# Deliverable 4.1
# Demonstrator and Piloting Plan

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| **Description:** | This deliverable documents the plan for the development of the seven demonstrators, the methodology and materials for the pilot trials. The starting point of the methodology is the identification and monitoring of communities. With this interaction, specific pilots to each communities' needs are proposed and several evaluation indicators are examined. |

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**Executive Summary**

This document presents the methodology by which pilots are formed in the context of the CAPSELLA project. The actions taken in the context of WP3 are closely connected in the planning, design and development of the proposed pilots. In WP3 the ways of requirements and needs collection of the communities are presented and a connection is made with WP4; WP4 builds upon the methodology followed in the previous work package. The overall methodology includes the interaction between partners with the corresponding communities. By applying several tools (for instance face - to - face meetings, questionnaires, workshops etc) project partners are able to monitor the specific needs and requirements for each community. Following this procedure, a number of pilot applications have been proposed. In this deliverable the objective is to describe the piloting plan, which includes the ways that pilots are going to be developed and the ways that these pilots are evaluated properly.

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## 1. Introduction

In this document the methodology of the pilot development is analyzed. The actions of Work Package 4 (WP4) are closely connected with those of Work Package 3 (WP3). In WP3 the interaction of partners with communities is described resulting in pilots which cover all three scenarios; seed, field and food. The outcomes of the aforementioned procedure (WP3 activities) are used as input to design, define, and implement the piloting activities in the context of WP4.

The pilot is an initial small-scale implementation that is used to prove the viability of the project idea. This could involve either the exploration of a novel new approach or the application of a standard approach recommended by outside parties. Pilots are subjected to an evaluation process during the phase of deployment. In order to measure the pilot implementation's performance, Key Performance Indicators (KPIs) are used. The usefulness of piloting plan lies on merging the planning and implementation stages of project development, while evaluates software, procedures and alternatives. The expected results of the analysis are the further elaboration of the pilots and the investigation of technical implementation and eventually the evaluation of the demonstrators.

The rest of this document is analyzed as follows; piloting plan is described in section 2 while an explicit description of each pilot is presented in section 3.

## 2. Piloting Plan

Pilot is a trial run, namely a small – scale version of a larger project. The piloting plan is an important step which facilitates the monitor of potential problems, as well as to prevent the deterioration of them and finally to ensure the accomplishment of several goals before full implementation of the project takes place. This section explores the necessity of a piloting plan by presenting its advantages.

Typically, a pilot program begins with a proposal that lists the objectives of the pilot program and documents how the program will be carried out. The documentation should also provide a time-line for the pilot and key performance indicators for how success will be determined.

### 2.1 Necessity of a piloting plan

This section provides some of the most important advantages for which piloting plans are widely used, in research projects:

- Piloting plans help to ensure the full – scale implementation. Therefore, piloting plan can serve as trial runs and can help in determining any adjustments to the implemented plans or adaptations to the programme. It also reveals hidden challenges or obstacles which might arise during the implementation phase and ensures the good preparation of all the involved partners.
- The piloting plan is an opportunity to measure the target population's reaction to the program. The samples which are collected so as to form focus groups are similar to the program's specific target population. One of the most important function of piloting plans is to confirm whether or not the program meets communities' special needs and requirements, and, if not, minor adaptations to the program are appropriate.
- Pilot testing can help in taking better decisions regarding the allocation of time and resources. Pilot testing of program can help in determining if spend more time or resources on particular aspects of the program is appropriate.

  Piloting plans ensure the degree of preparation of success measuring of the program. A pilot test can highlight any adjustments to the evaluation plan that might be necessary to ensure that the desired outcomes are measured in an appropriate way. The piloting test will give the chance to the involved partners, who are responsible of implementing the pilots, to work together and well before the full implementation to be able to come up with solutions in case an issue arises regarding the distribution and collection of the evaluation data.

### 2.2 Pilots Methodology

In this section the methodology which has been followed in CAPSELLA so as the pilots to be formulated is described. In figure 1, it is depicted the conceptual framework on which the procedure was based.

