



Deliverable D1.10

Methodology for Validation and
Impact Assessment



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Deliverable lead	Uta Wehn
Author(s)	Uta Wehn, Ellen Pfeiffer, Mohammad Gharesifard, Kim Anema, Meike Remmers
Internal reviewer(s)	Elizabeth Gil-Roldán Little, Stijn Vranckx, Hans van der Kwast, Leonardo Alfonso, Teresa Cerratto-Pargman
Contact for queries	Uta Wehn , u.wehn@un-ihe.org
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Abstract of deliverable	Ground Truth 2.0 is a three year project funded under H2020 by the European Commission. It will deliver the demonstration and validation of 6 scaled-up citizen observatories in real, operational conditions, with 4 European and 2 African demonstration cases. Ground Truth 2.0 will demonstrate the technological feasibility, the sustained use and the societal and economic benefits of such citizen observatories. The ultimate objective is the global market uptake of the concept and enabling technologies. This Deliverable presents the methodology for implementing core elements of the validation and impact assessment activities that are needed from the start and throughout the project life time.

Versions and Contribution History

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V0.1	16.12.2016	Mohammad Gharesifard	Content for institutional impact section and related methodology
V0.2	9.1.2017	Kim Anema	Content for social impact section
V0.3	11.1.2017	Uta Wehn	Complete restructuring of document; inclusion of assessment approach and application to project and Demo Case levels.
V1.0	23.1.2017	Uta Wehn and Ellen Pfeiffer	Detailed design of validation and impact assessment framework and procedure.
V1.1	30.1.2017	Uta Wehn	Integration and updating of co-author inputs; finalisation of economic and environmental IA indicators.
V1.2	30.1.2017	Uta Wehn	Updates according to reviewers' comments; consolidation of all final inputs by co-authors.

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List of abbreviations

CAPEX	Capital Expenditure
CO	Citizen Observatory
DoA	Description of the Action
EC	European Commission
EU	European Union
GEO	Group on Earth Observations
GEOSS	Global Earth Observation System of Systems
GDP	Gross domestic product
GT2.0	Ground Truth 2.0
ICTs	Information and Communication Technologies
IPR	Intellectual property rights
IT	Information Technology
LUM	Land Use Mapper
OECD	Organisation for Economic Co-operation and Development
OGC	Open Geospatial Consortium
OPEX	Operational expenditure
PMT	Project Management Team
SDGs	Sustainable Development Goals
UN	United Nations
UNEP	United Nations Environment Programme
UNDP	United Nations Development Programme
WP	Work Package

Executive Summary

The Ground Truth 2.0 (GT2.0) project will deliver the demonstration and validation of 6 scaled-up citizen observatories in real, operational conditions, with 4 European and 2 African demonstration cases. It will demonstrate the technological feasibility, the sustained use and the societal and economic benefits of such citizen observatories. The ultimate objective is the global market uptake of the concept and enabling technologies.

This document presents the methodology and procedures for the Ground Truth 2.0 validation and impact assessment. The combination of monitoring, validation and impact assessment will provide a comprehensive feedback tool to inform improvements to the final citizen observatories and innovate specific aspects of the products, closing the gap between a proven technology and a commercialized product.

Citizen observatories are not products, but represent phenomena of citizen science enabled by Information and Communication Technologies (ICTs). They involve communities of actors such as citizens, scientists, policy and decision makers, as well as private sector data aggregators engaged in complex social practices. Capturing progress, outcomes and impacts requires a tailored conceptual frame, drawing on generic approaches. Moreover, the object of the assessment undertaken by GT2.0 concerns two distinct levels: i) the GT2.0 project at large and ii) the six individual observatories in the Demonstration Cases.

The Ground Truth 2.0 approach to validation and impact assessment serves for performance appraisal of the project implementation, for the assessment of changes in the social context as well as for producing timely feedback to enable learning and adjustments during the course of the GT2.0 project. With respect to the latter, it uses results-based evaluation practices based on the Theory of Change, impact assessment and adaptive management principles. Key elements of the Theory of Change (influential factors, strategies and assumptions) are used to trigger changes in the adaptive management of the GT2.0 implementation. This constitutes a consistent feedback loop that enables learning and adjustments during the GT2.0 project implementation.

Given the conceptual design of the GT2.0 validation and impact assessment and the diversity of indicators involved, the implied methodological choices are carefully considered. Specifically, appropriate data collection methods are selected and data collections instruments are designed. Moreover, the implementation of the data collection part of the assessment are planned in a resource-efficient manner to ensure that these efforts remain within the GT.20 project's resource boundaries. Finally, the analysis of the collected data is set up in line with the framework and in accordance with the driving validation and impact assessment criteria.

1 Introduction

1.1 Background

Citizen science, enabled by ICTs, is on the rise. Using their own observations and mobile devices, citizens provide a new data stream that generates localized information about the environmental situation on the ground, complementing existing data systems and surveys. However, many efforts to implement citizen observatories are facing problems sustaining engagement by citizens, limited scalability and limited impact on governance processes.

The Ground Truth 2.0 project will deliver the demonstration and validation of 6 scaled-up citizen observatories in real, operational conditions, with 4 European and 2 African demonstration cases. It will demonstrate the technological feasibility, the sustained use and the societal and economic benefits of such citizen observatories. The ultimate objective is the global market uptake of the concept and enabling technologies.

The work undertaken in WP1 'Social dimensions: Co-design, validation and impact assessment of citizen observatories' of Ground Truth 2.0 provides the basis for co-designing and co-creating citizen observatories via a range of social interaction mechanisms. It establishes a sound understanding of the social context which will ensure that the technological developments in the other work packages achieve the desired social innovation impacts in terms of environmental monitoring, cooperative planning and environmental stewardship. Within WP1, Task T1.6 'Validation and Impact Assessment of the Ground Truth 2.0 Citizen Observatories' is dedicated to assessing and validating the results from all six demonstration cases. This document is one of the T1.6 outputs.

1.2 Purpose of the document

The validation and impact assessment activities in the Ground Truth 2.0 project consist of formal, evidence-based procedures measuring project results against specific reference points:

1. Progress monitoring measuring general project-wide progress against the Ground Truth 2.0 objectives according to identified indicators and outputs.
2. Validation of the Demo Case Observatories both against requirements of local stakeholders and against the overall Ground Truth 2.0 concept for citizen observatories in terms of functionalities, scale, extent of use, and types of actor interactions.
3. An Impact assessment will capture social, institutional, economic and environmental changes that can be attributed to the Ground Truth 2.0 Demo Cases, comparing the situation during and following the up-scaling of the citizen observatories to an early initial baseline.

Together, the combination of monitoring, validation and impact assessment will provide a comprehensive a feedback tool to inform improvements to the final citizen observatories and innovate specific aspects of the products, closing the gap between a proven technology and a commercialized product.

This Deliverable presents the methodology and procedures to be employed iteratively throughout the project life time and beyond. The results will inform work being carried out in Task T1.2 'User-centred co-design of citizen observatories', the technical implementation in WP2 'Enabling technologies: customization, deployment and upscaling', the exploitation strategy and market uptake in WP3, as well as Task T1.8 'Guidelines for sustainable citizen observatories and future recommendations'.

1.3 Structure of the document

This document is structured as follows. Section 2 provides the rationale for the assessment and provides a brief introduction to relevant concepts and approaches before presenting the overall approach chosen for GT2.0 purposes. Section 3 details the procedure for monitoring progress towards achievement of the objectives of the GT2.0 project at large. Section 4 presents the procedure and criteria for validating the Demo Case outcomes in comparison to local stakeholder requirements and overall GT2.0 concepts. Section 5 outlines the framework for assessing broader outcomes and impacts of the project; it provides additional conceptual inputs to capture social and institutional changes triggered by the GT2.0 citizen observatories, while economic and environmental changes will be captured using existing methods. Section 6 describes methods for data collection and analysis.

2 Design of the GT2.0 Monitoring, Validation and Impact Assessment

2.1 Why assess?

Developing the assessment framework faces a methodical challenge because of the multiple objectives of the GT 2.0 project. It is both a EU-funded project which aims to deliver platforms for “extensive citizen participation” on a given budget (a “political” objective), and an innovation endeavour aiming to transition the resulting platforms into a stable, long-term business model after the end of the project (a “business” or “product development” objective). As a result, the GT2.0 validation and impact assessment framework contains two different elements.

On the one hand, monitoring activities serve as a condition for and enabler of performance management, i.e. measures and decisions that ensure goals are being met in an effective and efficient manner. On the other hand, it has characteristics typical for evaluations of public programmes, projects, research, policies, interventions and other collective activities, i.e. assessment activities serve the dual purpose of accounting for resources spent (Carman & Fredericks, 2010; Preskill & Boyle, 2008), and to enable learning in the ongoing or for subsequent activities (Morras Imas and Rist, 2009; EC, 2013).

Traditional approaches to evaluation overlap. A performance appraisal in the business-sense and an impact assessment in the political sense share common procedures, and the shared goal of comparing the results of a plan or programme to the original goals. They differ, however, significantly in the scope of ‘results’ taken into considerations. Evaluation as performance appraisal provides insights into the quality of planning and management activities, determining if good assumptions and projections led to plans and courses of action that successfully delivered expected outcomes, satisfying specific objectives and needs, but usually not considering unintended consequences for unconnected third parties. An impact assessment in the political sense serves as an assessment of changes in a social context as a whole, including unintended or unexpected ones, regardless of whether they were intended in this form by the intervention manager. In other words, it is both possible that a high-performing manager nevertheless achieves little impact, or that faulty management decisions nevertheless lead to high impact due to un-anticipated factors.

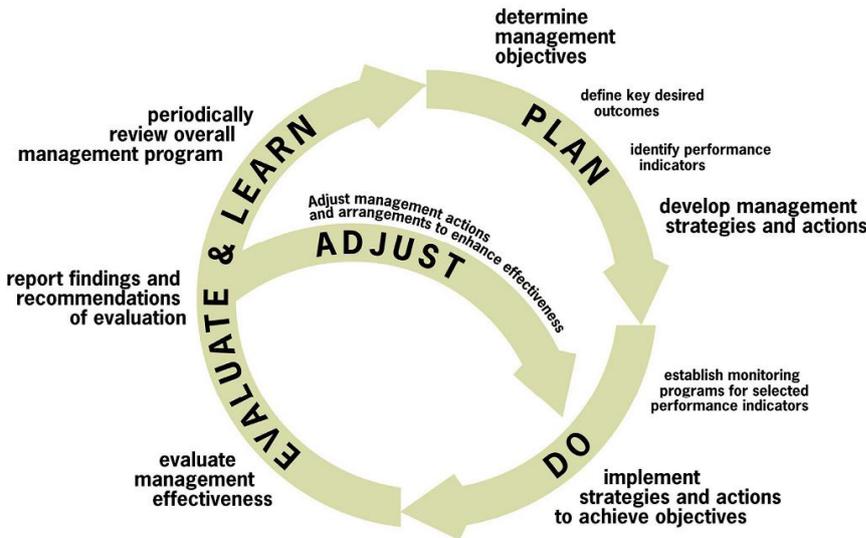


Figure 1 Monitoring, evaluation and validation as aspects of the adaptive management cycle

Source: Jones (2005)

In Ground Truth 2.0, the approach selected needs to satisfy both purposes. In addition, the assessment and validation methods need to provide timely feedback as a basis for learning and adjustments during the course of the project. This is the core principle of adaptive management, illustrated in Figure 1, whereby the evaluation leads into a feedback loop ('adjust') that triggers adjustments in the implementation ('do'). Figure 1 also illustrates monitoring of an intervention in the short-term which constitutes the observation and control activities of implementation (starting in step 5) and provides evidence for accountability purposes.

2.2 What to assess?

Given the different elements and purposes of the GT2.0 assessment, the object of the assessment undertaken by GT2.0 concerns two distinct levels:

- The GT2.0 project at large
- The six individual observatories in the Demonstration Case

Citizen observatories are not products, but represent phenomena of citizen science enabled by Information and Communication Technologies (ICTs). They involve communities of actors such as citizens, scientists, policy and decision makers, as well as private sector data aggregators engaged in complex social practices. Capturing progress, outcomes and impacts requires a tailored conceptual frame, drawing on generic approaches such as Impact Assessment, Evaluation, Theory of Change, Outcome Mapping and Environmental Impact Assessment.

Reflecting the multiple objectives outlines above, the GT2.0 monitoring, validation and impact assessment framework builds on a results-based approach, including monitoring of the implementation based on the generation of outputs, validation of the resulting Citizen observatories (outputs plus specified outcomes), and assessment of broader social, institutional, economic and environmental outcomes and impacts. Figure 2 illustrates the generic logic behind the GT2.0 intervention implementation (from objectives to the generation of outputs) which is under the control of the GT2.0 partners. The results relating to the outcomes and impacts (vertical box) are outside the immediate control of the intervention implementation.

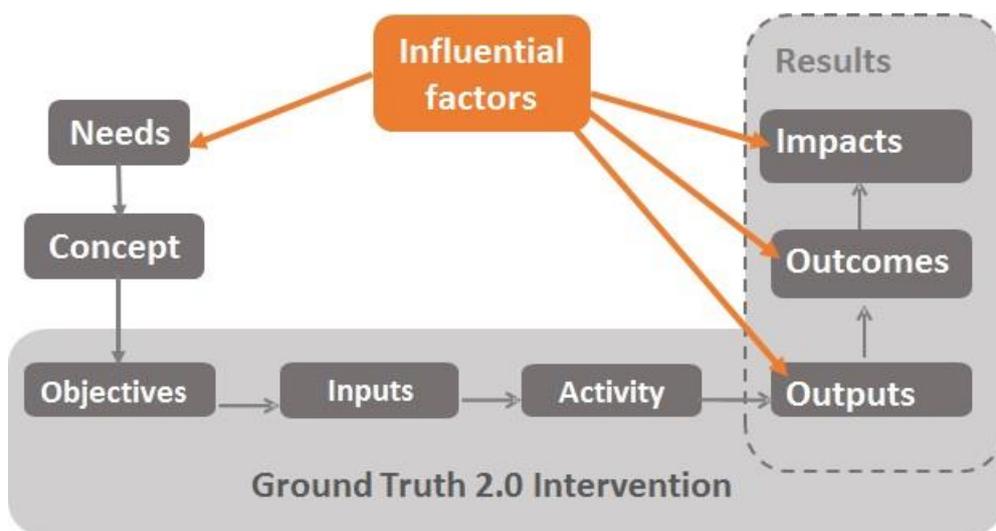


Figure 2 Logic behind Ground Truth 2.0 intervention implementation

Source: adapted from EC (2015)

Following Morra Imas and Rist (2009), combining monitoring of the implementation process with assessment of outcomes and impacts enables the adaptive management process required to ensure that the desired objectives and results can actually be achieved. While the monitoring and assessment of results provides information about performance and need for adjustments, the conceptualisation of the intervention logic adds to the traditional evaluation both a foundation for validation, and entry points for adjustments to the intervention.

Box 1. Definitions of key terms and elements

Elements of a monitoring and assessment framework

Monitoring: The supervision of activities in progress to ensure they are on-course and on-schedule in meeting the objectives and performance targets.

Assessment: The process of determining, judging or deciding the amount, value, quality, or importance of a something (e.g. a person or a situation); as well as the resulting judgment.

Evaluation: Rigorous analysis of completed or ongoing activities that determine or support (management) accountability, effectiveness, and efficiency (i.e. an assessment with a judgment based on organization-internal criteria). Evaluation of completed activities is called ex-post evaluation, post-hoc evaluation, or summative evaluation. Evaluation of current or on going activities is called in-term evaluation.

Impact assessment is the study of the effects of a new project (i.e. an assessment with a judgment based on organization-external factors). Impact assessments can be conducted ex ante as a study of possible negative consequences (e.g. environmental impact assessment), or ex post to determine the summary benefits and consequences of a policy or project with dispersed effects on larger populations or geographical areas.

Validation: Assessment of an action, decision, => *concept*, plan, or transaction to establish that it is correct, complete, being implemented (and/or recorded) as intended, and/or delivering the intended outcome (i.e. an assessment including a binary judgments such as correct/incorrect). Preliminary validation based of ongoing activities can be used as part of adaptive management to inform adjustments of => *assumptions* and derivative => *actions*

Baseline: Clearly defined starting point from where implementation begins, improvement is judged, or a comparison is made. A baseline study is an analysis of current situation to identify the starting points for a program or project, providing an initial collection of data which serves as a basis for comparison with the subsequently acquired data.

Types of results in results-based assessment approaches

Outputs are what is directly produced or supplied by an intervention, they often relate to the expected deliverables of the intervention and consist of tangible products or services produced as a result of the activities (and can be subject to external factors).

Outcomes capture the immediate changes in a situation, including behavioural changes that result from the intervention outputs (including intended and unintended, positive and negative). They generally have a clear link with the intervention, but are influenced by external factors as well.

Specific outcomes (assessed in the validation part of this framework) are emerging, observable => *social practices* that involve stakeholders directly interacting with the outputs of the project.

Wider outcomes (assessed in the impact assessment part of this framework) consist of the social, institutional, economic and environmental changes triggered by and attributable to the outputs.

