ACTIVAGE PROJECT

ACTivating InnoVative IoT smart living environments for AGEing well

Tools and processes for the implementation of the evaluation methodology

Deliverable No.	D6.2	Due Date	30-*Sep*-2017
Type	Report	**Dissemination Level**	*Public*
Version	1.0	**Status**	Release 1
Description	Contains the description of the overall methodologies to assess different KPI and the specific ACTIVAGE Evidence Open Data Base tool for data collection for common indicators and for local indicators for each site.		
Work Package	WP6 – Socio-economic impact assessment and evaluation		

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History

Date	Version	Change
30-Jun-2017	0.0	Initial ToC proposal
15-Jul-2017	0.1	Structure of the document and task assignments
20-Jul-2017	0.2	Sections 2, 3 & 4 – first contributions
31-Aug-2017	0.3	Sections 2, 3 & 4 – improvements
16-Aug-2017	0.4	AHA-IoT evaluation tool mockup
23-Aug-2017	0.5	Interim Review version
01-Sep-2017	0.6	Including review suggestions from Isabel Perez
04-Sep-2017	0.7	Section 1 finished
15-Sep-2017	0.8	Including Appendix A, B
18-Sep-2017	0.9	Contributions to sections 2, 3 & 4
26-Sep-2017	0.10	Section 3 finished
01-Oct-2017	0.11	Sections 2 & 4 finished
04-Oct-2017	0.12	General revision and improvement
05-Oct-2017	0.13	Peer Review version

| 09-Oct-2017 | 0.14 | Added collecting information from DS, formatting |
| 13-Oct-2017 | 1.0 | Official release |

Key data

Keywords	Evaluation, Framework, Tool, Evidence, KPI, data-model, AHA-IoT
Lead Editor	Giuseppe Fico (05 UPM)
Internal Reviewer(s)	Isabel Perez (04 MYS)
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Abstract

This document describes the tools that are being developed for the evaluation activities.

First, the overall strategy to generate evidence from the experiment carried out in each Deployment Site (DS) is described. Then, the procedures to collect information and generate the Key Performance Indicators from the different sources (mainly Deployment Sites, the Impact Attainment Strategy and AIOTES) are explained. Finally the tools and their views are provided in the conclusive chapter.

Statement of originality

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1 About This Document

This document represents the contribution of WP6 to Milestone 1, which consists in providing the *tools and methods of the ACTIVAGE reference evaluation framework*, towards the *Generation of Evidence and Value*, as described in the DoA.

This contribution is the first step throughout the *ACTIVAGE Innovation Phases*: aligned with the *Experiment Plans* defined in WP9 and described in D9.1, the tools and methods developed will allow to collect and aggregate information from the experiments of each deployment sites and, at the same time, to collect and process the Local and Global KPIs, in accordance to the *GLOCAL evaluation framework*, described in D6.1 and further implemented in this deliverable.

Further versions of the deliverable, synchronized with the next innovation phases, will describe the evaluation tools in detail, and how they are providing information on the evidence and impact that the project is bringing to end-users and stakeholders of the AHA and IoT Ecosystems.

1.1 Deliverable context

Project item	Relationship
Objectives	<u>O3</u> *(GLOCAL evaluation framework):* D6.2 provides the processes for the implementation of the evaluation methodology as well as the development of the ACTIVAGE EO-DB including its views.
Exploitable results	The main exploitable result is the ACTIVAGE OE-DB and its views: ACTIVAGE Public Evidence Website, AHA-Advisor and LSP Dashboard. The deliverable also contributes to the knowledge assets exploitable results as it will contribute to the ACTIVAGE White Book. D6.2 has a direct link since increases the exploitation opportunities for both the ACTIVAGE IoT Ecosystem Suite and the LSP applications and services through being used in evaluating these technologies.
Work plan	This deliverable reflects mainly the work done in T6.2 (Deployment of the coordinated evidence data aggregation procedures and tools), from WP6 (Socio-economic impact assessment and evaluation). The task contributing with data to this set of tools and infrastructure will be T6.4, T6.5, T6.6 and T9.3 for the DS.
Milestones	MS1 - Build
Deliverables	<u>D1.4</u> has provided the data management plan and the data life cycle management model considered in the design of the ACTIVAGE EO-DB. <u>D6.1</u> has provided the main input, KPI list and the GLocal Evidence Generation Protocol which will be implemented in the GLocal software infrastructure. <u>D9.1</u> has served as input in this document to homogenize the information collected in the DS and its contribution to the data

model.

D6.3, D6.4 & D6.5 will use D6.2 and its updates as input for the data collection and the evidence creation process; specifically in the evaluation framework with regard to QoL, Independence assessment, Innovation and Growth.

Risks	Rk2 – *Difficulty to extract and communicate benefits*, by collecting and presenting the most relevant data for the project through the GLocal software infrastructure.
	Rk3 – *Break the confidentiality or privacy of the user data*, by ensuring the compliance with GDPR throughout the tool.
	Rk11 – *Data for evidence generation is insufficiently defined at each site and not aligned across sites*, by establishing a common reference data model for all DS that will be implemented in the GLocal software infrastructure.
	Rk19 – *KPI and the evidence not relevant*, by defining KPIs and data collected with all the actors involved regarding impact, assessment, DS information, AHA services based on IoT, etc. in order to generate relevant evidence.

2 Creation of the ACTIVAGE Evidence

One of the main achievements of the first six months of work in the project has been to understand that ACTIVAGE is building a set of reference elements around Internet of Things for Active and Healthy Ageing (IoT-AHA). This achievement allows to produce, gather and analyse information which is structured according to these elements. Accordingly, the Information is going to be dynamically and continuously generated during the pilot execution, but incrementally synchronized around the ACTIVAGE innovation phases (i.e. Build, Demonstrate, Expand, Growth and Sustain). In a nutshell:

1. Reference Use Cases, Scenarios will allow to cover User Needs and Requirements.

2. Reference IoT-AHA Data Model will allow to collect information around the main technological elements of the solutions deployed in the DSs through the tool that AIOTES will provide.

3. Reference IoT-AHA Ecosystem will allow to define the main innovative elements and assets towards impact achievement.

The realization of these reference elements is incremental: first they are defined in the Build Phase, then they are created, refined and re-assessed in the other innovation phases. Accordingly, the generation of evidence is conceived in a continuous and incremental manner too: therefore, the tool that allow to collect information and evaluate the results of the pilot, developed in T6.2 and described in this deliverable, is going to be released in different moments of time and with different versions:

1. At the end of the Build Phase, where the DSs have defined their experiment plan, the tool allows to collect "static" information of each DS, such as study objectives and endpoints, Local KPIs and contextual information about the solutions deployed (e.g. geographical context, architecture, end-users, stakeholders, etc.).

2. At the end of the Demonstration Phase, information about the preliminary evidence that each DS has generated separately is going to be provided. Additionally, according to the evolution of the Data Model, Analytics and Services that will be provided by AIOTES, new hypotheses and means of verifications are expected to be defined (and demonstrated in the Expand Phase) and therefore these new elements will be included in the Evaluation tool

3. At the end of the Expand Phase, evaluations will show how the replicability and interoperability elements have effect on the outcomes of each DS

4. At the end of the Sustainability Phase, a complete picture of the project results will allow to have a clear map of how the IoT-AHA ecosystems defined in each DS have been successful towards solutions for Ageing well

Therefore, the Evaluation framework will allow to cyclically obtain information that has to be aligned both with the Impact attainment strategy and with the needs that users and stakeholders are identifying during the co-creation activities. This continuous generation of evidence that ACTIVAGE is pursuing, connecting Impact attainment (blue elements) and covering needs defined with Users (yellow elements) is shown in Figure 1.
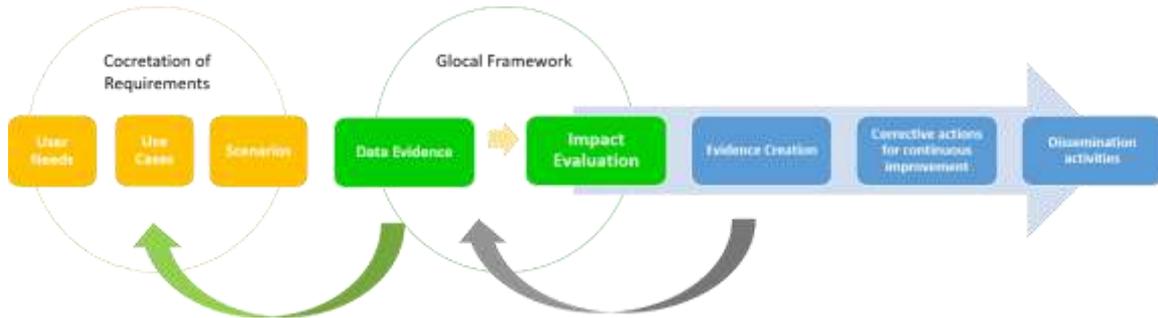
Figure 1. The ACTIVAGE continuous generation of evidence (source D6.1)

Moreover, the information that will allow to collect evidence is coming from two main type of sources:

- Evaluation instruments that DSs have defined in their experiments

- Data Processed for each IoT Element of the IoT-AHA architecture that the Analytics services of AIOTES will provide

Finally, the evidence is going to be locally generated and centrally aggregated in such a way that:

1. It allows DS to achieve their local objectives

2. It allows the ACTIVAGE Large Scale Pilot to demonstrate the overall effect of IoT on AHA

3. It covers needs from end-users and stakeholders of the IoT, AHA and IoT-AHA ecosystems (see D8.1).

Figure 2 provides an overview of the Evaluation Framework, in terms of main information elements and main actors involved in the evaluation activities: end-users and stakeholders of the DS (defined in WP2), evaluators of each DS who are in charge of carrying out the experiments in their settings, representatives from the Demand side who are interested to verify whether the indicators are prospectively relevant to make a real and sustainable impact, and the IoT community that will be interested, through AIOTES, to verify whether the IoT KPIs defined in ACTIVAGE are relevant and useful to other domains.
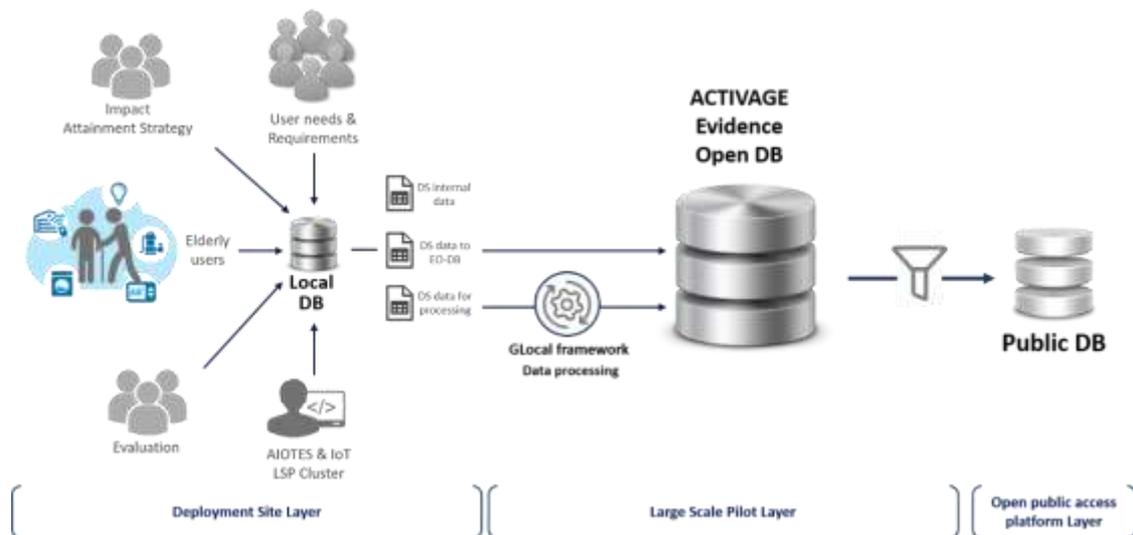
Figure 2. Data sources to generate Evidence