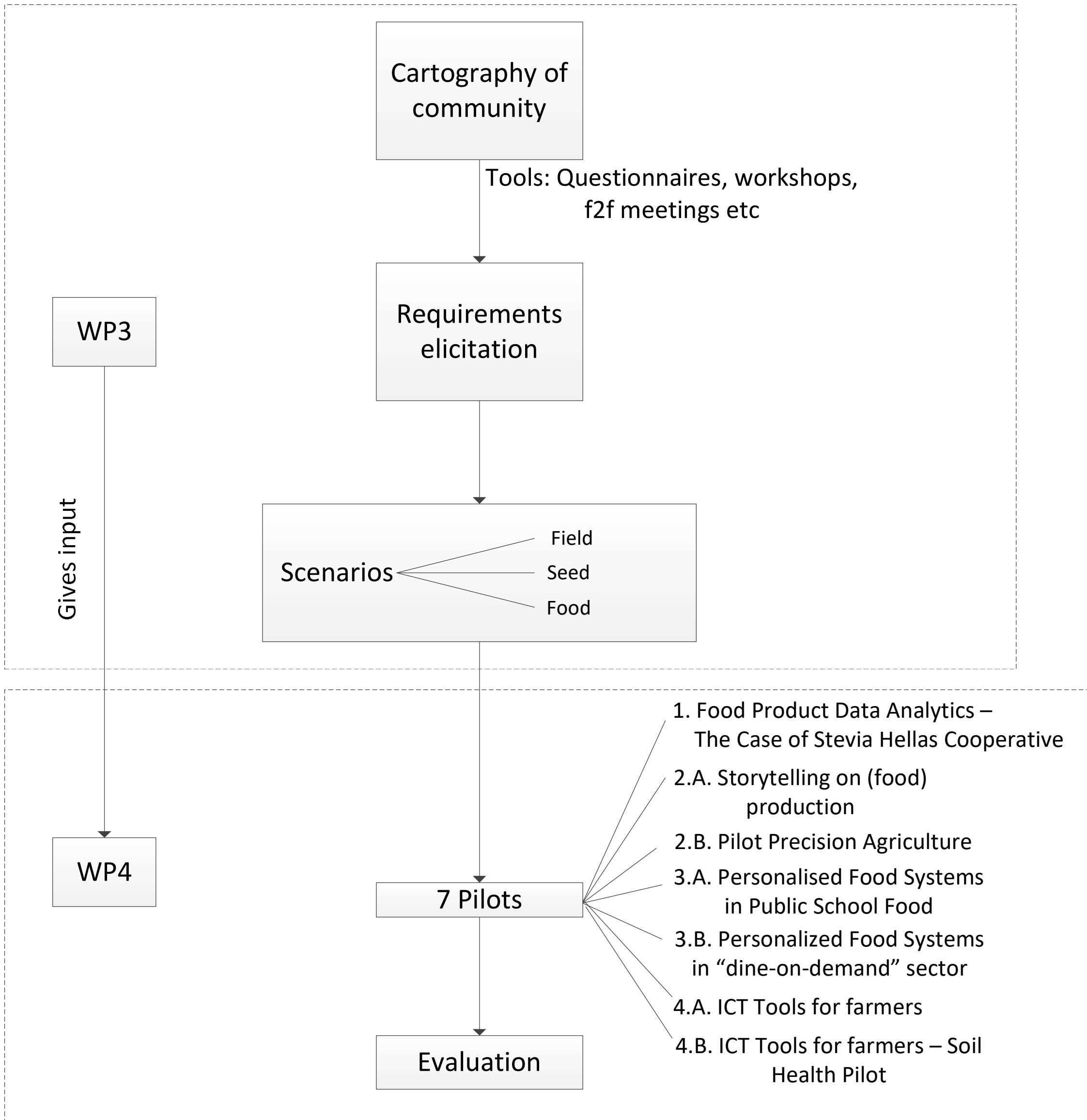


**Figure 2-1:** Conceptual model for pilot methodology

The actions taken in Work Package 4 (WP4) are, to a large extend, interconnected with the actions that will or have been taken in Work Package 3 (WP3). Consequently WP4 builds upon the WP3, in terms of clarifying the proposed pilots, describing the tools by which these pilots are going to be (partially or as whole) implemented and the tools by which they will be evaluated. The methodology includes the cartography of communities, requirements elicitation and the formulation of scenarios. These actions are part of WP3; however they provide input for actions which are going to be implemented in the context of WP4 and specifically for the description of the pilots as well as their evaluation.

### 2.1.1 Interaction with communities

The method by which a pilot is created, is described in Figure 1. It starts with the identification of the communities (cartography of communities, T3.1 – WP3) and proceeds with the tools used by partners (AK/SSSA/RSR/ZLTO/ZPH) to interact with communities. These tools have been analyzed in previous tasks (T3.2 – T3.5, WP3) and are, among others, questionnaires, interviews meetings (either face – to face or online) and workshops. With the application of these tools, partners can monitor the requirements of the communities and propose pilots which will be useful for their specific needs. The specific needs of each community that belong to either the seed, field and food scenario, were analytically presented and discussed in the 1st CAPSELLA Worksop which took place in Voltera, Tuscany on the 30th and 31st of May 2016 (http://www.capsella.eu/first-workshop/). During the discussion conducted between the key – personas of each community with the corresponding project partner, 7 pilot applications have been proposed and are going to be developed and evaluated.

### 2.1.2 Pilot Development

The pilot development concerns the method by which the proposed pilots are going to be implemented, as well as, the way that these pilots are going to be evaluated. In the existing literature a wide variety of tools have been suggested for the development of the pilots however hackathons are the widely used ones (Briscoe, 2014).

**Hackathons** relate to broad trends in "making" in society (Agre, 1997; Kuznetsov and Paulos, 2010; Lindtner and Li, 2012) and they have two distinguishing characteristics. They are technical and they are events. When participating in a Hackathon, attendees collaborate in developing technical systems, such as applications, software, or visualizations. Success or failure comes, and a technical artifact is vital for a valid argument. Hachathons are characterized less by their material composition and more by their activities limited by time.

Hackathons may be seen as a type of co – design which non – experts' co – create a product with business owners. Originated in the field of software development, Hackathons are about building working technical prototypes with software and data in a very short period of time (one or several days). Consequently, Hackathons are technology driven and the actors are business case owners seeking for business solutions or opportunities and software developers. Stakeholders, profit from their intellectual resources of software developers.

An overview of Hackathons is presented in the following table:

| | |
|---|---|
| Duration | 12 - 48 hours |
| Stakeholders | Organizations with business case/challenges, Software Developers |
| Participants | Software developers Companies |
| Authority | Business - led |

| | |
|---|---|
| Relationship | |
| Goal | Technical concepts to explore future innovation |
| Results | Business concepts, Technical prototypes (Artifacts) for future product development |

**Table 1:** Hackathons overview.

Hackathons typically start with one or more presentations about the event, including the challenge prizes if available. Aims or challenges can be gathered beforehand, and they can be shared or kept secret depending on the format of the event. Alternatively, they can be generated at the event, or the event may be focused around a specific task. Suggestions or requirements for the size and participant types for the teams sometimes follow this. Then participants suggest ideas and form teams, based on individual interests and skills. Sometimes they will pitch their ideas to recruit additional team members, because without sufficient technologists paper prototypes have to be utilized. Then the main work of the hackathon begins, which can last anywhere from several hours to several days. However, they typically last between a day and a week in length.

At the end of hackathons, there is usually a series of demonstrations in which each group presents their results. However, hackathons intended simply for educational or social purposes sometimes do not require the participants to create viable software prototypes. There is sometimes a contest element as well, in which a panel of judges select the winning teams, and prizes are given. At many hackathons, the judges are made up of organizers as well as the sponsors of the event. In addition hackathons and challenges are organized as a crowd sourced way for collecting requirements, developing solutions, and offering input for the registry of problems.

In specific, AgroKnow organizes the first hackathon for the needs of CAPSELLA project (https://www.eventbrite.com/e/1st-capsella-hackathon-tickets-29045245110). Partners have contributed with challenges relative to their pilots. Participants in this hackathon will work on code developing, design of business plans and ideas on how these challenges can become a feasible solution. These challenges are a gap that stem from the requirements and needs of communities, include the available datasets and finally form a feasible goal to be achieved by hackathon's participants. Participants are expected to work on the available data which are provided by the organizers, so as to come up with technical solutions which eventually be used for the demonstrators. Several datasets are collected in order demonstrators to be developed.

These datasets are:

- Online databases (for instance AGRIS database), data extracted from social media channels and data from other sources (for instance data concerning agricultural machinery and food safety)

- Data types such as satellite data concerning location , images, photos and videos, data collected by consumers relating to their preferences and finally data collected from social media
- The data sets and data types which will be required for the proposed pilot application include data collected from existing databases such as Crop-r.nl in which the 3 parcels in the experiment are selected, consumer preference data, raw and pre processed satellite images (http://www.spaceoffice.nl/nl/Satellietdataportaal/) and GIS data (different presentations of the terrain and soil conditions).
- Data collected from producers' website, environmental data from national records, macro-economic data from online databases (such as Eurostat), consumer preferences data (collected from Eurobarometer), data from social media channels and Wikipedia.
- Experimental data on the on-farm performance of varieties, mixtures and populations, external research data (reports, publications, etc.), local environmental data and farmer data (location of the farm, farm management approaches, etc.)

