/botellon/barcelona

[12] DECODE website: https://www.decodeproject.eu/

We cannot say that CLIs were the sole source of these developments, indeed they were never intended to be a discrete source of information or data. However, we can promote their use to complement and position existing work and advancements in the participatory sensing campaigns of Making Sense.

5.2 Implimentations of CLIs in a large-scale IoT and Smart City Demonstrator

Following scoping of CLIs within Making Sense, and the publication of the first report, CLIs were implemented in CityVerve, the UK's Internet of Things (IoT) and Smart City Demonstrator.

CityVerve is funded by InnovateUK (£10M) and led by the City of Manchester as a part of a consortium of 18 partners that includes Cisco, BT and FutureEverything. Starting with Manchester, CityVerve hopes to create projects, tools, and a way of doing things with Internet of Things Smart City technologies that can be replicated in cities around the world. The primary aim is to demonstrate how IoT is used to realise a "smart city" agenda, with focus on subsequent objectives that examine public engagement with IoT technology and transferable insights (Georghiou et al., 2017).

5.2.1 The potential for policy impact in CityVerve

CityVerve presented an additional opportunity for Making Sense to to pilot and demonstrate CLIs in the context of a large-scale, industrial project, very different to the participatory sensing case studies in Making Sense. The Making Sense team identified potential for policy impact in CityVerve, because, on the one hand, of the size of the IoT Smart City sector, and, on the other hand, because in the IoT Smart City development there has previously been a deficit of citizen-led strategies and methodologies.

5.2.2 Introducing and positioning CLIs in a large-scale IoT and Smart City Demonstrator

From the original report on CLIs (Making Sense D5.4, 2016), authors implemented the concept of CLIs in CityVerve by FutureEverything. They were positioned as a framework to involve communities and residents in the design process of the Smart City, and to engage them

as stakeholders and contributors to define and measure success criteria for the CityVerve project.

The aims of the implementation were defined as to:

> give local residents and citizens a voice on emerging IoT technologies and services developed in their city or neighbourhood; contribute to user research and requirements gathering in early stages of design; and demonstrate a collaborative framework for assessment that might be replicated in other IoT and Smart Cities projects globally. (Georghiou et al., 2017, not paginated)

5.3 Replicability and Impact of Policy Outcomes

From the ongoing work on CLIs, Making Sense had the opportunity to share its insights into this area.

From this knowledge transfer, CityVerve have incorporated the concept of CLIs into organisation policy and engagement strategies (Hemment et al. 2016). CLIs were built on and tailored for a large scale IoT Smart City demonstrator, referencing Making Sense as background.

A core objective in both Making Sense and CityVerve is replicability: to develop insights, methods and tools to be replicated in other participatory sensing, Smart Cities and IoT projects. Consequently, an ambition for a CLI approach is that it will be flexible enough to implement into projects elsewhere. While the design for Making Sense and CityVerve does contain some features that are distinct to each project, the intent is that the framework can be applied to other cities, sectors, technologies and communities. There is also an important opportunity for communities who do not have access to sensor, or who contest narratives around official monitoring, to take up CLIs in order to demonstrate and evidence hyper local issues. Any new implementation, would require equivalent local strategies to be developed in order to account for differences in audience, technologies, context, resources and constraints.

6
CONCLUSION

The research conducted on CLIs as part of Making Sense has allowed for the investigation into the challenge areas of participatory sensing and illuminate new approaches to further citizen participatory and data literacy of those citizens.

We have positioned our assessment against four key challenges areas in participatory sensing: 1) generating and communicating information and understanding; 2) analysing and finding relevance in data; 3) building community around participatory sensing; and 4) achieving or monitoring change and impact. To this end, we discussed how the use of CLIs can tend to these challenges and reported on six ways in which CLIs can address these challenges and thereby support participatory sensing initiatives: accountability; community assessment; short-term evaluation; long-term evaluation; policy change; and, capability. We have also demonstrated the capability to transfer the concept into the practice of adjacent IoT initiatives who are operating at a differing scale, but who share objectives to engage citizens in collaborative goal setting and monitoring.

However, through this research the authors have identified areas for further development:

- The accessibility in the concept of CLIs, which has been noted to be a difficult to grasp concept with those unfamiliar with working with data
- Development of approaches and tools to facilitate and support those trying to collect and evaluate CLIs
- The long-term collection of CLIs
- Further investigation into the policy outcomes and impact using CLIs, undertaking through a longitudinal study.

These are primary considerations and ones which should be embedded into further research into participatory sensing and the specific use of CLIs in community monitoring activities.

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ANNEX

Making Sense

SENSING NOTES

Making Sense in Plaça del Sol

April 2017

Hola Making Sensers!

This book is a little helpful assistant for the measuring experiments you will be doing in April.

Here you will find some tips for taking care of your Smart Citizen Kit, a space for basic descriptions of your sensing space, a timetable for the monitoring of noise, and some extra pages for notes.

We're very excited to have you on board!

The Making Sense EU team

Making Sense

Who am I?

It will help if you add some details about your kit for everyone to remember later!

SENSOR 1

SENSOR NAME
What did you call your sensor?

_____

SENSOR LOCATION
Where in the house did you put your sensor?