For all the reasons explained herein, the definition of the Evaluation Framework, initially drafted in D6.1, has evolved in this deliverable and will evolve in the following iteration of the project (as anticipated in D6.1, "*The analysis of Local and Global indicators and features to form the evaluation framework, is not based on EX-ANTE design, but on distinctive features of the ACTIVAGE strategy called GLocal: a BOTTOM UP approach and an ITERATIVE process to discover "hidden" and not explicit KPI, success factors and enabling ecosystem features that will guide the update of the ACTIVAGE GLocal Evaluation framework.*").

Next chapter provides a more detailed description of the evaluation framework, which will allow to have a first collection of information, mainly from WP9, WP3-4-5, WP8 and WP2.

2.1 Collecting information from Deployment Sites related to the co-creation phase

Even though the requirement phase, developed within WP2, is not strictly associated with the evaluation activities, it would be useful to get access to the information that the project is being generating in the co-creation phase and re-analyse it in the context of the evaluation and impact assessment activities. Therefore, socio-demographic information of end users, their needs is going to be provided in the evaluation tool.

2.1.1 Elderly users

- Users sociodemographic data
    - Sex: male/female
    - Age: number
    - Education level: International Standard Classification of Education (ISCED)*
    - Technology level: basic, intermediate, advanced, excellent
    - Living conditions: home/residency
    - Living status: alone/with family
    - Working status: unemployed, self-employed, employed, retired
    - User target group: elderly, informal carer, formal carer, (health/care) service provider, IoT developer, IoT deployer.
- Technical solution
    - Architecture: devices/gateway/middleware/applications/users
    - IoT infrastructure
    - Scenarios
    - Data model & Information model

2.1.2 User needs & requirements

The User Needs Data Model is reported in the Figure below. It can be considered as tool to store and classify the data gathered trough the different activities performed for the identification of the User Needs.

Deployment site	Tools	the activity (please	the activity (in	Number of participants			Age (Minimum-max)	Average Age	Living status	Educational level	Employment situation	Technology level	Literature (describe if any)	Related UC	Involved stakeholders (#)					
					Female	Male			describes if the participants are **alone, in couple** or **with relatives.**	describes if the participants are **Without studies, Primary studies,**	the participants are **Employed, Unemployed** or **Retired.** Please note that here just the number of participants	describes if the participants are **Poor Skilled, Medium Skilled** or **Skilled.** Please			Target users	Formal and informal caregivers	Social and healthcare professionals	Authorities and supporters	Developers of IT solutions	Deployers of integrated IoT solutio
Please specify DS	please select													Please specify UC						
Please specify DS	please select													Please specify UC						
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Figure 3 — User Needs Data Model

In order to gather user needs and requirements a UCD methodology has been provided to guide each Deployment Site. Four main tools to be applied in each DS for the extraction of the user needs and provide input for the description of the demography, social and economic context have been provided:

- Documentary analysis;

- Open questionnaires;

- Structured and semi-structured interviews;

- Focus groups.

The mentioned tools will support to reach KPIs related to user needs domain and arrange the corresponding activities as planned in the experiment protocol of each DS (e.g. time to perform a focus group; administration of a questionnaire at the due time).

The tools will support in the involvement of the identification of stakeholders according to the four categories established in D2.1:

1. Target users;

2. Formal and informal care givers;

3. Professionals of the health and social environment (i.e. assistance providers);

4. Key informants:

   - Authorities and supporters;

   - Developers of IoT solutions;

   - Deployers of integrated IoT solutions.

2.2 Collecting information from Deployment Sites related to the operation phase

2.2.1 LSP and DS experiments' protocols

The ACTIVAGE Large Scale Pilot has as overall goal to demonstrate the *effect* of IoT paradigm on AHA solutions deployed throughout Europe. Experimental plans are being defined in D9.1. In terms of study design and protocols of each DS, this information is going to be collected and centralized in the context of WP6 between Month 9 and M12. In accordance with WP9, a template to collect this information, based on WHO guidelines has been defined, and is described in Appendix A. This will allow to work on the single experiments and define the overall experiment, following the GLOCAL evaluation framework approach.

2.2.2 Operation data model

Operation phase comprises different activities that the DS will perform and that are relevant to the goal of ACTIVAGE. These activities range from user recruitment, training, installations, maintenance and support and the normal operation of the solutions to be deployed at DS, through the different innovation phases that has been defined in the project.

Collecting data and indicators that reflects the execution of all these activities in a systematic and consistent way from all DS will enable to perform deeper analysis on the effectiveness of the IoT-AHA approach.

In the forthcoming months, between M9 and M12, definition of these indicators will be finalised and agreed between WP6 and WP9, based on the following initial proposal:

- Minimum socio-demographic data, to be collected from every person contacted during recruitment activities:
    - Sex: male/female
    - Age: number
    - Education level: International Standard Classification of Education (ISCED)*
    - Technology level: basic, intermediate, advanced, excellent
    - Living conditions: home/residency
    - Living status: alone/with family
    - Working status: unemployed, self-employed, employed, retired
    - User target group: elderly, informal carer, formal carer, (health/care) service provider, IoT developer, IoT deployer.
- Minimal dataset after signed informed consent: All the previous socio-demographic data plus:
    - Local Use Case assigned to
    - Cohort assigned to (if applicable: intervention/control)
    - Date of entering in the pilot
    - Solution/application used (if more than one is available for the selected LUC) / version
    - Date of termination
    - Reasons for termination
- Operation indicators
    - Recruitment activities:
        - Number of contacted individuals
        - Number of signed informed consent
        - Number of recruitment events realised
    - Training sessions:
        - Number of training sessions per stakeholder type
        - Number of attendants to training sessions
    - Installations:
        - Time of installation
    - Support and maintenance:
        - Number of bugs
        - Number of change requests
        - Average time to solve a bug
    - Operation:
        - Number of users in operation

- ▪ Number of users with an operation time >12weeks
- ▪ Average time of operation for each application/service

2.3 Audit & Data Quality check

Assuring data quality is an essential component of strengthening service–based information systems. When they are of good quality, data are important inputs for creating **Evidence**. They also provide the basis for local performance assessment. However, service data are often beset with data quality issues. When data are perceived to be inaccurate and unreliable, they will not be trusted and will, therefore, not be used.

Data are considered to be of good quality if they are accurate, complete, timely, and consistent. These elements of service data quality in ACTIVAGE will be assessed by an examination of the following components:

- • Completeness, timeliness, accuracy, integrity and internal consistency of reported data from the service provider to the DS evaluation committee;
- • Quality of users data used in the calculation of performance indicators, and
- • Comparisons of indicator values derived from routinely reported data to the same indicators measured by period users-based surveys.

Assuring good data quality begins during data-collection and continues at the phase of data compilation, transfer and aggregation into summary indicators. At the data collection stage the focus of data quality assurance is on microdata – that is, the accuracy and completeness of the information contained in each individual record or register. During the later stages of data compilation and transfer, the focus is on the accuracy, consistency and plausibility of the aggregated (macro) data.

Data and quality check at DS level in ACTIVAGE will be executed through the establishment of a committee of evaluation managers, to be appointed by each DS that will perform the following actions:

1. Identifying and accounting for biases due to incomplete reporting, inaccuracies and non-representativeness to enhance the credibility of the results. This involves a multi-step process including: (i) assessment of the completeness of reporting by each DS committee; (ii) accuracy of coverage estimates from reported data; (iii) systematic analysis of service-based and users survey-based indicator values; and (iv) adjustments of the indicator values, using transparent and well-documented methods. The audit should be done on a regular basis and the results should be made public. Each DS has to specify the committee responsible for the process.
2. Assessing of service quality combined with a record review. This will serve to fill critical data gaps on service delivery as well as serve to verify the quality of routine data. Regularly, a service assessment can be conducted in each DS to independently review the quality of data and the status of service delivery. The assessment can be combined with a review of the records to ascertain the completeness and quality of reporting by comparing the results with aggregated data at local level.
3. Regular training of staff and provision of routine feedback to staff at all levels on the completeness, reliability and validity of data.
4. The DS committee must meets on a regular basis and supports data quality assurance checks at local level in order to raise the credibility of the data.

The ACTIVAGE self-audit process will be specified more in detail with the WP9 collaboration. Specifically, the following is the list of main activities that are overseen in order to execute the self-audit process by DSs:

- Planning
    - Plan and Set-up the Self-Audit
    - Collect Relevant Documents
- Identification, Classification and Assessment of Datasets
    - Analyze Documents
    - Identify Data Sets
    - Classify Data Sets
    - Assess Data Sets
- Report of Results and Recommendations
    - Collate and analyze information from the audit
    - Report on the compliance with the Data Management Plan
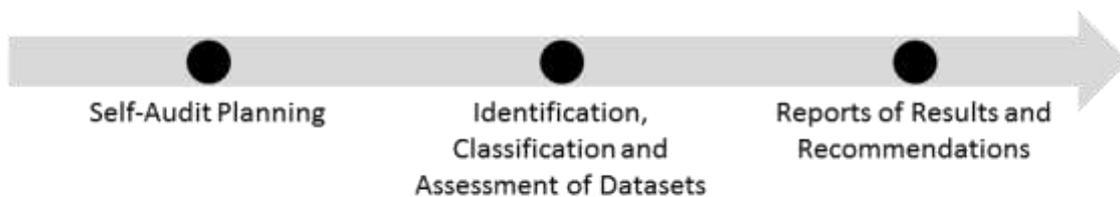   - Identify weaknesses and decide on corrective actions

Figure 4. ACTIVAGE Self-Audit Process

3 Procedures for collection and processing of KPIs

The main objective of this chapter is to describe which methods, tools and steps will be used to collect and/or generate global evidence starting from local heterogeneous data sources with different information and perspective, such as socio-economic evaluation, IoT/AIOTES performance, and Impact attainment (see Figure 2).