- Weather data:
  - Historical weather data from ECMWF re-analysis (weather foresting corrected with actual data – available for all Europe: http://apps.ecmwf.int/datasets/data/interim-full-daily/levtype=sfc/)
  - Actual weather data from Veneto region: http://dati.veneto.it/dataset/dati-meteo-arpav
  - Actual weather data from other regions
- Soil data:
  - European Soil Data Center – European set of maps about soil types, soil condition, soil threats: http://esdac.jrc.ec.europa.eu/
  - Veneto region data about the maximum amount of sewage sludge for each administrative division: http://www.arpa.veneto.it/dati-ambientali/open-data/file-e-allegati/carico-unitario-fanghi-depurazione
- Other Spatial data:
  - Copernicus Datasets: the Copernicus data (Sentinel 2) will be tested to collect info about the farm vegetation coverage
  - Italian Open Spatial datasets: http://www.pcn.minambiente.it/GN/
  - Greek Open Spatial datasets: http://geodata.gov.gr/
  - Openstreetmap – Global crowdsourced map: www.openstreetmap.org

The majority of these datasets is incorporated in the CAPSELLA platform and has been contributed by several partners.

The technical partners who are going to provide support to pilot partners regarding the development and deployment of each demonstrator are the ATHENA research center and Agroknow.

### 2.1.3 Pilot Evaluation

In this section, the methods, tools and evaluation metric that will be used in the context of the CAPSELLA pilot trials, are described. The proposed experiments for evaluation are explained.

*Review of evaluation methods*

Evaluation methods can be either quantitative or qualitative methods in nature. Table 2 provides a summary of various testing and evaluation methods that allow for comparison (Holzinger, 2005, Matera *et al*., 2006, Rohrer, 2008, USINACTS, 1999). The selection of the evaluation methods to adopt was made by taking into account our requirements on evaluation, which cover the following aspects:

- Use of qualitative and quantitative methods in order to ensure an appropriate number of users (quantitative) and depth of involvement (qualitative);
- Consideration of the difference between opinions versus actual behaviour (i.e. what users say about tested the pilot demonstrators vs. what they actually do with them); and
- Consideration of different contexts of actual use: i.e. evaluation with selected users in the lab environment versus open, online use of tools and services.

The assessment of which methods should be selected depends on the pilot specifications for each demonstrator. Thus, different dimensions have been considered in the selection of the set of evaluation methods. In the table below the selected methods are highlighted (in grey), and briefly described.

Evaluation methods used in software projects include the experiments, interviews, surveys, observations, focus groups etc. Table 2 provides a summary of the properties of each method reviewed in USINACTS guideline (USINACTS, 1999) to compare them and choose the most appropriate for CAPSELLA requirements for the evaluation phase. The CAPSELLA controlled pilot trials will be based on structured interviews, usability evaluation, surveys (on-site and on-line questionnaires) and input logging, which support the aims of the evaluation methodology.

| Method | Lifecycle Stage | Users | Main Advantage | Main Disadvantage |
|---|---|---|---|---|
| Experiments | Components design (hardware or software).<br>Establishing generic principles for system design. | Usually few, but depends on complexity | It allows testing design hypotheses or alternatives in an optimal way. | Complex techniques involved, which requires expert knowledge for maximum benefit.<br>Usually made in the usability laboratory, and not in the real use environment. |
| Interviews | User requirements. Task analysis | 5 | Flexible, in-depth attitude and experience probing. | Time consuming.<br>Hard to analyze and compare. |

| | | | | |
|---|---|---|---|---|
| Observation | Task analysis Usability testing | Several (>3) | It is made in real use environment. | Very costly. Difficult to analyse, and to know the reasons for behaviour. |
| Usability testing | Early design, "inner cycle" of iterative design | None (it is made by experts) | Finds out individual usability problems. Can address expert user issues. | Does not involve real users, so does not find "surprises" relating to their needs. |
| Focus groups | User group feedback | < 10 / group | Spontaneous reactions and group dynamics. Allows to find out opinions or factors to be incorporated in other methods (i.e., surveys) | Hard to analyse. Low validity. |
| Input logging (Web analytics) | Final testing, follow-up studies | At least 20 | Finds highly used (or unused) features. Can run continuously. | Analysis programs needed for huge mass of data. Violation of users' privacy must be prevented. |
| Surveys (User Feedback) | Follow-up studies. Also for user requirements. | Hundreds | Tracks changes in user requirements. Analysis of user's opinion for the working system in its real environment. | Special organization needed to handle replies. |

**Table 2:** Evaluation methods (source: USINACTS, 1999)

*Experiments*

Experiments allow to obtain "strong" conclusions about research hypotheses, and to make optimum decisions between competing alternatives. In addition, using appropriately the experimental framework the obtained knowledge is accumulative, the continuous replications and variations of the conditions in a particular series of experiments allow the researcher to obtain more data to confirm or not his or her hypotheses. Experiments are essential to develop guidelines that can be generalized to a broader scope than the case that has been tested.

Experiments may become really complex, so it is important to clearly point out its requirements so that the usability expert can obtain the maximum benefit of these powerful techniques:

- Experiments are the best method to test between competing hypotheses or alternatives. This also means that, for really making an experiment, there must be alternative systems or situations to be compared. In system development this can be complex, difficult, or impossible. However, they are usually very easy to do in the prototype phase.

- The basis of any experiment is control. The more variables are controlled, the better. However, this does not mean that for controlling the variables they should be included in the experimental design.
- Experiments are never made in isolation. It is a complex and costly technique, which only gives its full potential when made in a most planned and structured way. Therefore, think on any particular experiment not as the final part of a research program, but as the beginning of a series of experiments to iteratively find out the solution to the hypotheses. The basic concept of experiments is replication.
- Detailed design of all aspects of the experiment is essential. For complex research situations (i.e., many interacting factors), avoid complex designs as those including many experimental factors, and try to solve the complex problems in an iterative way, eliminating and controlling more factors in each step. Experiments are not the best method to handle the complexity of many applied usability evaluations, but used appropriately can provide response to surprisingly complex questions.
- Sampling of the participants in the experiments (usually called subjects) is an essential phase of the experimental method. Although it is very often neglected, a rigorous sampling is the best guarantee to have generalizable results from the experiments. In this sense, we do not consider these methods as different from those as surveys or observation.

The controlled experiments have a number of advantages (Stufflebeam, 2001) and they focus on results and not just intentions or judgments. They provide strong methods for establishing relatively unequivocal causal relationships between treatment and outcome variables, something that can be especially significant when program effects are small but important. Moreover, because of the prevalent use and success of experiments in such fields as medicine and agriculture, the approach has widespread credibility.