Impacts broadly define the (widespread) changes over a longer period of time that result from an accumulation of outcomes and affect the wider economy and society beyond those directly affected by the intervention. They are strongly influenced by external factors.

Elements of an Intervention

Objectives define and delineate the purpose and goals of a project, program or policy. Ideally, they are formulated to be SMART (Specific, Measurable, Achievable, Realistic, Time-dependent) in relation to the => *concept*.

Concept articulates *what* action needs to be taken and *how* in response to a challenge or problem that needs solving. The concept of citizen observatories suggests that the observations, insights and involvement of

'ordinary' citizens - and not just those of scientists and professionals - form an integral part of (earth) observation and decision making. **The GT2.0 concept** stipulates that sustainable citizen observatories can be achieved based on a social-technical approach that is centred around an innovative multi-actor co-design process.

Inputs are resources such as people, raw materials, energy, information (including the => *concept*), or finance that are put into a system such as a project, program or policy to obtain a desired => *output*.

Activities are the actions undertaken by the intervention; tasks undertaken to transform inputs into outputs. Activities are usually based on => *strategies*.

Outputs see definition in types of results

Elements of a Theory of Change

Strategies are successful approaches which a review of the state-of-the-art has identified that helped similar communities or organisations to achieve the kinds of => *results* the project, programme or policy is attempting to elicit.

Assumptions are statements about accepted cause and effect relationships, or estimates of a fact deduced or from the known existence of other fact(s). They provide a basis for the generation of => *concepts*, => *strategies*, and => *actions* by enabling the creation of "what if" scenarios to simulate possible situations and explain how and why the strategy will work. Assumptions can be misleading when accepted as reality without examination; the Theory of Change approach ensures assumptions are transparent and accessible to => *validation*.

Influential factors or external factors are outside influences that can impact the ability of a project or investment to achieve its strategic goals and objectives. These external factors might include competition; social, legal and technological changes, and the economic and political environment.

Elements of Social Practice

Materials are all "things", technologies, tangible entities and input materials required to engage in or perform a social practice. In the case of GT 2.0 this specifically includes the technical platforms delivered as project outputs, but also, for example, the equipment contributed by users in the form of smartphones and computers, sensors and binoculars.

Competencies are all skills, know-how and techniques required to engage in a social practice. In the case of GT 2.0 this specifically the abstracted generic knowledge sources that are circulated as part of the project and subsequently integrated into the local practice, but also the competencies and prior experience of local stakeholders required to 'receive' and contextualize it.

Meanings are ideas, symbolic representations and aspirations that give participants (=> *carriers*) a status and that they use to locate themselves within a social context. In GT 2.0, this includes localized definitions, associations, attitudes and agreements that shape the resulting interaction patterns.

Carriers of social practice are people engaging in a social practice and thus contributing to its continued existence. The concept enables validation of the coherence between users in the emerging CO communities and the target groups defined in the GT 2.0 CO => *concept*.

Source: based on EC (2015), Morra Imas and Rist (2009), Shove, Pantzar & Watson (2012) and businessdictionary.com

2.3 How to assess?

Reflecting the various elements and purposes outlines above, the framework includes the following assessment procedures and activities:

Monitoring of project-wide progress will draw on the established Demo Case methodology, comparing reporting and outputs delivered against the Ground Truth 2.0 objectives;

Validation of the Demo Case Observatories will document the observable (evolving) social practices in the CO communities, and assess the performance in terms of (a) coherence of observable practice with the requirements of local stakeholders and with the overall Ground Truth 2.0 concept for citizen observatories; (b) effectiveness in achieving results (comparing results to objectives); and (c) efficiency (comparing results to inputs).

Assessment of impacts will capture social, institutional, economic and environmental changes that can be attributed to the Ground Truth 2.0 Demo Cases. The impact assessment includes particular attention to the longer term results. The linear assumption underlying the attribution of impacts to projects or intervention activities has received much criticism (Vallejo and Wehn, 2015), whether related to the impacts of research, capacity development or social interventions. We concur with these criticisms; not only are impacts difficult to align in a causal manner with the GT2.0 activities, they are also likely to materialise over a much longer process of time than the project period of 3 years. Nevertheless, we conceptualise our efforts as an impact assessment since a) we do want to frame and capture longer term changes and effects, even beyond the project life time and b) we argue that extensions made to 'traditional' evaluation provide adequate extensions and methodological improvements. Moreover, for the observatory-level analysis, in line with Morras Imas and Rist (2009), we include unanticipated (positive or negative) as well as direct and indirect effects in our approach, meaning that we include the evaluation of actual results and not just expected results in line with an observatory's objectives.

Overall, the Impact Assessment reveals insights into the 'added value' of the overall results. The criterion 'added value' assesses the changes that can be reasonably be argued to be due to the intervention (rather than any other factors) and hence combines the findings of the other criteria by drawing conclusions on the performance of the intervention (EC, 2015). The EC (2015) argues that if limited time since the start of the intervention has passed, the continued relevance of the intervention (objectives cf. overall needs) can be safely assumed; this criterion is therefore not considered in our assessment.

The assessment will take place iteratively during the time period March 2017 (M7 in the GT2.0 project) till the end of the project (August 2019).

3 Monitoring Progress of the GT2.0 project

This section presents how the GT2.0 validation and impact assessment detailed in section 2 will be operationalised and implemented for the project level progress monitoring. The main issues addressed by this assessment concern the ability of the project in delivering outputs that address the defined objectives in an effective and timely manner. This focus is highlighted in Figure XX below.

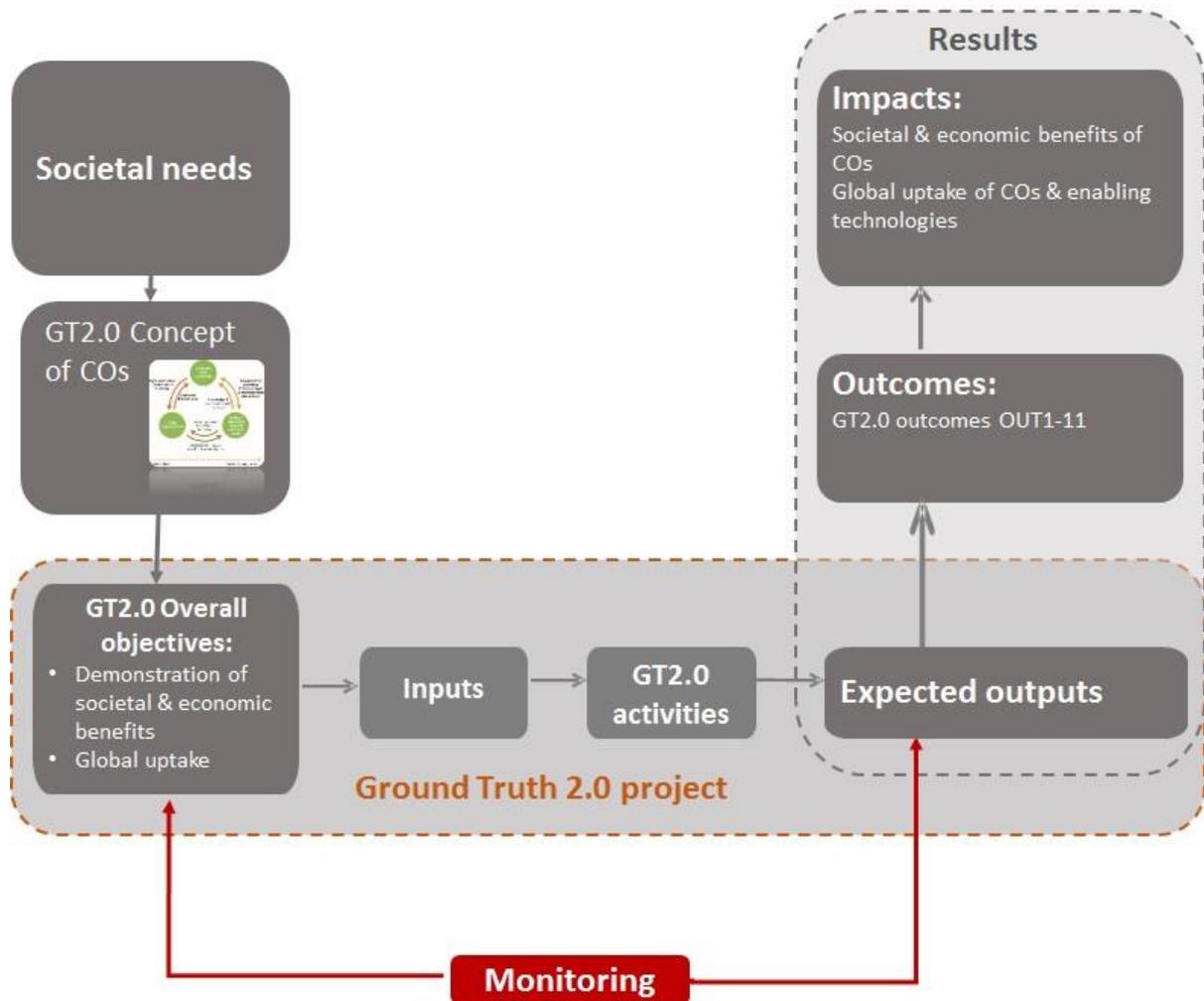


Figure 3 GT2.0 project-level intervention logic and monitoring focus (in red)

As agreed in the GT2.0 DoA, GT2.0 is expected to deliver specific outputs in line with its two overarching and seven specific objectives. The monitoring of the outputs is part of the regular GT2.0 project management reporting activities in WP5. This will take place according to the means of verification indicated in Table 1.

Table 1 Ground Truth 2.0 objectives and envisaged GT2.0 project outputs

GT2.Objectives	GT2.0 outputs	Means of verification	Source
Demonstration of societal and economic benefits			
Objective 1 (OBJ1) <i>To engage citizens in large-scale data collection and maintain their active and continuous engagement in the observatories for cooperative planning and environmental stewardship</i>	<ul style="list-style-type: none"> Active citizen observatories set up at the six demonstration sites. 	<ul style="list-style-type: none"> URLs of the COs Statistics on the use of the COs (e.g. # of downloads, # of entries) 	Demo case leaders
	<ul style="list-style-type: none"> Mechanisms for cooperative planning and increased environmental stewardship established. 	<ul style="list-style-type: none"> List of mechanisms for cooperative planning 	T2.7 lead (Hansje Hooghiemstra)
	<ul style="list-style-type: none"> Guidelines for setting up sustainable (active, continued engagement) citizen observatories 	<ul style="list-style-type: none"> Status of D1.13. recommendations for similar initiatives best practices recommendations for policy makers 	T1.8 lead (Uta Wehn)
Objective 2 (OBJ2) <i>To customise, test and validate interoperable and scalable technologies for large scale citizen-based data collection that lower costs compared to existing data sources</i>	<ul style="list-style-type: none"> Operational systems for citizen-based data collection: i) Capable of handling large amounts of data, ii) A global network of sensors deployed without high infrastructure expenses, iii) IT tools ready, working and intensely used by citizens. 	<ul style="list-style-type: none"> D2.2 – D2.7 (first versions of customized platforms) D2.8 – D2.13 (second versions of customized platforms) Statistics on the use of the platforms (e.g. # of entries) 	WP2 lead (Alberto Masa)
	<ul style="list-style-type: none"> Data fusion by integrating all possible data sources (data via crowd-sourcing and social media monitoring, existing in-situ observations and remote sensing) to accurately model the rural and urban hydrological cycles to describe and determine the effects of abundant water, water 	<ul style="list-style-type: none"> # and type of data sources merged (per Demo Case) 	T1.7 lead (Leonardo Alfonso)
	<ul style="list-style-type: none"> Ensure data quality (spatial, thematic and temporal). (WP2) 	<ul style="list-style-type: none"> # of datasets accompanied by quality indicators (spatial, thematic, completeness and temporal) Deliverable D2.15 (Collected Data) 	T2.5 lead (Joan Masó)

GT2.Objectives	GT2.0 outputs	Means of verification	Source
	<ul style="list-style-type: none"> Evidence of cost-reduction of citizen-sensed data compared to existing data sources. (WP1) 	<ul style="list-style-type: none"> Results of T1.7 Economic impact of data fusion. # of arguments that demonstrate that the use of multi-sensor data fusion and assimilation techniques may reduce costs 	T1.7 lead (Leonardo Alfonso)
Objective 3 (OBJ3) <i>To provide technologies and approaches that address concerns about the use of citizen-sensed data in terms of privacy, trust and accountability</i>	<ul style="list-style-type: none"> Technical solutions and protocols for layering and aggregating data before passing it on to other actors or agencies to ensure anonymity based on local regulations. (WP2) 	<ul style="list-style-type: none"> # of data fusion techniques improved and applied # of previously developed algorithms identified for optimal data assimilation # of data portal and standard repositories linked up to 	T1.7 lead (Leonardo Alfonso)
	<ul style="list-style-type: none"> Appropriate data policies developed. 	Data policies adjusted or devised	?
	<ul style="list-style-type: none"> Practical guidelines for awareness raising about adopted policies and technological solutions to foster trust prepared. (WP1, WP4) 	<ul style="list-style-type: none"> Status of Task 1.8 Deliverable D1.13 	T1.8 lead (Uta When)
	<ul style="list-style-type: none"> Communication material produced to clarify to citizens what, why and how data are collected. (WP4) 	# and type of communication materials produced	WP4 lead (Joan Masó)
	<ul style="list-style-type: none"> Protocol developed to evaluate veracity of citizen-sensed data to eliminate unintentional or intentional errors. (WP2) 	Status of protocol	T2.5 lead (Joan Masó)
Objective 4 (OBJ4) <i>To improve land-use mapping in terms of availability of land-use data, consistency of time series of land-use maps and accessibility to land-use information.</i>	<ul style="list-style-type: none"> Innovative web-based service for worldwide mapping and updating land-use data, building on existing mobile applications, sensors, community-driven services such as OpenStreetMap as well as Copernicus and GEOSS, to generate land-use maps and time series for multiple uses at multiple spatial and thematic resolutions. (WP2) 	Status of the Land Use Mapper throughout the stages of development and employment <ul style="list-style-type: none"> Progress of development Actual delivery of LUM Use of LUM (# of maps, # of updates) 	T2.4 lead (Hans van der Kwast)
Objective 5 (OBJ5) <i>To empower citizens' active role in planning, decision making and governance which results in the improved management of environmental issues</i>	<ul style="list-style-type: none"> Fully functioning citizen observatories for land resource management in the six demonstration cases. (WP1-2) 	<ul style="list-style-type: none"> D1.11 D1.12 	T1.8 lead (Uta Wehn)
	<ul style="list-style-type: none"> Online platforms actively used by citizens providing feedback and response to/from authorities. (WP2) 	# of entries in online platform # of individual users (citizens) # of implicit data (e.g. Tweets) per demo case	Demo case leaders

GT2.Objectives	GT2.0 outputs	Means of verification	Source
	<ul style="list-style-type: none"> Evidence about the citizens' involvement and contribution of data and additional information. (WP1) 	D1.7 Initial report on the incentives & barriers D1.8 Updated report on the incentives & barriers	T1.5 lead (Uta Wehn)
	<ul style="list-style-type: none"> Extensive citizen participation in activities in environmental governance via data collection, co-operative planning and environmental stewardship. (WP1-2) 	# of observations / entries in the COs # of serious gaming (# of views, # of data manipulation) # of citizen – policy maker interactions	Demo case leaders, T2.7 lead (Hansje Hooghiemstra)
Objective 6 (OBJ6) <i>To ensure the long-term sustainability of the citizen observatories</i>	Sound business models for the long-term sustainability of the citizen observatories of the demonstration cases. (WP3)	Progress of / identify status of: <ul style="list-style-type: none"> Deliverable D3.3 Business model canvas Cost benefit analysis Market strategy Sales & pricing strategy Financial planning 	T3.1 lead (Elizabeth Gil-Roldan), T3.2 lead (Rianne Giesen, Business developer (Nina Costa)
	<ul style="list-style-type: none"> Integration of citizen-sensed data into GEOSS at the same level as in-situ observations (WP4) 	# of citizen-sensed data integrated into GEOSS	T2.3 lead (Joan Masó)
Global Uptake			
Objective 7 (OBJ7) <i>To create business opportunities and market access (EU and worldwide) for the Ground Truth 2.0 partners as well as other European companies</i>	<ul style="list-style-type: none"> Roadmap for market uptake and exploitation of the Ground Truth 2.0 technologies and services. Business development based on real-life demonstration of Ground Truth 2.0 citizen observatories in a wide range of settings. (WP3) 	Progress of: <ul style="list-style-type: none"> Deliverable D3.4 # of exploitation / promo events held of the EU demo cases # of promo events held for the African demo cases Feasibility study assessment User feedback Implementation roadmap Awareness strategy 	WP3 lead (Elizabeth Gil-Roldan)
	<ul style="list-style-type: none"> Strong business case developed and new market opportunities created both inside and outside of Europe. (WP3) 	<ul style="list-style-type: none"> D3.1 Initial report on market analysis and uptake D3.2 Updated report on market analysis and uptake D3.3 Sustainable Business Models for the GT2.0 products/services 	T3.1 lead (Elizabeth Gil-Roldan), T3.2 lead (Rianne Giesen, Business developer (Nina Costa)
	<ul style="list-style-type: none"> Be a reference implementation for a common set of interoperable standards for citizen observatories (WP2, WP4). 	<ul style="list-style-type: none"> set of standards approved by the OGC? (yes/no) data generated in GT2.0 COs integrated in the GEOSS Common Infrastructure? (yes/no) 	T2.3 lead (Joan Masó)

4 Validation of the GT2.0 Demo Cases

4.1 Demo Case validation criteria

As defined in section 1, validation is a form of assessment that establishes if an action, decision, concept, or plan is correct, complete, implemented as intended, and/or is delivering the intended outcome. This means the assessment result includes a judgement such as yes/no, achieved/not achieved, correct/incorrect. In the context of this framework, the validation activities focus on comparing information on project progress and preliminary outcomes with documented intentions. This serves to inform adaptive performance management, guides the collective learning effort and ensures the case experience informs the development of generic guidelines.