_____ _____
Room Floor number

_____ _____
Inside or outside? Direction Facing

SENSOR 2

SENSOR NAME
What did you call your sensor?

_____

SENSOR LOCATION
Where in the house did you put your sensor?

_____ _____
Room Floor number

_____ _____
Inside or outside? Direction Facing

The Smart Citizen Kit

It should be very simple to become familiar with the Smart Citizen Kit.
It only has one button and one light! :)

1

USB PORT

This is where you plug in the blue cable to charge the kit.

2

THE BUTTON

The button is how you power the kit on and off, change modes, and reset the kit.

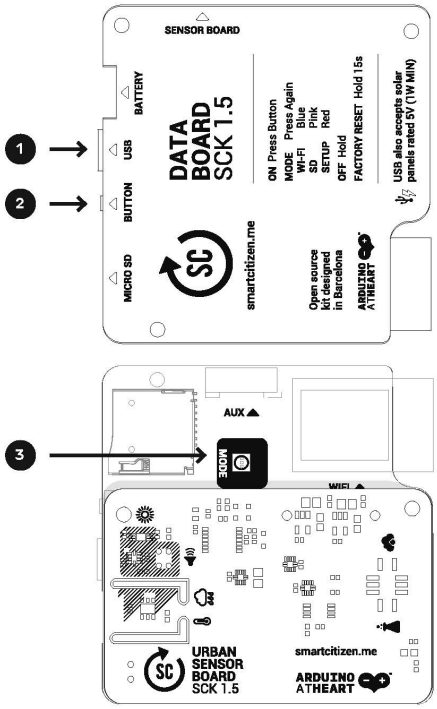
3

LIGHT

The light, lets you know what the sensor is doing. If you want to know what hey mean we've written them here.

IF THE LIGHT IS:

RED : It's setting up
BLUE : It's sensing & publishing
PINK : It's sensing & saving to card
YELLOW : It has an error.
GREEN : It has recieved settings.



Tips to care for the Smart Citizen Kit

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

BATTERY

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

CHARGING

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

CHARGING TIME

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

PLUGGING-IN

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

SWITCHING OFF

To switch off the kit, press the button and hold for a few seconds until the lights go off

WATER

If water gets into the Smart Citizen kit, don't panic. Wait 5-8 hours and then try again. If that doesnt work, try restarting the sensor.

DIRECT SUNLIGHT

Leaving the kit in direct sunlight will affect the temperature settings, as air heats up inside the case

RESTARTING THE SENSOR

To restart the sensor as new, press and hold the button for 15 seconds, until the lights go off and then turn **red**.

PLACEMENT

Make sure the kit's window is facing the noise source, and don't place it near other noisy devices (fridge, TV etc)

Seeing your data

We will be designing better and better ways to see your data. Right now you can go online to check this.

Remember to search for your device at the top if you haven't logged in

Visit the website

SMARTCITIZEN.ME

LET'S GET SENSING

Plan, calendar & notes

How to sense well...

We want to try to get the best data we can possibly get. This means the sensor data, but also the softer data that the sensor can't capture. Here's some guidelines for everything to go well!

1. We have to keep the sensors on line as much as possible and capturing the noise in the Plaça del Sol. So we have to keep them plugged in to a power source or charge them every **two** days.

2. The sensors **have** to be active during the 3 weeks between **05th** & **25th of April**.

3. To install / re-install the sensor visit the website **onboarding.making-sense.eu**

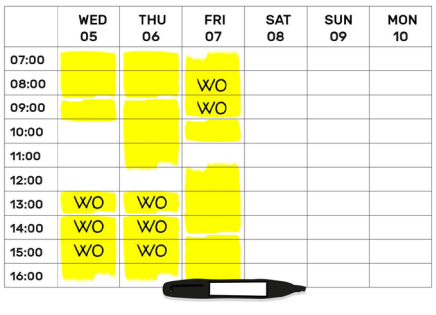
4. If you have problems conecting the sensor please contact us in the **Whatsapp** group or by email on **support@smartcitizen.me**

5. Please fill the calendar with any notes that help us make sense of the data (window open / closed, barking dogs etc)

CALENDAR

05 APRIL – 25 APRIL

To make sense of our data we will need to fill out this very simple calendar.



To do this you will need a highlighter and a pen.

- In **yellow** we will mark when people are in the house.
- In **pen** we will write **WO** when the window is open.

Make sure you do it accurately as possible so we have the best data to use!

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04:00						
05:00						
06:00						

NOTES

	TUE 11	WED 12	THU 13	FRI 14	SAT 15
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08:00					
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06:00					

NOTES

	SUN 16	MON 17	TUE 18	WED 19	THU 20
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NOTES

	FRI 21	SAT 22	SUN 23	MON 24	TUE 25
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NOTES

NOTES

05 APRIL – 25 APRIL

05.04

06.04

07.04

08.04

08.04

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13.04

15.04

15.04

16.04

17.04

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21.04

22.04

23.04

24.04

25.04

NOTES

05 ABRIL – 25 ABRIL

REMEMBER

To install your sensor, your unique sensor number is

SMARTCITIZEN[ ]

Making Sense

making-sense.eu

Making Sense

Advances and experiments
in participatory sensing