*Interviews*

Interviews are a very helpful evaluation tool for gathering participants' feedback, allowing for direct interaction between the analyst and the individuals for whom the piloting event is being considered or for whom it is specifically intended. This interaction can provide clarification on various needs. For the stakeholders, this part of interviews is important of the collection of assessment process, providing valuable feedback on the evaluation of the service demonstrators. However, in order to provide a high level of qualitative feedback, interviews must be conducted in a consistent manner (McClelland, 1994). Research has shown that interviews are the most effective means for gathering feedback and that their yield of data is richest (Bloom, 1998). The major advantages of interviews are that they:

- Produce direct, observable feedback

- Produce excellent qualitative data
- Can be used in a structured (forced-choice) format thereby producing quantitative data on objectives which are focused and well defined
- Can be used in a non-structured (open-ended) format thereby generating feedback on objectives which have been only broadly defined
- Can probe for meaning of responses
- May create participant willingness to disclose sensitive information
- Can control when and how questions are asked

*Questionnaires*

Questionnaires are among the easiest and simplest tools for gathering individuals' feedback data. A questionnaire offers several advantages and disadvantages (Crompton, 1996). The advantages are that it covers a lot of information in a simple format, it allows for anonymity, perhaps eliciting more genuine responses, it is fairly simple to administer and easy to analyse. The disadvantages is a difficulty in getting a useful response rate, open ended questions are more difficult to categorize, responses may be based on the more memorable events, any follow up must be done through interviews, and it is necessary to keep the questions focused and to ask the right kind. It requires substantial planning time.

When building a questionnaire, the choice for a specific question form depends on the testing aims and for precision with which it has to be measured (USINACTS, 1999). For the scope of CAPSELLA evaluation, questionnaires will include questions of different formats (open ended questions, multiple choice, nominal or grade scales etc.). For example, in cases that users are asked to express their opinion with complete freedom, open ended questions will be used, while in cases that they are asked to make their subjective choice from a limited set of alternatives, will be used questions with grade scales.

*Usability evaluation*

Usability is widely acknowledged as one of the most important factors, which can directly affect the overall acceptability and success of any ICT application and service.  Usability is defined in ISO 9241 as "the effectiveness, efficiency and satisfaction with which specified users achieve specified goals in particular environments":

- Effectiveness refers to the accuracy and completeness with which specified users can achieve specified goals in particular environments,
- Efficiency refers to the resources expended in relation to the accuracy and completeness of goals achieved, and
- Satisfaction refers to the comfort and acceptability of the work system to its users and other people affected by its use.

The main quality components attributed to usability (Nielsen, 1993) can be summarized as follows:

- Learnability: how easy is it for users to accomplish basic tasks the first time they encounter the design?
- Efficiency: once users have learned the design, how quickly can they perform tasks?
- Memorability: when users return to the design after a period of not using it, how easily can they re-establish proficiency?
- Errors: how many errors do users make, how severe are these errors, and how easily can they recover from the errors?
- Satisfaction: how pleasant is it to use the design?

Usability can be evaluated through a number of different methods and techniques (Matera *et al.*, 2006; Holzinger, 2005), which are generally divided into inspection methods (without end users) and test methods (with end users) (Arh and Blažič, 2008). Inspection methods are methods for identifying usability problems and improving the usability of an interface design by checking it against established standards (Holzinger, 2005). These methods include evaluation, cognitive walkthroughs, and action analysis. Testing with end users is the most fundamental usability method and it provides direct information about how people use our systems and their exact problems with a specific interface (Arh and Blažič, 2008). In case of CAPSELLA controlled pilots, the methods of Cognitive Walkthrough and Thinking Aloud could be used.

*Web analytics*

Web analytics is the measurement, collection, analysis and reporting of Internet data for purposes of understanding and optimizing web usage[1]. Web analytics is not just a tool for measuring website traffic but can be used as a tool for research, as well as a means to determine and improve upon the effectiveness of a portal (Books, 2010). Web analytics is an important tool which will enable us to analyse the profile of the service users, reveal their preferences regarding the tested services and identify possible problems that they encountered. The variables, which could be used in the CAPSELLA evaluation process, based on their paradigm, are presented in Table 3.

There is a lot of existing log file analysis environments, like Google Analytics[2], that can track the visits and document the usage of the service demonstrators. Google Analytics can support in the comparison of inferred user profiles, preferences, etc. of the CAPSELLA demonstrators. Statistics reports that will be used for monitoring the Integrated Services will include:

- Descriptive statistics of the Integrated Services: For example, statistics such as total visits, total page views, average time for a reference period etc., indicating the general recognition, access and use of the services;

[1] http://www.webanalyticsassociation.org

[2] http://www.google.com/analytics

- User level statistics: Statistics on user activity in/with an service demonstrator, for example, differences between current and foreseen implementation;

| Variable | Description |
|---|---|
| Visits/day | Visits per day per integrated service demonstrator |
| Bounces/day | Bounces per day per integrated service demonstrator |
| Page views/day | Page views per day per integrated service demonstrator |
| Unique visitors/day | Unique visitors per day per integrated service demonstrator |
| Average time on site | Average time on site for users per integrated service demonstrator |
| Average time on page | Average time on page for users per integrated service demonstrator |
| Pages per visit | Number of pages per visit per integrated service demonstrator |
| Visits from search engines | Number of visits from search engines per integrated service demonstrator |
| Search depth | Average number of pages that user views after using portal search function integrated service demonstrator |
| Total unique searches | Total number of unique searches using portal search function per integrated service demonstrator |
| Number of keywords used in portal search | Total number of keywords used in portal search per integrated service demonstrator |

**Table 3:** Variables to be used

*Review of evaluation tools*

There are various evaluation tools available for data collection and measurement, which include questionnaires, performance measures, checklists, thinking aloud, audio-video recording, etc. The following table (table 4) provides a summary of the properties of the evaluation tools that were reviewed in USINACTS guideline (USINACTS, 1999) to compare them and choose the most appropriate for the evaluation of the CAPSELLA demonstrators.

For the evaluation of the CAPSELLA demonstrators, the tools of questionnaires and the input logging are expected to be used. Through questionnaires, we can find subjective user preferences and it is an easy way to repeat once a validated instrument is developed. The main reason we selected input logging are that it provides us with objective results that are easy to compare.

| Evaluation tool | Evaluation method in which it is used | Advantages | Disadvantages |
|---|---|---|---|
| Question-naires | Surveys<br>Experiments<br>Structured inter-views | Finds subjective user preferences. Easy and cheap to repeat once a validated instrument is developed. | Pilot work needed to val-idate the instrument. |
| Cognitive Walkthrough | Usability testing<br>Experiments | Easy and cheap to repeat once all the test case forms are developed.<br>Very good at identifying certain classes of prob-lems with a Web portal or software | Difficult for expert evalu-ators to consider the procedures from the perspective of an inex-perienced or naïve user |
| Performance measures | Input logging<br>Experiments | Objective measures.<br>Results easy to compare. | Does not find subjective constructs (opinion, atti-tudes, satisfaction). |
| Thinking aloud | Experiments<br>Interviews | Points out cognitive pro-cesses implied in the use of the system. | Unnatural for users.<br>Hard for expert users to verbalise.<br>Information is difficult to analyse. |
| Audio-video recording | Observation<br>Experiments | Records all behaviours and can be kept for anal-ysis in the future | Behaviour has to be cat-egorized.<br>Very costly |