The framework tasked to validate the Demo Case Observatories is based on comparison of functionalities, scale, extent of use, and types of actor interactions to two specific references, the objectives and requirements identified by local stakeholders on the one hand, and the elements of the Ground Truth 2.0 concept for citizen observatories on the other. However, while direct comparison of requirements and functions can determine requirements to be “delivered/not delivered”, and concept elements to be “present/not present”, such basic judgements are not sufficient to inform learning and management adjustments. For this purpose, the validation needs to produce insights into *why* results are (*not*) achieved, if the project on a trajectory to achieve is still missing results, and if the concept and approach is actually responsible for bringing the result about.

To perform this analysis, the validation will integrate elements of a traditional evaluation, and base assessment of case-specific outcomes on three separate criteria, analysing coherence (comparison to the GT2.0 CO concept as well as to stakeholder requirements), effectiveness (comparison to case-specific objectives) and efficiency (comparison to inputs needed) of each Demo Case’s citizen observatory, as illustrated in Figure 4 below.

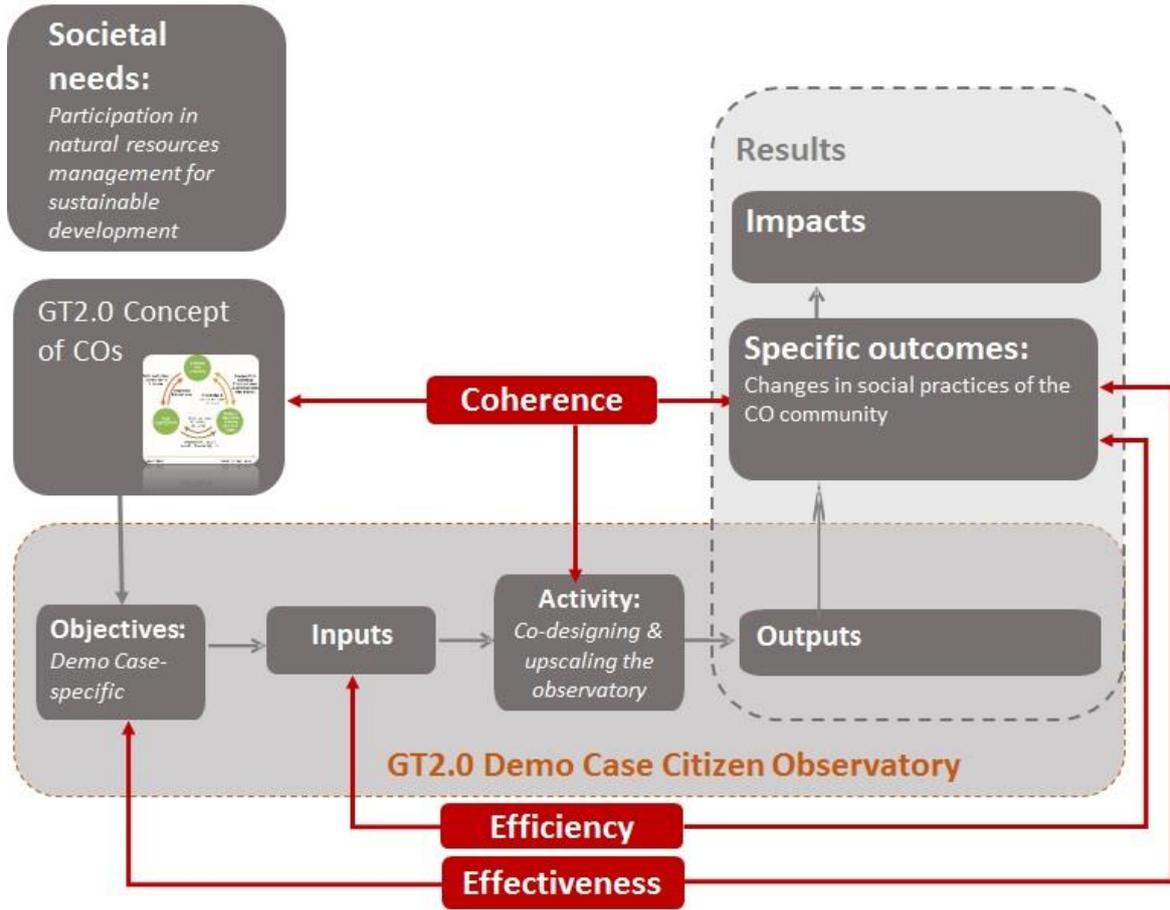


Figure 4 GT2.0 Demo Case-level intervention logic and validation focus (in red)

Specifically, these criteria translate into the following validation questions and comparison of validation elements (see Table 2). The order of the three criteria also reflects their relative relevance in the timeline of the project (see section 6). The first interim validation will mainly concentrate on coherence criteria (to inform upscaling activities based on the coherence of the pilot platforms). Assessment based on efficiency criteria will only become feasible closer to the end of the project, when upscaling investments and exploitation opportunities become visible (and inform finalization of the generic guidelines).

Table 2 Ground Truth 2.0 validation criteria

Criteria	Demo Cases validation questions
<p>Coherence</p> <p>Measure of the extent to which the results of an intervention align with the general needs and priorities in a given context</p>	<p><i>To what extent does the Demo Case Citizen Observatory align with the stakeholder requirements?</i></p> <p><i>To what extent do the Demo Case Citizen Observatories conform to the concept of citizen observatories envisioned in GT2.0?</i></p>
<p>Effectiveness</p> <p>Measure of the extent to which an intervention attains its objectives</p>	<p><i>To what extent did the GT2.0 Demo Case approach deliver the desired outcomes? (“Doing the right things”)</i></p>

Criteria	Demo Cases validation questions
Efficiency Measure of inputs in relation to outcomes (qualitative and quantitative)	<i>What inputs were needed to bring observable outcomes about? Could any of the observed inputs be avoided by improvements to the approach? (“Doing things right”)</i>

4.2 Demo Case validation elements

The validation criteria defined above require identification of five different elements: Specific information on the Demo Case Citizen Observatories to validate, and stakeholder requirements, the GT2.0 CO concept, case-specific objectives and case-specific inputs for comparison.

4.2.1 ‘Measuring’ the Demo Case Citizen Observatories

According to the objectives of this framework, Task 1.6 validates ‘Citizen Observatories’. In the GT 2.0 context, a functioning citizen observatory involves more than the GT 2.0 outputs, as it requires actively engaged stakeholder to ‘exist’. At the same time, validating Citizen Observatories does not extend to validating all project outcomes, as outcomes by definition include changes that are linked to, but not necessarily caused by, the observatories, might occur after time-lags, and are influenced by external factors (see sections 1 and 5). Therefore, data produced by other monitoring or assessment activities in the project might in places be “too narrow” or “too broad”.

In these cases, the validation exercise has to capture a sub-set of case-specific outcomes for the validation. This sub-set has to identify constituting elements of each specific citizen observatory in a way that is observable during the run-time of the project; that allows distinguishing between contributions by the project and contributions by its stakeholders where necessary, and that is capable to link findings back to the intervention logic.

For this purpose, the Citizen Observatories will be analysed as emerging social practices with four distinct dimensions, following the approach suggested by Shove, Pantzar & Watson (2012):

Table 3 Social practices dimensions

Dimension	Case-specific outcomes
Materials	<ul style="list-style-type: none"> ▪ Inventory of “things”, technologies, tangible entities and input materials required to engage with the Citizen observatory ▪ Possible distinction between materials produced by the project, available as context factor (infrastructure), or contributed by stakeholders where necessary ▪ Link to intervention logic via analysis of provision (inputs) or access (I&B, Context analysis) to materials
Competencies	<ul style="list-style-type: none"> ▪ Measures of skills, know-how and techniques required to engage in the Citizen Observatories ▪ Possible distinction between knowledge sources developed and circulated as part of the project and competencies and prior experience of local stakeholders required to ‘receive’, and implement it ▪ Link to intervention logic via analysis of generic knowledge ‘packages’ (inputs) and contextualization activities (activities, T1.2)

Dimension	Case-specific outcomes
Meanings	<ul style="list-style-type: none"> ▪ Representations of ideas, understanding and aspirations reflected in the design of the Citizen Observatories ▪ Possible distinction between ‘status functions’ and definitions built into the platforms as part of the project, and social patterns emerging through user activities ▪ Link to intervention logic via analysis of user-defined visions (objectives), associations and classifications (activities, T1.2).
Carriers	<ul style="list-style-type: none"> ▪ Configuration of people engaging in the Citizen Observatory and thus contributing to its continued existence ▪ Possible distinction between users actively recruited through implementation of the engagement strategy and independent activities of local users ▪ Link to intervention logic via analysis of status and commitment of participants (activities, T1.4)

Source: Shove, Pantzar & Watson (2012)

4.2.2 Stakeholder requirements

Stakeholder requirements are jointly defined in the co-design process. Validating the Citizen Observatories in the Demonstration Cases against the specific requirements of various local stakeholders will be based on

- a technical validation of functionalities against the user requirements based on data of the requirements tracking tool (D1.6) and WP2 reporting
- a subjective assessment by the stakeholders based on reflections captured in the co-design log (D1.9) and feedback collected in user-based testing sessions performed as part of the co-design process (T1.2)

4.2.3 The Ground Truth 2.0 concept

The Ground Truth 2.0 concept represents a full feedback-loop in the information chain from citizen-based data collection to knowledge sharing for joint decision-making, cooperative planning and environmental stewardship (see Figure 5). The concept contains essential references for validation, an envisioned configuration of users and participants (carriers), and a catalogue of desirable actor interactions (social practice).

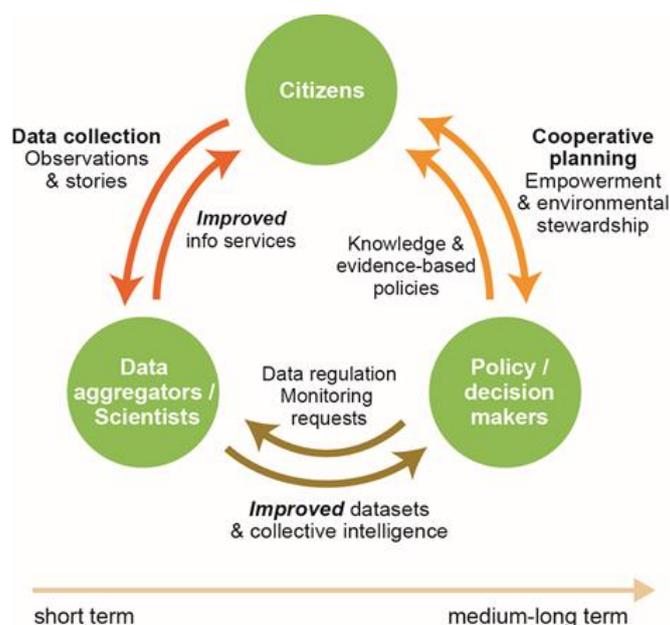


Figure 5 Illustration of the Ground Truth 2.0 Concept

Source: Ground Truth DoA

Reference for user configuration

The information flow in a Citizen Observatory is cyclical and each observatory needs at least three roles fulfilled, before the exchange and interactions on it become meaningful:

1. **Citizens** who are provided with the possibility to play a crucial role in several ways in land and natural resource management
2. **Data aggregators and scientists** who are involved in integrating multiple data sources (citizen observations, existing and new in-situ networks and remote sensing) to accurately describe the observed situation and who can support policy and decision makers with improved inputs.
3. **Policy and decision makers** who engage to enhance policy and decision making processes by improving the response to monitoring requests and use of a broader knowledge base and better data sets for policy responses.

Reference list of desirable actor interactions

- 1) **Environmental monitoring via citizen-based data collection** (knowledge discovery via human sensors)
 - a) *explicit* data collection via Apps, social media (e.g. using #-tags on Twitter), and via Open-StreetMap (and similar existing services),
 - b) *explicit* data collection via personal weather stations and other physical devices¹;
 - c) *implicit* data collection via social media,
- 2) **Cooperative planning** via
 - a) *interactive verification* of land-use maps,

¹ Such as drones (Unmanned Aerial Devices - UAV) and other existing or upcoming technologies

- b) *feedback and discussion* of environmental issues related to the land-use (change) in their neighbourhood which can be used by decision makers for incorporation into their decision support tools,
- c) *interactive, 3D online serious gaming* to empower the active role of citizens in planning, decision making and governance, via a platform where they can view and manipulate data for local areas and environmental issues, in an easy and intuitive manner;
- d) derivation and construction of *indicators* by citizens;

3) Environmental stewardship

Enabling stakeholders jointly taking care of the natural system, incl. via online platform and social media-based communication and interactions for interest and community groups.

4.2.4 Demo Case Objectives

The specific objectives of each Demo Case will be jointly defined by the stakeholders participating in the core LivingLabs group during the co-design process (in T1.2). Objectives represent aspirations and the collaborative development of the objectives form part of giving meaning to participating in the Citizen Observatory. To enable assessment of the effectiveness of the GT 2.0 approach, the objectives will be captured in the SMART format (Specific, Measurable, Achievable, Realistic, Time-dependent), as appropriate.

4.2.5 Demo Case Inputs

Inputs are all resources including labour, raw materials, energy, information, or finance that the project and its collaborators invest to bring the Citizen Observatories about and establish the related social practices. As an innovation action, the project will try out a new approach that might include 'dead ends' or activities that could be implemented more efficiently with more experience. Assessment of Demo Case inputs will be based on project reporting and periodical reviews and reflection moments implemented as part of the Demo Case methodology.

4.3 Performance Indicators and Reference Points for Assessment

Key Performance Indicators (KPIs) provide evidence for the traditional validation, and are assessed in terms of reaching specific targets or benchmarks for each outcome. While objectives are typically expected to be SMART (see above), guidelines for the construction of indicators suggest that they should be CREAM (clear, relevant, economic (available at reasonable cost), adequate, and monitorable) (Schiavo-Campo, 1999 cited in Morra-Imas and Rist, 2009).

Ideally, a clear (set of) indicator(s) should show whether a specific outcome has been achieved. However, the commitment to adaptive management and learning from the Demo Case experience means that assumptions and concepts might also evolve over the course of the project. Similarly, it is impossible to determine precise and reliable benchmarks for an as-of-yet undefined innovation. Accordingly, the validation will have a strong qualitative component, checking both whether targets based on the validation elements have been achieved, whether the case experience revealed aspects of the validation elements to be wrong or irrelevant, and establish or clarify benchmark values.

Therefore, for each of the validation criteria, performance indicators have been elaborated, along with relevant reference points for the assessment and sources of information (see Table 4).