The GLocal evaluation framework is the reference method to collect local indicators which are useful to generate global evidence [ref D6.1]. The GLocal framework takes into account two types of indicators:

- LOCAL KPI: local performance indicators adapted to the local ecosystems or DS;
- GLOBAL KPI: mandatory KPIs which are relevant for the ACTIVAGE LSP as a whole and that have to be measured by each DS, sharing the same attributes (same population, same data source, same frequency of measurements).

A Key element of the framework is the "GLocal" concept. *GLocal* refers to the approach allowing to aggregate and to process local indicators from different DSs and ecosystems. The GLocal framework is composed of two main steps: data collection and data processing.

Section 3.1 provides an overview of the reference method for collection of different type of local Indicators (socio-economic KPIs, AIOTES KPIs, IAS KPIs) and the following section describes the reference Indicator Data Model.

Subsections 3.1.3-3.1.5 describe which type of indicators we are referring to, and how local indicators are collected and classified (*Data collection*), so that specific tools can be applied to generate global evidence Indicators (*Data aggregation)*, section 3.2.

3.1 KPIs collection

A common Indicators Data Model will be used to collect different type of indicators: socio-economic impact evaluation KPIs, AIOTES/IoT KPIs and IAS KPIs.

3.1.1 KPIs data classification

The GLocal framework allows to collect three main type of indicators: socio-economic indicators, AIOTES/IoT KPIs, IAS KPIs. These indicators are classified in 9 big areas or boxes.

These boxes are containers aiming at *classifying* info in order to allow:

- The creation and updating of a dynamic and structured list of local indicators.
- The comparison between methodologies, approaches, evaluation methodologies, to see how partners with similar questions measure specific items, and to aggregate results. It could be also used as a check list to see if an important item is not measured by a specific DS.

9 different boxes have been defined:

- Box 1 Well being and QoL

- Box 2 Clinical benefits

- Box 3 Organization of care
- Box 4 Economics
- Box 5 Acceptability
- Box 6 Sustainability
- Box 7 Ethical, Legal and Social Issues (ELSI) and cultural issues
- Box 8 Technical reliability
- Box 9 IoT performance

Each Box is then composed of subcategories and subquestions concerning the item, the innovation degree, the dissemination level.

This model allows us to classify each KPI at 3 different levels: big box, subcategory and subquestion.

3.1.2 Indicators Data Model

This section establishes the <u>required fields for each indicator for assuring a homogeneous and comprehensive data assessment and evaluation.</u> This structure must be followed for all the performance indicators used in the project: socio-economic impact evaluation, AIOTES/IoT and IAS indicators.

These performance indicators will be assessed along the project and used for two important tasks: 1) the GLocal evaluation framework and 2) impact assessment strategy.

The data model follows the rationale underpinning the GLocal Evaluation framework described in deliverable D6.1, defining the next different fields:

- *Name* of the indicator to be evaluated;
- **Category of the *Triple Win strategy*** the indicator refers to;
- *Data source/measurement tool* used to detect data and if it is a standard tool or not;
- Exposure of the *obtained results*, measurement unit used (percentage, numeric, or to be defined) and related target (if any);
- *Where* (at Deployment Site level or at WP3, WP4, WP5 or WP8 level) and *when* the indicator has been measured;
- *Dimension* of the indicator (Local, Global);
- Definition of the indicator accomplishment to a specific **Big boxes/area, subcategory and subquestion**
- Identify the **Use Case** where this indicator will be measured.

In order to facilitate the indicators collection, an excel sheet was created with all these fields. In this way, we will be able to check number of indicators assigned per use case, per big boxes, and so on. Figure 5 shows an example of the indicator data model.

Figure 5. Indicators Data Model

Quite all the boxes provide the possibility to use a multiple-choice index thus making the filling easier and precise. Specifically, related to the Big Questions section, each DS has the possibility to make a multiple choice firstly picking the reference Big Question, then selecting the related Big Question sub-categories and finally choosing the related sub-categories question.

In order to facilitate this activity, a guidance document has been prepared, giving instructions on the different categories of the data model. The entire document is provided in this deliverable, in Appendix B.

3.1.3 Socio-economic Evaluation

"Evaluation KPIs" play a pivotal role within the Evaluation Framework. The GLocal framework focuses on them as a fundamental source for producing evidence about the *socio-economic* aspects.

Their main goal is to produce evidence about the improvement of users' *Health and Quality of Life*, as well as at verifying the *sustainability* and *efficiency* of local health and social care systems, their replicability and scaling up.

With a concept of the Quality of Life an attempt is made to measure the well-being of the population in its various dimensions. Well-being is determined by both material living conditions and the subjective perception of the quality of life. The "Evaluation KPIs" aim at evaluating this multi-dimensionality in which all the elements are strictly connected. As such, they try to move between elements that seem even far apart, but allow to produce a concrete mapping of progresses or failures.

On the other side, the word Sustainability is used frequently and in many different combinations. In the GLocal framework, "Evaluation KPIs" related to the sustainability concept are parameters that try to analyse changes towards the sustainable use and management of economic, social, institutional and environmental resources, in order to produce evidence of these changes.

The "Evaluation KPIs" aim at avoiding one important risk that may arise when using indicators; basically that people easily lose sight of the ultimate goal (i.e. "Where do we want to be? Or go?") and instead become occupied with what they want to measure and how. As such the identified evaluation indicators are bound-up with an infrastructure (see the Data Model) that never forgets the "why", "who" and "how" a measurement is done.

The current list of Global KPIs is:

- Users QoL
- Social Interaction
- Safety Perception
- Daily Physical activity
- Number of participants to the service
- Improved efficiency of service providers
- Costs reduction
- New IoT based AHA Services
- Number of services with a performance evaluation system

To these indicators, the Data Model table has been filled, as reported in the table below (more details about Local and Global Evaluation KPIs can be also found in deliverable D6.1).

Table 1 — Data Model for Socio-economic KPIs (Global)

Name	Triple Win strategy	Data Source	Standard	Outcome/target/measur.unit	Where	Dimension	When	measur.unit2	Big Question	Sub-categories	Sub-categories question
Users QoL	**Impact on QoL**	HRQOL	YES	To be defined	DS	Global	9	months	WELL BEING, QoL	WELL BEING, QoL indicators and measurments (1)	WELL BEING, QoL (1) How do I measure QuOL improvement of patients ?
Social Interaction	**Impact on QoL**	Iterative questionnaires/interview	NO	To be defined	DS	Global	9	months	WELL BEING, QoL	WELL BEING, QoL indicators and measurments (1)	WELL BEING, QoL (1) How do I measure QuOL improvement of patients ?
Safety Perception	Impact on QoL	Self assessment questionnaire	NO	To be defined	DS	Global	9	months	WELL BEING, QoL	WELL BEING, QoL indicators and measurments (1)	WELL BEING, QoL (1) How do I measure QuOL improvement of patients ?
Daily Physical activity	Impact on QoL	Barthel scale	YES	#	DS	Global	6	months	WELL BEING, QoL	WELL BEING, QoL indicators and measurments (1)	WELL BEING, QoL (1) How do I measure QuOL improvement of patients ?
Number of Hospitalization and re-hospitalization	Impact on QoL	Number of visits	NO	#	DS	Global	9	months	CLINICAL BENEFIT	CLINICAL BENEFIT Clinical evidence indicators and measurments (1)	CLINICAL BENEFIT (1) How do I measure my clinical benefits ?
Number of Hospitalization and re-hospitalization	Sustainability	Number of visits	NO	#	DS	Global	9	months	SUSTAINABILITY	SUSTAINABILITY Sustainability indicators and measurments (1)	SUSTAINABILITY (1) How do I evaluate the sustainability of my solution ?

Name	Triple Win strategy	Data Source	Standard	Outcome/target/measur.unit	Where	Dimension	When	measur.unit2	Big Question	Sub-categories	Sub-categories question
Number of participants to the service	Sustainability	User Experience Questionnaire	NO	To be defined	DS	Global	9	months	ACCEPTABILITY	ACCEPTABILITY Scalability indicators and measurments(acceptability in different European societies) (2)	ACCEPTABILITY (2) How do I measure the acceptability level of my solution at regional scale ?
Improved efficiency of service providers	Sustainability	User Experience Questionnaire/Administrative and economic official data	NO	To be defined	DS	Global	9	months	ORGANIZATION OF CARE	ORGANIZATION OF CARE Organization of care indicators and measurments (1)	ORGANIZATION OF CARE (1) How do you measure the changes or the improvements in the organization of care ?
Costs reduction	Sustainability	Administrative and economic official data	NO	To be defined	DS	Global	9	months	PROFITABLE	PROFITABLE Care ressource optimization indicators and measurments (3)	PROFITABLE (3) How do I measure the care ressource optimization allowed by my solution ?
New IoT based AHA Services	Innovation	Number of services	NO	#	LSP	Global	9	months	PROFITABLE	PROFITABLE Number of start-up created indicators and measurments (8)	PROFITABLE Number of start-up created indicators and measurments
Number of services with a performance evaluation system	Innovation	Number of services	NO	#	DS	Global	9	months	PROFITABLE	PROFITABLE Number of start-up created indicators and measurments (8)	PROFITABLE Number of start-up created indicators and measurments

3.1.4   Impact Attainment Strategy (IAS) related KPIs

The Impact Attainment Strategy (IAS) aims to maximize the impact of the ACTIVAGE project based on a set of strategies actions and related guidelines to be followed throughout the project (for details see deliverable D8.1).

It foresees a set of global KPIs affecting different impact domains, to be measured in different phases of the ACTIVAGE innovation path. These indicators include socio-economic KPIs, but also indicators affecting technological issues, contribution to standards, development of IoT ecosystem, promotion of the ACTIVAGE project.

The list of the IAS related KPIs used for the project is listed below and full information from IAS KPIs are reported in the Appendix D.