**Table 4:** Evaluation tools (source: USINACTS, 1999)

*Evaluation metrics*

This section provides information about the properties from the CAPSELLA demonstrators that will be measured in order to collect useful feedback for the success of the evaluation process. An indicative list of evaluation metrics has been proposed by Shani and Gunawardana (2011) and presented in table 5.

| Evaluation metric | Explanation |
|---|---|
| User preference | The involved users in the evaluation are not always equal, since the system (i.e. the demonstrator of one CAPSELLA pilot) could be interested mostly for users with specific characteristics and needs. |
| Accuracy | Prediction accuracy means that the system provides more accurate predictions according to the queries by the user. |
| Confidence | Confidence can be defined as the system trust in its results to the user's queries. |
| Trust | This property refers to user's trust on the results of the system |
| Novelty | It refers to the users' feedback, whether they were already familiar with the proposed solution by the system (Jones & Pu, 2007), in our case the CAPSELLA demonstrators. |
| Serendipity | It refers to the measurement of how surprising the successful results of the system (CAPSELLA demonstrator) are. |
| Diversity | It is generally defined as the opposite of similarity, which refers to the wide range of results that could be interested for the user. |
| Utility | Utility refers to the value that either the system or the user gains from the results. |
| Risk | This refers to the potential risk that it could be associated with the results of the system. |
| Robustness | Robustness is the stability of the system in the presence of fake information (O'Mahony *et al*., 2004). |
| Privacy | This refers to the privacy of the data, that user provides willingly to the system in order to get the results in his query. |
| Adaptivity | This refers to the rapidly change of the collection data or the interest over the data may shift. |
| Scalability | The systems are usually designed to help users navigate in large collection of data and to scale up to real data sets. |

**Table 5:** Evaluation metrics (Shani & Gunawardana, 2011)

*Economic and societal Key Performance Indicators (KPIs)*

One of the major parts in project implementations is information. Information may be derived from various sources, among which, measureable and quantifiable indicators. Key Performance Indicators (KPIs) is a measurable value that demonstrates how effectively an organization, a project or any form of system, is achieving key objectives. There are two types of KPIs; high – level KPIs which focus on the overall performance of the enterprise and the low – level KPIs which focus on low level processes.

Except for KPIs, there are other indicators for retrieving information regarding the operations being conducted (in a project, organization, etc). These types of indicators are the following:

Key Results Indicators (KRIs): Provide information as to how well the operations have been implemented. In a way KRIs act as a validation and correction tool of KPIs.

Performance Indicators (PIs): Provide information regarding the methodology and approach of the operations being conducted.

Generally KPIs provide information in areas (organizations, projects) with high level of diversification of the underlying actions and operations. Surrogate measures are used to proxy the latent constructs. The segregation of KPIs according to the functionality has been analyzed in the literature. Bunte et al. (1998) indicates that KPIs should relate to efficiency and effectiveness of the supply chain and the corresponding actors. In the special case of agri-food supply chains, KPIs are clustered generally in four main categories; efficiency, flexibility, responsiveness and food quality. All the aforementioned categories impose a direct or indirect effect on the performance of the supply chain. The KPIs are shown in the next table (table 6) along with a corresponding definition (Beamon (1998, 1999a), Bowersox and Closs (1996), Hobbs (1996), Persson and Olhager (2002), Lai et al. (2002), Womack and Jones (2002), Gunasekaran et al. (2001), Van der Spiegel (2004), Beamon (1999b)).

| | Categories | Definitions | Measure |
|---|---|---|---|
| Efficiency | Production-Distribution/cost | Combined costs of raw materials and labor in producing goods/combined costs of distribution, including transportation and handling cost | The sum of the total costs of inputs used to produce output/services (fixed and variable costs) |
| | Transaction costs | The costs other than the money price that are incurred in trading goods or services (e.g. searching cost, negotiation costs, and enforcement costs) | The sum of searching costs (the costs of locating information about opportunities for exchange), negotiation costs (costs of negotiating the terms of the exchange), enforcement costs (costs of enforcing the contract) |

| | | | |
|---|---|---|---|
| | Profit | The positive gain from an investment or business operation after subtracting all expenses | Total revenue less expenses |
| | Return on investments | A measure of a firm's profitability and measures how effectively the firm uses its capital to generate profit | Ratio of net profit to total assets |
| | Inventory | A firm's merchandise, raw materials, and finished and unfinished products which have not yet been sold | The sum of the costs of warehousing of products, capital and storage costs associated with stock management and insurance |
| Flexibility | Customer satisfaction | The degree to which the customers are satisfied with the products or services | The percentage of satisfied customers to unsatisfied customers |
| | Volume flexibility | The ability to change the output levels of the products produced | Calculated by demand variance and maximum and minimum profitable output volume during any period of the time |
| | Delivery flexibility | The ability to change planned delivery dates | The ratio of the difference between the latest time period during which the delivery can be made and the earliest time period during which the delivery can be |

| | | | |
|---|---|---|---|
| | | | made and the difference between the latest time period during which the delivery can be made and the current time period |
| | Backorders | An order that is currently not in stock, but is being reordered (the customer is willing to wait until re-supply arrives) and will be available at a later time | The proportion of the number of backorders to the total number of orders |
| | Lost sales | An order that is lost due to stock out, because the customer is not wiling to permit a backorder | The proportion of the number of lost sales to the total number of sales |
| Product quality Sensory properties and shelf life | Appearance | First sight of the tomato, combination of different attributes (color, size and form, firmness, lack of blemishes and damage) | Amount of damage, colour scale, size and form scale |
| | Taste | Determined by the sweetness, mealiness and aroma of a vegetable/fruit | Brix value, which is measurement of a soluble dry substance in a liquid (providing an approximate measure of sugar content) |
| | Shelf life | The length of time a packaged food will last without deteriorating | The difference in time between harvesting or processing and packaging of the product and the point in time at which it becomes unacceptable for consumption |

| | | | |
|---|---|---|---|
| Product safety and health | Salubrity | The quality of the products being healthy and nutritious | Nutritional value and lycopene content |
| | Product safety | Product does not exceed an acceptable level of risk associated with pathogenic organisms or chemical and physical hazards such as microbiological, chemical contaminant in products, micro-organism | Lab checks and monitoring processes according to certification schemes |
| Product reliability and convenience | Product reliability | Refers to the compliance of the actual product composition with the product description | Number of registered complaints |
| Process quality Production system characteristics | Traceability | Traceability is the ability to trace the history, application or location of an product using recorded identifications | Information availability, use of barcodes, standardization of quality systems |
| | Storage and transport conditions | Standard conditions required for transportation and storage of the products that are optimal for good quality | Measure of relative humidity and temperature, complying with standard regulation |
| | Working conditions | Standard conditions that ensure a hygienic, safe working environment, with correct handling and good conditions | Compliance with standard regulations |
| Environmental Aspects | Energy use | The amount of energy used during the production Process | The ratio of cubic meters of gas used per square meter of glasshouse |