Table 4 Performance Indicators and point of reference for validation of Ground Truth 2.0 Demo Cases

Validation Criterion	Performance indicators or Demo Case-specific outcomes	Point of reference for assessment	Information sources
Coherence			
To what extent does the Demo Case Citizen Observatory align with the stakeholder requirements?	<ul style="list-style-type: none"> • Materials produced: <ul style="list-style-type: none"> • Technologies produced by the project (first and second version of the customized platforms, D2.2 – D2.13) • Contents such as instructions, examples communication elements produced on user request • Subjective Assessment of functionality <ul style="list-style-type: none"> • Level of satisfaction observed in T1.2 testing and feedback sessions • User perception regarding participation in the platform • Observed use of the platforms (e.g. # of downloads, # of entries) 	<ul style="list-style-type: none"> • High percentage of user requirements implemented, under consideration of <ul style="list-style-type: none"> (a) Total value of story points delivered (as user requirements might simply exceed the capacities of the project) and (b) Technical restrictions (as the GT2.0 commitment to certain standards might restrict implementation of some requirements) • Majority of users expresses satisfaction with the platform under consideration of <ul style="list-style-type: none"> (a) # of users actually using functionalities (as stated/assumed and actual priorities might diverge) (b) reasons for satisfaction/dissatisfaction (as users might be dissatisfied with elements implemented at their request) 	<ul style="list-style-type: none"> • T1.3 Requirements Tracking Tool • T1.2 Co-Design Log-Books • WP 2 Reporting • If needed: minutes documenting larger PMT/plenary decisions • T1.2 Log on co-design process • T1.6 Online Survey results on participation • CO Use statistics
To what extent do the Demo Case Citizen Observatories conform to the concept of citizen observatories envisioned in GT2.0?	<ul style="list-style-type: none"> • Observable social practice <ul style="list-style-type: none"> • Materials: scale and functionality of the platforms produced by the project • Carriers: # and configuration of registered, active users of platforms and collaborators • # and type of interactions observed on the platforms • Meanings: representations of ideas and aspirations for each observatory 	<ul style="list-style-type: none"> • (High share of) functionalities implemented in the platforms serve to enable desired interactions • All three key user groups (citizens, decision-makers and data aggregators) are actively involved in the CO • (High share of) observed interactions represent a or aspire to establish a ‘full feedback loop’ between the user groups • A significant share of observed interactions can be classified as desired interaction according to reference list or serve to affirm shared principles of the community 	<ul style="list-style-type: none"> • Use statistics • T2.7 reporting • Initial/Updated Stakeholder Analysis • Reference list user configuration • Reference list user interactions • List of mechanisms for collaborative planning (T2.7) • Data collected for impact assessment

Validation Criterion	Performance indicators or Demo Case-specific outcomes	Point of reference for assessment	Information sources
Effectiveness			
<p>To what extent did the GT2.0 Demo Case approach deliver the desired outcomes? (“Doing the right things”)</p>	<ul style="list-style-type: none"> Observed social practice in each Citizen Observatory, specified in terms of <ul style="list-style-type: none"> Interactions Carriers Materials Competencies Meanings relevant to the Demo Case objectives (tbd) 	<ul style="list-style-type: none"> Degree of achievement of specific Demo Case objectives, and trajectory of development at the time of validation as ‘on target’, under consideration of <ul style="list-style-type: none"> ‘Achievability’ and quality of case objectives agreed by stakeholders from a SMART perspective significant or abrupt changes occurring in the CO objectives, community or context prior to validation resilience of the CO displayed in reactions to internal or external changes 	<ul style="list-style-type: none"> Demo Case objectives (T1.2) Use statistics Data collected for impact assessment Initial/Updated Stakeholder Analysis Initial/Updated report Incentives& Barriers
Efficiency			
<p>What inputs were needed to bring observable outcomes about? Could any of the observed inputs be avoided by improvements to the approach? (“Doing things right”)</p>	<ul style="list-style-type: none"> Observable social practice in each Citizen Observatory, in terms of <ul style="list-style-type: none"> Carriers: # and configuration of registered, active users of platforms # and type of interactions observed on the platforms Materials produced by project as well as contributed by users Competencies displayed in use of the CO 	<ul style="list-style-type: none"> Assessment of the total ‘implementation investments’ based on <ul style="list-style-type: none"> Total estimated effort per ‘active user recruited’ Total estimated effort per ‘observed interaction’ Qualitative evaluation of ‘leverage’ of project efforts considering, for example <ul style="list-style-type: none"> Level of voluntary ‘un-facilitated’ efforts by users Investment in private materials Relation of local expertise to GT2.0 knowledge products required to create observed competencies Commercial prospects Assessment of possible efficiency gains in the implementation of the approach (Lessons Learned) 	<ul style="list-style-type: none"> Activity Planning and Project Reporting (WP5) Use statistics Data collected for impact assessment Reporting WP 3

5 Impact Assessment

5.1 Impact Assessment Criteria

Previously separate thematic types of impact assessments are increasingly overlapping. Early approaches for Environmental Impact Assessments (EIAs), for example, were almost exclusively focused on the biophysical environment whereas subsequent integrated EIAs encompass a more comprehensive understanding of impacts, including human health and safety, heritage assets and historical and cultural sites as well as livelihoods, lifestyle and well-being of those living in affected areas (UNEP 2002). Nevertheless, citizen observatories are specific and recent phenomena that are triggering particular types of changes that are not yet easily captured within those generic existing frameworks. We therefore enhance our selected results-based approach with relevant theoretical conceptualisations in order to be able to capture the particular social and institutional changes linked to the implementation of citizen observatories. For economic and environmental changes, we draw on existing definitions and indicators.

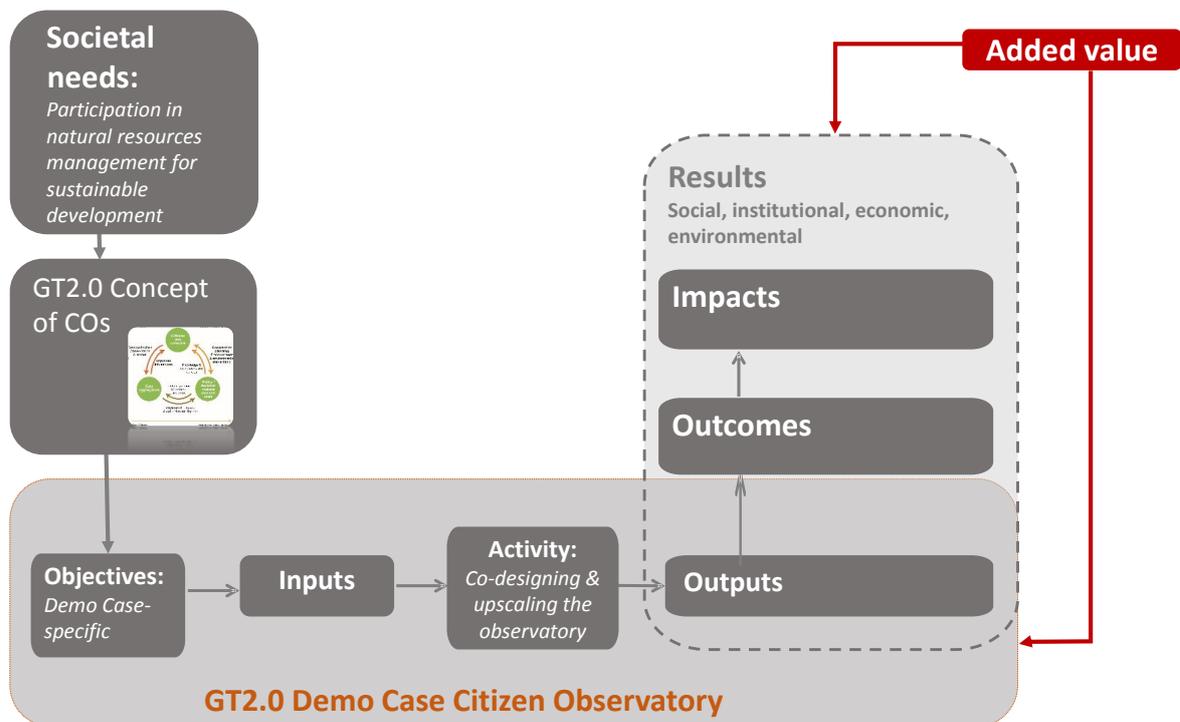


Figure 6 Ground Truth 2.0 Impact Assessment focus (in red)

At the level of the Demonstration Cases, the assessment is designed to capture the social, economic, environmental and institutional changes triggered by the development, implementation and upscaling of the respective GT2.0 observatories. These changes can be expected as well as unexpected, desirable or adverse, vary in space and time, and cumulative versus counterbalancing.

Social changes affect the individual person (e.g. individual citizens) in terms of their perceived trust, privacy, well-being, etc. as well as communities and their resilience. Institutional changes refer to alterations of the formal/informal arrangements ('the rules of the game') that shape the behaviour of different actors

and define how decisions are being made within a community or society at large. Economic changes relate to the financial implications for both, public and private sector stakeholders, such as the operating costs and administrative burdens; they also include changes to the competitiveness, company growth and employment of SMEs and industry. Environmental changes relate to the quality and quantity of natural resources.

In order to capture and assess these changes, in the subsections below, we provide detailed conceptualisations. These will provide the basis to capture the initial baseline status in each Ground Truth 2.0 Demonstration Case against which to compare subsequent situations.

In sub-section 5.1, we present the template for capturing the Demo-Case specific outcomes and indicators. In sub-sections 5.2-5.3, we present the conceptualisation for capturing the social, economic and institutional changes triggered by the GT2.0 citizen observatories. In section 5.5, the corresponding methods for collecting data for the devised indicators and its analysis is detailed.

5.2 Impact assessment of the GT2.0 Demo Cases

The impact assessment of the Ground Truth 2.0 citizen observatories consists of analysing the social, economic and institutional changes triggered by the observatories. Such changes can be expected or unexpected, desirable or adverse, can vary in space and time, and be cumulative versus counterbalancing. Table 5 below illustrates the envisaged outcomes and impacts for each of the six GT2.0 Demo Cases, respectively.

Table 5 Envisaged outcomes and impacts per Demo Case

Demonstration case	Outcomes	Impacts
Belgium <i>Environmental quality of life in Flanders</i>	Citizens increase awareness of, and influence on, benefits and risks of local environmental quality. Improved toolbox for environmental policy making.	Civil participation and two-way communication with local authorities on environmental topics, resulting in improved environmental quality of life.
Spain <i>Preparing for Climate Change</i>	Citizens demonstrate a direct effect of climate change in immediate natural environments. Improved forest management (e.g. reduce forest fires) and biodiversity conservation by considering vegetal activity evolution.	Mesoscale phenology are now possible. Phenology becomes an Essential Variable in GEO for monitoring UN SDGs. Informed land management policies for climate change adaptation and precision farming.
The Netherlands <i>Water and climate-proof water management</i>	Enhanced water and geo- information for climate resilient urban development. Water risks communication and public awareness.	Sustained services with up-to-date hydrological, environmental and infrastructural status of the urbanised environment. Citizen engagement in co-creation of information. Cost savings in urban redevelopment.
Sweden <i>Water quality management in socio-ecological systems</i>	Large established communities of citizen scientists in environmental monitoring and stewardship. Improved understanding of fresh water quality and impacts on urbanization and agriculture.	Large established communities of citizen scientists in environmental monitoring and stewardship. Improved understanding of fresh water quality and impacts on urbanization and agriculture.

Demonstration case	Outcomes	Impacts
Kenya <i>Biodiversity Conservation</i>	Citizens, tourists, policy makers and stakeholders in the Masai Mara National Reserve and Mara Triangle have easy access to biodiversity status. Sustainable and responsible tourism (e.g. use of legal tracks) and less land degradation.	Increased knowledge on land-use and climate change. Sustainable mass tourism management in reserves and national parks. Visitors are empowered to contribute to conservation while having fun.
Zambia <i>Sustainable Natural Resources Management</i>	Enhanced capacity for data quality, monitoring and reporting. Enhanced linkage between monitoring, management and environmental stewardship. Improved understanding of natural resources economic value to the rural economy.	Improved community based natural resource management (CBNRM), environmental stewardship and governance. Improved quality of lobby and advocacy based on good quality data (evidence).

Source: Ground Truth 2.0 DoA

Social impacts are those changes that affect the individual person (e.g. individual citizens) in terms of their perceived trust, privacy, well-being, etc. as well as communities and their resilience. Economic impacts constitute the costs and benefits of implementing the Ground Truth 2.0 citizen observatories using the Ground Truth 2.0 approach. Institutional impacts consist of changes to the formal/informal arrangements ('the rules of the game') that shape the behaviour of different actors and define how decisions are being made within a community or society at large. In order to assess such changes, a coherent framework is required to capture the initial baseline status in each Ground Truth 2.0 Demonstration Case against which to compare subsequent situations. In sub-sections 5.2.1-5.2.1, we present the conceptual underpinnings for capturing the social, economic, institutional and environmental outcomes and impacts of citizen observatories. In chapter 6, the corresponding methodology for implementing the impact assessment is detailed.

5.2.1 Social outcomes and impacts

The conceptual framework for assessing the social impacts is building on relevant theories on community resilience, more specifically on the community-inherent components of such resilience. Resilience in itself might not have a direct link to the observatories and demo cases in Ground Truth 2.0; nevertheless, both share the same inherent objective. The 'social' objective of the GT2.0 observatories is to empower citizens' active role in planning, decision making and governance, which in turn should result in the improved management of environmental issues. This relates to the objective of community resilience to achieve the best possible 'population wellness' in collaboration with the community (Norris, 2008). Population wellness can be captured with different indicators. In order to compare the progress in the six demonstration cases in Ground Truth, it is important to choose indicators with which relative change can be measured. Therefore, an established framework grounded in the psychological approach by Norris et al. (2008) is used (Anema et al., *in press*; Wehn et al., 2016). This conceives of four primary sets of resources that are elementary for the wellness of any population: dependable information, skills and competences, social capital and equity.

The first two sets of resources are relevant for resilience or wellness at individual level, whereas social capital and equitability are more relevant for collective wellness. Since social impacts of the observatories can occur at both, individual and community level, the framework does accommodate the monitoring of

changes at both levels. In the operationalization of the framework, the elements of ‘dependable information’ and ‘skills and competences’ are using indicators on the individual level, whereas the remaining two sets of resources (‘social capital’ and ‘equity’) will make use of collective or community-level indicators.

5.2.1.1 Dependable information and communication

For community members to be able to play a role of significance in planning, decision making and governance, one of the first requirements is that they have access to dependable and complete information. Communication refers to the creation of common meanings and understandings and the provision of opportunities for members to articulate needs, views, and attitudes. This is important for the interpretation and uptake of this information.

Shared stories

The available information and data will only be used and make sense if its relevance to individual members of the community is clear. Community members’ shared understandings of reality contribute to a sense of place and connectedness, which in turn affects resilience (Alkon2004). Stories shared between community members can bring or highlight shared values in the community.

Trusted sources

Information is valuable only if it is considered true. The perceived trustworthiness of information is important because it reflects how willing people are to act upon it and interact with it. If individuals know how to assess the quality of information from different sources and where to find information that they trust, they are better equipped to participate in planning, decision making and governance. Closer, local sources of information are more likely to be relied upon than unfamiliar, distant sources.

Timely and accurate information

With the rise of the Internet it has become important for information not only to be correct and verifiable, but also to be timely and as specific as possible. Individuals have become used to receiving tailor-made updates any time of day. If community members are informed (about the specific issue of the observatory) in a timely and accurate way, they are more likely to participate. This indicator also relates to the on- and/or offline communication infrastructures available between community members and policy officials.

5.2.1.2 Skills and competences

There are specific skills and competences that a community needs to participate in planning, decision making and governance processes. Longstaff (2005) argued that the capacity to acquire trusted and accurate information, to reflect on that information critically and to solve emerging problems is far more important for community resilience than is a detailed plan that rarely foresees all (see also Comfort 2005; Handmer and Dovers1996).

Working together

The first competency that should be present in a community is the skill to work together. Individuals should trust in their effectiveness as a group and organize community actions. Governmental representatives should acknowledge those actions and readily collaborate with organized community forces.

Creativity & flexibility

Problem solving, creative and flexible thinking is the skill that strengthens resilience most. With it, community members are able to solve problems and tackle unexpected situations effectively. To reconcile all interests from different perspectives in one policy decision, it can be useful to think out-of-the-box and address issues before they turn into problems.

Ability to learn

Learning the lessons from past experiences can be difficult since (some) people tend to forget and decision makers are replaced. An important skill for a community in order to arrive at successful participatory decision making is the ability to learn. If community members do change their ways based on past experiences and expert advice, the added value of their participation will be higher.

Internet savviness

Last but not least on this list is internet savviness of community members. With a lot of information and interactions exchanged over the web, it has quickly become important to understand and use online tools. Members of the community need to understand how to work with online fora and mobile applications.

5.2.1.3 Social Capital

Social Capital is the first of two sets of indicators that will be used to capture social outcomes and impacts at the collective community level. Social capital within a community is important for participation and decision making because it indicates the level of trust between community members and their willingness to understand each other's points of view. Social capital can be captured by three different elements, one of which is split into online and neighbourhood dimensions.

Formal engagement

Social capital does not necessarily consist only of informal interactions. It can be built on formal ties as well; the presence of a "loosely coupled" inter-organizational network or a community member positioned to play a meaningful role in formal structures, are important means for creating social capital. This relates closely to the indicator for institutional outcomes and impacts 'Communication and decision mode' (see below).

Trust and belonging (neighbourhood)

Trust and belonging are important indicators of how much people care about their mutual environment. It is linked to the likelihood with which they will participate in decision making if it concerns their neighbourhood. Trust and belonging is measured with the presence of mutual concerns and shared values amongst neighbours and an emotional connection to the neighbourhood or city.

Trust and belonging (online)

In the digital age, people are connected in online communities and might feel more connected to their online peers than to their physical neighbours. These online communities often revolve around specific topics and the belonging that group members feel to the group is linked to the likelihood with which they will participate in decision making if it concerns the topic of their community. Trust and belonging is measured with the presence of mutual concerns and shared values amongst social media groups and an emotional connection to the online community.

Helping behaviour

Finally the actual helping behaviour between community members is a direct indicator for social capital. The extent to which neighbours expect and offer actual assistance to each other when needed is at the core of social capital and reflects the connectedness community members feel towards each other.

5.2.1.4 Equity

Finally, equity within a community is a very characteristic attribute of the social system. The difference or equivalence between members of the community is an important indicator of the coherence of the community as a whole and, with that, of their level of agreement on decision-making topics concerning their community interest.

Distribution of resources

The most well-known indicator for (in-)equity is the size of the gap between people with the highest and the lowest income. This indicates the equity within a community and the relative wealth of people.

Digital divide

With the digital age, another source of (in)equity has emerged. As internet savviness has become important to sustain oneself (see: Skills and capacities), the gap between people that do know their way around the computer and internet and those who do not has become another societal divider.