- Number of IoT technologies and sensors developed and the ACTIVAGE pilot and incremental (i.e. in the Expand and Growth phases) effect of AIOTES in terms of performance and efficiency

- Interoperability properties (e.g. number of platforms and 3rd party services integrated) that AIOTES is providing and their effect in terms of replicability and sustainability

- Standardization aspects that AIOTES is providing and their effect in terms of replicability and sustainability

- Privacy and Security aspects (e.g. improved transparency of information provided to end-users, improved control and management of their personal data, number of architectural components that integrate security and privacy by design) that AIOTES is providing and their incremental effect in terms of replicability and sustainability

- Number of business models defined for the different DS and use cases

- Cost-benefits KPIs such as the cost per user per long term care (more than 2 years)

- Legal and ethical safeguard

- Business model and market sustainability

- Replicability and scaling-up

- User acceptance and satisfaction

- Clinical benefits

- Users' empowerment with the control of their medical data

- Accomplishment of the Ethics and Privacy Protection Manual (Deliverable 1.5)

- Number of synergies created with standardization bodies

- Number of white papers, congress and publications created related to the ACTIVAGE standardization activities

- Number of guidelines and methodologies created to standardize the AHA services based on IoT

- Users' Quality of Life and wellbeing in terms of autonomy, convenience, health and social participation, including caregivers and family

- Efficiency of the organization of care

- Maturity and accessibility of the AHA services based on IoT (SCIROCCO tool)

- Numbers of agreements with international funding

- Number of funded start-ups that enter in the next open calls

- Number of AHA services from one DS scaled-up to other European DS

- Number of IoT technologies from one DS scaled-up to other European DS

- Numbers of start-ups accelerated to implement innovative solutions on IoT

- Number of services replicated and deployed across Deployment Sites in the Expand Phase and with 3rd parties in the Grow phase

- Integration and agreements with other IoT Platforms organizations

- Reference KPIs of the AIOTES "effect" on the Triple Win Indicators

- Reference MVP, Business Model and Value Proposition for AIOTES

- Potential scalability of the solutions

- Potential savings and contributions to the sustainability of the health care and social system

- Maturity of the technology: Readiness of the IoT ecosystems to host other solutions

In table below, the data model is described.

Table 2 — Data Model for the Impact KPIs

Name	Triple Win strategy	Data Source	Standard	Outcome	Target	measur.unit	Where	Dimension	When	measur.unit 2	Big Area	UC1	UC2	UC3	UC4	UC5	UC6	UC7	UC8
Number of IoT technologies and sensors developed and the ACTIVAGE pilot and incremental (i.e. in the Expand and Growth phases) effect of AIOTES in terms of performance and efficiency.	Innovation	- Number of new IoT technologies. - Number of new sensors	NO	Number of IoT technologies	#	DS	GLOCAL	12	months	IoT PERFORMANC	1	2	3	4	5	6	7	8
Interoperability properties (e.g. number of platforms and 3rd party services integrated) that AIOTES is providing and their effect in terms of replicability and sustainability.	Sustainability		NO			#	DS	GLOCAL	12	months	IoT PERFORMANC	1	2	3	4	5	6	7	8
Privacy and Security aspects (e.g. improved transparency of information provided to end-users, improved control and management of their personal data, number of architectural components that integrate security and privacy by design) that AIOTES is providing and their incremental effect in terms of replicability and sustainability.	Sustainability						WP8	GLOCAL	12	months	ETHICAL, LEGAL, S	1	2	3	4	5	6	7	8
Number of business models defined for the different DS and use cases.	Sustainability		NO	Number of business models	#	WP8	GLOCAL	12	months	PROFITABLE	1	2	3	4	5	6	7	8
Cost-benefits KPIs such as the cost per user per long term care (more than 2 years)	Sustainability	New ACTIVAGE ratio define	NO			to be defined	Evaluation fra	GLOCAL	12	months	PROFITABLE	1	2	3	4	5	6	7	8
Legal and ethical safeguard. --> USING THE LOCAL AND GLOBAL KPIs USED IN THE EVALUATION FRAMEWORK TO MEASURE IT	Sustainability						DS	GLOCAL	12	months	ETHICAL, LEGAL, S	1	2	3	4	5	6	7	8
Business model and market sustainability. --> USING THE LOCAL AND GLOBAL KPIs USED IN THE EVALUATION FRAMEWORK TO MEASURE IT	Sustainability	New ACTIVAGE scale define	NO	Degree of sustainability (0-1	%	DS	GLOCAL	12	months	SUSTAINABILITY	1	2	3	4	5	6	7	8
Replicability and scaling-up.	Sustainability	New ACTIVAGE scale define	NO	Degree of scalability (0-100	%	DS	GLOCAL	12	months	SUSTAINABILITY	1	2	3	4	5	6	7	8
User acceptance and satisfaction. --> ALL THE GLOBAL USER ACCEPTANCE USED IN WP6	Impact on Qo	Questionaire used to measu	NO	% of satisfaction and user ac	%	DS	GLOCAL	12	months	ACCEPTABILITY	1	2	3	4	5	6	7	8
Clinical benefits. --> ALL THE GLOBAL CLINICAL BENEFITS USED IN WP6	Impact on QoL						DS	GLOCAL	12	months	CLINICAL BENEFIT	1	2	3	4	5	6	7	8
Users' empowerment with the control of their medical data.		Questionaire used to measu	NO			%	DS	GLOCAL	12	months	ACCEPTABILITY	1	2	3	4	5	6	7	8
Accomplishment of the Ethics and Privacy Protection Manual (Deliverable 1.5).	Sustainability	New ACTIVAGE scale defined in the evalu	Ethics and privacy complian	%	Evaluation fra	GLOCAL	12	months	ACCEPTABILITY	1	2	3	4	5	6	7	8
Number of synergies created with standardization bodies.	Sustainability	Number of synergies create	NO	Number of synergies	#	WP8	GLOBAL	12	months		1	2	3	4	5	6	7	8
Number of white papers, congress and publications created related to the ACTIVAGE standardization activities.	Innovation	Number of white papers, co	NO	Number of standardization	#	WP8	GLOBAL	12	months		1	2	3	4	5	6	7	8
Number of guidelines and methodologies created to standardize the AHA services based on IoT.	Innovation	Number of guidelines and n	NO	Number of guidelines and methodologies	WP8	GLOBAL	12	months		1	2	3	4	5	6	7	8
Efficiency of the organization of care. --> TO BE DEFINED IN THE EVALUATION FRAMEWORK	Innovation	Questionaire used to measu	NO			DS	GLOCAL	12	months	PROFITABLE	1	2	3	4	5	6	7	8
Maturity and accessibility of the AHA services based on IoT (SCIROCCO tool).	Sustainability	Maturity and accessibility	YES	SCIROCCO Scale	SCIROCCO Sca	DS	GLOCAL	12	months	IoT PERFORMANC	1	2	3	4	5	6	7	8
Numbers of agreements with international funding.	Sustainability	Numbers of agreements wit	NO		#	WP8	GLOBAL	12	months	SUSTAINABILITY	1	2	3	4	5	6	7	8
Number of funded start-ups that enter in the next open calls.	Sustainability	Number of funded start-ups	NO		#	WP7	GLOCAL	12	months	SUSTAINABILITY	1	2	3	4	5	6	7	8
Number of AHA services from one DS scaled-up to other European DS.	Sustainability	Number of AHA services fro	NO		#	Evaluation fra	GLOCAL	12	months	SUSTAINABILITY	1	2	3	4	5	6	7	8
Number of IoT technologies from one DS scaled-up to other European DS.	Sustainability	Number of IoT technologies	NO		#	Evaluation fra	GLOCAL	12	months	IoT PERFORMANC	1	2	3	4	5	6	7	8
Numbers of start-ups accelerated to implement innovative solutions on IoT.	Sustainability	Numbers of start-ups accele	NO		#	WP8	GLOCAL	12	months	SUSTAINABILITY	1	2	3	4	5	6	7	8
Number of services replicated and deployed across Deployment Sites in the Expand Phase and with 3rd parties in the Grow phase.	Sustainability	Number of services replicat	NO		#	DS	GLOCAL	12	months	SUSTAINABILITY	1	2	3	4	5	6	7	8
Integration and agreements with other IoT Platforms organizations.	Sustainability	Number of integration and a	NO		#	WP8	GLOCAL	12	months	SUSTAINABILITY	1	2	3	4	5	6	7	8
Potential scalability of the solutions.	Sustainability		NO			to be defined	DS	GLOCAL	12	months	SUSTAINABILITY	1	2	3	4	5	6	7	8
Potential savings and contributions to the sustainability of the health care and social system.	Sustainability	New ACTIVAGE scale define	NO			to be defined	DS	GLOCAL	12	months	PROFITABLE	1	2	3	4	5	6	7	8
Maturity of the technology: Readiness of the IoT ecosystems to host other solutions.	Sustainability	Maturity of the technology	YES	SCIROCCO Scale	SCIROCCO Sca	DS	GLOCAL	12	months	IoT PERFORMANC	1	2	3	4	5	6	7	8

3.1.5 AIOTES/IoT KPIs

AIOTES/IoT KPIs definition is a continuous process that has been initiated within WP6 with the aim of proving a first guideline (this deliverable D6.2) to the technical workpackages (WP3, WP4, WP5). A second step consists in refining those according to the current development strategies and progress of AIOTES developments. Indeed new KPIs might emerge while other might become obsolete of valueless. Therefore in a first approach, the main AIOTES/IoT KPIs categories identified are: interoperability, monitoring, analysis, scalability, privacy/safety.

- KPIs related to **Interoperability** capacities:
  - *Presence of Service Level Agreement (SLA)*. It is a proven concept that can handle a wide variety of technical requirements to guarantee a certain level of operations. The concept is to create a type of contract between the system (IOTES) and the service provider which outlines numerous service performance metrics with corresponding service level objectives. The nature of the SLA allows the IOTES ecosystem in offering good quality services and let the ecosystem work as it is designed: keep good services and replace non-compliant ones.
    Measurement tool: scan of the number of service agreement established
    Target: to be determined
  - *Node Discovery Time (NDT)*: It is the time elapsed between the connection of a node to the network and until it is detected in the system.
    Measurement tool: experimental evaluation in a controlled environment.
    Target: to be determined.
  - *Service Discovery Time (SDT)*: It is the time elapsed between a new service is associated to the network, and until is detected by the system.
    Measurement tool: experimental evaluation in a controlled environment (automatic addition of a service at a pre-defined time and time logged when service detected)
    Target: to be determined
  - *False Falling Events (FFE)*: It is the number of times a node disappears of the system, despite being still connected.
    Measurement tool: experimental evaluation in a controlled environment
    Target: to be determined
  - *Packet Delivery Delay (PDD)*: This metric is used to measure the temporal efficiency of the packet delivering. In particular, it is calculated as the average latency between the transmission of a data packet from a sensor node and its reception at the gateway (or at another node in the platform).
    Measurement tool: log files post processing.
    Target: to be determined.
  - *Packet Delivery Ratio (PDR)*: The ratio of the number of delivered data packet to the gateway (or at another node in the platform) with respect to the total number of sent packets. This metric serves to measure the reliability of the network in term of packet delivering.
    Measurement tool: log files post processing.
    Target: to be determined.
  - *Total number of Nodes Alive (TNA)*: This metric is strictly related to the network lifetime.
    Measurement tool: platform status service.
    Target: to be determined.
  - *Storage-related services*
    Measurement tool: persistent memory allocation service.