| | | | |
|---|---|---|---|
| | Water use | The amount of water used during the production Process | The ratio of liters of water used per square meter of land under the vegetables |
| | Pesticide use | A permitted amount of pesticides used in the production process | The amount and the frequency of pesticide use complying with standard regulations |
| | Recycling/reuse | Collected used product from crop, packaging, etc., that is disassembled, separated and processed into recycled products, components and/or materials or reused, distributed or sold as used, without additional processing | Percentage of materials recycled/reused |
| Marketing | Promotion | Activities intended to increase market share for product (e.g. branding, pricing and labeling) | Increase in number of customers and sales |
| | Customer service | The provision of labor and other resources, for the purpose of increasing the value that buyers receive from their purchases and from the processes leading up to the purchase | Ratio of provision of recourses used to increase customer service to increased sales |
| | Display in stores | Demonstration of the | Increase in number of customers and |

| | | | |
|---|---|---|---|
| | | product in the store Increase in number of customers and sales | sales |

**Table 6:** An overview of KPIs from agri-food industry (Aramyan et al, 2007).

CAPSELLA will foster the awareness of agro-biodiversity and its importance for (agro)environmental sustainability through bottom-up participatory action supported by targeted, on-demand novel ICT tools and solutions. In the following table (table 7) a set of consolidated agri – environmental Key Perfomance Indicators is presented. This set of indicators consists of three major domains: responses, driving forces and pressures.

| Domain | Categories | Strategic Objectives | Indicator |
|---|---|---|---|
| Driving Forces | Land Use | Prevention of soil erosion | Machine hours to sow cover crop per hectare |
| | | Loosen and aerate soil | Machine hours to prepare soil per hectare |
| | Input Use | Provide the soil with the optimal amount of water | Amount of $m^3$ per hectare |
| | Costs | Economic evaluation of the inputs and economic evaluation of the activities | Production value in € |
| | Revenues | Information regarding the profit per product sold or per farmer | Direct profit per hectare or direct profit per kilograms of production |
| Responses | Common policy | Information of the extent of farmlands funded by agri – environmental subsidies | Number of support programmes |
| | Attitude skills | Introduction of ecological farming | Hectares of ecological production per as percentage of total farm hectares |
| Pressure | Pollution | Improve the environment by controlling the use of fertilizers, phytosanitary products and other inputs | Purchase of inputs in € per farm |

**Table 7:** An overview of KPIs from agri-environmental aspect (Montero et al, 2007).

*CAPSELLA evaluation experiments*

The evaluation process will address the assessment of six pilot demonstrators on top of the CAPSELLA data storage infrastructure, taking place through different phases and involve different stakeholder / users groups.

The evaluation will include four main phases:

- Deployment - First functional version of the CAPSELLA Demonstrators
- Controlled pilot trial - Cycle I
- Deployment II - Refinement and alignment of the CAPSELLA Demonstrators
- Controlled pilot trial - Cycle II

The controlled pilot trials will take place at partners' sites where selected groups of stakeholders will be invited to test and evaluate CAPSELLA demonstrators and provide their feedback. This task will be organized and run with selected users that belong to the different communities that are being considered. The group of users (between 10 and 20) will give feedback on how they can overcome their information related challenges by using the CAPSELLA demonstrators. Two types of controlled pilots have been planned, controlled pilot cycle I and controlled pilot cycle II:

- Controlled pilot trial - Cycle I: This pilot will take place immediately after the first deployment of CAPSELLA demonstrators, giving input for further refinements and alignment
- Controlled pilot trial - Cycle II: After the second version of CAPSELLA demonstrators, the second phase of controlled pilots will take place in order to ensure a realistic vision of how the CAPSELLA demonstrators may be deployed in real life environments

Results will be collected by each pilot trial and analyzed in an integrated report that will provide recommendations for the further improvement of the CAPSELLA demonstrators and ideas for the possible deployment of the demonstrators under real life conditions.

## 3. Pilots Description

This section presents the pilot applications that will be developed. For each pilot a general description is provided about the aim and scope of the demonstrator. Furthermore it is important to present the end users of each pilot in order to focus on the demonstrator's utility. The pilots are presented and validated in several events in which stakeholders and end users participate. This procedure helps the audience of interest to acquire a full knowledge of the demonstrator.

### 3.1 Pilot 1: Food Product Data Analytics - The Case of Stevia Hellas Cooperative (AK)

#### 3.1.1 Description

Open agriculture and food data can help cooperatives' managers to better market, promote and design their product. Important decisions regarding the cultivation and production can be supported by the available open scientific, market and social information. AgroKnow is developing a pilot demonstrator for the Stevia Hellas Cooperative (http://www.steviahellas.coop/), which produces the La Mia Stevia product (http://www.lamiastevia.gr/). The scope of the pilot demonstrator is to access open scientific, market and social data (i.e. twitter data), so as to facilitate the Stevia Hellas Cooperative to improve and better position their product in the Greek Market.

#### 3.1.2 Target Users

This pilot application was designed so as to facilitate the following key end-users:

- Farmers/Food Producers
- Cooperative Managers

#### 3.1.3 Trials

The pilot demonstrator will be presented in spring 2017 during the event that is organized by the Agro-nutritional Cooperation of Central Greece. There will be a first trial with target users to collect feedback about the pilot demonstrator. Furthermore, in spring 2018 another trial will be organized with target users during the event that is organized by the Agro-nutritional Cooperation of Central Greece, so as to test the final pilot demonstrator.

#### 3.1.4 Evaluation Objectives

The main evaluation objectives of this pilot are to assess whther the pilot demonstrator (a) facilitates the collection, processing and presentation of information from different open data sources and (b) facilitates the target-users to discover useful discovery useful information that will help them to address possible food production problems.

### 3.2 Pilot 2A: Storytelling on (food) production (ZLTO)

#### 3.2.1 Description

Consumers want to know information regarding the products that they consume, such as where the product comes from and how it was grown. The quality of food products is very important as consumers are increasingly aware of what they eat. They want to know how it is made in order to choose healthy foods. There is also a growing demand for products made without artificial colours or flavourings. Relevance of allergens information increases as the number of people with allergic disease grows. Technology is omnipresent. New (communication) technologies are making it easier and more readily available.