Distribution of adverse effects

Finally, considering environmental challenges and the quality of the living environment, some groups will be more affected than others. Either because they live closer to an affected area or because they are affected in their daily routines (hobbies, work, etc.).

Table 6 Indicators of envisaged Social Outcomes

Aspect	Indicator
<i>Information</i>	
Shared stories	<ul style="list-style-type: none"> ▪ Diversity of the opinions about the topic of the observatory: level of consensus on implications, causes, etc. ▪ The awareness or urgency for the topic of the observatory among the involved community members
Trusted sources	<ul style="list-style-type: none"> ▪ The awareness of residents of the available official information sources (about the issue of the observatory). ▪ The amount and distribution of other (non-)trustworthy information sources. ▪ The information that community members use to base their opinions on.
Timely and accurate information	<ul style="list-style-type: none"> ▪ The location-specificity of the available information on the observatory topic ▪ The time intervals in which is the available information is being distributed. The correlation of that with the speed at which reality changes. ▪ The channels through which the information is shared with the public and the part of the community that is reached.
<i>Capacities</i>	
Working together	<ul style="list-style-type: none"> ▪ Perception of community members of the influence they can have as a group ▪ Frequency in which community actions are being organised ▪ The frequency of formal collaborations between regulatory entities and stakeholder groups

Aspect	Indicator
Creativity & flexibility	<ul style="list-style-type: none"> ▪ Experience of the community (incl. decision makers) in dealing with unexpected situations ▪ Stringency of the regulations (under normal circumstances; when faced with a problem?) ▪ Who can suggest new policy options? (only decision makers, also other professionals, all community members)
Ability to learn	<ul style="list-style-type: none"> ▪ The uptake and reaction of community members to expert advice. ▪ Past experiences and lessons community members are drawing on.
Internet savviness	<ul style="list-style-type: none"> ▪ Percentage of the community that has Internet access at home (- with average speed or more) ▪ Percentage of the community that regularly exchanges images via the Internet ▪ Percentage of the community that has Internet access at a friend's house
<i>Social capital</i>	
Formal engagement	<ul style="list-style-type: none"> ▪ Which community members have a role in formal organisations/institutions (e.g. as spokes persons)? ▪ The score on the indicator for Communication and decision mode in the institutional outcomes (Table XX)
Trust and belonging (neighbourhood)	<ul style="list-style-type: none"> ▪ Migration rate in a neighbourhood ▪ Perceived 'togetherness' of respondents from the community
Trust and belonging (online)	<ul style="list-style-type: none"> ▪ Duration of membership in a relevant online group(s) ▪ Intensity/frequency of posts in the group(s) ▪ Diversity of members participating in that group(s)
Helping behaviour	<ul style="list-style-type: none"> ▪ Frequency and nature of neighbourly help in the community. ▪ Circumstances under which neighbours would ask each other for help.
<i>Distribution of risks</i>	
Distribution of resources	<ul style="list-style-type: none"> ▪ Gap between people with the highest and the lowest income ▪ Distribution of creative and flexible capacities ▪ Distribution of access to information and potential help
Digital divide	<ul style="list-style-type: none"> ▪ Distribution of Digital Savviness ▪ Perceived level of own digital skills ▪ Availability of internet connection (mobile, fixed)
Distribution of adverse effects	<ul style="list-style-type: none"> ▪ (Availability of) impact maps of relevant region ▪ Perceived distribution of potential impacts

Table 7 Indicators of envisaged Social Impacts

Aspect	Indicator
<i>Information</i>	
Shared stories	Intensity of social conflicts (excluding conflicts relating to land) ¹
Trusted sources	People reporting to be not at all interested in politics ²
Timely and accurate information	Internet use by type of activity Individuals using the Internet from any location ³
<i>Capacities</i>	
Working together	Proportion of cities with a direct participation structure of civil society in urban planning and management that operate regularly and democratically. (SDG 11.3.2) ⁴ Proportion of the population satisfied with their last experience of public services. (SDG 16.6.2) ⁴
Creativity & flexibility	Individuals with low problem-solving skills in technology-rich environments. ²
Ability to learn	Participation in formal and/or non-formal education, by literacy proficiency level and educational attainment. ⁵
Internet savviness	Fixed Internet broadband subscriptions per 100 inhabitants, by speed. (SDG 17.6.2) ⁴
<i>Social capital</i>	
Formal engagement	People who volunteered time to an organisation in the past month. ²
Trust and belonging (neighbourhood)	People reporting trust in others. ²
Trust and belonging (online)	People engaging in social networking online. ²
Helping behaviour	% of people who believe they can rely on their friends in the case of need ⁶
<i>Distribution of risks</i>	
Distribution of resources	Gini coefficient of household disposable income and gap between richest and poorest 10%. ²
Digital divide	Proportion of individuals who own a mobile telephone, by sex (SDG 5.b.1) ⁴ Proportion of individuals using the Internet (SDG 17.8.1) ⁴
Distribution of adverse effects	Direct disaster economic loss in relation to global GDP (SDG 1.5.2) ⁴

¹ Source: Institutional Profiles Database (IPD) - <http://www.cepii.fr/ProfilsInstitutionnelsDatabase.htm>

² Source: "Society at a glance 2016" OECD Social Indicators - DOI: 10.1787/9789264261488-en

³ Source: "Measuring the Information Economy"- OECD 2002; www.oecd.org/sti/measuring-infoeconomy/

⁴ Source: Report of the Inter-Agency and Expert Group on Sustainable Development Goal Indicators (E/CN.3/2016/2/Rev.1), Annex IV

⁵ Source: Education at a Glance 2014: OECD Indicators - DOI: 10.1787/eag-2014-en

⁶ Source: OECD Better Life Index, <http://www.oecdbetterlifeindex.org/topics/community/>

5.2.2 Institutional outcomes and impacts

The conceptual framework for assessing the institutional impacts draws on relevant theories of citizen participation in decision making processes (e.g. Arnstein, 1969; Connor, 1988; Fung, 2006; Hurlbert & Gupta, 2015; Wehn et al., 2015b) and conceptualizations of the dimensions of Citizen Science initiatives and Citizen Observatories (Ciravegna et al., 2013; Haklay, 2015; Macintosh, 2004; Roy et al., 2012; Wehn and Evers, 2015; World Bank Group, 2016; Gharesifard et al., 2016). This conceptual framework is a part of the overall framework for validation and impact assessment in the Ground Truth 2.0, takes into account the inherent complexities of Citizen Observatories by including multidimensional characteristics of these initiatives such as overarching participation paradigms, power dynamics among the stakeholders, and existing institutional setup in each Demo Case. The following sections provide further explanations about these dimensions and the reason for their inclusion.

5.2.2.1 Participation

Participation is one of the core dimensions for evaluating the institutional impact of citizen observatories as it helps unpack which stakeholders have a say when it comes to (re)shaping the institutions, and how they communicate with each other within the Citizen Observatory setting. This dimension is thus added to help answer '*who participates in the decision making process (via the citizen observatory) in each Demonstration Case and how?*' Participation is not static and the number and composition of the participants in the citizen observatories change at different stages of the project, therefore it is important to monitor these changes over the lifetime of the project. Several aspects need to be included and studied in order to be able to answer this question.

Geographic scope

The first issue is the 'geographic scope' of the citizen observatory that indicates how narrow or wide the pool of potential stakeholders is and has also been recognized by previous studies that tried to analyze the dimensions of citizen science initiatives (Haklay, 2015; Macintosh, 2004; Roy et al., 2012; Wehn et al., 2015b). For the purpose of this research, different categories are defined for the geographic scope, namely local, national, regional (supra-national) and global. Understanding the geographic scope of each Demo Case on the one hand helps identifying the social, economic and environmental boundaries of the Demo Case, and on the other hand helps linking these to the relevant political and administrative boundaries.

Participant groups

Citizen science and e-participation studies often recognize a dimension for actors and stakeholders who are involved in these initiatives (Ciravegna et al., 2013; Macintosh, 2004; Wehn et al., 2015b). In Ground Truth 2.0 individuals, groups or organizations who are involved in data collection/knowledge sharing (related to the CO activities), co-design/co-creation of the observatories, and environmental stewardship (related to the CO activities), in each Demo Case are referred to "participant groups". This information, as compared to the demographic characteristics of the population in each Demo Case provides the basis for assessing the representation of different groups within society in the citizen observatory.

Efforts required to participate

'Effort required to participate' refers to different types of requirements and investments such as time, resources, knowledge, and commitment that are needed for participation in this Citizen Observatory. This aspect was also identified by previous research (Roy et al., 2012; Gharesifard & Wehn, 2016) and helps understand and eliminate possible barriers for stakeholder participation.

Support offered for participation

'Support offered for participation' considers the investments made by the internal stakeholders to communicate about the citizen observatory and facilitate stakeholder participation. The indicators for this aspect are mainly based on Ciravegna et al. (2013); Gharesifard (2016); Roy et al. (2012); and Wehn et al. (2015) and include 'flexibility of participation methods'; 'usability of web-platforms and mobile applications'; 'incentives for participation'; and availability of 'supporting material'.

Communication paradigm

Understanding the pattern of information flow that is taking place between different stakeholders is essential for explaining how citizen observatories operate. Three distinct patterns for information flow may be recognized within a citizen observatory; namely 'unidirectional', 'bi-directional' and 'interactive' (Ciravegna et al., 2013; Wehn et al., 2015b). The 'communication paradigm' is thus introduced to distinguish and monitor the pattern of information flow in each Demo Case. Continuous monitoring of the communication paradigm helps establishing or maintaining an interactive exchange of information among the triangle of citizens, data aggregators and policy makers (Wehn et al., 2015a) that may have profound influences on existing institutions and processes of environmental management. Moreover, information flows between citizens and authorities may (already) be digitally mediated within the context of e-participation (Macintosh, 2004; Macintosh & Coleman, 2003).

Communication & decision mode

Fung (2006) initially introduced a dimension for six modes of communication (i.e. 'listen as spectator', 'express preferences', and 'develop preferences') and decision making (i.e. 'aggregate and bargain', 'deliberate and negotiate', and 'technical expertise') and defined it as the way by which "participants interact within a venue of public discussion or decision" (Fung, 2006, p. 68). The adjusted version of this spectrum (Wehn et al., 2015b) was customized for citizen observatories of the environment and will be utilized to help depict how participants interact with each other and what role they play.

Communication

- Unaware social sensor: implicit data provision
- Listen as spectator (e.g. at public hearing)
- Voluntary human sensor: direct & intentional data provision
- Express preferences to audience/officials
- Develop preferences (learn from educ. material, in small groups)

Decision making

- Aggregate & bargain (turn preferences into social choice)
- Deliberate and negotiate (interact to resolve what group wants)
- Deploy technique and expertise (professional expertise)

5.2.2.2 Power Dynamics

Environmental governance is inherently a socio-economic and political process that involves competing interests and conflicting norms and values for different actors. Thus, while evaluating the institutional impact of the Citizen Observatories, it is important to acquire an in-depth understanding of the power dynamics and understand '*who controls and influences the citizen observatory and how*'? And how does this change over the lifespan of a project and beyond? This section introduces the indicators, which will be used to assess power dynamics in the Demonstration Cases.

CO Core Community composition

The stakeholders who are a part of the citizen observatory core community have a strong say in defining its overarching objectives, participation mechanisms and the chosen technological media. According to the definitions presented in the GT2.0 Stakeholder Analysis (Deliverable D1.1), this group consists of the 'Citizen Observatory Community members' (i.e. stakeholders that are actively and personally involved in the Citizen Observatory and the effort to develop it), expert advisors, and also the 'internal stakeholders' in each Demo Case (i.e. stakeholders who are engaged with the CO activities based on a formal appointment, assignment, mandate or employment contract). Since the GT2.0 Citizen Observatories are being co-designed and co-created in a collaborative way, they have a 'hybrid' form in terms of establishment and do not follow the conventional 'top-down', 'bottom-up' or 'commerce driven' models; nevertheless, the composition of the CO Core Community in each demo case (at each stage of the project) is a good indicator for understanding the inclination towards any of the three models.

Revenue stream

'Revenue stream' is another aspect that depicts how Citizen Observatory generates its revenue or receives its required source of funding to sustain during the lifespan of the project and beyond. This indicator helps to explain critical issues such as motivations of different stakeholders (especially internal stakeholders and market forces) for engaging with the Citizen Observatory activities, the sustainability of the observatories, data ownership and level of access to the generated information for different stakeholders. Despite its significant importance, previous research has barely identified and studied this aspect. Macintosh touches upon funding issues when she discusses about 'resources and promotion' (Macintosh, 2004). In Ground Truth 2.0, we classify the existing revenue streams of the observatories into seven distinct categories. This classification is primarily adopted from Osterwalder and Pigneur (2010) and further adjusted/extended to best describe the revenue streams in ICT-enabled Citizen Observatories. (1) 'Government sponsorship' that usually exists in top-down systems. In this case, government has (or envisions) strategic use for the data and thus allocates funding to establish and maintain the observatory. (2) Rather than the rare case of commercializing raw citizen-contributed data, initiatives may combine citizen contributed data with other data sources such as satellite and radar data and sell the resulting products to individuals or organizations. They may also process the data (e.g. using models) to generate information such as forecasts, warnings, maps, etc. and make profit out of selling these products. This classification of revenue streams is here referred to as 'data/ information usage fee'. (3) 'Subscription fee' refers to the membership fees that engaged stakeholders may have to pay in order to gain continuous access to services provided by the observatory (e.g. sharing data via an online platform or using the ad-free version of a website or mobile application). (4) 'Asset sale' or selling the ownership of physical products such as physical sensors, measurement kits and accessories such as data-loggers or modems. (5) 'Advertising'; Citizen Observatories may directly offer advertisement opportunities on their web-platforms and mobile applications or share users' log-data with advertisers, advertising networks/servers or analytics companies (e.g. Google 'AdSense') for targeted advertisement in return for a share of the advertising income. (6) 'Licensing' is generated as result of providing intellectual property rights to data-sharers or any other stakeholder. An example of this classification may be licenses to use a specific software or application that is developed by an internal stakeholder. (7) The last revenue stream is 'donation' and exists in the initiatives that are fully or partially dependent on contributions of others (i.e. their active members, other Citizen Observatory stakeholders, and even general public beyond the borders of the project).

Access to & control over data

Another aspect to be considered while analyzing power dynamics is 'access to and control over data' (Roy et al., 2012; World Bank Group, 2016). Who defines the level of access to data for different participants? Who decides the quality control procedure? Who has the required skills to analyse the data? And who can veto the data collection and aggregation procedures and the publication of 'harmful' data? These are the type of questions that may be asked to determine the access to and control over data. These aspects will also (at least partially) be addressed by the Demo Case-specific Data Management Plans.

Authority & power

'Authority and power' refers to the actual level of impact of different stakeholders on the decision making processes about the environmental problem that the Citizen Observatory is trying to address. Evaluating authority and power of different stakeholders in the citizen observatory, builds on classifications suggested by Fung (2006) and are divided into two distinct categories; (1) 'Next to none'; where the stakeholder has is no significant impact on the relevant decision making process, and (2) 'Exert influence' that refer to different levels of influence on the decision making process. This categorization is as follows:

Next to none

- Stakeholder participates in order to be informed,
- Little expectation of influence,
- Affect participants rather than policy

Exert influence

- Via discussion, mobilizing/altering public opinion
- Advice/consultation: input from participants (e.g. public meetings/hearings)
- Join officials to make plans (e.g. participatory planning)
- Direct authority over public decisions

5.2.2.3 Institutional setup

Understanding the institutional and political context of each Demo Case is crucial for co-designing and maintaining a successful Citizen Observatory. These are a set of (formal/informal) multi-level social and legal arrangements that shape the behaviour of different actors and define how the decisions are actually being made and implemented within a community or society at large. Institutional and political contexts are multilevel (i.e. local, national, etc.) and include (1) the 'formal institutions and policies' (rules and strategies that govern the decision making processes) related to the environmental problem in focus, (2) 'informal institutions' (value, norms, traditions) that come into play when decisions about the environmental problem at hand are, (3) the multilevel interactions of actors, organizations, institutions, and current strategies (policies) about the environmental problem in focus, as suggested by OECD (2011) and Pahl-Wostl, (2009), and (4) possible plural legal systems (i.e. parallel/overlapping rules/roles/responsibilities (formal & informal) regarding the specific decision making processes) in each Demo Case.