Target: to be determined.

- KPIs related to **Monitoring** capacities:
  - *Measurement Accuracy (MA)*: This indicator is defined as the dispersion which presents several measures of a magnitude in the same conditions. The lower the dispersion, the greater the accuracy.
    Measurement tool: data extraction from device specifications.
    Target: to be determined.
  - *Measurement Exactitude (ME)*: It is the degree of closeness of measurements of a quantity to that quantity actual value.
    Measurement tool: data extraction from device specifications.
    Target: to be determined
  - *Sampling Rate (SR)*: It is defined as the number of samples per unit of time taken of a continuous signal in order to produce a discrete signal, or the equivalent from analogic to digital. This parameter is related with the characteristics of the analogic/digital converter.
    Measurement tool: data extraction from device specifications.
    Target: to be determined.
  - *Number of A/D Conversion bits (NADCB)*: Parameter used on the analogic digital conversion. On the first stage the input is sampled, and a value is assigned to each analogic value depending on the number of bits of the analogic/digital converter.
    Measurement tool: data extraction from device specifications.
    Target: to be determined.
  - *Sensing Time (ST)*: It defines the elapsed time between two consecutive measures.
    Measurement tool: data extraction from device specifications.
    Target: to be determined.
  - *Storage/sending Ratio (SSR)*: Number of measurements to be stored before they are sent.
    Measurement tool: data extraction from device specifications.
    Target: to be determined.

- KPIs related to **Analysis** capacities:
  - *Single-Sensor Analysis Service (SSAS)* which performs an analysis of individual measurements and relying on input data models.
    Measurement tool: enumeration of SSAS deployed services.
    Target: to be determined.
  - *Multi-Sensor Analysis Service (MSAS)* which aggregates SSAS.
    Measurement tool: enumeration of SSAS deployed services.
    Target: to be determined.

- KPIs related to **Scalability** capacities (see Figure 6):
  - *Number of Concurrent Users (NCU)*
    Measurement tool: enumeration of concurrent users.
    Target: to be determined.
  - *Network Bandwidth Utilization(NBU)*
    Measurement tool: extraction of server performance statistics
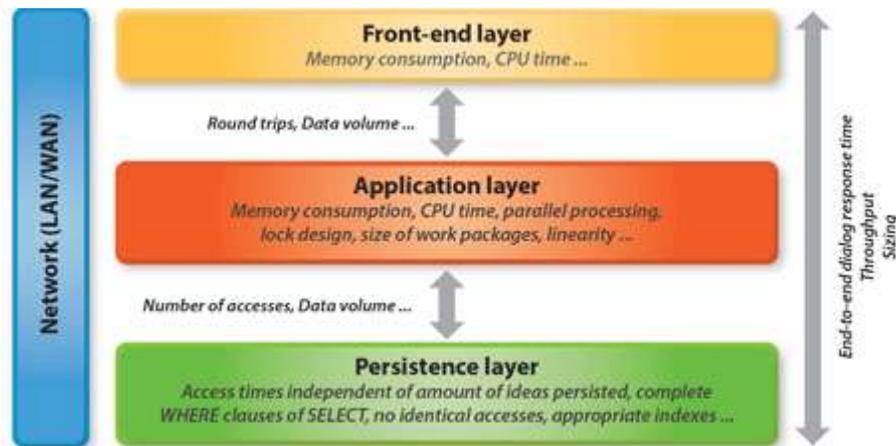   Target: to be determined.

Figure 6. Key performance indicators in performance tests

- KPIs related to **Privacy/safety** capacities:
  - *Authentication* is the process of confirming an identity whether this is a person or a system.
    Measurement tool: enumeration of authentication mechanisms
    Target: to be determined.
  - *Encryption* (e.g. asymmetric cryptography, symmetric-key algorithms, XML Encryption).
    Measurement tool: enumeration of encryption mechanisms
    Target: to be determined.

In the case of AIOTES/IoT related KPIs, the definition will be provided in WP5, more concretely in D5.1 Implementation Plan and Operational Framework, Month 12, where the outputs coming from WP3 and WP4 deliverables will be processed, and the KPIs, describing the performance of the IoT solutions, will be delivered at the same time that the full experiments will start in each DS.

3.2 KPIs data processing

Indicators are collected and classified into the Boxes according to the Indicators Data Model and, more specifically, according to the boxes subcategories and sub-questions (see Figure 5).

At the end, each box covers a specific evaluation domain (e.g. Wellbeing and QOL) answering to a Big Question and consists of a large number of structured indicators.

Each DS will load in a proper box the outcomes from indicators measurement activity. The challenge is now to design methods to aggregate these outcomes and to generate global evidence.

Different methods can be identified to aggregate and process data from boxes, according to the type of outcome and the local context. Data at Global and GLocal scale will be processed by WP6 task force, both quantitative and qualitative data.

In case of quantitative data, that means data coming out from statistics, demographics, economics, clinical studies, we can implement different type of processing approach according to the local context:

a) **Data Aggregation:** cohorts, methods, contexts, conditions of experiment, goals, measurement, frequency are identical in different DSs, so that it's possible to use mathematical tools to aggregate data in a very simple way. This approach provides **Global results.**

For instance, several DS may measure the decrease of re-hospitalization, in the same conditions, i.e., the same pathology, the same treatment during the first hospitalization, the same results of these treatments, the same duration of hospitalization, the conditions in returning home, the same demographics (age, gender, social group, education), the same equipment at home, the same follow-up at home, the same type of caregivers at home, the type of environment (rural, sem-urban, urban) (…). In those conditions, results could be strictly and simply aggregated.

This exercise is easier to do with demographics for instance, we can provide averages following this approach: if we consider all the persons aged more than <75 in the countries engaged in ACTIVAGE, the prevalence of Parkinson disease is % of the population.

b) **Data Adjustment:** cohorts, methods, contexts, conditions of experiment, goals, measurement, frequency are slightly different in the DSs, but can be adjusted. This approach provides **Global results.**

For instance, several DS may measure the decrease of re-hospitalization, in the same conditions, but with small differences: in the group A, all the patients have professional and informal caregivers at home; in the group B, some have, some do not have professional and informal caregivers. If we are able to clearly separates the two population in the group B, or two establish the impact of not having a caregiver on the other items measured, the results could be adjusted and provide Global results.

c) **Data Comparison:** cohorts, methods, contexts, conditions of experiment, goals, measurement, frequency are different in the DSs and can only be analyzed and compared when possible. This approach provides **GLocal results.**

If DS are addressing the same issue with two different means, one can compare the results, without aggregating the results. If a DS addresses the problem of social isolation through a system that simplifies the mobilization of a social worker, and another DS address this question through an app offering online games and meeting, results can be compared but aggregated.

The number of stable and new relationships or the decrease of the feeling of loneliness could be KPIs in the two DS but the results cannot be aggregated because even if using the same questionnaires, answers are not provided in the same context, and cannot be adjusted. But of course, the efficiency of the two solutions can be compared. Those two DS are simply not measuring the same thing. This will be particularly true in case of qualitative data, which means data coming out from focus groups, semi-conductive interviews, observations. A socio-anthropological approach should be used to process and analyze them.

For instance, if two DS choose to investigate the "demand side", in order to understand what it means and what it takes for old persons two remain autonomous and what do elderly people see as their "well-being", they would have to set up a questionnaire, to identify a cohort, to proceed to semi-conductive interviews with elderly people (interviewing or not caregivers, family, friends in addition). What will come up will be significations, motivations, representations, cultural aspects, specificity related to a culture, an environment, a socio-economic group, a community, differences between generations, professions. All those data will provide a precious opportunity to adapt from the beginning the solution to the population it's targeting. But interviews, if one wants to be more precise and accurate than a semantic statistical analysis, can't be aggregated. Interviews of the same cohorts will be interpreted at a local scale, results from different cohorts will be interpreted by WP6 task force.

To allow a smooth and transparent processing, it is very important that the DS provide all the required information about the data: panel's characteristics, methodology, questionnaires, items, etc.

4 The ACTIVAGE "AHA-IoT evaluation tool"

4.1 Description

In a nutshell, the ACTIVAGE "AHA-IoT evaluation tool" is composed of two main views, the *ACTIVAGE Public Evidence Website* and the *AHA Advisor*. Both views will be accessible to public communities (to be noted that it is a separate system with respect to the ACTIVAGE Project website[1]). A third element, the *LSP Dashboard*, being used by project partners upon authentication, allows to collect and visualize information related with the overall pilot, as well as with the single experiments of the DS. Therefore, the LSP Dashboard can be conceptually seen as a tool that collects information that is going to be used and processed to design and develop the two main views in the next innovation phases.

Figure 7 shows the home of the tool, which will provide IoT-AHA information and access to the three menus from the main view.

Figure 7. Home View of the GLocal Software Infrastructure

All these views are gathering information from the ACTIVAGE Evidence Open DB (AEOD), which is the repository that collects information from each DS. Each DS has its own data base, where the Local information and KPIs is stored. The DS databases deliver information to the AEOD following the logic and procedures described in the previous chapter. From a technological perspective, the information may be sent directly to the AEOD or upon pre-processing, in the case that a GLocal information is generated. The overall schema is depicted in Figure 8.
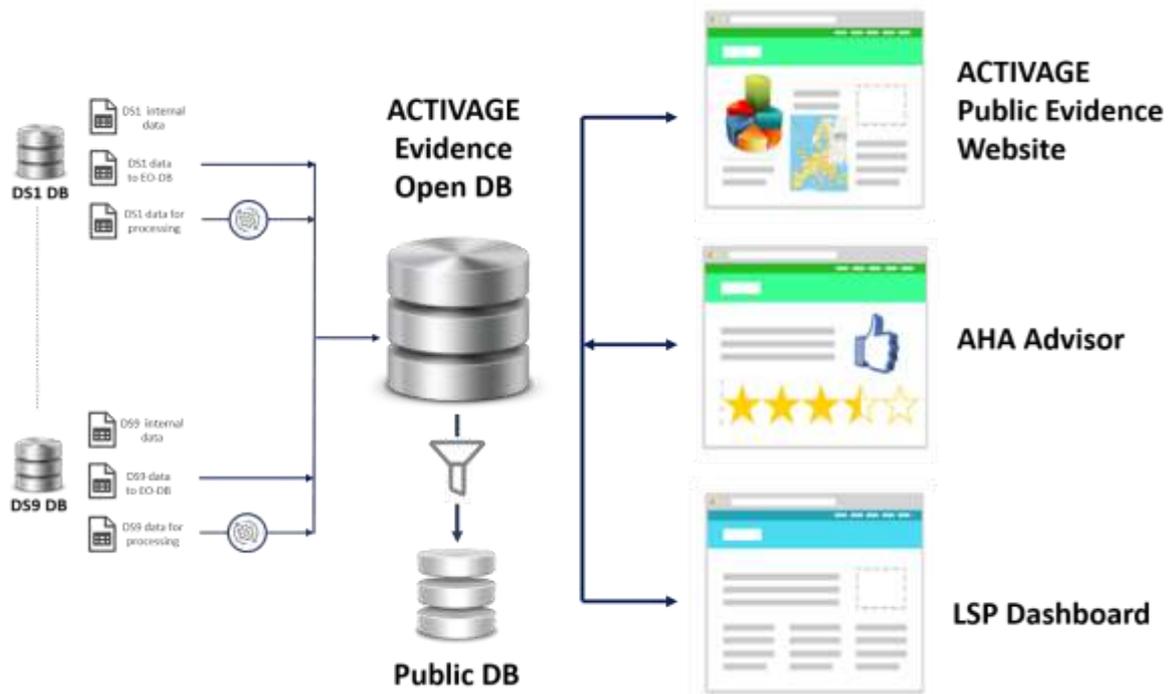
Figure 8: GLocal software infrastructure