#### 3.2.2 Target Users

The main end users for this pilot application are the following:

- Farm Estate Barendonck
- Visitors– Parents with children – Business– Guests of the hotel
- Other farmers with visitors (>10)
- Other related projects– 1 connected in FarmHack 2016 NL

#### 3.2.3 Trials

The events, which are going to be organized, so as pilot to be validated, are the following:

- Set up ICT structure and content of stories beginning 2017
- Explore opportunities to use content for stories (in an app)
- Presentation in ZLTO/farmers events in summer 2017
- Experiments are going to take place in 2018

#### 3.2.4 Evaluation Objectives

- The number of farmers who are going to be informed via newsletters or magazines are expected be 100.
- The number of citizens who are going to be informed via online media, article in regional newspapers are expected be 500.
- The percentage of satisfied customers to unsatisfied customers is expected to reach 70%.
- The increase in the number of customers and sales is expected be at least 5%.

### 3.3 Pilot 2B: Pilot Precision Agriculture (ZLTO)

#### 3.3.1 Description

The proposed pilot will focus on the reduction of CO2 emissions and will provide support to maximize farming efficiency by improving the sector's accountability to market and society. Through the aforementioned processes, farmers can prove with facts and figures that they improve soil quality, to landlords' neighbors, politicians, market partners and consumers.

Existing open datasets from satellite images, soil features, soil structure, and weather conditions will be used for this analysis. Relevant data sources are suggested for the pilot, which for instance may be datasets providing information about consumer preference. Access to proprietary datasets with field registrations is organized in the management program Crop-R.nl.

Furthermore the following fieldworks are included:

- a demo experiment is conducted so as to become clear if there are differences in practice, rather than scientific research
- Some soil treatments are evaluated and data are gathered in result tables.

### 3.3.2 Target Users

The proposed pilot is designed to be used by consumers, chain partners, farmers who are early adopters of innovative products, researchers and policy makers.

### 3.3.3 Trials

The pilot is going to undergo two phases of trials: The first is going to take place in 2016 and the second in 2017.

### 3.3.4 Evaluation Objectives

- The experimental plots which are expected to be produced are 9
- The datasets which are expected to be produced are 9 plus 6 other sets per plot. The visualizations which are going to be implemented are 2 per plot, 20 graphics and tables.
- At least 2 organizations are expected to be involved in the process (compost, manure and share vision)
- Through magazines and during open days 500 farmers are expected to be informed about the pilot.
- Through articles in regional newspapers 2000 citizens are expected to be informed about the pilot.
- The sum of the total costs of inputs used to produce output/services (fixed and variable costs) should exceed 10% of quantity of potatoes produced at same level of compost, distributed in conventional way.
- Lab checks and monitoring processes according to certification schemes is measured by the quantity of potatoes grown on safe compost, guaranteed with certificates and tracking and tracing.
- Information availability, use of barcodes, standardization of quality systems is measured by the quantity of potatoes grown on safe compost, guaranteed with certificates and tracking and tracing.
- The ratio of liters of water used per square meter of land under the vegetables should be 5% later use of irrigation, because field has more water buffer, tested with variable water gift.

- The amount and the frequency of pesticide use complying with standard regulations should be 5% less N use.

### 3.4 Pilot 3.A: Personalised Food Systems in Public School Food

#### 3.4.1 Description

CAPSELLA, in collaboration with a major EU city, will develop open data-driven services in order to enhance transparency and inform decision making in food supply chain management, public procurement and consumption of meals served at public schools. Based on given food recipes, the application will acquire data by users and will exploit nutritional, health, environmental and other data available in open databases. Aggregated data will form an interface informing parents about the nutritional value and environmental footprint of the meals their children consume at school. It will enhance interaction between public procurement officers, canteen managers and parents, in order to reduce the risk and cost of non-communicable diseases, such as obesity and allergies.

The development of the pilot is based on participatory research in collaboration with local stakeholders in major EU cities, in order to increase understanding on community needs/requirements and explore the types of data already exist and can be openly shared with the CAPSELLA platform. This research involves fieldwork on location, and knowledge generation through online questionnaires/surveys and in physical space, involving multi-stakeholder consultations with local actors and international experts, as well as hackathons planned under the scope of CAPSELLA.

#### 3.4.2 Target Users

The main users of this pilot are procurement officers, canteen managers and parents.

#### 3.4.3 Trials

The timeline at which the demonstrator is going to be developed and trialed is given below:

October 2016 - March 2017: Deployment I - First Functional version

February 2017 - September 2017: Controlled Pilot Trial - Cycle I

March 2017 - June 2017: Deployment II - Refinement

September 2017 - March 2018: Controlled Pilot Trial - Cycle II

March 2018 - May 2018: Dissemination Phase

#### 3.4.4 Evaluation Objectives

- Number of Pilot Cities that will take part to Alpha and Beta testing and prototyping. (min. 1 major European City).
- Number of subjects/users that will test and evaluate the application (min. 35)

- Number of registered users (city representatives) to the service by the end of the project (min. 5 per city)
- Number of registered users (end-users) to the service by the end of the project (min. 50)
- Index of appreciation (min. of 50% of subjects/subject above neutral opinion)
- How many users would suggest the application to others (min. 50%)
- Number of standards (in terms of technology, data formats, etc) exploited
- Bugs fixing ratio during testing phase (3-4 days)
- Distinct datasets used, either produced or existing ones

## 3.5 Pilot 3.B: Personalized Food Systems in "dine-on-demand" sector

### 3.5.1 Description

CAPSELLA will prototype an open data driven solution to enhance transparency and better inform consumer choices in the "dine-on-demand" sector. Based on given food recipes, the application will acquire data by users and will exploit nutritional, environmental and other data available in open databases, in order to inform consumers about the nutritional value and environmental footprint of the meals they order. Moreover, additional historical data like: consumers' purchasing behavior, demand trends and location-aware orders, will also be considered. Sentiment analysis will be conducted in order to assess the sentiment expressed regarding certain food trends and habits as they become evident in social media. Aggregated data will be used in order to inform better selection of food ingredients and menu development. This will help to more accurately forecast the demand and therefore make ingredients purchases more efficient by harmonizing the composition of menus offered with consumer purchasing patterns. This is expected to generate further benefits such as improvement of nutritional value, reduction of food miles and waste, reduction of costs and increase in labor efficiency.

### 3.5.2 Target Users

The main users of this pilot are consumers, stakeholders in the food and hotel sector (i.e restaurants and hotels).