Table 8 Indicators for envisaged Institutional Outcomes

Aspect	Indicator
<i>Participation</i>	
Geographic scope	<ul style="list-style-type: none"> ▪ Geographic scope of the issue in focus ▪ Location of stakeholders (inside/outside the geographic boundaries)
Participant groups	<ul style="list-style-type: none"> ▪ Demographic characteristics of the population in the Demo Case location ▪ Composition of stakeholders involved in decision making process in focus of the Demo Case
Efforts required to participate	<ul style="list-style-type: none"> ▪ Time (hours/month) required for participation ▪ Equipment required for participation ▪ Infrastructure required for participation ▪ Knowledge required for participation ▪ Skills required for participation ▪ Investment required for participation; capital (€) and long term (€/month)
Support offered for participation	<ul style="list-style-type: none"> ▪ Type of material support provided for participants (e.g. manuals, instructions, training, sensor devices, etc.) ▪ Perception of the users about the flexibility of the participation methods ▪ Type of incentives offered to encourage different participant groups
Communication paradigm	<ul style="list-style-type: none"> ▪ Channels of data and information flow between different stakeholders <ul style="list-style-type: none"> - Traditional media, newspaper, newsletter, TV, Radio - Web-based communication technologies (online platforms, e mail, social media, website, app, etc.) - Hotlines - Public meetings to disclose and discuss the monitoring and evaluation results - Stakeholder-specific communication strategies ▪ The pattern of information flow ('unidirectional', 'bi-directional' and 'interactive') between different stakeholders
Communication and decision mode	<ul style="list-style-type: none"> ▪ Mechanisms for stakeholder interactions in decision making processes (e.g. data provision, expressing preferences, deliberation and negotiation, etc.)
<i>Power dynamics</i>	
Revenue stream	<ul style="list-style-type: none"> ▪ The (envisioned) revenue stream(s) that help cover the expenses for running the CO
Access to and control over data	<ul style="list-style-type: none"> ▪ Access restrictions to the data for different stakeholder groups ▪ The procedures for storing, quality control, visualization of the data (Data Management Plan and policies)
Authority and power	<ul style="list-style-type: none"> ▪ The level of influence/impact of each stakeholder on the results of the decision making processes regarding the environmental problem in focus

Aspect	Indicator
	<ul style="list-style-type: none"> ▪ Change in the level of authority and power off each stakeholder as result of participation in the CO
<i>Institutional setup</i>	
Formal institutions and policies	<ul style="list-style-type: none"> ▪ National or sub-national laws and regulations that assigns and distinguishes competent authorities related to the environmental problem in focus: <ul style="list-style-type: none"> - Policymaking - Implementation - Regulation - Operation ▪ National or sub-national policy related to the environmental problem in focus ▪ Binding international or supranational frameworks related to the environmental problem in focus
Informal institutions	<ul style="list-style-type: none"> ▪ Value, norms, and traditions related to managing the environmental problem in focus ▪ Influential (non-governmental) local leaders ▪ Alternative methods of influencing the decisions (e.g. protests)
Multilevel interactions of actors, organizations, and institutions	<ul style="list-style-type: none"> ▪ Co-ordination mechanisms across different governmental levels (e.g. between ministries, across central and national government, and local government) ▪ Co-ordination mechanisms between governmental and non-governmental stakeholders
Possible plural legal systems	<ul style="list-style-type: none"> ▪ Existence of plural legal systems (formal & informal) with regards to the environmental problem in focus

Table 9 Indicators for envisaged Institutional Impacts

Aspect	Indicator
Participation	<ul style="list-style-type: none"> ▪ Percentage of population who believe decision-making at all levels is inclusive and responsive¹ ▪ Participation in political processes and civic engagement at local level¹ ▪ Proportion of public funds allocated to public participation in decision making; Civil society organizations¹ ▪ Individuals who used the internet for interaction with public authorities³
Power dynamics	<ul style="list-style-type: none"> ▪ Percentage of budget documents, off budget revenue documents, procurement and natural resource concessions publically available and easily accessible in open data format¹ ▪ Turnout as a share of voting-age population in national election¹
Institutional setup	<ul style="list-style-type: none"> ▪ Existence of constituencies (mechanisms or bodies) and enforcement agencies (e.g., youth, women, traditional leaders) to ensure consulta-

	<p>tive, bottom-up process of representation in decision making; existence and enforcement of legislation for ensuring representation of specific groups¹</p> <ul style="list-style-type: none"> ▪ Proportion of population satisfied with their last experience of public services, disaggregated by service¹ ▪ Perception of failure of regional and global governance¹ ▪ Perception of failure of national governance¹
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¹Source: UNDP, The Indicators We Want; <http://www.undp.org/content/undp/en/home/librarypage/democratic-governance/the-indicators-we-want.html>

²Source: World Economic Forum, The Global Risks Report <https://www.weforum.org/reports>

³Source: Eurostat, <http://ec.europa.eu/eurostat/web/regions/data/database>

5.2.3 Economic outcomes and impacts

The economic outcomes and impacts that can be associated with the implementation of the GT2.0 Demo Case observatories are a subset of the much wider scope of all possible economic outcomes and impacts that exist (e.g. EC, 2015). Specifically, the following will be used (see Table 10). Nevertheless, in line with our impact assessment methodology, evidence of unexpected and unintended outcomes and impacts will also be sought so that subsequent iterations of the assessment may include additional aspects.

Evidence of the potential cost-reduction of the in-situ component due to the presence of citizen-sensed data is generated by Task T1.7 and hence outside the scope of this deliverable.

Table 10 Indicators of envisaged Economic Outcomes

Aspect	Indicator
<i>Demand</i>	
Employment	<ul style="list-style-type: none"> ▪ # subject-related jobs ▪ Nature of jobs
Conduct of business	<ul style="list-style-type: none"> ▪ Cost of essential inputs (e.g. data, opinions, knowledge) ▪ Availability of essential inputs (e.g. data, opinions, knowledge)
Value added of CO	<ul style="list-style-type: none"> ▪ Cost avoidance due to CO (CAPEX/OPEX)
<i>Supply</i>	
Company growth	<ul style="list-style-type: none"> ▪ # subject-related jobs ▪ Nature of jobs ▪ # of CO related products/services ▪ Turnover ▪ Market share in the business of COs ▪ # of clients in CO business and enabling technologies
International trade & investment	<ul style="list-style-type: none"> ▪ # of international clients CO business and enabling technologies ▪ Customer segments (sectors) related to CO ▪ Amount of investment in CO-related activities
Innovation & research	<ul style="list-style-type: none"> ▪ IPR (patents, trademarks, copyright, other know-how rights)

	<ul style="list-style-type: none"> ▪ # of CO-related research projects ▪ Total budget of CO-related research projects
Competitiveness	<ul style="list-style-type: none"> ▪ # of revenue streams ▪ # of market segments served ▪ # of CO topic-related partners

Table 11 Indicators of envisaged Economic Impacts

Aspect	Indicator
Employment (sector)	<ul style="list-style-type: none"> ▪ Employment by sector (services)^{1, 2}
Growth (sector)	<ul style="list-style-type: none"> ▪ GDP growth (annual %)^{3, 4}

¹ Source: ILOSTAT, International Labour Organisation Estimates and Projections series, <http://www.ilo.org/ilostat/>

² Source: OECD, Employment by activity (indicator). doi: 10.1787/a258bb52-en, <https://data.oecd.org/>

³ Source: The World Bank Open Data, <http://data.worldbank.org/>

⁴ Source: OECD Quarterly National Accounts, DOI: 10.1787/data-00017-en, http://www.oecd-ilibrary.org/economics/data/oecd-national-accounts-statistics/quarterly-national-accounts_data-00017-en

5.2.4 Environmental impacts

Outcomes are stipulated to relate directly to the GT2.0 Demo Case outputs. The GT2.0 citizen observatories are being implemented to foster environmental awareness, improved decision making and environmental stewardship, among others (see Table 5 above); nonetheless, changes of a specific natural resource quality or quantity will be unlikely during the project life time as a result of an observatory's implementation and upscaling. We therefore do not devise indicators for environmental outcomes; tailored to each Demo Case, we do include open questions on the current status and changes to the environment in the primary data collection instruments (see Annex 2) and indicators of the more indirect and long term impacts resulting from the GT2.0 observatories (see Table 12). *Importantly, in the medium to long term, a relevant data source for indicators informing about the state of the environment in each Demo Case area will consist of the human sensed data of each respective observatory.* Since each observatory has its own thematic focus, only a subset of indicators will be covered by human sensed data in all cases.

In line with our impact assessment methodology, evidence of unexpected and unintended outcomes and impacts will also be sought so that subsequent iterations of the assessment may include additional aspects.

Table 12 Indicators for envisaged environmental impacts

Aspect	Indicator
<ul style="list-style-type: none"> • Urban/spatial planning 	<ul style="list-style-type: none"> ▪ Perceptions of ‘Failures of urban planning to cope with the needs of growing populations in towns and cities’(likelihood, impact)²
<ul style="list-style-type: none"> • Fighting climate change 	Mitigating the impacts of Climate Change: <ul style="list-style-type: none"> ▪ SDG Indicator 13.1.2: # of deaths, missing persons and persons affected by disaster per 100,000 people per GT2.0 Demo Case country¹
<ul style="list-style-type: none"> • Efficient use of resources 	<ul style="list-style-type: none"> ▪ Environmental performance⁷
<ul style="list-style-type: none"> • Quality of natural resources/fighting pollution (water, soil, air, etc.) 	<ul style="list-style-type: none"> ▪ Quality of specific natural resources⁵ ▪ % of people reporting to be satisfied with the quality of local water⁶ ▪ Average concentration of particulate matter (PM2.5) in the air⁶ ▪ Net ecosystem productivity measured by CO2 sequestration or release (in g/m²)⁸
<ul style="list-style-type: none"> • Biodiversity of flora, fauna and landscapes 	<ul style="list-style-type: none"> ▪ Threatened species as % of known species^{3,5}
<ul style="list-style-type: none"> • Environmental risks 	<ul style="list-style-type: none"> ▪ Perceptions of environmental risks (likelihood, impact)² ▪ Perceptions of extreme weather events (likelihood, impact)² ▪ Perceptions of climate change (likelihood, impact)² ▪ Perception of water crises (likelihood, impact)²

¹Source: SDG Indicators Global database, unstats.un.org/sdgs/indicators/database

²Source: World Economic Forum, The Global Risks Report, <https://www.weforum.org/reports>

³Source: For EU Demo Cases only: Organisation for Economic Cooperation and Development, stats.oecd.org

⁴Source: Global Climate Risk Index, [germanwatch.org/en/crri](https://www.germanwatch.org/en/crri)

⁵Source: **GT2.0 Demo Case human sensed data**

⁶Source: OECD Better Life Index: Environment, <http://www.oecdbetterlifeindex.org/topics/environment/>

⁷Source: OECD Environmental performance review (per country), <https://www.oecd.org/env/country-reviews/>

⁸Source: OECD Regional Social and Environmental indicators, stats.oecd.org

6 Data collection and analysis

Given the conceptual design of the GT2.0 validation and impact assessment outlined in the previous sections and the diversity of indicators involved, this implies methodological choices that need to be carefully considered. Specifically, it necessitates the selection of appropriate data collection methods and the design of data collection instruments. Moreover, the implementation of the data collection part of the assessment needs to be undertaken in a resource-efficient manner to ensure that these efforts remain within the GT.20 project's resource boundaries. Finally, the analysis of the collected data needs to be done in line with the framework and in accordance with the driving validation and impact assessment criteria.

6.1 Data collection methods and instruments

Overall, the validation and impact assessment relies on both, qualitative and quantitative data, as specified for each indicator (see sections 4 and 5). The appropriate methods for collecting the respective data consists of a wide range such as interviews, survey, social media analysis, content and analytics from the GT2.0 Demo Case observatory online platforms, observation, focus groups and the use of secondary data sources (e.g. official statistics). The specific data collection method(s) for each indicator are detailed in Annex 3. Data collection instruments associated with the selected data collection methods have been designed to capture data for sets of indicators and are presented in Annex 4. Since the impact assessment aims to capture not only pre-specified but also unintended and unexpected outcomes (and impacts), open questions or instructions have been added to relevant data collection instruments (namely, the interview protocol, questionnaire, the observation and the focus group protocols) in order to elicit and capture these. The timely availability of official statistics can present a potential bottleneck for the data collection for the concerned indicators.

To conduct the baseline measures, desk study research will be required in order to collect data from primary and secondary literature about institutions and policies in place in each Demo Case. This, in combination with the results of T1.1 will help create an initial understanding about how decisions are being made with regards to the environmental problem at hand, in each Demo Case. Furthermore, an overview of the existing ICT infrastructure and communication channels is essential to understand the communication paradigm between different stakeholders in each Demo Case. After collecting initial information about the stakeholders, institution, policies and technological infrastructure in each Demo Case, data collection will continue with other methods such as interviews or online surveys. In order to align the data collection moments in this task with other data collection efforts in the Ground Truth 2.0 project, the first interaction moment in each Demo Case will be used to conduct the majority of the interviews. The interviews will be conducted employing a mixture of implementation, including Face to Face, phone and Skype interviews.

In order to complement these sources of data, open online social media data will be explored, using the Gavagai monitor technology (<http://monitor.gavagai.se>). A Gavagai monitor will be set up for each Demonstration Case. This will help to (1) better understand the decision making processes in each case, (2) monitor the changes in the political and institutional atmosphere of each Demo Case, throughout the project, and (3) link the discussion on open online sources to different stakeholder categories such as citizens, data aggregators and decision/policy makers.

Sampling aspects come into play for the primary data collection methods, particularly in order to capture not only intended and expected effects but also unintended and unexpected changes. Different sampling approaches apply, depending on the nature of the population, the purpose of data collection, data collection method and resources available. Ideally, the chosen sample should be unbiased and representative of the population. In GT2.0 we consider six methods of sampling; (1) simple random sampling, (2) convenience sampling, (3) cluster sampling, (4) stratified sampling, (5) multi-stage sampling, and (6) snowball sampling (see Box 2). In practice, this means that project-related respondents (e.g. active participants in

the observatories, drop outs, project staff of the GT2.0 partners) as well as non-project respondents will be approached during the data collection activities.

Box 2 Sampling methods for Ground Truth 2.0

(1) Convenience sampling: In this method the researcher basically selects the sample from the accessible or readily available population. This method has its biases because it is often not representative of the whole population and also might have self-selection bias (e.g. participants who have an interest in the topic are most likely to participate). However, this method might be inevitable while trying to reach certain stakeholder groups (e.g. interviewing tourist population in the Kenyan Demo Case).

(2) Cluster sampling: In cluster sampling, the population is divided into recognizable clusters and the sample is chosen randomly within these clusters (e.g. a set of managers within governmental organizations). Although this sampling method might be less precise than the simple random sampling method, it is often more practical and less costly to conduct.

(3) Stratified sampling: This method is similar to cluster sampling; however, groups (strata) are chosen specifically in ways that represent different characteristics (age, gender, ethnicity, etc.) within the population. Random samples are then chosen within each stratum (often as a proportion of the size of the group)

(4) Snowball sampling: This method is not based on equal chance of selection for all of the population (i.e. a non-probability sampling technique), but rather is implemented to leverage the connections of sampling subjects to reach unknown parts of population with common characteristics (e.g. users of a certain technology within a population). In this method, the researcher asks the sampling subject to direct him/her towards the next subjects.

The sampling approach for the primary data collection via interviews and online surveys draws on the stakeholder analysis of each Demo Case (detailed in D1.1 and ongoing Task T1.1 activities) which presents details of the relevant populations from which to draw a sample, e.g. the CO core community cf. the larger range of stakeholders in a Demo Case. Table 13 indicates which sampling method(s) will be used for targeting specific stakeholders. The Core Co-design group refers to the initial set of CO core stakeholders participating in the co-design of the observatory undertaken by Task T1.2.

Table 13 Sampling method for primary data collection via interviews and online surveys

Stakeholders		Sampling methods	
Internal Stakeholders (GT2.0 partners)		<i>all</i>	
CO Core Stakeholders	Community members	Citizens	<i>Core Co-Design group + stratified & convenience sampling</i>
		Scientists	<i>Core Co-Design group + cluster sampling</i>
		Data Aggregators	<i>Core Co-Design group + cluster sampling</i>
		Decision Makers	<i>Core Co-Design group + stratified & snowballing</i>
		Policy Makers	<i>Core Co-Design group + stratified & snowballing</i>
	Expert Advisors	Citizen Science	<i>Core Co-Design group</i>
		Technology	<i>Core Co-Design group</i>
		Science	<i>Core Co-Design group</i>
Policy		<i>Core Co-Design group</i>	

Stakeholders		Sampling methods	
Market Forces	Suppliers	<i>Cluster sampling</i>	
	Customers & Buyers	<i>Cluster sampling</i>	
	Shareholders & Investors	<i>Cluster sampling</i>	
Enabling Environment	Regulatory Entities	Legislative	<i>Stratified & snowballing</i>
		Executive	<i>Stratified & snowballing</i>
		Technical	<i>Stratified & snowballing</i>
		Project	<i>Stratified & snowballing</i>
	Allies & Umbrella Movements	Like-minded groups	<i>Stratified & snowballing</i>
		Associations	<i>Stratified & snowballing</i>
		Endorsers	<i>Stratified & snowballing</i>
	Media & the Public	Social groups	<i>Stratified & snowballing</i>
		Multipliers	<i>Stratified & snowballing</i>
		Media Channels	<i>Stratified & snowballing</i>
Opponents & Critics	<i>Stratified & snowballing</i>		

6.2 Data collection stages

Data collection for the impact assessment will be done in three stages and in all six demonstration cases; an early baseline measure (in year 1) will be compared to the situation during and following the up-scaling of the citizen observatories in the demonstration cases (year 2 and year 3). The GT2.0 PhD student contributing to this task focussing on the institutional impact assessment will cover the data collection for a subset of the cases (three) while the task contributors cover the remaining cases, using the same data collection instruments. The basic validation of the first versions of the platforms in terms of coherence and effectiveness will take place after their launch to inform the upscaling. The final validation will take place towards the end of year 3 as inputs to the guidelines in T1.8. As indicated above, synergies between data collection activities or with other GT2.0 activities will be sought as much as possible.