4.2 Implementation Phases

The tool versioning strategy is propaedeutic to the implementation and innovation phases of the pilot. As such, development priorities are adjusted to them. The first and most urgent need in M9 is to provide tools for data collection, ready for the deployment in Living Labs and carry out tests for data collection. In M12 all data collection forms will be ready in all aspects: Use Cases, Scenarios, Users, Technology – IoT elements and AHA services. The following versions will be provided, as shown in Figure 9:

- 1st release, M9. LSP Dashboard (Data collection) that will be updated at the beginning of each Innovation phase. , new features and views of the tool will be added at the end of the "Demonstration", "Expand" and "Growth" phases.

- 2nd release, 12. LSP Dashboard (Data visualization)

- 3th release, M21. ACTIVAGE Public Evidence website, to show to the public communities the results of the project

- 4th release, M30. AHA Advisor, which provide stakeholders with an overview of how to convey the project results and suggest them solutions for AHA.
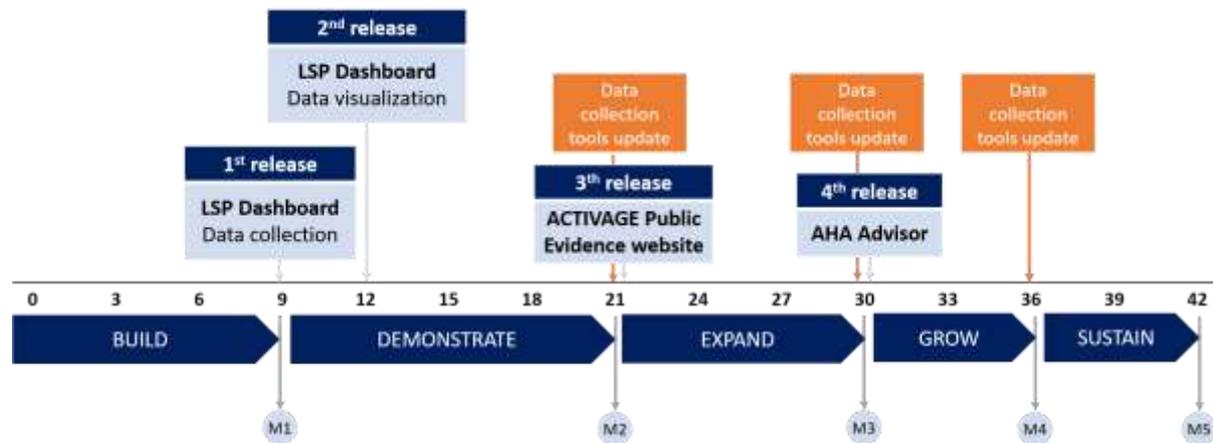
Figure 9. GLocal software implementation phases

4.3 ACTIVAGE Public Evidence Website

The *ACTIVAGE Public Evidence Website* is a public user interface, accessed openly by any person/professional/institution/company that may have an interest in be informed about the data and results that the project is generating.

Results of the Large Scale Pilot and its data generated can be visualized and explored according to different categories and stratification levels. Additionally, search filters and visualization criteria will allow to show information according to different perspectives:

- Deployment Site

- Users sociodemographic data

- AHA services

- IoT elements

- Innovation phases

- KPIs

- Geographical Region

- Use Cases

- User needs

An example is provided in Figure 10, showing results from the experiment conducted in a DS, here, again, an example from the Madrid DS.

Information will be shown according to the relevance, following common sense and high readability, so to be understood from different type of persons with different expertise and background.

The tool will be active, available and accessible after project ends with the aim of offer a rich interface to the whole ACTIVAGE evidence.
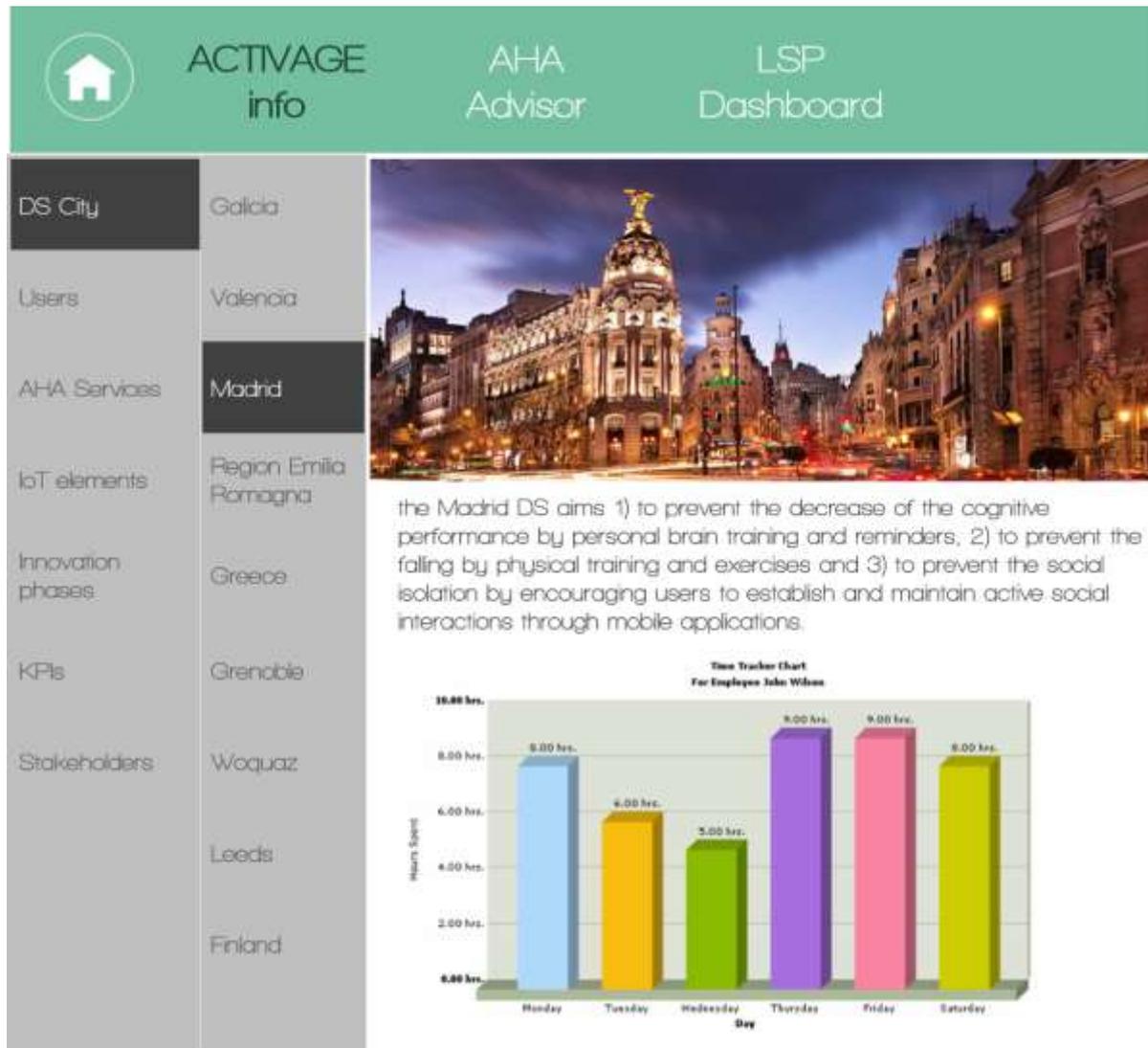
Figure 10. Information shown in the Public Version of the ACTIVAGE AHA-IoT tool

4.4 AHA-Advisor

The **AHA Advisor** will be a tool providing a dynamic reference framework concerning the IoT solutions for AHA domain. It will offer complete information about AHA services and companies available in Europe (not only developed in ACTIVAGE), including benchmarking, real experience and opinions about each AHA solution as well as experts advisors in accordance to your needs.

The AHA-Advisor will be publicly accessible, and the main target audience will be any person or institution with interest to access to AHA services based on IoT technology. Additionally, it will be also an interest forum for AHA companies or institutions which would like to increase or complement their services with new alternatives.

It will include a constantly enriched knowledge base related to:

- Description of AHA services and companies available in each region and country, including the main functionalities, technical requirements and cost.

- Rating and benchmarking of each AHA services in accordance to AHA experts' opinion, customers' opinion and experiences (including end-users, socio/health care service providers) who can post supervised feedbacks and free comments contributing to a true collective intelligence build-up.

- Special discounts and advances if a user would like to contract any AHA service via AHA-advisor.