### 3.5.3 Trials

The timeline at which the demonstrator is going to be developed and trialed is given below:

October 2016 - March 2017: Deployment I - First Functional version

February 2017 - September 2017: Controlled Pilot Trial - Cycle I

March 2017 - June 2017: Deployment II - Refinement

September 2017 - March 2018: Controlled Pilot Trial - Cycle II

March 2018 - May 2018: Dissemination Phase

### 3.5.4 Evaluation Objectives

- Number of Pilot Partners that will take part to Alpha and Beta testing and prototyping. (min. 1 EU-based SME).
- Number of subjects/users that will test and evaluate the application (min. 35)
- Number of registered users to the service by the end of the project (min. 100)
- Number of recipes influenced by consumer preferences (min. 3)
- Reduction of leftover (not ordered) meals (min. decrease by 5% on monthly basis)
- Automatised purchases of key ingredients (min. From 12 suppliers)
- Keeping food cost between 25-30%

## 3.6 Pilot 4.A: ICT Tools for Farmers (SSSA/RSR)

### 3.6.1 Description

The outcome of this pilot aims at developing an ICT tool, which each EU seed networks directly or indirectly involved in Capsella, could use in their own country for keeping track and monitoring the movement of seed among members and for gathering and analyzing the on-farm experimental data, they are collecting, thanks to participatory research projects.

The proposed ICT tool should:

- Organize national databases of varieties, users, farmers and farms where they are grown and multiplied
- Manage data coming from decentralized on-farm experimental fields if and when established by networks.
- Link externally available data such as weather or soil data for each experimental location, gathered on the CAPSELLA platform, with the variety data.
- Include a connection to a statistical analysis platform (maybe based on the R language) for data elaboration and delivery in graphical form, which could then be used for dissemination, training or awareness purposes.

### 3.6.2 Target Users

The proposed application is destined to be used by:

- Seed network members
- Farmers (and their associations)
- Breeders
- Researchers
- Technicians

### 3.6.2 Trials

The affiliated events that have taken place or are going to be conducted are the following:

- Presented the Capsella pilot idea at RSR general assembly (Feb 2016)

- Informed Diversifood partners of Capsella project and pilot (March 2016). Diversifood is an EU research project in which Capsella partner RSR is involved together with other large European seed networks, and the plan is to develop an MoU with Capsella to integrate these communities into the requirements and needs elicitation processes, as well as in the validation of the tools produced.
- Prepared MoU with Diversifood Prepared questionnaire for RSR members about pilot
- Meeting on 20 September 2016 with Diversifood for agreeing on database standard format for a harmonized data storage system, to be then communicated to CAPSELLA.

### 3.6.3 Evaluation Objectives

The evaluation objectives are social and environmental:

**Social (to measure the awareness raising)**

1) Number of subjects that will take part to Alfa and Beta testing and to final event. (Minimum 20)

2) Number of subjects that will use and evaluate the application (Minimum 20)

3) Via a questionnaire to provide to the subjects that will use the application by the end of the project:

3.1 How many users would suggest our application to others (Minimum 50%)

3.2 Index of appreciation (Minimum of 50% of the subjects over the neutral opinion)

4) Number of users that will access or register to the web-portal by the end of the project (Miminum 50 or more)

**Environmental**

Via a questionnaire to provide to the subjects that will use the application by the end of the project: "How many subjects declare that the use of the application will influence (for better) the fertilization and soil organic matter management? (Minimum 20% of the subjects).

## 3.7 Pilot 4.B: ICT Tools for Farmers – Soil Health Pilot (SSSA)

### 3.7.1 Description

The soil, the skin of the planet Earth, is an extremely complex, variable and living medium. It is formed by mineral particles, organic matter, water, air and living organisms. Only "living" things can have health, so viewing soil as a living ecosystem reflects a fundamental shift in the way we care for soils. Soil health is defined as the continued capacity of soil to function as a vital living ecosystem that sustains plants, animals, and humans.

Soil is increasingly degrading, both in the EU and at global level. Erosion, loss of organic matter, compacting, salinization, landslides, and contamination, among the several possible types of degradation, has negative impacts on natural ecosystems and climate, agriculture and human health.

A common philosophy among sustainable agriculture practitioners is that a healthy soil is a key component of sustainability; that is, a healthy soil will produce healthy crop plants that have optimum vigor and are less susceptible to pests. While many crops have key pests that attack even the healthiest plants, proper soil, water and nutrient management, can help prevent some pest problems brought on by crop stress or nutrient imbalance. Furthermore, crop management systems that impair soil quality often result in greater inputs of water, nutrients, pesticides, and/or energy for tillage to maintain yields.

In sustainable systems, the soil is viewed as a living medium that must be protected to ensure its long-term productivity and stability.

At the moment, tools that integrate farmers' qualitative evaluation of soil health with laboratory soil and water quality measurements are missing. CAPSELLA will empower the action of farmers applying sustainable management measures by implementing a web-app that integrates modeling of experimental data together with participatory assessments by the farmers to forecast the effect of fertilization and irrigation on soil health and therefore on the sustainability of the production.

### 3.7.2 Target Users

The proposed application is intended for organic farmers and farmers' associations.

### 3.7.3 Trials

The pilot development is strictly farmer-driven. A set of participatory events will ensure that during the pilot development the farmers, as end-users, will guide the development of the prototypes and tests.

The list of events for the Soil Health Pilot includes:

- Meetings to collect **farmers' requirements**:
    - Volterra meeting [Done-May 2016]: during the field round-table a list of requirements was collected that put foward soil health analysis as the main topic of interest for the tool development;
    - Esapoda meeting [Done-September 2016]: the soil health idea was discussed with a group of farmers in Italy; it was suggested by farmers to include their own knowledge and experience in qualitative soil evaluation;
    - Aegilops meeting [Planned - November 2016]: review the pilot specification with Greek farmers, harmonizing the requests from Italian and Greek farmers.
- Meeting for **data collection** [October- December 2016]: we already asked data from local farmers (Italian and Greek) about farm location, agronomic practices, available soil and water data. We will have at least one face-to-face meeting in Italy to collect the data and to test on the field the soil qualitative evaluation.
- **App testing** events [Spring-Autumn 2017]:
    - Alfa testing: we are planning to start to show the first on-line tools to a small set of farmers (early adopters) at a very first stage of development, in order to refine the initial requirements;
    - Beta testing: after the App updated a refined version of the App will be tested with a larger set of user to get feedback also from the "average farmer" prospective

- **Final event** [January 2018] – the final version for the App will be released and presented to farmers

### 3.1.4 Evaluation Objectives

The evaluation objectives are social and environmental:

**Social (to measure the awareness raising)**

1) Number of subjects that will take part to Alfa and Beta testing and to final event. (Minimum 20)

2) Number of subjects that will use and evaluate the application (Minimum 20)

3) Via a questionnaire to provide to the subjects that will use the application by the end of the project:

 3.1 How many users would suggest our application to others (Minimum 50%)

 3.2 Index of appreciation (Minimum of 50% of the subjects over the neutral opinion)

4) Number of users that will access or register to the web-portal by the end of the project (Miminum 50 or more)

**Environmental**

Via a questionnaire to provide to the subjects that will use the application by the end of the project: "How many subjects declare that the use of the application will influence (for better) the fertilization and soil organic matter management? (Minimum 20% of the subjects).

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