6.3 Data analysis

The preparation of the data analysis for this assessment includes documentation of the steps taken in collecting the data, transcripts of interviews, and audio/video files, and observations during the interaction moments and other data collection instances. The collected data from the literature, interviews, and surveys will be categorized and organized based on their relevance for different cases, respondent groups, and dimensions/aspects of the observatories. To help categorize, organize, codify and analyse qualitative data, qualitative data analysis software (Possibly NVivo or MAXQDA) will be utilized. This will help manage and analyse the collected data easily and identify links between the different interdependent aspects of each Demo Case. Moreover, it will help compare and contrast the evolving processes and outcomes at different stages of data collection in an integrated way. In order to explore and identify major themes within the collected data (e.g. from open online social media), the Gavagai explorer (<https://explorer.gavagai.se>) tool will be utilized. This tool helps organizing unstructured and qualitative text into quantitative measures by automatically identifying and ranking common themes.

The qualitative empirical data and material will be analysed employing a deductive analysis approach, using the indicators introduced in sections 4 and 5. The analysis for selected indicators will triangulate the data from different information sources, such as interviews, workshops and official statistics.

Table 14 Template for GT2.0 Demo Case outcome tracking

Indicator	Definition	Unit of measurement	Source of data	Frequency of measurement	Baseline	Current status

Following these preparations, the analysis for validation and impact assessment, respectively, will be undertaken according to the specified criteria and using the findings for selected elements of the framework, as indicated in Tables 15 and 16 below.

Table 15 Data analysis per validation criterion

Validation Criteria	Demo Cases validation questions	Data analysis
Coherence	<ul style="list-style-type: none"> To what extent do the specific outcomes of the GT2.Demo Case align with the stakeholder requirements? To what extent did the GT2.0 approach to developing citizen observatories generate the expected outcomes? 	<ul style="list-style-type: none"> Specific Demo Case CO outcomes (based on technical validation of functionalities and subjective stakeholder evaluation) assessed against the respective Demo Case requirements in terms of functionalities, scale, extent of use, and types of actor interactions Specific Demo Case CO outcomes assessed against the GT2.0 CO concept
Effectiveness	<ul style="list-style-type: none"> To what extent did the GT2.0 Demo Case achieve the desired outcomes? 	<ul style="list-style-type: none"> Specific Demo Case CO outcomes assessed against the baseline situation and the respective Demo Case objectives The aggregation of the effectiveness results from all six Demo Cases will serve as the basis for validating the general GT2.0 Concept (co-designing the observatory with the stakeholders in the triangle).
Efficiency	<ul style="list-style-type: none"> What inputs were needed to bring observable outcomes about? Could any of the observed inputs be avoided by improvements to the approach? (“Doing things right”) 	<ul style="list-style-type: none"> Learnings about efficiency of implementing the Demo Case observatories to generate the outcomes

Table 16 Data analysis per impact assessment criterion

Impact Assessment Criteria	Impact Assessment questions	Data analysis
Added value	<ul style="list-style-type: none"> What are the results of the Demo Cases? What is the additional value resulting from the Demo Case CO, compared to what could be achieved by traditional/existing means of participation? What would be the most likely consequences of stopping the Demo Case CO? 	<ul style="list-style-type: none"> Wider Demo Case outcomes and impacts - (un)expected, (un)intended, positive/negative Wider Demo Case CO outcomes and general impacts assessed against total Demo Case efforts

The PhD student will provide the within and cross-case analysis of the institutional impacts for selected cases while the task contributors will undertake the analysis of their selected cases. All task contributors

will contribute to the analysis of all six GT2.0 cases. The results of this task, including the elaboration of specific success cases, will regularly feed into the exploitation and market uptake of WP3. The results of T1.1 (stakeholder analysis of the demo cases) and the initial baseline scan of T1.5 Incentives and Barriers will provide inputs for the baseline assessment.

6.4 Feedback for adaptive management of the GT2.0 project implementation

As outlined in the beginning of this deliverable, the Ground Truth 2.0 approach to validation and impact assessment serves for performance appraisal of the project implementation, for the assessment of changes in the social context as well as for producing timely feedback to enable learning and adjustments during the course of the GT2.0 project. With respect to the latter, it uses results-based evaluation practices based on the Theory of Change, impact assessment and adaptive management principles. Key elements of the Theory of Change (influential factors, strategies and assumptions) are used to trigger changes in the adaptive management of the GT2.0 implementation (as indicated in Table 17 below). This constitutes a consistent feedback loop that enables learning and adjustments during the GT2.0 project implementation.

Table 17 Theory of Change elements as a feedback tool

Theory of Change elements	Initial knowledge base	Specific sources of feedback during validation and impact assessment	Generated insights & implications for GT2.0 implementation
<i>Influential factors supporting or hindering the desired results</i>	In GT2.0, the baseline mapping of the potential barriers and support that may affect the attainment of the envisaged results has been done as part of the Stakeholder Analysis in Tasks T1.1 (see Deliverable D1.1).	<i>Institutional analysis</i> (Impact assessment – (un)intended, (un)expected changes) <i>Meanings analysis</i> (social practice evaluation)	<i>“Something in the context has changed”</i> <ul style="list-style-type: none"> ▪ Update T1.1. Stakeholder Analysis ▪ Reconsider conditions for T1.2 Co-design sessions
<i>Strategies to achieve the envisaged results, based on previous efforts / experiences</i>	The socio-technical approach of GT2.0 combines the social dimensions of citizen observatories with their enabling technologies in an innovative multi-actor innovation process that allows key stakeholders to co-design citizen observatories within a LivingLab context.	<i>Coherence</i> validation against user requirements <i>Carriers of social practice analysis</i> (social practice evaluation)	<i>“Current strategy is wrong”</i> <ul style="list-style-type: none"> ▪ Trigger relevant WP2 tasks to update functionalities in line with user requirements ▪ Trickle-down changes into GT2.0 concept ▪ Update T1.8 Guidelines for developing sustainable COs
<i>Assumptions on how and why the strategies will work</i>	The co-design process allows careful tailoring to the local stakeholder setting and context and is informed by a detailed stakeholder analysis.	<i>Effectiveness</i> validation of the GT2.0 concept	<i>“Assumptions are wrong”</i> <ul style="list-style-type: none"> ▪ Update assumptions ▪ Trickle-down changes into T1.2 Co-design sessions

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Annexes

A1 – Data collection methods

Data collection methods to capture Social outcomes

Aspect	Indicator	Interview	Online survey	Second. material	Social media analysis	GT2.0 platform content	GT2.0 Plat-form analytics	Observations	Synergies with other GT2.0 (data collection) activities
<i>Information</i>									
Shared stories	How outspoken are the different opinions about the causes and / or implications of the issue (of the observatory)?	✓		✓	✓				Incentives and barriers T1.5
	How is the awareness or urgency for the topic distributed between those involved? (e.g. are some groups very aware while others not at all)	✓		✓	✓			✓	
Trusted sources	How aware are people of the legitimate information that is available? (about the issue of the observatory)	✓	✓		✓				
	Which other (non-)trustworthy sources do exist?	✓		✓					co-design in T1.2
	What do community members base their opinions on?	✓			✓			✓	WP2
Timely and accurate information	How location-specific is the available information on the CO topic?	✓		✓					WP2
	At what time-intervals is the available information distributed? How does that relate to the speed in which reality changes?	✓		✓					WP2
	Through which channels is the information shared with the public and what part of the community is reached by that?	✓	✓	✓	✓				Incentives and barriers T1.5
<i>Capacities</i>									
Working together	How do community members perceive the impact they can make as a group?	✓	✓		✓			✓	
	Was or is there community action organized?	✓	✓	✓	✓				Stakeholder analysis T1.1
	Formal engagement ties between regulatory entities and stakeholder groups	✓	✓	✓					Institutional impact
Creativity & flexibility	How was the latest problem or unexpected situation dealt with?	✓						✓	

Aspect	Indicator	Interview	Online survey	Second. material	Social media analysis	GT2.0 platform content	GT2.0 Plat-form analytics	Observations	Synergies with other GT2.0 (data collection) activities
	How stringent are regulations (normally and when faced with a problem)?	✓						✓	
	Who can suggest new policy options?	✓		✓					Stakeholder analysis T1.1
Ability to learn	How is expert advice treated?	✓						✓	Incentives and barriers T1.5
	Is there past experience that the community members are drawing on?	✓	✓		✓			✓	
Internet savyness	What part of the community indicates to have Internet access at home and at what speed?	✓	✓	✓					
	What part of the community indicates to regularly exchange images over the Internet?	✓	✓	✓					
	What part of the community indicates to have Internet access at a friends house?	✓	✓	✓					
<i>Social Capital</i>									
Formal engagement	Are there community members with a role (i.e. spokes person) in a formal organization?	✓		✓					Institutional impact
	Are NGOs /community groups taken seriously in the discussion (on the topic of the observatory)?	✓						✓	
Trust and belonging (neighbourhood)	Migration rate in a given neighbourhood			✓					
	Perceived 'togetherness' of respondents from the community	✓	✓						Incentives and barriers T1.5
Trust and belonging (online)	Duration of memberships of a relevant online group(s)			✓	✓				Stakeholder analysis
	Intensity/frequency of posts in that group(s)			✓	✓				
	Variation in members participating in that group(s)	✓		✓	✓			✓	
Helping behaviour	When did you last help one of your neighbours out?	✓	✓						
	In what kind of situations would you ask your neighbours for help?	✓	✓						
<i>Equity</i>									
Distribution of resources	Income discrepancy	✓	✓	✓					
	Distribution of creative and flexible capacities	(see capacities)		✓					

Aspect	Indicator	Interview	Online survey	Second. material	Social media analysis	GT2.0 platform content	GT2.0 Plat-form analytics	Observations	Synergies with other GT2.0 (data collection) activities
	Distribution of access to information and potential help	(see under information)		✓					
Digital divide	Difference in Digital Savvyness	(see capacities)	✓	✓					
	Perceived level of own IT skills	✓							
	Availability of internet connection			✓					
Distribution of adverse effects	Impact maps			✓					
	Perceived distribution of potential impact of adverse effects	✓	✓						

Data collection methods to capture Institutional Outcomes

Aspect	Indicator	Interview	Online survey	Second. material	Social media analysis	GT2.0 platform content	GT2.0 Plat-form analytics	Observations	Synergies with other GT2.0 (data collection) activities
<i>Participation</i>									
Geographic scope	<ul style="list-style-type: none"> ▪ Geographic scope of the issue in focus ▪ Location of stakeholders (inside/outside the geographic boundaries) 	✓		✓			✓		Stakeholder analysis Co-design sessions
Participant groups	<ul style="list-style-type: none"> ▪ Composition of stakeholders involved in decision making process in focus of the Demo Case ▪ Demographic characteristics of the population in each Demo Case location 	✓					✓		Stakeholder analysis Co-design sessions
Efforts required to participate	<ul style="list-style-type: none"> ▪ Time (hours/month) required for participation ▪ Equipments required for participation ▪ Infrastructure required for participation ▪ Knowledge required for participation ▪ Skills required for participation ▪ Investment required for participation; capital (€) and long term (€/month) 		✓	✓		✓			Incentives and Barriers (the results of PBC may feed into the analysis of this aspect)
Support offered for participation	<ul style="list-style-type: none"> ▪ Type of material support provided for participants (e.g. manuals, instructions, training, sensor devices, etc) ▪ Perception of the users about the flexibility of the participation methods ▪ Type of incentives offered to encourage different participant groups 		✓	✓		✓			
Communication paradigm	<ul style="list-style-type: none"> ▪ Channels of data and information flow between different stakeholders <ul style="list-style-type: none"> - Traditional media, newspaper, newsletter, TV, Radio - Web-based communication technologies (online platforms, e mail, social media, website, app, etc.) - Hotlines - Public meetings to disclose and discuss the monitoring and evaluation results - Stakeholder-specific communication strategies 	✓				✓	✓	✓	

Aspect	Indicator	Interview	Online survey	Second. material	Social media analysis	GT2.0 platform content	GT2.0 Plat-form analytics	Observations	Synergies with other GT2.0 (data collection) activities
	<ul style="list-style-type: none"> The pattern of information flow ('unidirectional', 'bi-directional' and 'interactive') between different stakeholders 								
Communication and decision mode	<ul style="list-style-type: none"> Mechanisms for stakeholder interaction in decision making processes (e.g. data provision, expressing preferences, deliberation and negotiation, etc.) 	✓	✓				✓	✓	
<i>Power dynamics</i>									
Revenue stream	<ul style="list-style-type: none"> The (envisioned) revenue streams that help cover the expenses for running the CO 	✓							WP3 (later)
Access to and control over data	<ul style="list-style-type: none"> Access restrictions to the data for different stakeholder groups The procedures for storing, quality control, visualization of the data (Data Management Plan and policies) 	✓					✓	✓	For baseline analysis: Data Management Plan of each demo case (q15-40)
Authority and power	<ul style="list-style-type: none"> The level of influence of each stakeholder on the results of the decision making processes regarding the environmental problem in focus (procedural and substantive) 	✓	✓	✓	✓			✓	Stakeholder analysis
<i>Institutional setup</i>									
Formal institutions and policies	<ul style="list-style-type: none"> National or sub-national laws and regulations that assign(s) and distinguish(s) competent authorities related to the environmental problem in focus: <ul style="list-style-type: none"> - Policymaking - Implementation - Regulation - Operation National or sub-national policy related to the environmental problem in focus Binding international or supranational frameworks related to the environmental problem in focus 	✓	✓	✓					Stakeholder analysis
Informal institutions	<ul style="list-style-type: none"> Value, norms, and traditions related to managing the environmental problem in focus Influential (non-governmental) local leaders Alternative methods of influencing the decisions (e.g. protests) 	✓	✓	✓					Stakeholder analysis

Aspect	Indicator	Interview	Online survey	Second. material	Social media analysis	GT2.0 platform content	GT2.0 Plat-form analytics	Observations	Synergies with other GT2.0 (data collection) activities
Multilevel interactions of actors, organizations, and institutions	<ul style="list-style-type: none"> ▪ Co-ordination mechanisms across different governmental levels (e.g. between ministries, across central and national government, and local government) ▪ Co-ordination mechanisms between governmental and non-governmental stakeholders 	✓	✓	✓					Stakeholder analysis
Possible plural legal systems	<ul style="list-style-type: none"> ▪ Existence of plural legal systems (formal & informal) with regards to the environmental problem in focus 	✓	✓	✓					

Data collection methods to capture Economic Outcomes

Aspect	Indicator	Interview	Online survey	Second. material	Social media analysis	GT2.0 platform content	GT2.0 Plat-form analytics	Observations	Synergies with other GT2.0 (data collection) activities
<i>Demand</i>									
Employment	# subject-related jobs Nature of jobs	✓		✓					
Conduct of business	Cost of essential inputs (e.g. data, opinions, knowledge) Availability of essential inputs (e.g. data, opinions, knowl-edge)	✓		✓					
Value added of CO	Cost avoidance due to CO (CAPEX/OPEX)	✓		✓					T3.1 Market analysis
<i>Supply</i>									
Company growth	# subject-related jobs Nature of jobs # of related products/services Turnover Market share in the business of COs # of clients	✓		✓					T3.1 Market analysis
International trade & investment	# of international clients (linked to GT2.0 activities) Customer segments (sectors) related to CO Amount of investment in CO-related activities	✓		✓					
Innovation & research	IPR (patents, trademarks, copyright, other know-how rights)	✓		✓					
	# of CO-related research projects	✓		✓					
Competitiveness	# of revenue streams	✓		✓					
	# of market segments	✓		✓					
	# of CO topic-related partners	✓		✓					

A2 – Data collection instruments

Interview questions on Social Outcomes

Relevant aspect	Question	Internal Stakeholders	CO Core Stakeholders		Market Forces			Enabling Environment			
			Community members	Expert Advisors	Suppliers	Customers & Buyers	Shareholders & Investors	Regulatory Entities	Allies & Umbrella Movements	Media & the Public	Opponents & Critics
<i>Social Capital</i>											
Formal engagement	In what way can community members have a formal role (i.e. spokes person) in the organization?	X	X (C, DM)	X				X			
Trust and belonging (neighbourhood)	How are the opinions, expressed by ngo's or community groups, handled by the professional organizations?	X	X	X				X			
	Pride is an indicator of identity. To what extend would you be able to feel pride on behalf of your community?		X (C)								
	How many (estimate) registered community clubs and networks exist in the relevant region?	X									
Helping behaviour	When did you last help one of your neighbours out?		X (C)								
	In what kind of situations would you ask your neighbours for help?		X (C)								
<i>Information</i>											
Shared stories	How different are your opinions about the causes and / or implications of the issue (of the observatory) from those of your neighbours?		X (C)	X				X			
	How different are your opinions about the causes and / or implications of the issue (of the observatory) from those of the policy and decision makers / community members?		X (C, DM)	X				X			
	To what extend is there awareness and consensus about the urgency of the topic? (e.g, are some groups very aware and others not at all)	X	X (C, DM)	X				X			
Trusted sources	What do you think other community members base their opinions (about the issue of the observatory) on? And what about yourself?	X	X (C, DM)					X			