- Specific AHA services recommendations or suggestions in accordance to the user's needs. In particular, the user introduce her/his current situation and needs applying some specific filters (such as user with poor mobility, risk of isolation, region), and the system gives back information about the most appropriate AHA services and sorted according to the AHA rating.
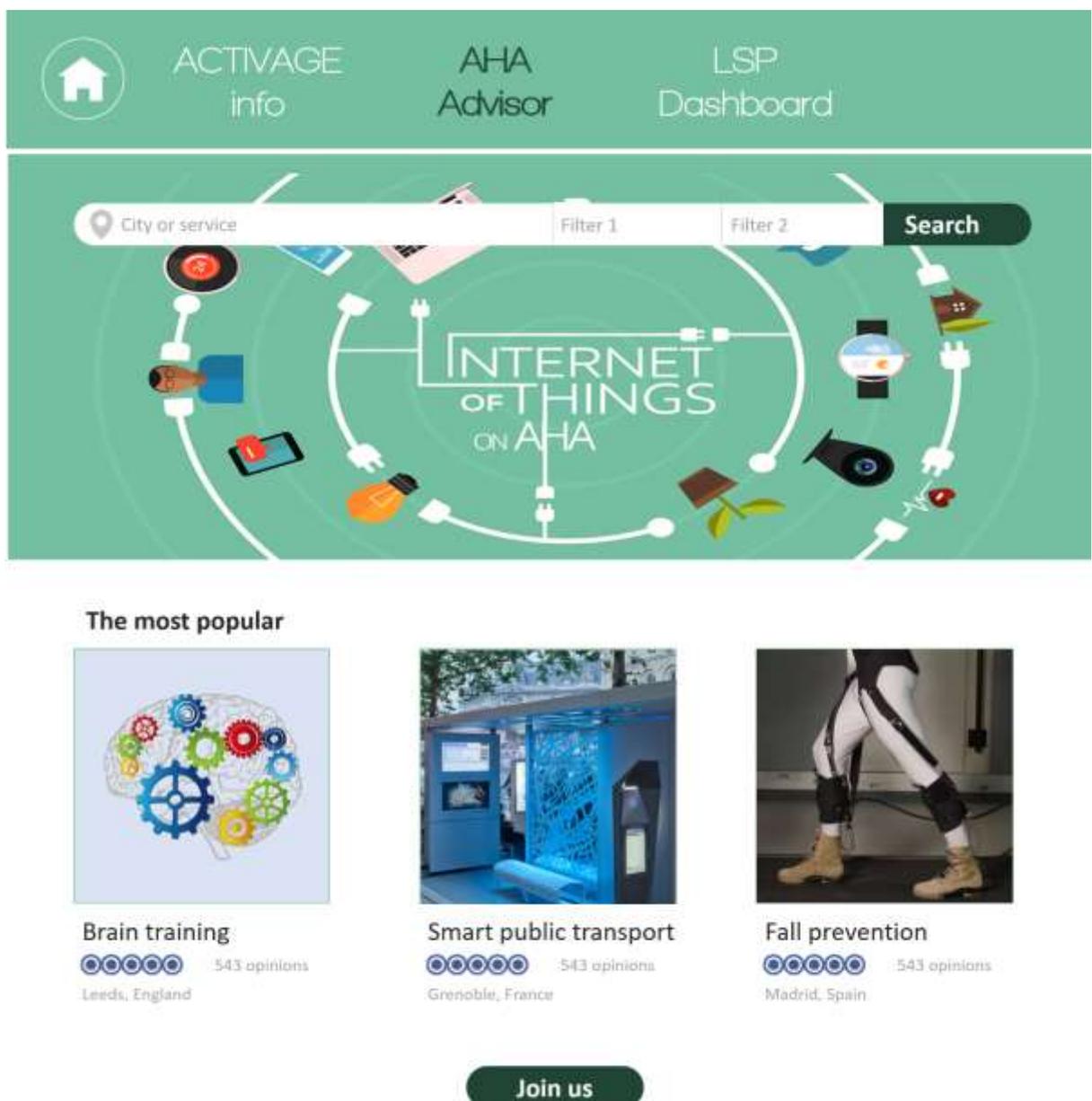
Figure 11. AHA Advisor view

From the **users' side**, **AHA-Advisor** will be able to provide a set of high level services, such as:

- Facilitated searching tool.
- Possibility to compare similar products matching with personal needs.
- Possibility to post comments and feed-backs and to consult the evaluations carried out or posted by others.
- Access to an explicit and documented methodology about a specific solution, supporting tutorial, reference use cases.

From the **supply side**, AHA-Advisor could allow:

- To post dissemination material concerning their solutions to more easily attract users.
- To carry out preliminary fast-track evaluations integrating the user's perspective (according to their needs/ their criteria).
- To consults the evaluations carried out or posted by others.
- To post and value updates and improvements of their solutions.

The AHA Advisor is created in order to accomplish three main objectives:

- To bring closer these AHA services and companies to the end users and institution, increasing the knowledge about the feasibility and status of these solutions and providing a quick access to them.

- To be a "store window" for all the AHA services and companies that would like to expand their business with new on-line alternatives.

- To become a reference of AHA services based on IoT technology, with objective advisory and real opinions from the users.

A first concept of how the AHA Advisor could look like is provided in Figure 11.

This section could be considered as the "first step" of the ACTIVAGE project as an ORGANIZATION FOR ACCREDITATION OF AHA SERVICES BASED ON IoT, having the best knowledge and expertise about the best practices on IoT for AHA.

4.5 LSP Dashboard

All the information from DSs, and other WPs that are involved in data gathering activities, is collected and showed in this section. As mentioned above, this view will be available upon authentication from the project partners as shown in the next figure.

Next figures provide the first version and screenshots that are being implemented.

In this first phase, presented in this version of D6.2, the information is including static and descriptive information from DS, such as name, UCs, technologies adopted, users, etc., as shown in Figure 13.

This tool is designed to have a dynamic nature, allowing that data and information is collected as soon as it is needed or generated. This is done through forms or questionnaires, as shown in Figure 14 and Figure 15, or through data transfer services, that can be automatic (e.g. via a web service) or manual (e.g. a Data Officer from a DS send the results of questionnaires and they are uploaded in the tool).

In future versions, information will be completed and updated according to the needs of DS and of what will be defined as relevant in the project (e.g. definition of the ecosystem defined

in WP7) and in the LSP clusters (IoT solution defined according to a particular nomenclature or taxonomy).
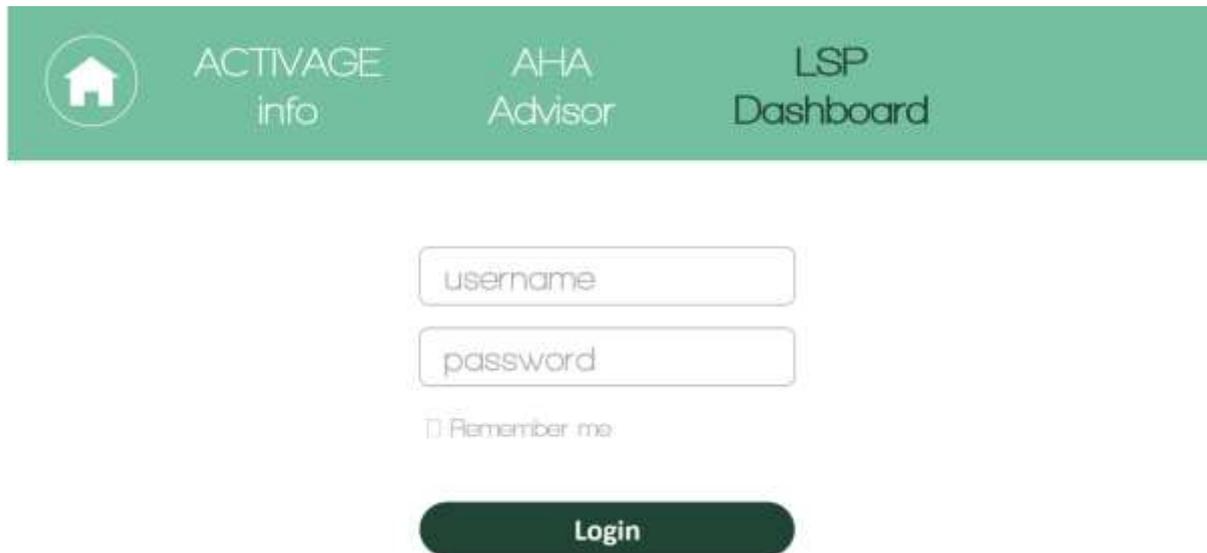
Figure 12. Access to the "LSP Dashboard" will be allowed only to ACTIVAGE partners
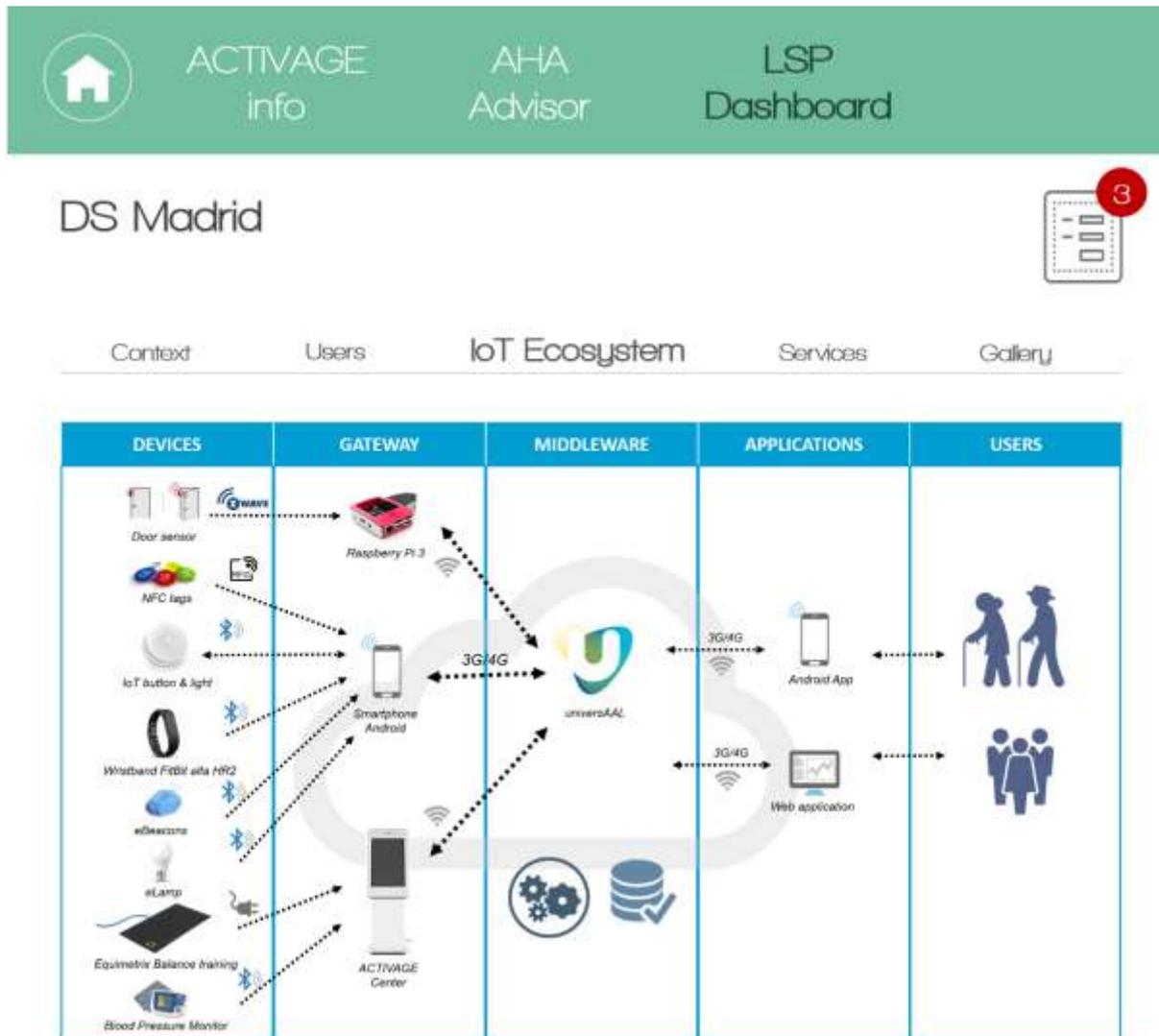
Figure 13. Description of the Technology used in a DS, in this example the Madrid DS

Id	Name	Due Date	State
07	Imported Ucs	12/11/2018	Pending
06	Demonstrate phase info	25/07/2018	Pending
05	New services implemented	08/01/2018	Pending
04	Users	26/12/2017	Completed
03	Living Labs Deployment	19/11/2017	Completed
02	Biuld phase info	01/11/2017	Completed
01	Context and basic info	30/09/2017	Completed

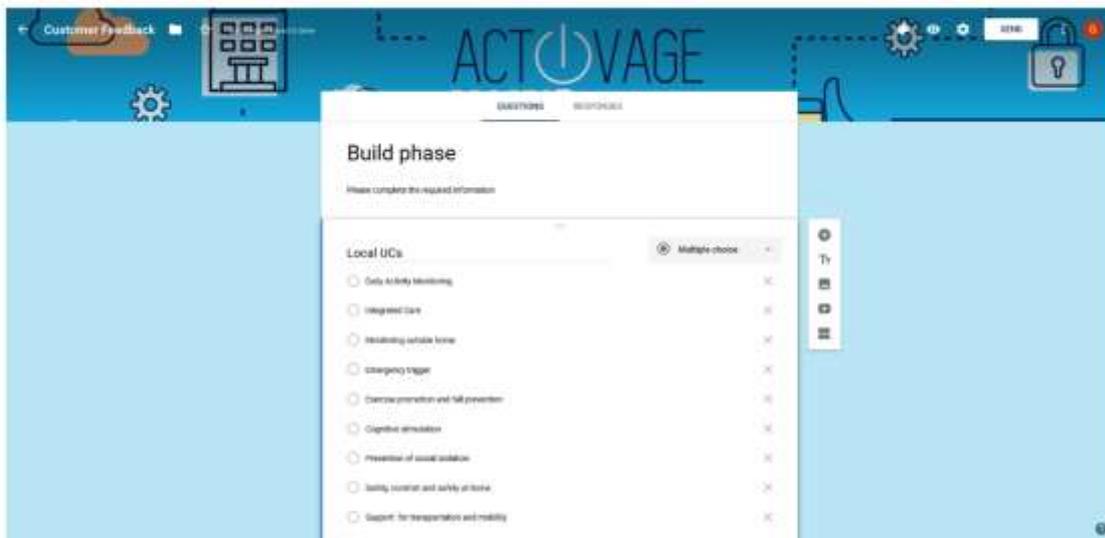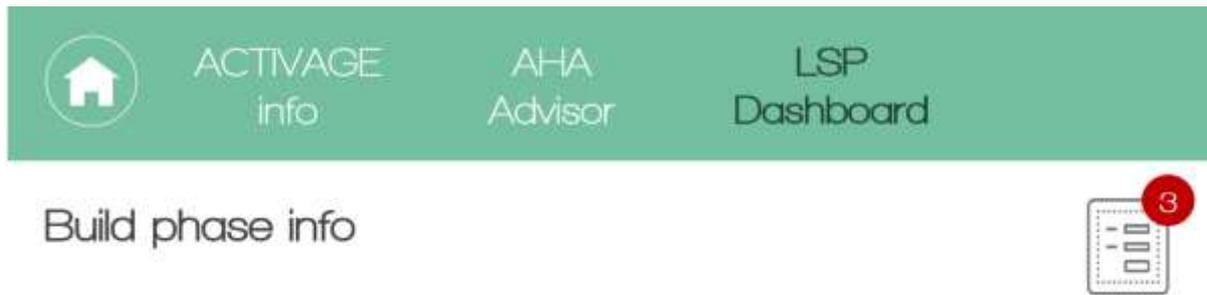Figure 14. Status of a DS, showing an overview of the tasks/activities to be completed

Figure 15. Example of a form that allows a DS to describe the UC implemented in the Build Phase

References

MONITORING, EVALUATION AND REVIEW OF NATIONAL HEALTH STRATEGIES: a country led platform for information and accountability. WHO, International Health Partnership+, Geneva 2011

Health facility & community data toolkit. WHO, USAID and University of Oslo. Geneva 2014

Blackmer, W. S. (2016). GDPR: Getting Ready for the New EU General Data Protection Regulation. Information Law Group, InfoLawGroup LLP, Retrieved, 22(08), 2016.

Appendix A LSP Experiment Protocol

In this appendix, the forms to be used by DS in order to describe the study protocols is provided.

A.1 Project summary

Like the abstract of a research paper, the project summary, should be no more than 300 words and at the most a page long (font size 12, single spacing). Provided preferably on a separate page, it should summarize all the central elements of the protocol, for example the rationale, objectives, methods, populations, time frame, and expected outcomes. It should stand on its own, and not refer the reader to points in the project description.

A.2 General information

Title		Date	
Project/s involved :		ACTIVAGE	
Researchers :			
Name	**Contact info**	**Responsibility**	
	...	...	
Entity			

A.3 LSP Experiment

A.3.1 Introduction: Background information and Rationale

- Background

- Rationale

- (Study Hypothesys)

- Known Potential Risks

A.3.2 Objectives

- Primary Objective (End Point)

- Secondary Objectives (End Points)

- Exploratory Objectives (End Points)

A.3.3 Study Design

We should here introduce the concept of Activage Innovation Path and to present a coherent Study design, covering in detail the Demonstration phase and providing a preliminary design for the next phases (Expand, Growth, Sustainability).

- Type of experiment (e.g., controlled, randomized, doubleblinded...)

- Sample Size

- Study Population

- Participating Sites (Single or Multicentric Study)

A.3.4 Study Enrollment and Withdrawal

- Participant inclusion criteria

- Participant exclusion criteria

- Strategies for Recruitment

- Participants Withdrawal

A.3.5 Study procedures and Evaluation (Methodology)

The methodology section is the most important part of the protocol. It should include detailed information on the interventions to be made, procedures to be used, measurements to be taken, observations to be made, laboratory investigations to be done etc. If multiple sites are engaged in a specified protocol, methodology should be standardized and clearly defined.

Interventions and Procedures should be described in detail.

Standardized and/or documented procedures/techniques should be described and bibliographic references, if not provided earlier should be provided. Instruments which are to

be used to collect information (questionnaires, FGD guides, observation recording form, case report forms etc.) must also be provided.

In the case of a randomized controlled trial additional information on the process of randomization and blinding, description of stopping rules for individuals, for part of the study or entire study, the procedures and conditions for breaking the codes etc. should also be described.

A graphic outline of the study design and procedures using a flow diagram must be provided. This should include the timing of assessments.

A.3.6 Data Management and Statistical Analysis

The protocol should provide information for computer analysis, monitoring on how the data will be managed, including data handling and coding The statistical methods proposed to be used for the analysis of data should be clearly outlined, including reasons for the sample size selected, power of the study, level of significance to be used, procedures for accounting for any missing or spurious data etc. For projects involving qualitative approaches, specify in sufficient detail how the data will be analysed.

- Statistical Plan
- Data Set Analysis
- Description of Statistical Methods
-

A.3.7 Quality Assurance

The protocol should describe the quality control and quality assurance system for the conduct of the study, including GCP, follow up by clinical monitors, DSMB, data management etc.

A.3.8 Schedule of the Study

The protocol should specify the time that each phase of the project is likely to take, along with a detailed month by month timeline for each activity to be undertaken.

Innovation Phases:

- Demonstration
- Enlargement
- Innovation
- Sustainability

Demonstration Phase:
- Enrolment
- Training
- Follow-Up
- Data Analysis

A.3.9 Human Subjects Protection

- Safety Considerations
- Ethics
- Informed Consent Forms

A.3.10 Dissemination of Results and Publication Policy

The protocol should specify not only dissemination of results in the scientific media, but also to the community and/ or the participants, and consider dissemination to the policy makers where relevant. Publication policy should be clearly discussed- for example who will take the lead in publication and who will be acknowledged in publications, etc.

Appendix B   Indicators Data Model Guidelines

In this appendix, the guidelines provided to DS to fill the "indicators data model" are provided.

B.1   Document objective

To provide ACTIVAGE Deployment Sites with a support to fill the "Indicators Data Model".
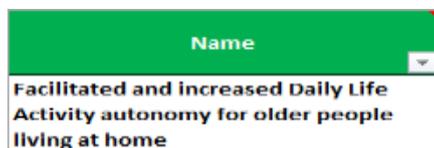
For info and support:

MEDEA	Pietro Dionisio,	p.dionisio@medeaproject.eu
	Elena Tamburini,	e.tamburini@medaeproject.eu
MADOPA	Alexander Duclos,	alexandre.duclos@madopa.fr

B.2   Use of the tool

The "Indicators Data Model" is an easy tool to be filled by each DS according to the following few steps:

1) Define the *name* of indicator you're going to measure:

2) Select the *EU Triple-Win strategy* the indicator refers to (multiple-choice index):

3) Define the *Data Source* or measurement tool you are going to use to measure it and if this is a *standard* scale or not (multiple-choice index):

4) Define the measurement *outcome* and the *target* you aim to reach:

5) Select the *measurement unit* used (multiple choice), *where* the indicator measurement took place (multiple choice) and the *dimension* of data (multiple choice):

6) Define *how often* the measurement is repeated:

7) Define to which "*Big Question*" and related "Sub categories" the indicator refers to, and related Sub-question and Use Case the indicator refers to (each of these columns foreseen a multiple choice index). The Big Questions are the following: **1) Wellbeing, 2) Clinical benefit, 3) Organization of care, 4) Profitable, 5) Acceptability, 6) Sustainability, 7) Ethical, Legal, Social or Cultural Issues, 8) Reliability and 9) IoT Performance:**

B.3 Filling phases

Each DS has to fill the Indicators Data Model tool in two main different phases:

1. **Pre- experiment phase/Build phase**

   To fill the *green columns* of the table according to your Local KPI table

2. **Experimental phase/Demonstration phase**

   Each DS will have to fill the other columns according to own experiment plan (i.e. the Outcome column will be filled when you collect the outcome value for each indicator).