Relevant aspect	Question	Internal Stakeholders	CO Core Stakeholders		Market Forces			Enabling Environment		
			Community members	Expert Advisors	Suppliers	Customers & Buyers	Shareholders & Investors	Regulatory Entities	Allies & Umbrella Movements	Media & the Public
	Are you aware of the legitimate information that is available? If possible, please give examples or link to sources.		X (C)					X		
	Which other sources do you know to get similar information from? Do you trust those?		X (C)					X		
Timely and accurate information	Is there information on the topic available that is relevant for you? Is it specific enough location-wise?		X (C)					X		
	How uptodate (or delayed) do you think the official information source is? Are there others more relevant/uptodate?	X	X (C)					X		
	Please name as many communication channels as you know that are used to share information about the observatory topic with the public.	X	X (C, DM)					X		
<i>Capacities</i>										
Working together	What do you think would or could be the influence of community members, if they organized themselves (in a group)?	X	X (C, DM)	X				X		
	Are you aware of any organized community action in the neighbourhood (or relevant region, red.), either going on now or in the past?	X	X (C, DM)					X		
	What connections are you aware of between regulatory entities (specify if possible) and community / stakeholder groups?	X	X (C, DM)	X				X		
Creativity and flexibility	How stringent are regulations (during normal times and when faced with a challenge)?	X	X (DM)					X		
	Who do you think can suggest new policy options?	X	X (C, DM)					X		
	How is expert advise treated?	X	X (C, DM)	X				X		
Ability to learn	What past experience are you and/or the community members drawing on?	X	X (C, DM)					X		

Relevant aspect	Question	Internal Stakeholders	CO Core Stakeholders		Market Forces			Enabling Environment			
			Community members	Expert Advisors	Suppliers	Customers & Buyers	Shareholders & Investors	Regulatory Entities	Allies & Umbrella Movements	Media & the Public	Opponents & Critics
	Do you have Internet access at home and at what speed?		X (C)								
Internet savviness	How often do you exchange images over the Internet?		X (C)								
	Would you have Internet access at a friend's house?		X (C)								
<i>Equity</i>											
Distribution of resources	How prominent are the differences between high and low income groups in your community?	X	X (C, DM)	X				X			
Digital divide	How skilled are you with ICTs? Better or worse than the average?		X (C)								
Distribution of adverse effects	How varying do you think the (forecasted / expected) impacts of the topic of the observatory will be for different parts of the relevant community / region?	X	X (C, DM)	X				X			
<i>Unintended and unexpected</i>											
Unintended /unexpected	What has changed in your life during the last year? To what extend can this be attributed to the CO?		X (C)								
	What has changed in your community during the last year? To what extend can this be attributed to the CO?		X (C, DM)								

Survey questions on Social Outcomes

Relevant aspect	Question	Internal Stakeholders	CO Core Stakeholders		Market Forces			Enabling Environment			
			Community members	Expert Advisors	Suppliers	Customers & Buyers	Shareholders & Investors	Regulatory Entities	Allies & Umbrella Movements	Media & the Public	Opponents & Critics
<i>Social Capital</i>											
Trust and belonging (neighbourhood)	How large is the 'engaged community' in this neighbourhood? (organized in clubs and networks or more informal)	X	X (C, DM)	X				X			
Trust and belonging (online)	What are the relevant online groups for this topic that you are aware off?	X	X	X							
	How often have you visited those yourself? - Are you a member?	X	X (C, DM)	X							
	How often do you post something in these groups? Do you think that is above or below the average contribution rate?	X	X (C, DM)	X							
Helping behaviour	How would you rate the social cohesion (people helping each other) between residents in this community?	X	X (C, DM)	X				X			
	In what kind of situations would the neighbours in this community help each other rather than call someone external?	X	X (C, DM)	X							
<i>Information</i>											
Trusted sources	What do you think is the main source of information on the observatory topic for community members?	X	X (C, DM)	X				X			
	Are you familiar with the following information sources: (fill in local, official sources on the topic of the observatory), do you ever use them?	X	X (C, DM)								
Timely and accurate information	How sufficient is the information supply to citizens about the observatory topic?	X	X (C, DM)	X				X			
	How tailored do you expect information on the topic to be (considering location- and time-specification)? What source best meets those expectations?	X	X (C)								

Relevant aspect	Question	Internal Stakeholders	CO Core Stakeholders		Market Forces			Enabling Environment			
			Community members	Expert Advisors	Suppliers	Customers & Buyers	Shareholders & Investors	Regulatory Entities	Allies & Umbrella Movements	Media & the Public	Opponents & Critics
<i>Capacities</i>											
Working together	On a scale from 1 (not at all) to 10 (very large): How big do you think would or could the influence of community members be if they organized themselves (in a group)?		X (C, DM)	X				X			
	Please name examples of organized community action in the neighbourhood (or relevant region, red.), currently or in the past.	X	X (C, DM)					X			
	By what channels and means do you think regulatory entities (specify if possible) and community / stakeholder groups collaborate with each other?	X	X (C, DM)	X				X			
Ability to learn	What past experience are you and the community members drawing on?	X	X (C, DM)					X			
Internet savyness	Do you have Internet access at home and what speed?		X (C)								
	Do you regularly exchange images over the Internet?		X (C)								
	Would you have Internet access at a friends house?		X (C)								
<i>Equity</i>											
Distribution of resources	On a scale from 1 (nonexistent) to 10 (very large): How big do you think are the differences between high and low income groups in your community?	X	X (C, DM)					X			
Digital divide	On a scale from 1 (nonexistent) to 10 (very large): How big do you think are the differences between the ICT skills of the community members?	X	X (C, DM)					X			
Distribution of adverse effects	On a scale from 1 (nonexistent) to 10 (very large): How big do you think are the differences between the (forecasted / expected) impacts of the topic of the observatory for different parts of the community / region?	X	X (C, DM)					X			
Unintended /unexpected	What has changed in your life during the last year? To what extent can this be attributed to the CO?		X (C)								
	What has changed in your community during the last year? To what extent can this be attributed to the CO?		X (C, DM)								

Interview/Online survey questions on Institutional Outcomes

Relevant aspect	Question	Internal Stakeholders	CO Core Stakeholders		Market Forces			Enabling Environment			
			Community members	Expert Advisors	Suppliers	Customers & Buyers	Shareholders & Investors	Regulatory Entities	Allies & Umbrella Movements	Media & the Public	Opponents & Critics
<i>Participation</i>											
Geographic scope	In which geographic area does the issue in focus manifest itself (local, national, regional (supra-national) and global)?	X	X	X							
	Where do you live in relation to the issue in focus (inside/outside the geographic boundary of the issue)?	X	X								
Participant groups	Which stakeholders are involved in the decision making process re. the environmental problem at hand?	X									
	Which stakeholders are involved in making the policies (re. the environmental problem at hand)?	X									
	Which stakeholders are part of the enabling environment in this Demo Case?	X									
Efforts required to participate	What kind of efforts (do you think) are required for your participation in the decision making process on [the focus of the Demo Case]?		C								
	What type of equipment is need for participation in the decision making process?	X	C	X							
	What incentives are offered to encourage different stakeholders to participate in this decision making process?	X									
	What incentives are offered to encourage you to participate in d?		C								
Communication paradigm	What are the communication channels for exchanging information on the issue in focus in this Demo Case?	X	X								
	What is the procedure for processing and providing feedback for the received communications?	X									
	Who is involved processing and and providing feedback on the received communications?	X									

Relevant aspect	Question	Internal Stakeholders	CO Core Stakeholders		Market Forces			Enabling Environment			
			Community members	Expert Advisors	Suppliers	Customers & Buyers	Shareholders & Investors	Regulatory Entities	Allies & Umbrella Movements	Media & the Public	Opponents & Critics
	How can you communicate with the decision makers on this issue? How can they send feedback to you?	X	C; DA								
Communication and decision mode	<p>How do you best describe the way you interact in the decision making process (re. the environmental problem in focus)? ^(a)</p> <p><u>Communication</u></p> <ul style="list-style-type: none"> - I (We) communicate about it via social media, but do not really take an action - I (We) listen to the discussions about it, but do not really take an action - I am (We are) involved in collecting and sharing data (Re. the environmental problem in focus) on a voluntary basis - I (We) express my (our) preferences to other people and/or officials - I (We) develop my (our) own preferences (e.g. by learning from educational material, discussing it in small groups, etc.) - I (We) communicate about it with interest and community groups and try to take part in fixing the problem myself <p><u>Decision making</u></p> <ul style="list-style-type: none"> - I (We) know how I (We) want to address this issue (my choice) and I (We) use my (our) influence to negotiate & bargain its implementation - I (We) take part in deliberating and negotiating about this with other community members and authorities to reach a joint decision (e.g. in a cooperative planning setting) - I am an official expert and therefore have a direct say in the decisions with this regard (professional expertise) 	X	X	X	X	X	X	X	X	X	
	How do you believe this changes as result of your (your organization's) participation in the Citizen Observatory?	X	X								
<i>Power Dynamics</i>											
Revenue stream	What are the (envisioned) revenue streams that help cover these expenses?	X		X			X				

Relevant aspect	Question	Internal Stakeholders	CO Core Stakeholders		Market Forces			Enabling Environment			
			Community members	Expert Advisors	Suppliers	Customers & Buyers	Shareholders & Investors	Regulatory Entities	Allies & Umbrella Movements	Media & the Public	Opponents & Critics
Access to and control over data	What are the access restrictions to data? And how does this differ for different stakeholder groups?	X									
	What are the procedures for storing, quality control, visualization of the data?	X									
	What is your personal experience with accessing data/information - please explain what you were looking for and whether you could assess it?	X	X								
Authority and power	<p>What influence/impact do you believe you have (your organization has) on the results of the decision making processes re. the environmental problem at hand?</p> <p><u>Next to none:</u></p> <ul style="list-style-type: none"> - I am (we are) only informed about the decisions that are already made - I (we) have little expectation of influence on the decisions - I (we) expect to be able to affect other people/ stakeholders rather than the decisions and policies <p><u>Exert influence:</u></p> <ul style="list-style-type: none"> - I (we) affect the decision making process via discussion, mobilizing/altering public opinion - I (we) affect the decision making process via providing advice/consultation - I (we) Join officials to make plans (e.g. participatory planning) - I (we) have direct authority over public decisions 	X	X	X	X	X	X	X	X	X	
	How do you believe this influence/impact changes as result of your (your organization) participation in the Citizen Observatory?	X	X								
<i>Institutional setup</i>											
Formal institutions and policies	What are the formal institutions and policies (rules and strategies that govern the decision making processes) related to the environmental problem in focus? And what is the extent of their implementation (e.g. into national law, by local authorities)?	X	DM	X				X			

Relevant aspect	Question	Internal Stakeholders	CO Core Stakeholders		Market Forces			Enabling Environment			
			Community members	Expert Advisors	Suppliers	Customers & Buyers	Shareholders & Investors	Regulatory Entities	Allies & Umbrella Movements	Media & the Public	Opponents & Critics
Informal institutions	What are the informal institutions (value, norms, traditions) that come into play when decisions about the environmental problem at hand are being made at different levels (e.g. local, national, etc)?	X	X	X	X	X	X	X	X	X	X
Multilevel interactions	What is the interplay of local authorities in this Demo Case (Re. the environmental problem in focus) with other administrative entities at national, provincial, and local levels?	X	DM	X				X			
	How is decision making authority (Re. the environmental problem in focus) organised across levels?	X	DM	X				X			
	What is the flow of authority (Re. the environmental problem in focus) between supranational, national, provincial, and local entities in this Demo Case? How is the interaction between these levels organised? - Unidirectional flow (via organizations) - Informal coordination groups to improve exchange in planning processes - Polycentric structure (distributed, nested decision making authority; balance of top-down and bottom-up approaches)	X	DM	X				X			
	Are there knowledge exchanges between the different administrative levels re. the environmental problem in focus? What form(s) do they take? - No knowledge exchanges - Informal knowledge exchanges (e.g. informal networking) - Established practice of knowledge exchanges across levels (e.g. Communities of Practice)	X	DM	X				X			
Possible plural legal systems	Regarding the management of the environmental problem in focus, do you know of any parallel/overlapping rules/roles/responsibilities (formal & informal)? If yes, what are they?	X	X	X	X	X	X	X	X	X	X
Unexpected/unintended	What has changed re. the management of the environmental problem in focus of the CO during the last year? To what extent can this be attributed to the CO?	X	X								

Note:

(a): This question may require prompting the interviewee with possible answers

C: Citizens

DA: data aggregators

DM: decision makers

Interview questions on Economic Outcomes

Relevant aspect	Question	Internal Stakeholders	CO Core Stakeholders		Market Forces			Enabling Environment			
			Community members	Expert Advisors	Suppliers	Customers & Buyers	Shareholders & Investors	Regulatory Entities	Allies & Umbrella Movements	Media & the Public	Opponents & Critics
Background	What is the core business of your organisation?	X	DM		X	X					
	What is the total number of employees of your organisation?	X	DM		X						
<i>Demand</i>											
Employment	In your organisation, how many jobs are currently directly related to [CO topic]?		DM			X					
	What is the nature of these jobs? (junior, medior, senior position(s))		DM			X					
Conduct of business	Overall, what are the current costs of external inputs (e.g. data, public opinions, expert knowledge) that your organisation needs in order to perform its function in relation to [CO topic]?		DM			X					
	How easily available are these external inputs (e.g. data, public opinions, expert knowledge)? (example of efforts)		DM			X					
Value added of CO	For your organisation, what is the value added of the citizen observatory focused on [CO topic] for your capital expenditure? (Cost avoidance due to CO - CAPEX)		DM			X					
	For your organisation, what is the value added of the citizen observatory focused on [CO topic] for your operating expenditure? (Cost avoidance due to CO (OPEX))		DM			X					
<i>Supply</i>											
Company growth	In your organisation, how many jobs are currently directly related to [CO topic] and enabling technologies?	DA			X						
	What is the nature of these jobs? (junior, medior, senior position(s))	DA			X						
	How many of your products/services are relevant for the provision of COs?	DA			X						
	What was your organisation's annual turnover in [year]?	DA			X						
	What is your organisation's market share in the business of Cos?	DA			X						
	How many clients does your organisation have in the CO business?	DA			X						

Relevant aspect	Question	Internal Stakeholders	CO Core Stakeholders		Market Forces			Enabling Environment		
			Community members	Expert Advisors	Suppliers	Customers & Buyers	Shareholders & Investors	Regulatory Entities	Allies & Umbrella Movements	Media & the Public
International trade & investment	How many international clients does your organisation have in the CO business?	DA			X					
	What specific customer segments does your organisation serve related to COs?	DA			X					
	How much has your organisation invested in CO-related activities in [year]?	DA			X					
Innovation & Research	How many IPRs related to COs and enabling technologies (patents, trademarks, copyright, other know-how rights) does your organisation hold?	DA			X					
	How many CO-related research projects is your organisation currently involved?	DA			X					
	In total, what is your organisation's budget (income & own investment) in these CO-related research projects?	DA			X					
Competitive-ness	What value proposition(s) related to COs and enabling technologies does your organisation have?	DA			X					
	Which market segments does your organisation serve?	DA			X					
	How many different revenue streams does your organisation have for CO-related value propositions?	DA			X					
	How many partners for Cos and enabling technologies does your organisation have?	DA			X					
Unexpected/unintended	What has changed with respect to your organisation's performance during the last year? To what extent can this be attributed to the CO?	DA	DM		X	X				

Note:

DA: data aggregators

DM: decision makers

The listed questions are for interview-based data collection. Should the interviews prove too difficult to set up, a survey based on these questions, will be designed.

Interview questions on Environmental Outcomes

Relevant aspect	Question	Internal Stakeholders	CO Core Stakeholders		Market Forces			Enabling Environment			
			Community members	Expert Advisors	Suppliers	Customers & Buyers	Shareholders & Investors	Regulatory Entities	Allies & Umbrella Movements	Media & the Public	Opponents & Critics
Unexpected/unintended	What has changed in the environment of the CO's geographical area during the last year? To what extent can this be attributed to the CO?	X	X	X							

Observation protocol

Code:	Reference audio/video record:
Date:	Start time: Finish time:
Title of event/observation opportunity: For example: Interview, focus group discussion, co-design event, field trip	
Goals What actors are trying to accomplish in this particular setting	
Physical surroundings For example: Room (space, comfort, suitability) Seating arrangements, noise, etc.	
Characteristics of participants (individually and as a group) The names and relevant details of people involved (e.g. gender, age, profession/vocation, dress, appearance, Ethnicity) attitude toward subject	
Facilitation For example: Clarity of communication Group leadership skills, encouraging participation Awareness of group climate Flexibility, adaptability Knowledge of subject, use of aids, other teaching/learning techniques Sequence of activities	
Interactions (collective) For example: Level of participation, interest Power relationships, decision making General climate for learning, problem-solving Levels of support, cooperation versus conflict	

<p>Nonverbal behavior</p> <p>For example: Facial expressions Gestures Postures</p>
<p>Direct quote(s)</p> <p>By whom? Importance or relevance</p>
<p>Other observations</p> <p>Narrative</p>